

Nomination of the

Glarus overthrust

as a UNESCO World Heritage site

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Nomination prepared by the Federal Office for the Environment
(FOEN), Berne, Switzerland

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Frontpage
IG UNESCO-World Heritage site Glarus overthrust, Switzerland
Top: Glarus overthrust on the Ringelspitz
(Photograph: D. Imper, Heiligkreuz)
Middle: Glarus overthrust on the Tschingelhoren
(Photograph: H. Rhyner, Elm)
Bottom: Glarus overthrust on the Graue Hörner
(Photograph: D. Kalberer, Heiligkreuz)

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Executive Summary

State Party

Switzerland

State, Province or Region

Cantons of St. Gallen, Glarus and Graubünden

Name of Property

Glarus overthrust

Geographical coordinates to the nearest second

The centre of the property is marked by Piz Sardona. The peak, measuring 3055.8 m above sea level, lies 750 m north of the point where the three cantons of St. Gallen, Glarus and Graubünden meet. The coordinates of Piz Sardona are N 46° 55’ 00” / E 09° 15’ 00” (Swiss National Coordinates 738,060 / 198,470).

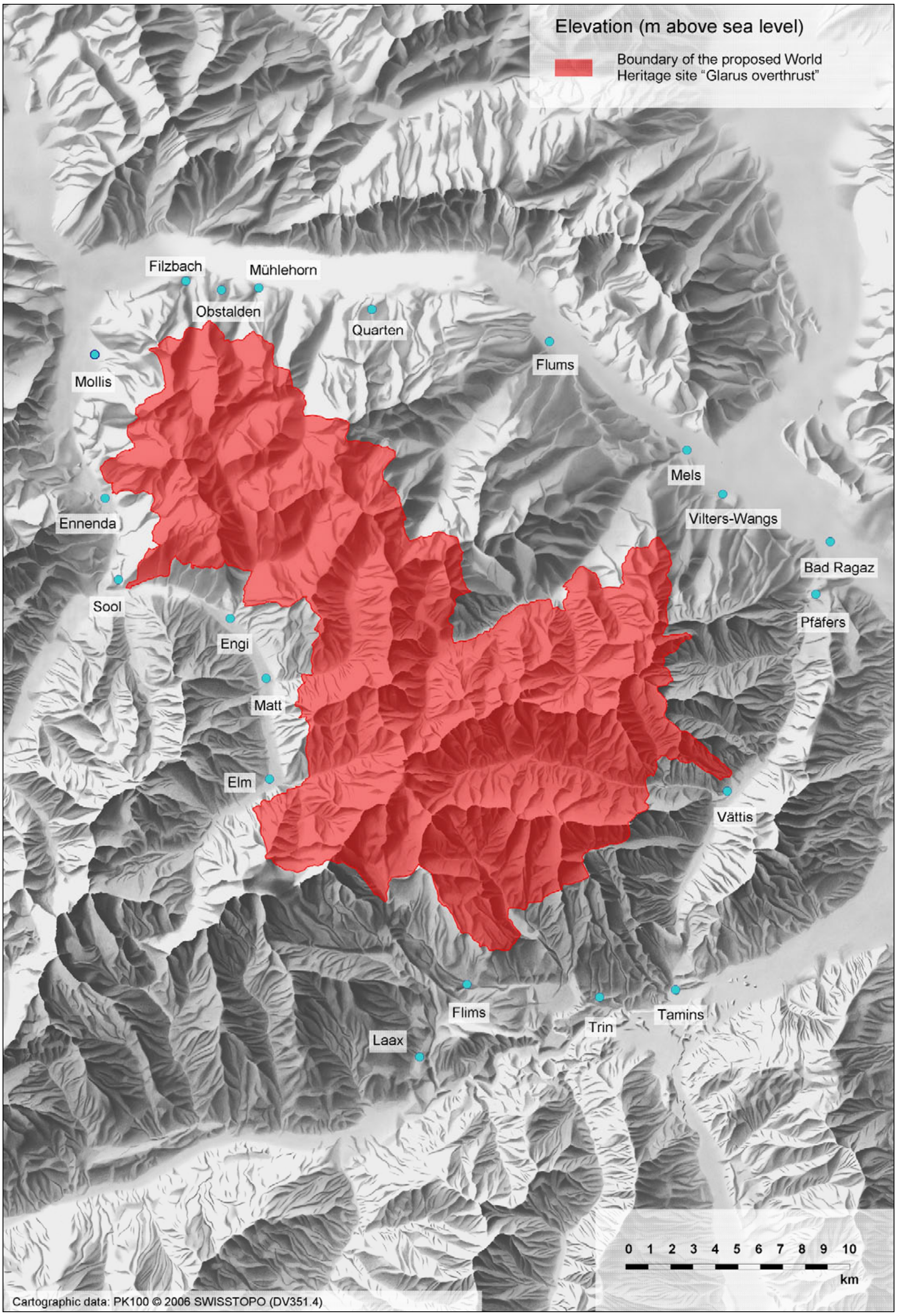
Textual description of the boundary of the nominated property

The proposed World Natural Heritage site encompasses the Ringelspitz group, the Calfeisental, the Pizol region, the Foostock and the southern Weisstannental, the Flumserberg area, the southern Murgtal and the southern Kerenzerberg region, the Mürtschen group, the Mülibachtal and the northern Chrauchtal, the Tschingelhoren–Vorab group, the Piz Sardona–Piz Segnas group and the Crap da Flem (Flimserstein). The lowest-lying point is near Enennda with an altitude of just under 520 m a.s.l., and the highest elevation is Ringelspitz (Piz Barghis), at 3247 m a.s.l.

There is no need for a buffer zone to be designated. In the area where a case might be made for establishing such a zone, the nominated property borders directly on the Flims–Laax–Falera ski resort, with no land available to be set aside for this purpose. Land use is, however, adequately regulated.

A4 size map of the nominated property, showing boundaries

Fig. S-01: Map of the proposed UNESCO World Heritage site “Glarus overthrust”.



Area of site proposed for inscription (ha) and proposed buffer zone (ha) if any

The total area of the nominated property is 32,850 ha, distributed as follows:

	Area (ha)	Proportion of total area (%)
St. Gallen	15,545	47.3
Glarus	12,748	38.8
Graubünden	4,557	13.9

Justification

Statement of Outstanding Universal Value

The mountains of the Glarnerland, Sarganserland and Graubünden Vorderrheintal offer what is surely the most complete and spectacular insight into nappe structure and development. Embedded in this landscape that is impressive and of major geological interest, the phenomena Glarus overthrust is the dominant, formative element. The deeply carved valleys make it possible to follow almost the entire course of a nappe from its site of origin to its front. The topography of the Glarus overthrust is also unique. The dome-like uparching in the southern part of the property (Vorab–Ringelspitz), succeeded by a trough-like depression in the north (Walensee), makes it possible to follow the course of the overthrust over a distance of more than 50 km (Vorderrhein-Säntis). As the path of the thrust sheet crosses peaks or mountainsides, it can be directly observed at many points. In addition, although the nominated property is readily accessible via the neighbouring villages, the core landscapes have remained largely untouched. Thanks to the excellent exposures and accessibility of the Glarus overthrust, numerous eminent geologists have visited this region since the early nineteenth century to carry out research. Many revolutionary discoveries concerning the formation of mountains have been based on observations made at this site. As a result of earlier studies, the geology of the site is very well known, which provides a sound basis for contemporary and future research.

Thrust faults represent unique features in orogens, demonstrating how contraction of continental plates thickens the crust and uplifts entire slices of crust to form mountain ranges and are singular witnesses of the processes that are going on at depth at plate interfaces and which are at the origin of earthquakes related to interfering tectonic plates. Thrust faults thus are of exceptional importance and features that cross many national boundaries.

Criteria under which property is nominated (itemize criteria)

Under the UNESCO World Heritage Centre's "Operational Guidelines for the Implementation of the World Heritage Convention", a property meeting one or more of 10 specified criteria may be inscribed on the UNESCO World Heritage List. The nominated property "Glarus overthrust" meets criteria (vii) "contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance" and (viii) "be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features" (Section 3.a):

Criterion (vii)
The extraordinary aesthetic value is based on the excellent visibility of the Glarus overthrust, surrounded by imposing peaks with small glaciers and various landscapes and biotopes, formed in thousands of years. Many major overthrusts, both in the Alps and elsewhere, are only identifiable on the basis of detailed cartographical and geological studies (e.g. dating of rock samples). By contrast, the Glarus overthrust is readily visible with contrasting colours as a well-defined line – the so-called magic line – extending across the landscape for dozens of kilometres. It is also a conspicuous feature when viewed from a distance – from a valley or mountain vantage point – and has been depicted by artists over the centuries.

Criterion (viii)
On account of the specific lithological characteristics and the interaction between metamorphism and tectonics which is best understood at this site, the Glarus overthrust is globally unique. From the northern to the southern limits of the property, one encounters rocks that, during the period of thrust activity, lay at a depth of 5 km or 12–16 km below the Earth's surface. This represents a cross section through the entire upper crust – a globally unique geological phenomenon. As well as the Glarus overthrust, the property includes nappe contacts between the Glarus and Mürtschen thrust sheets and between the Mürtschen and Säntis thrust sheets, which are exposed and readily observable. This geological diversity, the wide range of elevations and the morphodynamic processes created – and are still on-going on – a wide variety of landscapes and valuable habitats for species typical.

Thanks to the excellent exposures and accessibility of the Glarus overthrust, numerous eminent geologists have visited this region since the early nineteenth century to carry out research. Many revolutionary discoveries concerning the formation of mountains have been based on observations made at this site. The significance of this natural phenomenon has been further enhanced by the controversies that ensued, particularly at the end of the nineteenth century. Particularly noteworthy is the fact that, on the basis of observations made at the Glarus overthrust, nineteenth-century geologists were forced to overturn the prevailing orthodoxy on mountain formation and postulate the occurrence of events on a scale that was inconceivable at that time – decades before the theory of plate tectonics was first propounded. Ultimately, this fundamental geological theory – now taught in schools – only gained widespread acceptance in the 1960s. As a result of earlier studies, the geology of the site is very well known, which provides a sound basis for contemporary and future research. Intensive research is still being conducted at the Glarus overthrust with the aim of elucidating the causal mechanisms and processes involved in overthrusts and mountain building.

Name and contact information of official local institution/agency

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1 Identification of the Property

1.a Country (and State Party if different)

Switzerland

1.b State, Province or Region

Cantons of St. Gallen, Glarus and Graubünden

1.c Name of Property

Glarus overthrust

1.d Geographical coordinates to the nearest second

The centre of the property is marked by Piz Sardona (Fig. 01-01). The peak, measuring 3055.8 meters above sea level, lies 750 meters north of the point where the three cantons of St. Gallen, Glarus and Graubünden meet. The coordinates of Piz Sardona are N 46° 55’ 00” / E 09° 15’ 00” (Swiss National Coordinates 738,060 / 198,470).

Fig. 01-01: Piz Sardona Group. Photograph: D. Imper, Heiligkreuz.

1.e Maps and plans, showing the boundaries of the nominated property

The nominated property comprises an extraordinary wealth of structural geological elements. The boundary of the area follows, wherever possible, a natural route (Annex A01, Suppl. S04).

The proposed World Natural Heritage site encompasses the Ringelspitz group (Figs. 02-20, 05-02), the Calfeisental (Fig. 02-33), the Pizol region (Figs. 03-02, 04-02), the Foostock and the southern Weisstannental (Figs. 02-03, 03-04, 05-03), the Flumserberg area, the southern Murgtal (Fig. 05-01) and the southern Kerenzerberg region, the Mürtschen group (Fig. 02-04), the Mülibachtal and the northern Chrauchtal (Fig. 02-22), the Tschingelhoren–Vorab group (Figs. 02-07, 02-11, 03-01), the Piz Sardona–Piz Segnas group (Figs. 01-01, 02-14, 02-16) and the Crap da Flem (Flimserstein; Fig. 02-24). The lowest-lying point is near Enennda, with an altitude of about 520 m a.s.l., and the highest elevation is Ringelspitz (Piz Barghis), at 3247 m a.s.l.

There is no need for a buffer zone to be designated. In the area where a case might be made for establishing such a zone, the nominated property borders directly on ski resorts with no land available to be set aside for this purpose (Flims–Laax–Falera and Flumserberg). In other border areas, touristic use is not foreseen or possible due to topographic conditions, natural hazards (avalanches, rockfalls, ice conditions), or legal protection. Land use is, however, adequately regulated.

1.f Area of nominated property [ha]

The total area of the nominated property is 32,850 ha, distributed as follows:

Tab. 01-01: Proportion of total area of the three cantons involved.

	Area (ha)	Proportion of total area (%)
St. Gallen	15,545	47.3
Glarus	12,748	38.8
Graubünden	4,557	13.9

2 Description

2.a Description of Property

2.a.1 Climate

Nearby, but outside the proposed World Natural Heritage site, the following annual mean temperatures (in degrees Celsius, 1864–1959) have been recorded.

Tab. 02-01: Annual mean temperatures from 1864 to 1959 (Source: SCHÜEPP, 1960).

Station	Altitude (m a.s.l.)	Temperature in January °C	Temperature in July °C	Annual mean °C
Vättis (1899–1959)	950	-2.1	14.6	6.2
Bad Ragaz (1871–1959)	520	-0.4	17.3	8.8
Sargans (1864–1959)	510	-0.2	17.3	8.8
Glarus (1864–1959)	480	-1.7	16.7	7.7
Elm (1881–1959)	960	-3.0	14.5	5.8
Reichenau (1864–1935)	600	-0.9	16.8	8.1
Chur (1864–1959)	600	-0.7	17.2	8.5

From 1961 to 1990 the annual mean temperatures (in degrees Celsius) have been recorded at comparable stations.

Tab. 02-02: Annual mean temperatures from 1961 to 1990 (Source: *www.meteoswiss.ch).*

Station	Altitude (m a.s.l.)	Temperature in January °C	Temperature in July °C	Annual mean °C
Bad Ragaz (1961–1990)	496	-0.3	17.9	9.0
Glarus (1961–1990)	515	-1.2	16.9	8.0
Elm (1961–1990)	965	-2.7	14.5	5.9
Chur (1961–1990)	555	-0.5	17.7	8.7

In relation to the period 1864–1959 the average mean temperatures from 1960 to 1990 have risen considerably.

Tab. 02-03: Increase of the average mean temperatures from 1961 to 1990 and from 1864 to 1959.

Station	Altitude (m a.s.l.)	January °C	July °C	Annual mean °C
Bad Ragaz	496	0.1	0.6	0.2
Glarus	515	0.5	0.2	0.3
Elm	965	0.3	0.0	0.1
Chur	555	0.2	0.5	0.2

A phenomenon characteristic of the Rhein, Seez and Linthal valleys is the dry, southerly katabatic wind known as the föhn.

Precipitation levels are primarily altitude-dependent. The mountain ranges are subject to adverse weather influences from North to West. Locally, precipitation is significantly influenced by topography and exposure. Central Alpine valleys such as the Taminatal near Vättis have below-average levels of precipitation.

Tab. 02-04: Mean annual precipitation (in millimetres) at about 1000 m a.s.l.

Station	Altitude (m a.s.l.)	precipitation (mm)
Elm GL	960	1587
Weisstannen SG	1000	1397
Vättis SG	950	1061
Flims GR	1080	1221

At an altitude of 2000 m, mean precipitation ranges from 2200 to 2600 mm, while in the areas of Vorab-Segnas-Sardona-Foostock and Schilt-Mürtschen-Spitzmeilen levels in excess of 2800 mm are to be expected.

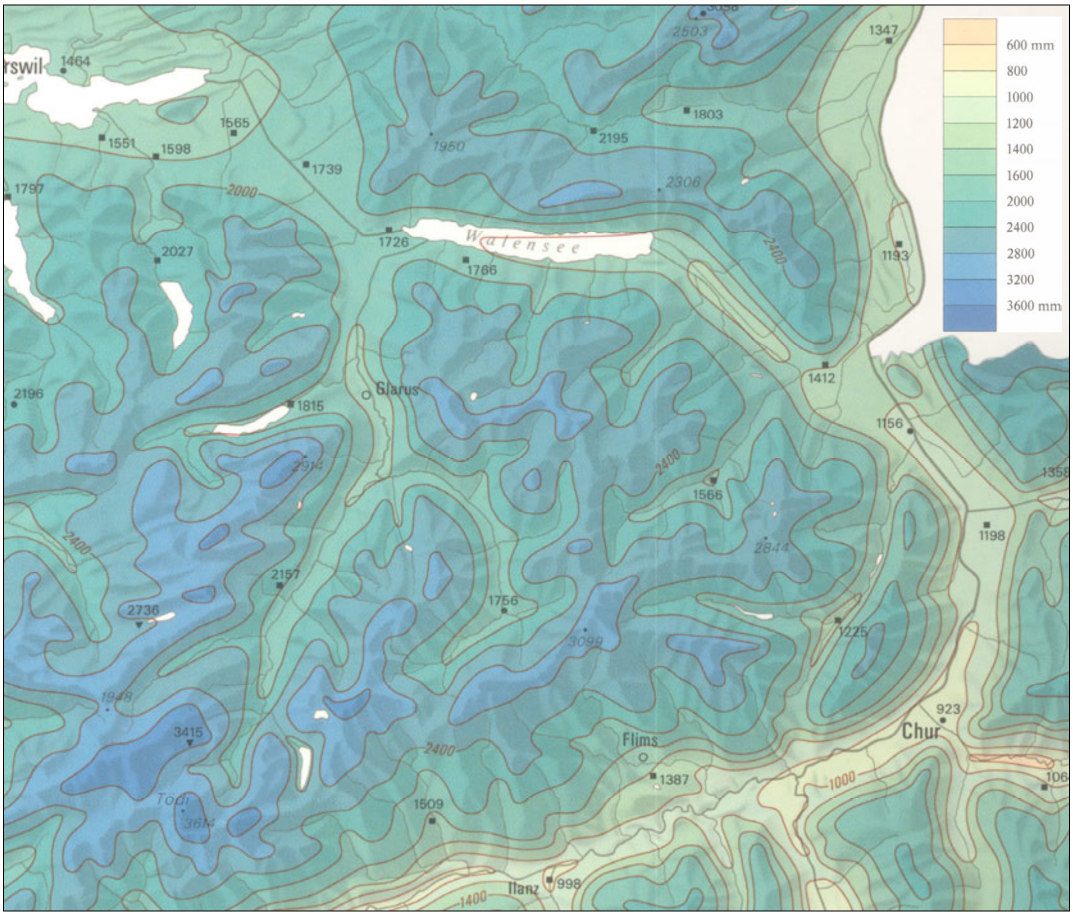

Fig. 02-01: Annual totals of precipitation (From: SPREAFICO, M., WEINGARTNER, R. & LEIBUNDGUT, CH., 1992).

2.a.2 Geology

The highest and best-known peaks in the nominated property are also the mountains that mainly consist of Verrucano: Ringelspitz (Piz Barghis), Piz Sardona, Piz Segnes, Foostock and Tschingelhoren. Lying further to the west are well-known peaks such as the striking Spitzmeilen or the imposing Mürtschenstock group, with peaks consisting of younger Liassic, or Upper Jurassic/Cretaceous sedimentary rocks.

On account of the abundance of highly interesting and impressive stratigraphic and tectonic phenomena and the excellent exposures, the Glarus Alps have been a popular location for research and excursions from the earliest days of geological studies. It is therefore scarcely surprising that the communes of the nominated property contain a surely unique concentration of type localities:

- Elm Formation (Tertiary)
- Engi Formation (Tertiary)
- Blattengrat Unit (Tertiary)
- Sardona Unit (Tertiary)
- Schilt Formation (Malm, Jurassic)
- Mürtschen Member (Malm, Jurassic)
- Sexmor Member (Lias, Jurassic)
- Spitzmeilen Member (Lias, Jurassic)
- Prodkamm Member (Lias, Jurassic)
- Quarten Formation (Triassic)
- Melser Member (Triassic)
- Kapfen Formation (Verrucano, Permian)
- Schönbühl Formation (Verrucano, Permian)
- Mären Formation (Verrucano, Permian)
- Grisch Member (Verrucano, Permian)
- Foostock Member (Verrucano, Permian)
- Murgtal Formation (Verrucano, Permian)
- Üblital Formation (Verrucano, Permian)

However, the nominated property also includes an extraordinary diversity of structural geological elements. Thus, from the microscopic to the macroscopic level, folds, imbrications, thrusts and faults can be observed, which also gave rise to windows and klippen.Within the boundary of the proposed World Natural Heritage site, the mountains consist of Helvetic nappes, an allochthonous (substantially displaced) pile of thrust sheets, and the underlying Infrahelvetic complex. This complex comprises a crystalline basement (exposed at the Vättis window) and its sedimentary cover, also shaped into folds and small-scale nappes. The Glarus overthrust separates the Infrahelvetic complex from the Helvetic nappes.

The crystalline basement of the Aar Massif

At Chrüzbachtobel near Vättis, the crystalline basement and the unconformity with the overlying autochthonous sedimentary series are exposed in the so-called Vättis window (Fig. 02-02). The gneisses, syenites and dykes of the basement belong to the Aar Massif. To the east of Vättis, the Aar Massif is no longer exposed – the nearest exposures to the west are at the Limmernboden window, more than 30 km away. The autochthonous sedimentary series is well exposed, from the underlying sandstones/breccia with overlying Röti dolomites (Triassic) to the Globigerina marls (Tertiary).

Fig. 02-02: The unconformity between the crystalline basement and the overlying sedimentary series at Chrüzbachtobel (Vättner window). Photograph: D. Imper, Heiligkreuz.

The Infrahelvetic complex

In the southern part of the property, from the Flimserstein to the Ringelspitz group, sedimentary strata (mainly limestones) that are highly deformed by folding and thrusting form part of the Infrahelvetic complex. In the north eastern flanks of Flimserstein and Ringelspitz, the imbricate structure of Mesozoic-Tertiary sediments can be readily observed. In the north face of the Panärahörner, up to four imbricate thrust sheets (Schuppen) are stacked on top of each other. Owing to the predominance of limestones, the landscape is dominated by steep cliffs bounding V-shaped valleys.

The Flysch units

The landscape is also shaped by flysch deposits, which often produce relatively soft landscape forms on account of the thick slate and marl beds. Flysch units predominate in the Calfeisental west of St. Martin, in the eastern and southern Weisstannental, and in the Sernftal east of Matt and Elm. The flysch units pertain to three parts: the North Helvetic Flysch (deposited 50–35 Ma ago), the South Helvetic Blattengrat unit (deposited 85–45 Ma ago) and the more southerly Ultrahelvetic Sardona unit (deposited 90–50 Ma ago). These flysch units were already transported many kilometres northwards at an early stage of the Alpine orogeny, so that the sediments of the Sardona unit originally deposited further south came to rest on the Blattengrat unit, which itself was thrust onto the North Helvetic Flysch.

The Lochseiten limestone

At certain points, e.g. on the Tschingelhoren or the Foostock, limestone masses several decametres thick lie between the flysch and the Glarus overthrust (Figs. 02-03, 02-07, 02-11, 03-01, 03-04). The uppermost 1–2 m of this material was sheared by the action of the Glarus overthrust and now constitutes what is known as Lochseiten limestone or calc-mylonite. The surface of the Glarus overthrust rises from 600 m a.s.l. in the Vorderrheintal to the culmination in the Vorab–Piz Segnes–Ringelspitz area, reaching an altitude of over 3000 m a.s.l. (Fig. 02-20), before falling away northwards further north (Figs. 03-04) and disappearing below the surface near Lochsite (Sool) at just under 570 m a.s.l (Figs. 03-03, 05-05).

Fig. 02-03: The Mesozoic Lochseiten limestone immediately below the Glarus overthrust on the Foostock in the Weisstannental. Photograph: D. Kalberer, Heiligkreuz.

The Permian rocks of Verrucano

Overlying the Glarus thrust are the Helvetic nappes. Within the boundary of the nominated property, these essentially consist of Verrucano formations, parts of which are more than 1500 m thick. The peaks of the Vorab, Piz Sardona (Fig. 02-14) and Ringelspitz (Figs. 02-20, 05-02) groups, and of the Pizol (Figs. 03-02, 04-02) and Foostock (Figs. 02-03, 03-04), the northern Pizol area, the western Weisstannental, the Schilstal, the Murgtal (Fig. 05-01), the Gufelstock area (Figs. 02-15, 05-04), the Mülibachtal and the northern Chrauchtal are composed of Permian Verrucano rocks. The lower and peripheral parts of these rocks consist of dark green and purple-red coarse-grained detrital Sernifit, while the central and upper parts tend to comprise purple-grey to blood-red fine-grained detrital siltstone and slate series.

The light-coloured Triassic rocks

In the Flumserberg area (Fig. 02-30), in the Mürtschental and in the Gufelstock region (Fig. 05-04), the light-coloured overlying Triassic rocks, generally less than 100 m thick, are exposed over an extensive area. While imbricate structures are difficult to detect in the Verrucano formations, the nappes in the Murgtal–Mürtschenalp–Schwarzstöckli area (Fig. 05-01, 05-04) can be divided thanks to the clearly evident Triassic horizon into the underlying Glarus nappe and the overlying Mürtschen nappe. This division can no longer be made to the east of the Flumserberg area.

The Jurassic to Early Tertiary sedimentary series

In the Mürtschen area, particularly within the Mürtschen group (Fig. 02-04) and on the Nüenchamm, the Mürtschen nappe is exposed. It consists of a sedimentary series ranging from the Permian (uppermost Verrucano) to the Early Tertiary.

At Vättis, the autochthonous cover of the crystalline basement, i.e. the entire Jurassic and Cretaceous series and the Tertiary, is continuously exposed. In the parautochthonous zone between Ringelspitz and Flimserstein, the similarly formed upper Jurassic, Cretaceous and lower Tertiary units are tectonically imbricated and repeated. These Jurassic and Cretaceous layers were deposited in a shallow shelf sea.

In Mürtschenstock and Nüenchamm, marls as well as limestones occur in the Jurassic and Cretaceous series. The picturesque landscape reflects the differing resistance of limestones and marls to weathering.

Finally, to the west of Habergschwänd on Kerenzerberg in the klippe of the Säntis nappe, the lower Cretaceous units appear in a facies dominated to an even greater extent by marls.

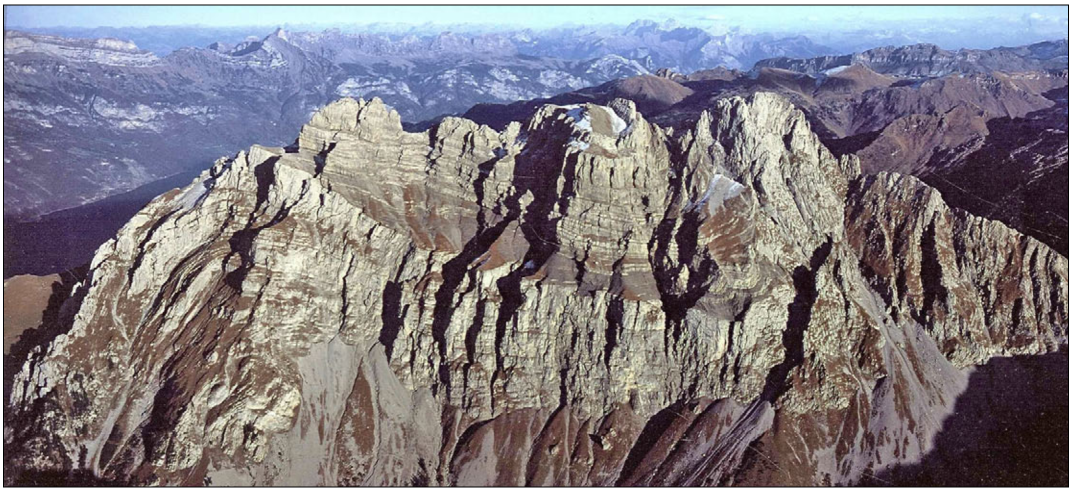

Fig. 02-04: The extensively folded Mesozoic limestones on the Mürtschenstock. Photograph: D. Kalberer, Heiligkreuz.

Folds

Within the nominated property, numerous spectacular folds can be observed, e.g. the Liassic folds of Magerrain or Sexmor, or the Upper Jurassic folds of Mürtschenstock (Fig. 02-04). In the Chrauchtal, thanks to the white Schönbühl quartzite, a large-scale (hectometer range) fold is visible in the otherwise uniformly reddish coloured Verrucano.

Thrust faults and thrust sheets

Within the nominated property, at least five important thrust faults can be observed in the field. Among these, the Glarus overthrust is not only the most significant in terms of extent of displacement. It is also the best and most extensively exposed, with the most impressive structures.

In the flysch deposits below the Glarus overthrust, the Blattengrat unit was thrust onto the North Helvetic Flysch, and the Sardona unit onto the Blattengrat unit. Although the thrust planes between the flysch units are only discernible to the trained geologist's eye in the field, their existence has been unequivocally established.

At the base of the Helvetic nappes, a Mesozoic limestone deposit was thrust onto the flysch rocks. This layer, known to geologists worldwide as Lochseiten limestone, served as a kind of lubricant in the thrust plane between the Verrucano and flysch. This mass is readily visible on the Foostock and below the Tschingelhoren.

To the north-west, in the Murgtal, Mürtschental and Linth Plain, the stacked layers above the Glarus overthrust can be subdivided into the Glarus nappe and the Mürtschen nappe (Mürtschen thrust).

Finally, a klippe of the Säntis thrust sheet is to be found on Habergschwänd. The Säntis nappe forms the magnificent Churfirsten panorama to the north of the Walensee and the impressive Wiggis and Glärnisch peaks to the west of the Linthtal. It thus represents an important link to these units. However, the Säntis thrust on Habergschwänd is considerably less spectacular than the Glarus overthrust.

Strike-slip faults

Between the Widersteinerfurggel and the Murgseefurggel, and also in the Murgtal, large strike-slip faults can be detected along which the rock masses slid past each other over a distance of more than a kilometre.

Windows and klippen (inliers and outliers)

Within the nominated property, a number of windows and klippen demonstrate that processes of erosion created substantial relief, making the geological structures strikingly amenable to observation in three dimensions.

Klippen are a significantly more common feature of the nominated site. Mention has already been made of the erosional klippe of the Säntis thrust on Habergschwänd. The dark greenish-grey Verrucano klippen are readily detectable on the brownish-light grey flysch, and on the light grey Mesozoic limestones. Well-known examples include the Stafinellagrat in the Pizol region, Ringelspitz, Glaserhorn-Tristelhorn, Piz Dolf (Fig. 02-05), or the Piz Sardona-Piz Segnas group and the Flimserstein.

Fig. 02-05: The Verrucano above the Glarus overthrust forms a tectonic klippe on the Piz Dolf/Trinserhorn. Photograph: B. Walder, Steffisburg.

In parts of the Murgsee region, fine-grained Verrucano of the Mürtschen nappe (Schönbühl shale) overlies coarse-grained Verrucano of the Glarus nappe (Murgtal Sernifit), giving rise to a well-formed klippe on Hochmättli.

Between the Mülibachtal and the Murgtal, various Liassic (Goggeien) and Dogger (Rottor) klippen indicate a major stratigraphic gap – at least the entire Triassic is missing.

At the foot of Siwellen and Schild, the outcrops show that Permian Verrucano and Triassic Rauhwacke (cellular dolomite) were thrust onto Upper Jurassic limestones – Siwellen and Schild are tectonic klippen.

The Vättis Window (inlier)

In the Vättis Window, surely Switzerland's best-known geological window, the crystalline rocks of the Aar Massif are visible under the overlying younger series (Fig. 02-02). This window, situated some 20 km away from the western end of the Aar Massif in the Tödi region, lies amid an impressive limestone landscape marked by steep-sided valleys.

A less well known and less conspicuous tectonic window is to be found south of the Spanneggsee on Alp Platten. Here, Cretaceous and lower Tertiary units crop out from the surrounding Upper Jurassic limestone exposures.

Soils

Essentially, the soils that developed on the crystalline units at Vättis, on the Verrucano units, on the Mels formation, on the sandy limestone of the Upper Lias in certain areas, on the Cretaceous siliceous limestone and Garschella (greensand) formations, and on Sardona quartzite tend to be acidic, while the soils that developed on the remaining, largely carbonate series are predominantly alkaline. On beds containing a high proportion of clay (Verrucano basin facies, Quarten series, Lower Lias, Lower Dogger, flysch), waterlogged soils developed, giving rise to mires.

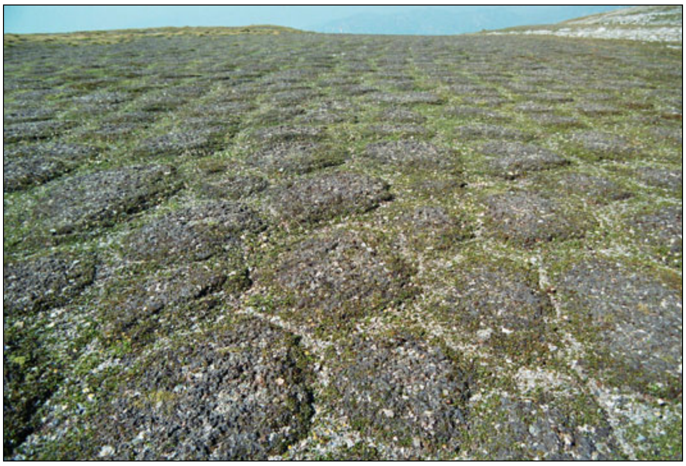

Fig. 02-06:
A wide variety of soil types developed, depending on the climatic conditions and the substrate (Crap da Flem, 2700 m a.s.l. on Verrucano). Photograph: B. Walder, Steffisburg.

Geology of the phenomenon of the Glarus overthrust

Many extraordinary geological phenomenons, among five important thrust faults, are to be found within the nominated property. Under these the Glarus overthrust is the most important and impressive and worldwide unique. At the Glarus overthrust, dark, greyish green or purple-red slates, sandstones and conglomerates (Sernifit) of the Verrucano group overlie lighter-coloured limestone or brownish grey, generally schistose flysch units (Figs. 02-03, 02-05, 02-07, 02-14, 03-01, 03-02, 03-04). The Verrucano rocks are 250–300 million years (Ma) old, the limestones 100–150 Ma and the flysch 35–50 Ma. Whereas younger sedimentary rocks are normally deposited on top of older formations, at the overthrust site older rocks overlie much younger ones.

Fig. 02-07: The contrasting colours are particularly striking on the Tschingelhoren. Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano *(top)* and flysch. Photograph: G. Danuser, Flims.

Situation and extent

The Glarus overthrust, which can be observed over a total distance of more than 50 km, is arched in shape: the thrust plane rises northwards from 600 m a.s.l. at the Vorderrheintal to more than 3000 m a.s.l. at the Hausstock–Vorab–Piz Segnas–Ringelspitz crest. North of the crest, the thrust plane dips in a north-northwesterly direction, at first gently and then ever more steeply (reaching a gradient of more than 15°) down to an altitude of only 570 m a.s.l. at Lochsite near Sool. North of the Sool–Weisstannen-Wangs line, the thrust dips below the Earth's surface, probably dropping to around sea level under the Walensee. Finally, north of the Walensee, it rises again, reaching the surface to the north of the Säntis mountains, where it can once again be directly observed, at Dunkelberndli in the canton of Appenzell Inner Rhodes (1300 m a.s.l.). Here, it is known as the Säntis thrust.

The Glarus overthrust exposures are mainly situated between the Rhine, Seez-Walensee and Linth, i.e. within the nominated property. The Glarus overthrust is exposed from Pizol to Lochsite near Sool/Schwanden over a distance of 30 km, running from west to east, and from Flims to Schwendi in the Weisstannental over a distance of 20 km from north to south. It is also the key scenic element of the land-scape.

The rock masses must have been thrust towards the north-northwest along a plane dipping gently in a south-southeasterly direction. Differential deformation occurring in the footwall of the overthrust explains the present arched form of the thrust plane. In the culmination area, erosion led to the formation of tectonic outliers (klippen) – Ringelspitz, Glaserhorn-Tristelhorn, Piz Dolf, Piz Sardona-Piz Segnas-Piz Atlas, Kalkstöckli, Mättlenstock, Hausstock, Ruchi and Stafinellagrat.

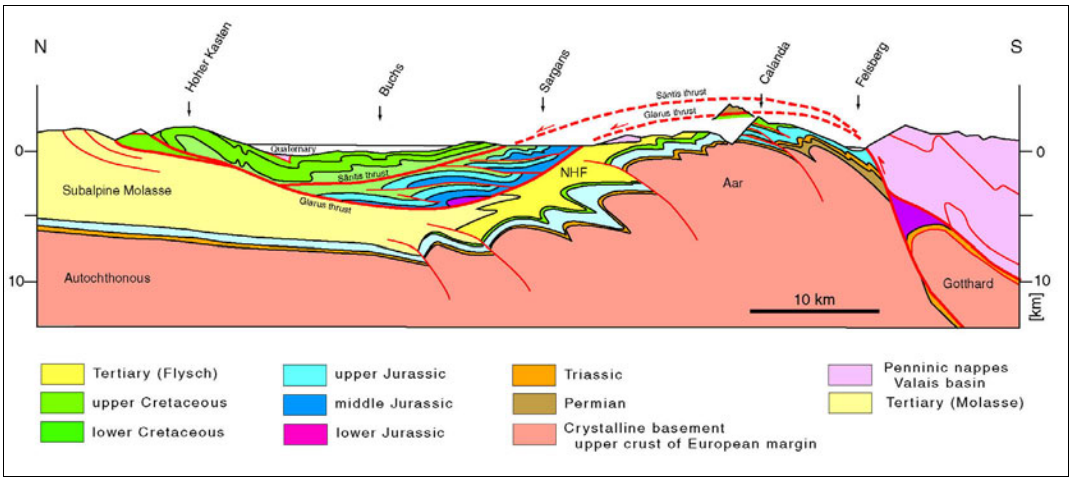

Fig. 02-08: Geological section through the Glarus Alps: The Glarus overthrust is arcuate in form and can be followed from the root zone in the Graubünden Rhine Valley up to the front of the nappe. From: PFIFFNER (1994).

The Lochseiten limestone

The currently prevailing view is that the Helvetic nappes at the Glarus overthrust were displaced northwards by at least 35 km. The process largely occurred in the overthrust zone – only 1–2 m thick at many points – where the so-called Lochseiten limestone can be observed. This light-grey limestone, weathering to yellow, often has a marble-like appearance. Analysis of the Lochseiten limestone indicates that the overthrust process must have occurred at temperatures of up to 320°C and pressures of up to 5 kbar, i.e. at depths of up to 16 km beneath what was at that time the Earth's surface.

South of the boundary, on the Nagiens-Vorab plateau, the Lochseiten limestone appears to have developed from an older sheared limestone layer (Late Jurassic Tros limestone). Further north, there are good reasons to suppose that the limestone was newly formed during the overthrust process. In any case, the Lochseiten limestone represents a kind of lubricant at the base of the thrust sheet of the Helvetic nappes.

Fig. 02-09:
Mélange structures of ductile deformation at Sardona.
Photograph: D. Imper, Heiligkreuz.

The significance of the Lochseiten limestone can best be illustrated with the aid of the mechanical paradox: if one calculates the shear stress required to transport a block of about the size of the Helvetic nappes (3 km thick, 50 km long, more than 100 km wide), the values are found to be so high that the block would shatter as a result. However, observation shows that this did not occur; rather, the thrust sheets take the form of more or less coherent masses of rock. The paradox can be resolved by invoking the presence of a soft "lubricant" at the base of the thrust sheet. Accordingly, many of the major overthrusts found in foreland fold belts involved mechanically soft rocks such as salt, anhydrite or clay beds. In contrast, the lubricant material at the Glarus overthrust is limestone.

Deformation mechanisms

Geologists are now confronted with the puzzle of how such highly localized deformation could occur – the Lochseiten limestone zone is generally only 1–2 m thick. Normally, limestones are not known for being particularly readily deformable. In the case of Lochseiten limestone, however, an extremely interesting phenomenon is observed: the "lubricant" formed itself in the course of the thrust process. The high level of deformation in the Lochseiten limestone is evident from the development of a characteristic foliation, which in parts is wildly refolded (Alb. Heim's "kneaded structure", Figs. 02-09, 02-10, 03-03). This foliation developed in a number of different ways. Local accumulation of carbon in limestone leads (by oxidation to carbon dioxide) to more unrestrained growth of calcite grains, and the limestone has a lighter appearance as a result. This interpretation accounts in particular for observations made in the south. In the north, on the other hand, well-defined light-coloured bands can possibly be interpreted as veins: joints created by brittle fracture were subsequently filled by calcite precipitation. The presence of stylolites suggests that pressure dissolution must have occurred in the rocks.

The seismic slip hypothesis proposes that the displacement was jerky and irregular, occurring in numerous small steps of a few metres per event. In support of this interpretation, traces of brittle deformation in the Lochseiten limestone have been adduced, together with the extraordinary oxygen isotope composition. In the Lochseiten limestone, both structural and geochemical evidence can be found to suggest that it was not deformed under dry conditions (superplasticity) but in the presence of large amounts of water. Oxygen isotopes both provide proof of the presence of water and permit estimates of the volumes involved. Under conditions of high pressure, these fluids could also have led intermittently to a marked reduction in resistance to friction, thereby facilitating sliding.

Fig. 02-10:
Fine structures in cut and polished Lochseiten limestone.
Photograph: D. Kalberer, Heiligkreuz.

Within the Lochseiten limestone itself, deformation at the microscale (hundredths of a millimetre) was shown to be essentially determined by grain boundary sliding: while the Lochseiten limestone underwent massive extension and compression (several thousand per cent), the 10-µm grains slid past each other without being substantially deformed internally. In the 1970s, following detailed structural geology studies in the northern part of the Glarus overthrust, flow behaviour was accounted for by superplasticity. It is known from laboratory experiments conducted with metals and rocks that under certain special conditions fine-grained limestones may exhibit abnormal flow behaviour (superplasticity). This occurs particularly with very small grain sizes, permitting considerable deformation at low differential stresses.

However, the Verrucano in the hanging wall and the Mesozoic and Tertiary sediments in the footwall in direct contact with the Lochseiten limestone are also intensely deformed, demonstrating that the Glarus overthrust actually involved ductile deformation (the footwall and hanging wall were deformed at the same time as displacement occurred). Although the principle underlying this essentially unique situation is clear, the fact that research projects are ongoing at a number of universities shows that the Glarus overthrust has not yet yielded up all its secrets and that new insights into mountain-building processes can be expected from this source.

Historical Geology at the phenomenon of Glarus overthrust

For a number of decades, acknowledging and explaining this phenomenon represented a major challenge for geologists. The recognition, at the turn of the nineteenth to the twentieth century, that the Alps consist of sheets of rock piled on top of each other dealt a severe blow to the “contracting Earth hypothesis”, which had dominated tectonic thinking for half a century. Around the same time, Palaeozoic nappes were identified in the Scottish Highlands and the Scandinavian mountains. The nappe tectonics of the Alps and similar ranges entailed crustal shortening that was no longer compatible with the contraction theory. During the Tertiary era, Basel and Lugano must have moved several hundred kilometres closer together. At the same time, the contraction doctrine was dealt a second, probably fatal blow: it was realized that the Earth is not cooling, and therefore not contracting, but is in fact rather being warmed by the decay of radioactive isotopes.

The logical corollary of the discovery of nappe structures was the mobility of continental masses. In 1912, the German geophysicist Alfred Wegener (1880–1930) propounded his theory of continental drift. According to Wegener, the relatively light masses of continental crust (sial) were able to move freely across the heavier oceanic crust (sima). Wegener’s hypotheses were enthusiastically adopted and elaborated by the leading Alpine geologists of the 1920s, particularly Emile Argand (1879–1940) of Neuchâtel. Even when the theory was widely rejected elsewhere between 1930 and 1950, most of these experts continued to adhere to the concept of the movement of parts of the Earth’s crust.

From about 1965, this concept was triumphantly vindicated by the theory of plate tectonics. However, it became apparent that what moved was not only the continental masses, but plates approximately 100 km thick, comprising the upper, rigid part of the Earth’s mantle, and continental or oceanic crusts with a thickness of 20–50 km and a few kilometres respectively. Although plate tectonics was largely developed on the basis of marine rather than Alpine geology, our knowledge of large-scale overthrusts and contemporary conceptions of a “living Earth” ultimately derive from observations dating back to the work of Hans Conrad Escher (1767–1823) and Arnold Escher (1807–1872).

Phenomenon discovered by the first “geognosts” at the beginning of the 19th century

Hans Conrad Escher von der Linth (1767–1823) was a gifted observer, draughtsman and watercolourist (Fig. 02-11). Looking at the Glarus overthrust, he was unable to comprehend it on the basis of the scientific orthodoxy prevailing at that time. As early as 1807, he pointed out that the sequence of rocks in the Glarus Alps did not accord with the contemporary theory which stated that “Alpine limestone” (Mesozoic limestones) must always overlie greywackes (including Verrucano). This view was notably advocated by the most influential German geognost of the period, Leopold von Buch (1774–1853). Despite his visit to the Glarus Alps in 1809, von Buch disputed Escher’s observations: “Greywacke forms part of the Transition formation [i.e. of the flysch, not the Verrucano group] and can never, must never, rest on Alpine limestone.”

Fig.02-11: One of the oldest depictions of the Glarus overthrust is the famous watercolour executed in 1812 by H. C. ESCHER von der Linth: The Tschingelhoren, with Martin’s Gap, viewed from the south-east (ETH Zurich Library, HCE A IX 180a).

Acceptance of overthrust and initial explanations advanced in the mid-19th century

Hans Conrad Escher's son, Arnold Escher (1807–1872), was appointed as the first Professor of Geology in Zurich. In the first half of the nineteenth century, the relative age of strata was successfully determined on the basis of their fossil content. Around mid-century, Arnold Escher recognized that in the Glarus Alps older rocks overlay younger ones. He concluded that a "colossal overthrust" was present and alluded to a *Decke* (nappe) in the tectonic sense as early as 1845 (Fig. 02-14). In 1848, he took one of the most eminent geologists of the age, Roderick Impey Murchison (1792–1871) onto the Pass dil Segnas (Segnespass). Murchison concurred with Escher's interpretation and wrote in 1849 of "one enormous overthrow" (Fig. 02-12). However, Escher himself soon began to harbour doubts, as the extent of the displacement would have exceeded anything then known: "Nobody would believe it, I would be considered a fool." He therefore devised the absurd double fold theory, positioning two recumbent folds, one from the north and one from the south, supposedly enclosing a pouch-shaped flysch trough. The fronts of the two folds were claimed to lie opposite each other in narrow gaps on the Richetlipass and Foopass, although there would never have been sufficient room for this to be possible (Figs. 02-13).

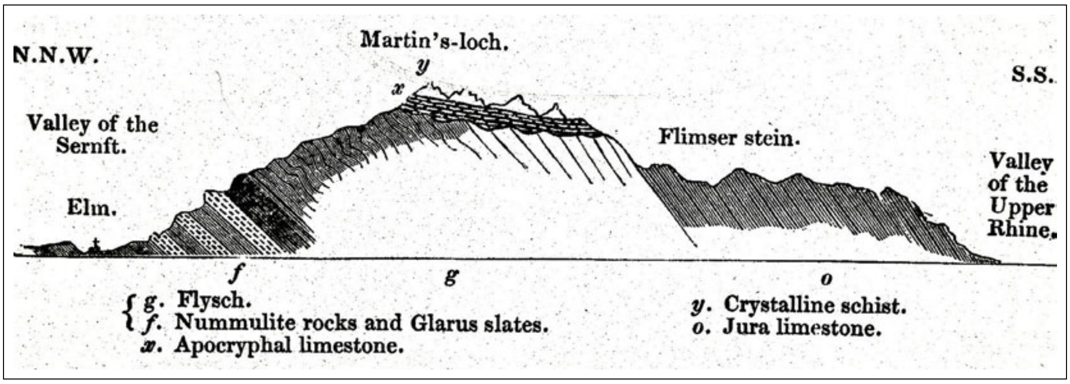

Fig. 02-12: Geological section through the Tschingelhoren. From: MURCHISON (1849).

Late 19th-century controversy: "Glarus double fold" or "a gigantic northward overthrust"?

It took leading geologists several decades to acknowledge and interpret the fact that old rocks overlay younger rocks at the Glarus overthrust. Europe's most eminent geologists were drawn to the Glarnerland region – and in particular to Lochsite near Schwanden – to seek explanations. The double fold theory was adopted by Escher's student Albert Heim (1849–1937), who succeeded him as Professor of Geology in Zurich (Fig. 02-13). Although the theory defied the laws of geometry and mechanics, it was widely accepted as a result of Heim's pioneering studies of rock deformation, his magnificent drawings and the clarity of his style. The double fold theory was also consistent with the prevailing orthodoxy according to which folds were caused by the contraction of the Earth's crust over a core that was shrinking as it cooled. Heim gave his critics short shrift, rightly in the case of Michael Vacek (1848–1925) of Vienna and largely unjustly in the case of August Rothpletz (1853–1918) of Munich.

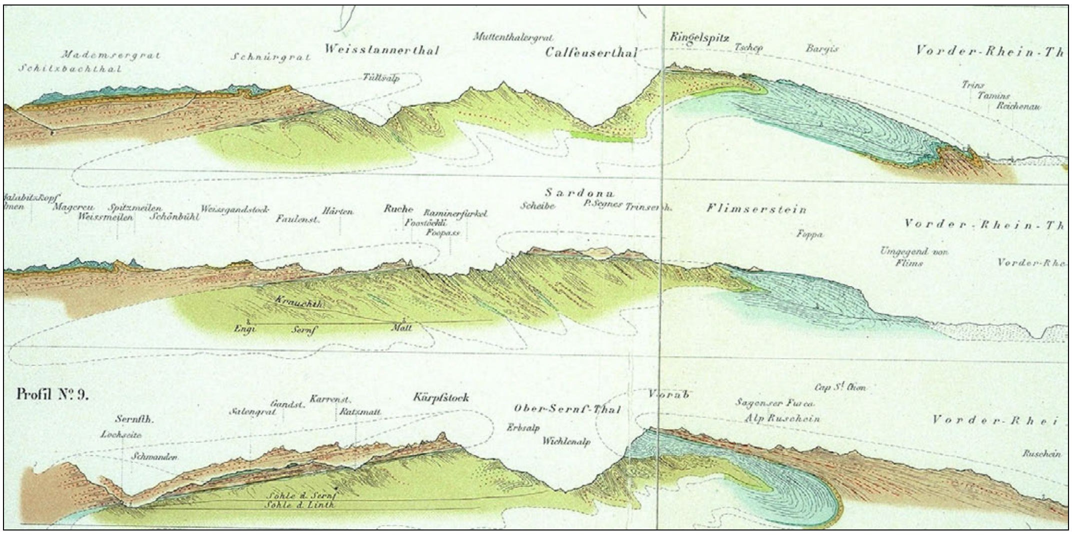

Fig. 02-13: Die Glarner Doppelfalte, From: ALB. HEIM (1878).

Thus, a short treatise published in 1884 by the Frenchman Marcel Bertrand (1847–1907) was largely disregarded. Bertrand, who did not have a first-hand knowledge of the Glarus Alps, showed that the structure of these mountains could be accounted for much more plausibly by a single overthrust, directed from south to north, than by the famous double fold (Figs. 02-13). On an expedition to the Foopass and the Baumgartenalp behind Linthal in 1892, Eduard Suess (1831–1914) of Vienna – the greatest Alpine geologist of the period – realized that Bertrand must be right, but he was not able to convince Heim that this was the case. In 1893, Hans Schardt (1858–1931) of Neuchâtel demonstrated that the Préalpes of Western Switzerland were part of an allochthonous thrust sheet from the interior of the Alps. This theory was more generally applied by Maurice Lugeon (1870–1953) of Vaud and the Frenchman Pierre Termier (1859–1930), and in 1903 it was also finally accepted by Albert Heim. Thereafter, its ascendancy was inexorable. In 1921, Albert Heim wrote in his standard work *Geologie der Schweiz:* “Anyone who still doubts the magnificent nappe tectonics should first inspect Lochseite …”

Extensive mapping and analysis in the first half of the 20th century

The readily accessible locality of Lochsite near Sool/Schwanden (Figs. 03-03, 05-05) thus became one of the most famous outcrops in the Alps. The following three decades probably represented the most productive period for Alpine geology. Previously incomprehensible structures and connections between areas of deposition were recognized as elements of a logical whole. The Glarus Alps became a region of crucial importance for the new doctrine. The drawing teacher Jakob Oberholzer (1862–1939), who had never studied at university level, produced outstanding geological maps of the entire region in all its complexity (Suppl. S05.1, S05.2). His *Geologie der Glarneralpen,* published in 1933 and including a wealth of precise observations and striking views and cross sections, still serves today as a valuable basis for new interpretations. The monograph on the Churfirsten–Mattstock group produced by Albert Heim's son Arnold Heim (1882–1965) is a model of stratigraphic/sedimentological analysis. This author also developed the principle of nappe cross section balancing and the reconstruction of deposition areas. The tectonics of the Glarus flysch units was elucidated by Wolfgang Leupold (1895–1986) and his pupils.

The nominated property also came to be used as a model, where new ideas and methods could be tested: Robert Helbling (1874–1954) and his co-workers, including Eugen Weber (1911–1994), applied photogrammetric techniques for the production of parallel projections of rock faces and the development of new geological mapping methods. Subsequently, Rudolf Staub (1891–1960) produced a highly idiosyncratic picture of the tectonics of the mountains between the Linth and Rhine and a historical survey of research in the region.

Detailed stratigraphic and structural geological studies in the second half of the 20th century

Rudolf Trümpy and his pupils focused on the various rock formations found between the Rhine and Reuss valleys and sought to reveal the connections between the individual nappes. The development of more detailed accounts of Verrucano stratigraphy and tectonics in the 1960s and 1970s made a significant contribution to scientific knowledge of the Glarus overthrust.

In the 1960s, Kenneth J. Hsü undertook quantitative analyses of overthrust processes. In the 1970s and 1980s, Adrian Pfiffner established associations between tectonic macro- and microstructures and investigated displacements along thrust faults and deformation mechanisms in limestones including Lochseiten limestone. In the 1970s, Stefan Schmid used Lochseiten limestone to analyse deformation mechanisms in mylonites (rocks found on thrust surfaces, highly deformed by tectonic processes). Martin Frey (1940–2000) studied the relationship between tectonic movements and low-grade metamorphism. He also published initial findings concerning the age of deformation phases.

Interest in the Glarus overthrust as a typical example of a major thrust fault continues unabated today. New approaches to old questions and problems have been facilitated by newly developed methods such as measurement of ratios of stable isotopes of oxygen, carbon or sulphur (Martin Burkhard) or the interpretation of fluid and gas inclusions in crystals (Josef Mullis). In addition, new insights into the mechanics and mechanisms of rock deformation have opened up new avenues of research. At present, a number of projects supported by the Swiss National Science Foundation are under way concerning Lochseiten limestone as well as the rocks below and above the thrust fault (researchers including Rainer Abart, Marco Herwegh, Adrian Pfiffner and their doctoral students).

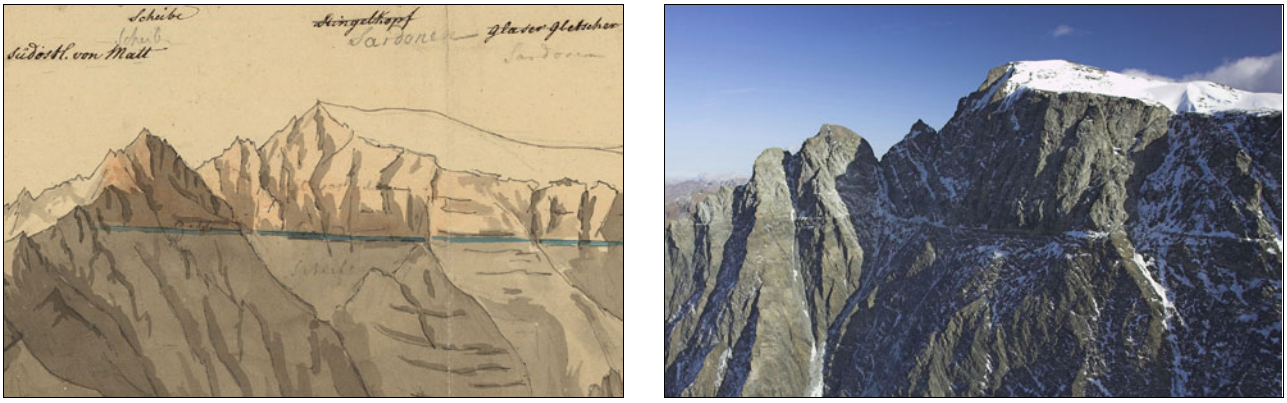

Fig. 02-14: Watercolour showing the Glarus overthrust on the western side of the Sardona group (ARN. ESCHER 1834, ETH Zurich Library, AE 268). Photograph: D. Kalberer, Heiligkreuz.

Past, Present and Future

Over a period of at least five hundred million years of the Earth's history, the nominated property has been the site of geological and geographical scenarios of every conceivable kind: tropical sea, desert climate and arctic glaciation, plate shifts and collisions leading to three successive cycles of uplift and erosion of mountain chains at intervals of 150–200 million years, accompanied by magmatism, vulcanism on both continent and sea floor and metamorphosis in the bowels of the earth. Within a small space, a summary of Central Europe's geological history can be found.

Developments are still under way. While we are most struck by signs of erosion and disintegration – weathering, rockfall, landslides and floods – measurements show that the Alps continue to rise at a rate of 0.5–1.0 mm per year. These values exceed the rate of erosion, which implies that the mountains are actually growing. Seismic activity in the Chur-Buchs/Vaduz-Walensee area – among the strongest in Switzerland – likewise indicates that the orogenic processes have by no means been completed.

2.a.3 Geomorphology/Geography

Geomorphology and Glaciers

The proposed World Natural Heritage site includes a wide variety of types of landscape.

Development of glacial landscapes during Ice Ages

The appearance of the present-day landscape was largely shaped by the last Ice Age and by weathering and erosion. During the Ice Ages, the area between Flims, Chur, Sargans, Ziegelbrücke, Schwanden and Elm was largely glaciated. The highest-lying Ice Age relicts indicate a minimum glacier elevation of 2300 m a.s.l. at Chur and 2100 m a.s.l. at Sargans. During the period of maximum glaciation, a connected network of main and side valley glaciers existed. Glaciers normally merge as they descend, but at two points – at Tamins and Sargans – the huge Rhine Glacier was forced to split into two large side branches.

Particularly where side valleys enter a (generally lower-lying) main valley, beautiful gorges were fashioned by streams. The best-known is certainly the Tamina Gorge, site of the famous thermal springs, but picturesque though sometimes inaccessible gorges were also created by the Seez at Mels, the Schils at Flums, the Murgbach at Murg, the Mülibach at Engi, and the Aua di Mulin at Trin.

The glaciers created the huge main valleys of the Linth and Rhine, with numerous U-shaped side valleys (Sernftal, Chrauchtal, Mülibachtal, Murgtal, Schilstal, Weisstannental and Calfeisen-/Taminatal). The main valleys were scoured out by the glaciers – in the Walensee area to a depth below today's sea level. After the end of the last major glaciation, moraines near Zurich and what is now Lake Constance dammed the meltwaters, forming a huge lake (Boden-Zurich-Walensee), which extended up the valley to beyond Chur, judging by the thick lacustrine deposits revealed by borings in the valley floor. However, the lake was soon subdivided by the development of deltas at the valley mouths, where Bad Ragaz, Mels, Flums and Murg now lie, and in the Glarnerland region.

In the Ringelspitz range, the Piz Sardona–Piz Segnas–Vorab group and the Pizol region, a number of glacial landscapes are to be found, with small glaciers (Figs. 02-16, 02-20, 04-02), cirque lakes (Figs. 04-02) and moraine ridges, and alluvial plains and outwash areas (Fig. 02-17, 02-23). The alpine alluvial plain of Plaun Segnas Sut (unterer Segnesboden, Fig. 02-17) and the foreland of the Glatschiu dil Segnas (Segnesgletscher, Fig. 02-17) are designated as sites of national importance. Many relicts of the last Ice Age, such as the glacial landscapes in the Pizol region (Fig. 04-02), in the Murgtal or on Fessis (Fig. 02-15), are geotope landscapes of national importance. In glacial landscapes of this type, a variety of raised bogs and mire landscapes of national importance have developed, e.g. in the Plaun Segnas Sut (Fig. 02-23), at Heubützli (Fig. 05-03), by the Murg lakes (Fig. 05-01) and on the Mürtschenalp.

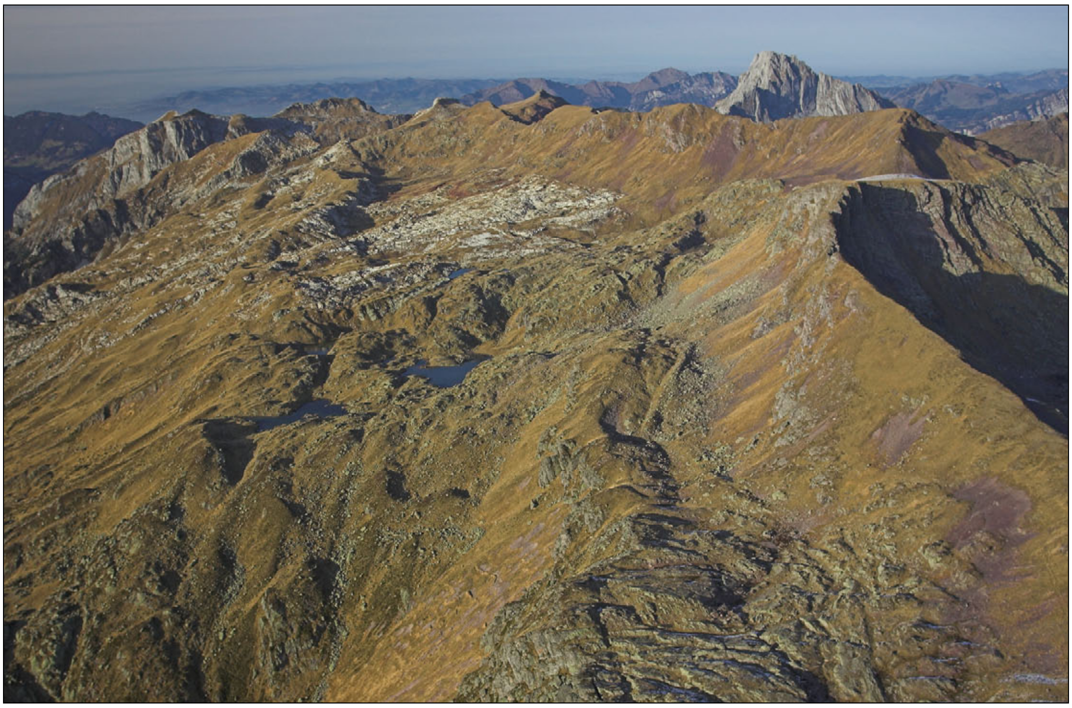

Fig. 02-15: The glacially formed lake landscape of Fessis. Photograph: D. Kalberer, Heiligkreuz.

Glaciers

During the Holocene, the glaciers would sometimes advance and sometimes retreat. On the terrain, from a distance, the moraines show on the whole the maximum level attained in 1850 – known as the end of the Little Ice Age – with great clarity. This maximum can likewise be determined from the vegetation (succession stages). Furthermore, within the 1850 level mark no mature soils are ever found. Since the maximum attained during the Little Ice Age, the glaciers have been melting fast, with a brief interruption around 1920. In the most recent past, their retreat has been dramatically accelerated, probably as a result of the anthropogenic portion of the greenhouse effect. This shrinkage can be seen most clearly by the lateral moraines of the 19th century in the Pizol region, the Ringelspitz-Tristelhorn group and in the Piz Sardona–Piz Segnas region. Even now, as the glaciers recede, many glacial and glaciofluvial phenomena are present.

Within this only lightly glaciated property, the following glacier complexes are to be found:

- Pizol–Graue Hörner–Schwarzchopf alpine glacier complex, comprising Zanai, Valplona, Pizolgletscher and Schwarzsee;
- Ringelspitz–Tristelhorn alpine glacier complex, comprising the Glasergletscher, Ringelspitz SE, Taminser Gletscher, Morchopf, Camutschera, Lavadignas I and II;
- Segnas–Sardona alpine glacier complex, comprising the Chligletscher, Sardonagletscher I and II, Glatschiu dil Segnas and Las Palas.

The Pizolgletscher and Chligletscher are included in the Swiss glacier monitoring network. The Pizolgletscher has been measured annually since 1894, and the Chligletscher (Sardonagletscher) since 1896. Between 1850 and 1973, the Pizolgletscher decreased in length from 1400 to 600 m, and the Chligletscher from 1500 to 700 m. From 1973 to 1987, both glaciers advanced again by about 20 m, but they have since further retreated.

The rate of glacial retreat within the boundary of the proposed World Natural Heritage site is striking. Between 1850 and 1973, the glaciers' total length decreased from 17 to 9.25 km (54 % reduction), with the total area declining from 7.02 to 3.29 km² (53 % reduction) and the total volume from 0.116 to 0.067 km³ (59 % reduction).

Between 1850 and 1973, the equilibrium line altitude rose by an average of 120 m, from 2580 to 2700 m a.s.l. The rise in altitude varies widely according to exposure: the increase was less pronounced for north-facing glaciers, such as the Sardonagletscher (55 m), Chligletscher (25 m) or Glasergletscher (15 m), than for south- or east-facing glaciers, such as the Glatschiu dil Segnas (100 m), Ringelspitz SE (220 m) or Taminser Gletscher (145 m). Exceptions to this rule are the north-facing Pizolgletscher (110 m) and the south-facing Lavadignas I and II (35 and 60 m).

Permafrost is widely found, chiefly at high elevations.

Fig. 02-16: More extensive glaciated areas are to be found in the central part of the proposed World Heritage site – in the Piz Sardona/Piz Segnes group. Photograph: D. Kalberer, Heiligkreuz.

Scree slopes and alluvial landscapes

At the foot of the cliffs, large scree slopes developed above the vegetation line. This is followed by the unforested zone, which is used for mountain farming. Here the landscape is shaped not only by glacial relicts (small lakes, moraine ridges, erratic blocks), but also by alluvial fans with untouched meandering mountain streams (Calfeisental, Weisstannental, Mülibachtal, Chrauchtal, La Rusna, Schneca, Plaun Segnas Sura, Figs. 02-17, 02-23). The scrub vegetation zone is followed by coniferous and finally mixed deciduous forests.

Fig. 02-17: Plaun Segnas Sura: the glacier foreland of the Glatschiu dil Segnas, which is also an alluvial zone of national importance. Photograph: H. Conrad, Berschis.

Karst phenomena

Also of interest are karst phenomena such as karren, dolines and caves in the limestone areas on Fans, and in the Mürtschen, Schilt and Flimserstein–Alp Mora regions (Fig. 02-18). The Helloch doline has a diameter and a depth of more than 20 m. The Spanneggsee has no surface outlet, and the Talsee has neither surface inlets nor outlets. Extensive cave systems found in the Mürtschen region have only been partly explored.

Fig. 02-18: Karst phenomena at Bargis. Photograph: D. Imper, Heiligkreuz.

Landslides and rockfalls

The scenery has also been and continues to be shaped by landslides and rockfalls, with scars, debris fields and fallen rock masses – the headwalls of the largest-ever Central Alpine, late to post-glacial landslide (Flims) and the disastrous Elm landslide of 11 September 1881 are situated on the periphery of the nominated property. The Flims landslide, which occurred on the south-eastern margin of the nominated site and involved a volume of 9 million cubic metres, created the spectacular landscape of the Ruinaulta Gorge.

In the Linthtal, large rockfalls also occurred at Näfels, Netstal, Glarus and Schwanden, damming up the Linth for a time. Major postglacial rockfall masses can also be found at Engi, Elm, Flims and Tamins, and in the Chrauchtal, Schilstal and Weisstannental.

Unique landscapes shaped by the elements

The landscape has been moulded and is constantly remodelled by weathering and erosion. It is thanks to the forces of erosion that the line of the Glarus overthrust is perceptible to the naked eye over such a long distance. The character of the following landscapes is unique: the Calfeisental, the Pizol region, the Murgsee–Mürtschen region, the Talsee, Fessis, the Tschingelhoren (including Martin's Gap), the Segnes Plains (Plaun Segnas Sut and Plaun Segnas Sura) and the southern slopes of the Ringelspitz range.

Martin's Gap, with a diameter of almost 20 m, is the scene of regular natural spectacles, when the sun or full moon shines through the opening onto the top of the church spire in Elm – an event that attracts numerous visitors (Figs. 02-07, 02-11, 02-19, 03-01).

Fig. 02-19: View throug the spectacular Martin’s Gap, which has a diameter of almost 20 metres. Photograph: D. Imper, Heiligkreuz.

Peaks of more than 3000 m a.s.l.

Within the boundary of the proposed World Heritage site (Fig. S-01, Annex A01), seven peaks rise to an elevation of more than 3000 m a.s.l.:

- **Ringelspitz*** / Piz Barghis 3247 m
- Glaserhorn* 3128 m
- **Tristelhorn*** / Piz da Sterls 3114 m
- Panärahörner* 3106 m
- Piz Segnes / **Piz Segnas*** 3099 m
- Surenstock / **Piz Sardona*** 3056 m
- Trinserhorn / **Piz Dolf*** 3028 m

* In general, only the names given in **bold** are used in the text.

Fig. 02-20: The Ringelspitz/Piz Barghis is the highest peak within the proposed World Heritage site (3247 m a.s.l.). Photograph: D. Kalberer, Heiligkreuz.

The table below shows the distribution of area by elevation. The cumulative frequency curve in Tab.02-05 shows the largest increment of area between 1600 and 2400 m above sea level (Map: Annex A03). These elevations occur most frequently in the nominated area.

Tab. 02-05: Cumulative elevation distribution for the nominated World Heritage property, the percentage of the total area and the cumulative area for each altitude band (Map: Annex A03).

Elevation (m above sea level)	Area (km²)	Area (%)
400–800	1.0	0.3
800–1200	6.0	1.8
1200–1600	41.0	12.5
1600–2000	101.5	30.9
2000–2400	125.5	38.2
2400–2800	48.5	14.8
2800–3300	5.0	1.5
Total	**328.5**	**100.0**

Land Cover and Land Use

The Weisstannental and the Calfeisental were decisively shaped by clear-felling associated with Walser settlements in the thirteenth century. The pastures that originated at that time have been preserved in the same form as a result of continuous use by mountain farmers. In most cases, forest clearance was carried out by the Walser people on valley slopes exposed to the sun. Accordingly, the original natural treeline can still be observed on the southern (shaded) slopes of the Calfeisental.

The table below, derived from Federal Statistical Office figures, shows the areas occupied by various land use and land cover types. Areas devoid of vegetation together with unproductive vegetation make up some 40 % of the total area. Another 8 % falls into the classes of forest with closed and open crown/forest with undergrowth and thickets, while alpine meadows account for 48 % (Tab. 02-06; Map: Annex A07).

Tab. 02-06: Areas assigned to land use and land cover classes in the nominated area (Map: Annex A07).

Class	Area in nominated property	
	km²	%
Glaciers	5.0	1.5
Rock	92.5	28.1
Rock slides, rubble	39.5	12.0
Alpine meadows	157.0	47.8
Forest/thicket	27.5	8.4
Meadows	3.5	1.1
Water	3.5	1.1
Residential / transportation	0.0	0.0
Total	**328.5**	**100.0**

2.a.4 Biology: Habitats/Vegetation/Flora/Fauna

The nominated property covers a wide range of elevations from colline to nival zones. Many kinds of rock are encountered. Most of the proposed World Natural Heritage site lies above the treeline; however, certain parts border on valley regions. The landscape is thus primarily shaped by the subalpine and alpine elevations. About 40 % of the area is barren under the classification system used. In spite of its barrenness, the region displays a wide variety of valuable habitats for species typical.

Habitats

Morphodynamic processes continually create new habitats and alter or destroy them. Successional areas, present in large numbers because of the dynamic environmental conditions, form the typical habitats of this region.

Habitats here are also affected by the factors of substrate (rock), temperature and precipitation. As the elevation rises, the temperature falls and the precipitation increases, although there are climatic differences from region to region, especially between the northern and southern sides of the mountain ranges running from east to west.

Vegetation and Flora

Owing to the variety of geological substrates (Sections 2.a.2 and 2.a.3), elevations and topographical features, the property harbours extremely diverse plant communities. The number of vascular plant species is estimated at around 800, including just under 50 species that are protected at the national level (Annex A08). For a northern Alpine region, this represents a high degree of species diversity. The property is home to a number of notable Tertiary relicts, such as *Callianthemum coriandrifolium, Ranunculus parnassifolius* and *Androsace pubescens*.

Because of the underlying geology, acidic soils (rankers and podzols), with flora typical of the primary rock, are more widespread than basic soils (rendzinas), which prevail chiefly in the region of the parautochthonous and autochthonous calcareous strata and in the Mürtschen-Kerenzerberg region, supporting a calciphile flora. Mixtures of calciphile and calcifuge species are found where limestone scree and primary rock occur.

The lowest point in the nominated area lies at 520 m above sea level near Ennenda/Glarus on the western side. This falls in the colline zone, ending at around 700 m. The montane zone is next higher and ends at around 1300 m. The subalpine or coniferous forest zone follows, extending to the treeline, the lower boundary of the alpine zone, at about 1800 m. The nival zone then runs from the snowline at 2700 m up to the highest peaks.

Forests of the Subalpine Zone

At the lowest elevations up to about 1100 m a.s.l., pure beech forests with *Fagus sylvatica* can still be found on relatively well developed soils in the Weisstannental and Sernftal and near Glarus. The dominant types are millet grass beech forest (Milio-Fagetum) with sweet woodruff *(Galium odoratum)* and early dog-violet *(Viola reichenbachiana)* in valleys and at the foot of slopes, and beech forest with *Adenostyles glabra* and dog's mercury *(Mercurialis perennis)* on steeper slopes. On dry, sunny hilltops, sedge beech forests with mountain sedge *(Carex montana)* can be found in rare cases. On damp, shady slopes, sycamore *(Acer pseudoplatanus)* occurs together with wych elm *(Ulmus glabra),* forming elm–maple forests. At higher elevations, the pure beech forests give way to beech–silver fir forests with *Abies alba*. These include in particular beech-silver fir forests on calcareous substrates with male fern *(Dryopteris filix-mas).* Herbaceous perennial–beech–silver fir forests with *Adenostyles alliaria* and *Ranunculus lanuginosus* are found in shady depressions. From 1300 to 1400 m a.s.l., beech disappears altogether and silver fir–spruce and spruce forests predominate. The most common forest community here is Homogyno-Piceetum with Norway spruce *(Picea abies),* villous small reed *(Calamagrostis villosa)* and bilberry *(Vaccinium myrtillus).* This community thrives on soils with high surface acidity. Herbaceous perennial–silver fir forests grow on damper ground, and silver fir forests with *Calamagrostis varia* are found on steeper and more base-rich slopes.

Forests of the Montane Zone

On sunny carbonate outcrops, isolated Scots pine *(Pinus sylvestris)* trees can occasionally also be found which, in combination with the dominant spruce, form spruce forest with blue moorgrass (*Sesleria varia*) and shrubby milkwort *(Polygala chamaebuxus),* e.g. in the somewhat continental Calfeisental. Swiss mountain pine *(Pinus mugo* ssp*. uncinata)* is found in hairy alpenrose *(Rhododendron hirsutum)* mountain pine forest on carbonate rocks in the Schilt region and in rusty alpenrose (*Rhododendron ferrugineum*) mountain pine forest on acidic substrates in the Murgtal (Fig. 05-01). Without regard to the carbonate content, dwarf mountain pine *(Pinus mugo* ssp. *mugo)* colonizes avalanche paths in dry areas, e.g. in the Spannegg–Mürtschen–Murg lakes region and in the Calfeisental.

A notable feature is the occurrence of arolla pine *(Pinus cembra)* at higher elevations in the Calfeisen, Murg (Fig. 05-01) and Mürtschen valleys; these are the northernmost examples of relatively extensive stands in the whole of Central Europe. In the nominated property, arolla pine is found at elevations of up to 2100 m a.s.l., while the main treeline lies at around 2000 m a.s.l.

Meadows

Within the boundary of the property, hay meadows are found at a few sites in the Glarnerland region. A relatively large mountain hay meadow lies in the Brand region above Ennenda, and various other sites can be found in the Mülibachtal and Chrauchtal. These are to be included in the forthcoming Inventory of Dry Grasslands of National Importance. In addition to low-nutrient valley grassland species, such as upright brome *(Bromus erectus),* the hay meadows harbour species characteristic of blue moorgrass slopes, such as evergreen sedge *(Carex sempervirens)* or round-headed rampion *(Phyteuma orbiculare).* The great majority of grassland communities above the treeline are used for mountain farming. *Cynosurus cristatus* pastures with the eponymous crested dogstail grass and autumn hawkbit *(Leontodon autumnalis)* are found at mid-range elevations, between 1000 and 1800 m a.s.l. Above 1600 m a.s.l., on damp, intensively grazed land, *Leontodon hispidus* pastures occur, with the eponymous rough hawkbit and golden hawksbeard *(Crepis aurea).* On drier soils, mat-grass pastures (Fig. 02-21) predominate, extending from 1600 to 2200 m a.s.l. and showing marked variation in floristic composition, depending on elevation and grazing intensity. Characteristic species include mat-grass *(Nardus stricta),* mountain tobacco *(Arnica montana),* trumpet gentian *(Gentiana kochiana)* and bearded bell-flower *(Campanula barbata).* With low grazing pressure, mat-grass pastures develop into dwarf-shrub heathland. Alpenrose heathland with rusty alpenrose *(Rhododendron ferrugineum)* is found widely throughout the property. Like mat-grass swards, it thrives only on base-poor soils. On pure limestone in the Mürtschenstock region, on parts of Alp Fessis, and in the Mülibachtal and Chrauchtal, the rarer type of dwarf-shrub heathland with hairy alpenrose *(Rhododendron hirsutum)* can also be found. In warm, sunny areas with low snowfall, alpenrose heaths give way to dwarf-shrub heaths with crowberry *(Empetrum nigrum),* juniper *(Juniperus nana)* and alpine blueberry *(Vaccinium gaultherioides).* In more exposed areas with low winter snow cover, trailing azalea heath develops, with the eponymous *Loiseleuria procumbens* and numerous lichens, e.g. alpine sulphur-tresses lichen *(Alectoria ochroleuca).*

Fig. 02-21: Dry grasslands Alpeli (Ennenda), Photograph: D. Imper, Heiligkreuz.

Dry Steep Slopes

Dry steep slopes on base-rich rock are generally covered by blue moorgrass-evergreen sedge swards, a type of community that occurs widely throughout the property. Blue moorgrass swards are generally very species-rich, with characteristic species such as evergreen sedge *(Carex sempervirens),* blue moorgrass *(Sesleria caerulea),* rock rose *(Helianthemum alpestre),* sweet-flowered rock jasmine (*Androsace chamaejasme*) and alpine aster *(Aster alpinus).* Often they also harbour rare and protected species such as edelweiss *(Leontopodium alpinum).* The mixed vegetation that thrives on Verrucano is often a rich assortment of species characteristic of blue moorgrass-evergreen sedge swards and mat-grass swards. At various sites, given the high degree of geological diversity of the property, several different types of grassland are interconnected within a small area, producing a high level of species diversity. Waterlogged channels, depressions and north-facing snow-covered slopes on base-rich soils are generally colonized by rusty sedge grasslands. On these luxuriant, long-stemmed grasses, typical species include rusty sedge *(Carex ferruginea),* round-headed orchid *(Traunsteinera globosa),* narcissus-flowered anemone *(Anemone narcissiflora)* and fescue *(Festuca pulchella).* In these communities, rare species are also found, e.g. *Stemmacantha rhapontica*, yellow bellflower *(Campanula thyrsoides)* or alpine columbine *(Aquilegia alpina).* While blue moorgrass-evergreen sedge swards are often intensively grazed, the steeper rusty sedge grasslands are frequently managed extensively or are not grazed at all. Sites where rusty sedge grasslands develop are often also colonized by green alder shrubs and herbaceous perennials. Green alder *(Alnus viridis)* forms thickets, often occurring in association with perennials such as masterwort *(Peucedanum ostruthium),* alpine sow-thistle *(Cicerbita alpina)* and broad-leaved yarrow *(Achillea macrophylla).*

Bogs

Also of special interest are the raised bogs – some of national importance – in the Murgtal (Fig. 05-01) and Mürtschental. Rare species thriving in these habitats include mud sedge *(Carex limosa)* and round-leaved sundew *(Drosera rotundifolia).* Of the various types of mire, fenlands (Fig. 02-22) are the most widespread, occurring in small patches at subalpine and alpine elevations throughout the property. Wherever fens occur in association with base-rich flushes, Davall sedge fens develop, dominated by *Carex davalliana*. These support numerous protected species, such as broad-leaved cotton grass *(Eriophorum latifolium)* or broad-leaved marsh-orchid *(Dactylorhiza majalis).* Fens developing on acidic soils, particularly in hollows, are dominated by common sedge *(Carex nigra).* Although they are usually less species-rich than Davall sedge fens, they are also home to protected species such as narrow-leaved cotton grass *(Eriophorum angustifolium).* The property encompasses a number of fens of national and cantonal importance (Section 5.b, Fig. 02-22). The highest-lying mire covering an extensive area is on Ober Heubützli in the Weisstannental (2280 m a.s.l., Fig. 05-03). In addition, raised bogs and fenlands frequently harbour an extremely diverse range of algal species. The special value of these habitats has been underlined by a number of studies of algae conducted in various parts of the property.

Fig. 02-22: A section of the Chrauchtal fen. Photograph: F. Marti, Mollis.

Seepage Communities

Almost all alpine spring brooks are associated with seepage communities, including ice sedge *(Carex frigida)* and yellow mountain saxifrage *(Saxifraga aizoides).* In alluvial riparian zones, rare plant communities may develop alongside glacier-fed streams on sandy soils and moraine substrates.

Alluvial Plains

A particularly fine example of an alpine alluvial plain has arisen at 2100 m a.s.l., at Plaun Segnas Sut (Fig. 02-23) – one of Switzerland's largest and most beautiful alpine alluvial plains. This harbours various characteristic species, such as bicoloured sedge *(Carex bicolor)* or three-flowered rush *(Juncus triglumis).* Plaun Segnas Sura is an extensive mire-free plain with a large glacier foreland of national importance (Fig. 02-17).

Fig. 02-23: Plaun Segnas Sut: a mire landscape and alluvial zone of national importance. Photograph: D. Imper, Heiligkreuz.

Alpine Rock and Scree Communities

Large parts of the property are covered by alpine rock and scree communities, with the nature of the flora depending essentially on whether the substrate consists of base-poor or base-rich rocks. The crevices and ledges of calcareous rocks are colonized by calcareous rock communities. Typical species occurring below about 2200 m a.s.l. include lax cinquefoil *(Potentilla caulescens),* buckthorn *(Rhamnus pumila)* and bear's ear *(Primula auricula).* Increasingly common in the highest-lying areas (from around 2200 m a.s.l., Figs. 02-24 and 02-06) are cushion-type plants such as Swiss androsace *(Androsace helvetica)* and other species such as blue saxifrage *(Saxifraga caesia)* or *Draba tomentosa*. Calcareous rocks are particularly widespread in the Mürtschenstock, Piz Segnas and Ringelspitz regions. In the Gufelstock-Schilt region, outcrops with karren features are colonized by limestone plants. Siliceous rock communities are mainly found on hard Sardona quartzite (Sardona Flysch). Primrose rock communities, found at altitudes ranging from the valleys to the alpine level, are dominated by *Primula hirsuta*, often occurring in association with mountain houseleek *(Sempervivum montanum)* and other species. This habitat also supports the rare fern species alpine cliff fern *(Woodsia alpina),* a few specimens of which have been recorded in the Calfeisental. Within the property, siliceous rock communities properly so called only occur in small patches. More commonly encountered are siliceous scree communities, with alpine rock jasmine *(Androsace alpina), Saxifraga aspera* and *Artemisia genipi*. Also widespread in limestone and flysch areas are calcareous scree communities with round-leaved pennycress *(Thlaspi rotundifolia), Cerastium latifolium* and *Campanula cenisia*, harbouring a number of notable and rare plant species. One species favouring calcareous fine-grained scree is Triglav hawksbeard *(Crepis terglouensis),* which is found in the Segnas region. Siliceous block scree slopes are generally inhospitable to plants and are only colonized by a few typical species, such as parsley fern *(Cryptogramma crispa).* In contrast to scree habitats, block fields lack fine earthy material.

Fig. 02-24: At Cassonsgrat, acidic and alkaline soils are directly adjacent to each other on account of the Glarus overthrust. Photograph: B. Walder, Steffisburg.

Fungi, bryophytes and ferns

Scant data are available on the occurrence of fungi, bryophytes and ferns; however, it may be assumed that this region harbours in particular the subalpine and alpine range of species typically found on the northern side of the Alps.

Lichens

Finally, on the highest summits, the only plants encountered are a number of lichen species such as map lichen *(Rhizocarpon geographicum)* on siliceous rock. Although scant data are available on lichen flora, a relatively high level of species diversity is to be expected in view of the geologically diverse nature of the property.

Fig. 02-25: Lady's slipper orchid *(Cypripedium calceolus)* is a rare species growing in sparse mountain forests on a base-rich substrate. Photograph: O. Good, Mels.

Fauna

Neither the fauna of the nominated area nor population figures are known in adequate detail. Only a few quite typical species are listed below.

Mammals

The area of the proposed World Natural Heritage site is only minimally developed in terms of tourist infrastructure. As a result, extensive, relatively tranquil areas remain which make the property an important habitat for mammals (Annex A09). The site is home to several colonies of the alpine ibex *(Capra ibex,* Fig. 02-26, 06-01), which after being eradicated in the nineteenth century was first reintroduced in Switzerland in the Graue Hörner region in 1911 (Fig. 02-32). In 2002, the ibex population in the Graue Hörner reserve and in the Foostock region alone numbered approximately 700. Around 1850, the red deer *(Cervus elaphus)* was also considered to be extinct in Switzerland. However, following natural migrations from the Montafon valley in Austria, populations soon became re-established in Graubünden and the Sarganserland region. Today red deer are found in all the potential habitats between the Glarnerland region and Chur Rhine valley. In the last century, intensive use of valleys and mountain pastures forced red deer to abandon these areas and take refuge in the (less hospitable) forests, where natural regeneration was impaired by browsing damage as a result. The chamois *(Rupicapra rupicapra)* is a common species throughout the property. Its habitat preferences change with the season: it favours forested areas in the winter and steep slopes and alpine rocks in the summer. Like the chamois, the roe deer *(Capreolus capreolus)* is found throughout the property, but only in forested areas.

Other mammals predominantly found in the forests include the red fox *(Vulpes vulpes),* badger *(Meles meles)* and pine marten *(Martes martes).* The lynx *(Lynx lynx)* is occasionally found but is not a sedentary species. Areas above the treeline serve as habitats in particular for the mountain hare *(Lepus timidus)* and alpine marmot *(Marmota marmota).* Isolated records of various small mammals exist (mainly mice, shrews and bats, but no information is available concerning special features of these populations.

Fig. 02-26:
Having been completely eradicated from Switzerland, the ibex was first reintroduced within the proposed World Heritage site "Glarus overthrust" in 1911, and populations have since flourished. Photograph: O. Good, Mels and Wildhut St. Gallen.

Birds

Of the total of just under 200 species of breeding birds found in Switzerland as a whole, 85 have been recorded to date as breeders within the property (Annex A10), representing virtually all of the species that would be expected to occur at altitudes of 1000–2500 m a.s.l. on the northern margins of the Alps. Species found in mixed deciduous forests at lower elevations include the wood warbler *(Phylloscopus sibilatrix),* pied flycatcher *(Ficedula hypoleuca)* and Eurasian woodcock *(Scolopax rusticola).* The coniferous forest belt harbours typical species such as the black woodpecker *(Dryocopus martius)* and nutcracker *(Nucifraga caryocatactes),* but also rare species such as the hazel grouse *(Bonasa bonasia),* northern three-toed woodpecker *(Picoides tridactylus),* Tengmalm's owl *(Aegolius funereus)* and pygmy owl *(Glaucidium passerinum).* Populations of the threatened capercaillie *(Tetrao urogallus,* Fig. 02-27) have only been recorded in the eastern part of the property (e.g. Aeugsten and Achseli). Species occurring widely along the treeline are the black grouse *(Tetrao tetrix),* redpoll *(Carduelis flammea)* and lesser whitethroat *(Sylvia curruca).* The commonest species of breeding bird on open mountain pastures is the water pipit *(Anthus spinoletta).* The barren plateaux and scree slopes are favoured by the alpine accentor *(Prunella collaris),* wheatear *(Oenanthe oenanthe)* and ptarmigan *(Lagopus mutus).* Cliff faces and steep, inaccessible areas on and above the treeline are preferred breeding grounds for the golden eagle *(Aquila chrysaetos),* kestrel *(Falco tinnunculus),* raven *(Corvus corax)* and wallcreeper *(Tichodroma muraria).* The alpine chough *(Pyrrhocorax graculus)* and snow finch *(Montifringilla nivalis)* use even the highest rocky areas as breeding grounds. Other species that have also been observed include the bearded vulture *(Gypaetus barbatus)* and common rosefinch *(Carpodacus erythrinus).*

Fig. 02-27: The capercaillie *(Tetrao urogallus)* is a threatened species characteristic of untouched mountain forests (Walabütz, Weisstannental). Photograph: O. Good, Mels.

Amphibians and Reptiles

Various amphibians and reptiles (Annex A11) are found even in the highest-lying areas. The alpine salamander *(Salamandra atra)* can be found throughout the property, although there is evidence that populations are declining. The alpine newt *(Triturus alpestris),* together with the European common frog *(Rana temporaria),* colonizes mountain lakes, alpine pools and fenlands up to an altitude of more than 2200 m a.s.l.

Although less frequent, the common toad *(Bufo bufo)* can be observed in various waterbodies. The slow-worm *(Anguis fragilis)* is only found in the lowest-lying parts of the region, especially in the Glarnerland near Ennenda and Schwanden; this is also true of the smooth snake *(Coronella austriaca),* with populations recorded near Ennenda and Sool. The common lizard *(Lacerta vivipara),* which is widespread in the property, colonizes sunny, rock-strewn mountain pastures, in some cases up to an altitude of more than 2100 m a.s.l. Adder *(Vipera berus)* populations have been recorded in the Weisstannen, Mürtschen, Mülibach, Chrauchbach and Murg valleys. In the Weisstannental, the adder is found on sunny scree slopes between 1600 and 2000 m a.s.l.

Fish

Among the fish species occurring naturally are the brown trout *(Salmo trutta fario)* and possibly miller's thumb (*Cottus gobio*). In addition, the lake trout *(Salvelinus namaycush),* rainbow trout *(Oncorhynchus mykiss)* and pike *(Esox lucius)* have been released in various waterbodies (e.g. Ober-Seeloch in the Mülibachtal).

Butterflies

As little is known about many of the species of insects and spiders that occur in the nominated property, the butterflies may stand proxy for the large invertebrate group. Butterflies have been studied both in the Glarnerland and in the Weisstannen and Calfeisen valleys. The documented spectrum of almost 90 species encompasses virtually all those expected to occur at subalpine and alpine levels (Annex A12). Notable species found at lower altitudes include the Clouded Apollo *(Parnassius mnemosyne)* and Small Copper *(Lycaena phlaeas),* both of which have been recorded in the Weisstannental, with the former also documented in the Mürtschental and Chrauchtal. A rare species found in herbaceous perennial mountain forests is Thor's Fritillary *(Clossiana thore),* which has been observed in the Sernf, Murg and Calfeisen valleys. A common species, found in flower-rich mountain forests, is the Scotch Argus *(Erebia aethiops).* Also found in the raised bogs of the Murg valley is the Cranberry Fritillary *(Boloria aquilonaris),* a species rare in Switzerland as a whole. Species diversity is particularly high in extensively grazed areas around the treeline and on higher-lying blue moorgrass slopes such as are found between Bargis and the Trinserhorn. Among the species encountered in this region are the Swiss Brassy Ringlet *(Erebia tyndarus),* Cranberry Blue *(Vacciniina optilete),* Knapweed Fritillary *(Melitaea phoebe),* Large Blue *(Maculinea arion)* and Northern Brown Argus *(Aricia Artaxerxes).* One very rare species, occurring in isolated populations, is the Chestnut Heath *(Coenonympha glycerion),* which has only been recorded in the Brand region. Characteristic of alpine levels are the Small Apollo *(Parnassius phoebus*, Fig. 02-28) and the diversity of ringlets, e.g. the Yellow-spotted *(Erebia manto)* and Blind Ringlet *(Erebia pharte)* species typical of and commonly found on mat-grass swards, and scree slope specialists such as the Silky *(Erebia gorge)* and Sooty Ringlet *(Erebia pluto).* Certain butterfly species such as the Dewy Ringlet *(Erebia pandrose)* or Cynthia's Fritillary *(Hypodryas cynthia)* prefer the highest ridges and peaks. Herbaceous perennial communities, dwarf-shrub heaths, fenlands and spring communities also support typical butterfly species, which are generally tied to their respective habitats by specific caterpillar food plants.

Fig. 02-28: The Small Apollo *(Parnassius phoebus)* is a characteristic alpine species found along seeps and streams, and in mires. Photograph: P. Weidmann, Chur.

Insects

Two species of insects are particularly noteworthy – the rare, endangered blue long-horn beetle *(Rosalia alpina),* recorded in the Weisstannental, and *Metrioptera saussuriana,* a bush-cricket only recently discovered in the Calfeisental (no populations had previously been known to exist south of the Seeztal).

2.b History and Development

The nominated property its present form over about a billion years of geological history. The petrologic situation together with tectonic processes became the clay, so to speak, for modelling by natural exogenous processes (see Section 2.a.3). In comparison with what went before, developments in the Holocene are mere trifles. After the end of the Younger Dryas, about 12,000 B.C., the glaciers returned to their present extent, fluctuating thereafter within a rather narrow range. While the current extents of glaciers lie within this range, they must be regarded as minimal in the context of the past millennium.

Settlement

The oldest human traces in the nominated property – and indeed in the whole of Eastern Switzerland – are the remains of fires found in the Drachenloch cave (2427 m a.s.l.) above Vättis, which date back over 53,000 years (too ancient for radiocarbon dating). At the same site, large numbers of cave bear bones have also been discovered, which must likewise be more than 53,000 years old. For some decades, controversy has raged over whether humans and cave bears occupied the cave at about the same time, and whether a bear cult was practised. Many of these magnificent finds are exhibited at the local museum in Vättis.

The Weisstannental and the Calfeisental were settled by the Walser people in the thirteenth century. Evidence of these bygone times survives in the form of characteristic dispersed settlements, old Walser houses and typical place names, which are also found within the boundary of the proposed World Natural Heritage site (e.g. St. Martin, Gigerwald, Gafarra, Valtnov). In addition, the Walsers settled in close proximity to the property, near Elm and on the Wissenberg near Matt. Many of today's mountain pastures can be traced back to the clear-felling carried out at that time. From the mid-fifteenth century onwards, the Walsers abandoned this area as a result of the deteriorating climate and more frequent avalanches triggered by forest clearance. Around 1400, the Walser population in the Calfeisental numbered about 100, with a dozen homesteads; by 1652, the last Walsers had left the valley and moved to Vättis.

Fig. 02-29: The Walser settlement of St. Martin (1350 m a.s.l.), which was occupied all year round until 1652, has been preserved and restored. Photograph: P. Donatsch, Bad Ragaz.

No farms or settlements occupied the whole year round are currently to be found within the boundary of the proposed World Natural Heritage site.

Use of Ores, Minerals and Rocks – Mining

In the Glarnerland and Sarganserland regions, mining has a long tradition, based on the relatively abundant deposits in this part of Switzerland. For centuries, the stone-works and mines were the most important source of income from non-agricultural activities. Hundreds of workers earned their living under arduous conditions in the Gonzen iron mine, the Engi slate workings, the Mels millstone quarries or the lime-stone quarries.

Within the boundary of the nominated property, mining did not play a major role, except on the Mürtschenalp (silver and copper ore mining) and in the Flumser mountains (gypsum extraction, Fig. 02-30).

The first documentary evidence of mining on the Mürtschenalp dates back to 1607. The most important mining eras were from 1611 to 1618 and especially from 1850 to 1863. Silver and copper ore were last mined from 1916 to 1918. Between the Murgtal and Mürtschenalp, traces of several old workings remain up to an altitude of more than 2200 m a.s.l. (Hochmättli). At the main pits between the Tschermannenalp and Mürtschenalp, some 900 tonnes of crude ores were extracted from 1855 to 1861. These were transported to the Mürtschenalp for processing, and the yields were always modest.

During the eighteenth century, gypsum was extracted from the Schilstal and the Flumser mountains and used in stuccowork on important buildings.

Historically, ore and gypsum extraction was short-lived, and it did not produce any adverse environmental impacts. Deposits are limited, and the resumption of mining would be neither economically viable nor possible from a legal perspective.

Fig. 02-30: Gypsum deposits at Wissmeilen. Photograph: D. Imper, Heiligkreuz.

Mention should be made of the uranium anomalies occurring in Permian Verrucano in the Weisstannental and Murgtal within the nominated property. As these uranium mineralizations are fine and irregularly distributed, they are not suitable for mining.

Present Uses

The nominated World Heritage site is subject to a variety of uses representing long traditions:

- Agriculture and Alpine farming
- Forestry
- Hunting
- Hydroelectric generation
- Tourism
- Knowledge Management / Research
- Mineral (crystal) collecting

Agriculture and Alpine farming

The pastures are situated on the slopes beyond the valleys, up to an altitude of 2500 m a.s.l. They are mainly grazed by dairy/beef cattle and sheep, and are only used for this purpose during the summer months (June to September). This traditional form of extensive management can be described as sustainable and environmentally sound. The rearing of dairy cattle and hence the summer pasturing of beef cattle is declining, and new forms of grassland management are becoming increasingly significant (single-suckling systems on pasture). As a landscape management measure, mountain farming helps to prevent the development of scrub (hedgerow management, path maintenance, etc.). As a result of the growing industrialization of agriculture and economic pressures, steep slopes and less favoured areas are no longer being grazed and are increasingly turning to scrub. Consequently, there is a risk that these important management measures may be abandoned. This use of the land, probably dating back to the Bronze Age, does not impair the value of the area as long as it remains sustainable.

A total of 68 mountain farming enterprises are to be found within the boundary of the nominated property, although in 12 cases the holdings lie largely outside the site. In the summer of 2002, these 68 farms were populated with around 2700 head of cattle, 5300 head of youngstock, just under 7000 sheep, 450 goats, and 50 horses and donkeys. In the canton of Glarus, a number of small, higher-lying areas (In den Zügen Obstalden, Äugsten Ennenda, Glattmatt Engi, Bruch Matt, Lauben Elm) are used as hay meadows.

Fig. 02-31: There is a centuries-old tradition of mountain farming. Within the proposed World Heritage site, the rare and now threatened breed of mountain goat known as the booted goat *(Stiefelgeiss)* is still farmed. Photograph: B. Walder, Steffisburg.

In the peripheral valley regions, year-round farming is practised up to an altitude of 1000 m a.s.l. or more. The boundary of the proposed World Natural Heritage site extends at only a few points (Weisstannen, Mullerenberg, Ennenda, Sool, Elm) into these lower-lying, year-round farming areas. Given the nature of the terrain, only extensive management is possible. These areas are mainly used by small farms as grass- and pastureland.

Forestry

Demand for timber as a source of energy and a construction material and also for pastureland led to the overexploitation of forests until well into the nineteenth century. After devastating storms in the mid-nineteenth century and considerable damage to the lower reaches of streams, the first forestry law was enacted at the federal level. Mountain forests were placed under legal protection and major efforts were undertaken to increase the forested area and promote replanting, mainly with Norway spruce. As can be seen from habitat maps, this policy did not necessarily reflect the natural conditions. The maps indicate that up to an altitude of about 1300 m a.s.l. most stands would consist of silver fir-beech forests and then up to about 1600 m a.s.l. silver fir-spruce forests, only giving way to subalpine, almost exclusively spruce forests in the highest altitude band below the treeline.

Wherever livestock could be pastured, the natural treeline, which would otherwise lie at an altitude of 1700 to almost 2000 m a.s.l., has been lowered by 100–200 m as a result of forest clearance. At certain points, however, natural forest development was preserved due to inaccessibility or adverse topographical conditions. A notable example is the arolla pine forest below the treeline in the Murgtal (a reserve since 1935, Fig. 05-01). Other arolla stands are to be found in the Sardonaalp region, in the Flumserberg area and in the Mürtschental. In the Weisstannental, primeval silver fir–spruce forest still grows on undeveloped areas towards the Marchstein.

The forests in this region serve a number of different functions. As well as offering protection against natural hazards such as avalanches and rockfalls, they are a source of raw materials and are valuable both as a habitat and an area for recreation. The legal foundations are provided by the forest development plan, which has binding force for the authorities.

Hunting

On this property, hunting has a long tradition and is well accepted and adequately regulated. Hunting is governed by a license system, and anyone wishing to hunt must pass an examination first. For most animal species that may be hunted at all, federal legislation defines close seasons, which the cantons can extend. The federal and cantonal governments keep accurate statistics of game taken. Hunting is practised in such a way as to promote sustainable use of game populations in the long term, based on planning principles derived from wildlife biology.

Two federal game reserves – Graue Hörner (St. Gallen canton) and Schilt (Glarus canton), where hunting is completely prohibited – lie within the boundary of the nominated site. The reserves were originally established in order to boost game populations; they now serve additional functions from the point of view of species and habitat protection.

The Graue Hörner game reserve, established in 1901, lies on the border between the communes of Mels and Pfäfers. Its particular importance dates back to 1911, when the ibex, which at that time had become extinct, was reintroduced in Switzerland for the first time, near Weisstannen (Section 2.a.4, Fig. 02-32, 06-01). With regard to flora, this reserve offers one of the most species-rich alpine landscapes anywhere in Switzerland. According to FOEN's Red List, a considerable number of plant and animal species are to be classified as rare and/or threatened. The Schilt reserve lies on the western slopes of Schilt and Schwarzstöckli, to the west of Ennenda and Mitlödi. The landscape on the steep valley slope is richly structured (forest, hayfields and meadows, scree slopes, rock ledges).

Fig. 02-32: In 1911 the alpine ibex *(Capra ibex),* previously eradicated from Switzerland, was first reintroduced in the Graue Hörner game reserve. Photograph: Wildhut SG.

The Graubünden region contains four general reserves where all hunting is prohibited (Muladera, Laax; Tschenghel, Trin; Lawoi, Tamins; Schreus, Tamins), as well as reserves for hares and for small game *(Niederwild).*

Outside the game reserves, hunting is regulated on a cantonal basis. The boundary of the nominated property passes through six gamekeeping management districts. In the canton of St. Gallen a preserves system *(Revierjagd)* is in operation, while in the cantons of Glarus and Graubünden a certification system *(Patentjagd)* is used.

As mentioned above, hunting is not permitted in the Graue Hörner reserve. Populations of ibex and red deer are reported on a regional basis, i.e. including game reserves. In 2002, the Graue Hörner ibex colony numbered 430 and the Foostock colony 265. In the preserves, maximum harvest rates are set at 5–15 % of the total population. In 2002, the red deer population was estimated at around 550, with the harvest limit set at around 40 %. Approximately 280 roe deer and 1100 chamois live in the preserves. The culling plan specifies around 60 % of the roe deer and a third of the chamois.

In the area of the nominated property belonging to the canton of Glarus, ungulate game populations are estimated to include 190 ibex, 1100 chamois, 70 red deer and

130 roe deer. Mean annual harvests are as follows: 200 chamois, 25 red deer and 50 roe deer.

In the communes of Flims, Trin and Tamins, 60–80 red deer, 35–70 roe deer, 140–200 chamois and 50–100 marmots are taken on average.

Fishing

Most of the streams within the boundary of the nominated property are fishing waters and valuable aquatic habitats. Angling is subject to cantonal laws and ordinances, with federal legislation taking precedence. Fishing is regulated on a cantonal basis and structures vary accordingly.

In the Glarus region of the proposed World Natural Heritage site, all watercourses are essentially considered to be fishing waters. By contrast, none of the watercourses in the territory of Graubünden are fishing waters. In the area belonging to St. Gallen, the following are designated as fishing waters: the Tamina from its source to St. Martin, the Fooalpbach and the upper reaches of the Seez to a point above Weisstannen, the upper reaches of the Schilsbach and Furschbach, and the upper reaches of the Murgbach.

The official angling lakes within the boundary are the Gigerwald reservoir, Wildsee, Schottensee, Schwarzsee, Baschalvasee, Upper, Middle and Lower Murgsee, Talsee, Fessisseelein and Ober-Seeloch.

In many fishing waters, young fish are regularly released by the cantonal authorities. Licences are sold which are valid throughout a given canton for periods of a day, a week, 2 weeks, a month or a year. In Graubünden, but not in Glarus or St. Gallen, people purchasing a fishing licence are required to provide evidence of their competence.

Electric power generation

Since 1977, water from the Seez and Tamina rivers has been used for power generation. The Gigerwald reservoir (upper level), with a capacity of 33.4 million m³, is situated in the Calfeisental, within the boundary of the nominated property. The equalizing basin and the Mapragg plant (lower level), as well as the Sarelli plant, are located outside the boundary. At the upper level (Gigerwald-Mapragg), Kraftwerke Sarganserland AG uses outflows from a catchment area of 45 km² in the southern Weisstannental and of 52 km² in the Calfeisental.

In the Murgtal, the Murgbach is used at four points between Bachlaui and the Merlen barrage. In this area, the Murgbach forms the boundary of the nominated property. The power generated meets a proportion of Murg's energy requirements. On the Alp Ramin, drinking and process water is used in a small plant to generate power supplies to meet local needs.

Fig. 02-33: The Gigerwald reservoir is used to produce renewable energy. Photograph: D. Imper, Heiligkreuz.

Given the water flows available in the watercourses within the nominated property, the construction of further large-scale hydropower plants would scarcely be possible or economically viable.

Tourism

Tourism is of major economic significance for all the regions concerned. In the Flims area and on Flumserberg almost the entire population is directly or indirectly dependent on tourism for its livelihood, and in the communes that are parties to the agreement the same applies to a large proportion of the population.

At most resorts, tourism had its origins in the establishment of *Kurhäuser* towards the end of the nineteenth century. The development of winter sports resorts began with the construction of the first ski lifts in the middle of the twentieth century. During the winter season, the average number of visitors per day is now 8000 (with a maximum of 20,000) in the resorts of Flims–Laax–Falera, 5000 (13,000) on Flumserberg, and 1500 (3500) in the Pizol region. Transport facilities are also to be found on Kerenzerberg, with a few ski tows near Weisstannen and Engi. All of the winter sports infrastructure lies outside the boundary of the property. Near Flims and Weisstannen, there may be overlaps between a small number of ski runs and the boundary of the proposed World Natural Heritage site.

The nominated property is exceptionally suitable for hikers, mountain walkers and experienced summer and winter climbers. Well-developed paths lead from the cable railway stations onto the territory of the nominated property. Within the site, a variety of mountain cabins are available: St. Martin, Schräahütte SAC, Sardonahütte SAC, Spitzmeilenhütte SAC, Murgseehütte, Skihütte Gams, Martinsmadhütte SAC and Niederen. In addition, a number of mountain pasture establishments offer simple accommodation.

Modern sports such as hang-/paragliding and mountain-biking are of secondary importance within the boundary of the property. Adverse technical conditions make the alpine and high-alpine zones unsuitable for mass tourism facilities.

Knowledge management/ research

The mountains lying between the Rhine, Seez-Walensee and Linth are known collectively as the Glarus Alps. Since the nineteenth century, the Glarus Alps and in particular the Glarus overthrust have been the subject of intensive geological research. These mountains have been a source of fundamental observations and insights of a general character in the fields of sedimentology, tectonics and Quaternary geology. However, no research or teaching institute is exclusively concerned with the Glarus Alps. Instead, specific topics are investigated by researchers from a variety of institutes and universities.

The nominated property is, to a greater or lesser extent, the subject of research in a wide variety of disciplines – ranging from the earth sciences through biology to tourism studies. If the site is inscribed in the World Heritage List, responsibility for knowledge management is to lie with the Scientific Advisory Committee (cf. Management Plan, Suppl. S01), which includes representatives from the most important Swiss research centres, particularly in the earth sciences field. The Secretariat (management), with the support of the Scientific Advisory Committee, is required to promote and coordinate scientific and socioeconomic research at universities of applied sciences and other universities.

The Glarus overthrust has given rise to a large volume of scientific literature (Section 7.e). With regard to flora and fauna, observations, maps and descriptions have also been made over the centuries. Under the Swiss Biodiversity Monitoring (BDM) programme, data on animal and plant species is collected using a sampling procedure, collated by a documentation centre and periodically published.

No documentation centre devoted to the Glarus Alps currently exists. The most important geology library is to be found at the Swiss Federal Institute of Technology (ETH) in Zurich. A collection of the works of Jakob Oberholzer – one of the most important researchers in the field, who produced detailed descriptions and maps of the Glarus Alps – was made accessible to the public in Engi in the summer of 2004. Natural history exhibitions and in some cases collections are also to be found at the Museum of Nature in Chur, the St. Gallen Nature Museum, or the Sarganserland Museum (Sargans Castle).

Mineral (crystal) collecting

Apart from a number of sites in the Calfeisental, the nominated property cannot be considered a happy hunting ground for crystal collectors. For this reason, mineral (crystal) collecting was never of major importance in the nominated property, even though in the 20th century attractive specimens were discovered in the Calfeisental, and collecting became a popular hobby as a result.

Particularly well known are the quartz and calcite specimens from the Vättis area (some of which are exhibited at the local museum in Vättis), the Talsee fluorite deposits and the Mürtschenalp mineralizations.

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Annexes A01, A02.1, A02.2, A03, A04.1, A04.2, A05, A06, A07, A08, A09, A10, A11, A12

Supplements S01, S02, S03, S04, S05.1, S05.2, S09.1, S09.2, S09.3, S10.1, S10.2, S11, S12

3 Justification for Inscription

The IUCN report entitled “Geological World Heritage: A Global Framework” (DINGWALL, WEIGHELL & BADMAN 2005) establishes a valuable framework for nominations of this kind. This document, together with the World Heritage Centre’s new “Operational Guidelines for the Implementation of the World Heritage Convention” (UNESCO, 2005), provides the basis for the revised submission.

According to DINGWALL, WEIGHELL & BADMAN (2005), the following preliminary steps are essential for a successful World Heritage nomination concerning geological and geomorphological phenomena:

a) fully consider the use of alternative designation options, through national or international programmes.

   In this connection – also as recommended by the IUCN in 2005 (IUCN 2005) – the establishment of a UNESCO Geopark has been investigated in detail. Since 1999, the Sarganserland-Walensee-Glarnerland GeoPark has been developed in the whole of Glarus canton and in the entire Sarganserland-Walensee region. This GeoPark covers a significantly greater area than the nominated property and includes many other sites of geological and cultural heritage interest.

   As a result of the investigations – including a visit to the European Geoparks Network Conference in Lésvos in the autumn of 2005, with a presentation of the Sarganserland-Walensee-Glarnerland GeoPark – it has been decided that membership of the European Geoparks Network is an interesting option for the Sarganserland-Walensee-Glarnerland GeoPark as a whole and should be further pursued. However, a UNESCO Geopark nomination should complement – rather than replacing – the nomination of the Glarus overthrust as a World Natural Heritage site. The examples of Lésvos (Greece) and the Geopark Bergstrasse-Odenwald with the Messel Pit Fossil Site (Germany) show that valuable synergies may develop between World Heritage sites and Geoparks.

   The core area of the Sarganserland-Walensee-Glarnerland GeoPark, the nominates World Heritage site Glarus overthrust, contains what is surely a globally unique concentration of superbly exposed geotopes, together with habitats meriting protection. Additionally the area was – and still is – of high importance for research in geosciences. The “Glarus overthrust” property should therefore be inscribed on the list of UNESCO World Heritage sites. World Heritage status would enable the property to enjoy better and more lasting protection than is possible within the Sarganserland-Walensee-Glarnerland GeoPark.

b) consider if a property merits nomination under criterion viii (alone or in combination with other criteria) or if the geological and geomorphological values are better represented as supporting biodiversity, cultural or landscape values.

   The results of these investigations are presented in Section 3a.

c) undertake a rigorous global comparative analysis to ensure that a property does have global significance.

   In order to assess whether the property is of “Outstanding Universal Value”, an in-depth “Comparative Study on Thrust Faults” (PFIFFNER et al. 2006, Suppl. S03) was commissioned from the structural geologists Professors A. Pfiffner, S. Schmid and M. Burkhard. This study, which was reviewed (Suppl. S03) by Professor J. Kley (Jena, Germany) and Professor S. Wojtal (Oberlin, Ohio, US), shows that the Glarus overthrust is unique worldwide in terms of the values assessed – scientific value, scenic value, geomorphic expression and educational value.

   The detailed results of this analysis are presented in Section 3b.

For geological sites, a list of thirteen themes was proposed by DINGWALL, WEIGHELL & BADMAN (2005). The nominated property includes valuable geotopes in the following categories: Tectonic and structural features (1), Mountain systems (3), Stratigraphic sites (4), Fossil sites (5), Fluvial, lacustrine and deltaic systems (6), Caves and karst systems (7), Glaciers and ice caps (10), and Ice Ages (11). The global uniqueness of the nominated World Heritage site “Glarus overthrust” relates to the wealth of well-exposed geological phenomena and in particular structural geological phenomena, with the unique Glarus overthrust.

In the list of existing World Heritage properties with earth science features of outstanding universal value (DINGWALL, WEIGHELL & BADMAN 2005, Appendix 1, Tables 1 and 2), “Tectonic and structural features” (theme 1) are somewhat underrepresented. Reference is made to this theme for the following properties in the provisional assessment:

- 3 sites listed under “Principal features of outstanding universal value”: Gros Morne National Park – Canada, Macquarie Island – Australia, Three Parallel Rivers of Yunnan Protected Areas – China.
- 1 site listed under “Possible features of outstanding universal value”: Uluru-Kata Tjuta National Park – Australia
- 3 sites (Canaima National Park – Venezuela, Lorentz National Park – Indonesia, Purnululu National Park – Australia) listed under “Other significant features”.

In the list of “World Heritage natural and mixed properties with significant earth sciences values, but which are inscribed on the World Heritage List for other reasons (provisional assessment)”, no properties are included under this theme.

3.a Criteria under which inscription is proposed (and justification for inscription under these criteria)

The Glarus overthrust not only meets the two criteria specified in paragraph 77 of the Operational Guidelines (UNESCO 2005), but also fulfils the integrity condition of paragraphs 87–95. The nomination of the Glarus overthrust for inscription on the World Heritage List is based on arguments presented under three main headings: aesthetics (Criterion vii), geological structures (Criterion viii) and history of geology (Criterion viii).

Criterion (vii): *"contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance"*

The extraordinary aesthetic value is based on the excellent visibility of the Glarus overthrust, surrounded by imposing peaks with small glaciers and various landscapes and biotopes, formed in thousands of years. Many major overthrusts, both in the Alps and elsewhere, are only identifiable on the basis of detailed cartographical and geological studies (e.g. dating of rock samples). By contrast, the Glarus overthrust is readily visible with contrasting colours as a well-defined line – the so-called magic line – extending across the landscape for dozens of kilometres. It is also a conspicuous feature when viewed from a distance – from a valley or mountain vantage point – and has been depicted by artists over the centuries (Fig. 02-11).

Criterion (viii): *"be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features"*

On account of the specific lithological characteristics and the interaction between metamorphism and tectonics which is best understood at this site, the Glarus overthrust is globally unique. From the northern to the southern limits of the property, one encounters rocks that, during the period of thrust activity, lay at a depth of 5 km or 12–16 km below the Earth's surface. This represents a cross section through the entire upper crust – a globally unique geological phenomenon. As well as the Glarus overthrust, the property includes nappe contacts between the Glarus and Mürtschen thrust sheets and between the Mürtschen and Säntis thrust sheets, which are exposed and readily observable. This geological diversity, the wide range of elevations and the on-going morphodynamic processes create a wide variety of landscapes and valuable habitats for species typical.

Thanks to the excellent exposures and accessibility of the Glarus overthrust, numerous eminent geologists have visited this region since the early nineteenth century to carry out research. Many revolutionary discoveries concerning the formation of mountains have been based on observations made at this site. The significance of this natural phenomenon has been further enhanced by the controversies that ensued, particularly at the end of the nineteenth century. Particularly noteworthy is the fact that, on the basis of observations made at the Glarus overthrust, nineteenth-century geologists were forced to overturn the prevailing orthodoxy on mountain formation and postulate the occurrence of events on a scale that was inconceivable at that time – decades before the theory of plate tectonics was first propounded. Ultimately, this fundamental geological theory – now taught in schools – only gained widespread acceptance in the 1960s. As a result of earlier studies, the geology of the site is very well known, which provides a sound basis for contemporary and future research. Intensive research is still being conducted at the Glarus overthrust with the aim of elucidating the causal mechanisms and processes involved in overthrusts and mountain building.

Although overthrusts can also be observed elsewhere (Suppl. S03), these sites lack the unique perspective afforded by the topography of the nominated property. This is true in particular of the Helvetic nappes of Western Switzerland. In other cases, overthrusts are largely obscured by vegetation (Appalachians, pre-Andean Cordillera ranges, Canadian Rockies, Scottish Caledonides), or the thrust zones are covered by debris from the erosion of neighbouring mountains (Himalayas, parts of the Rockies).

Fig. 03-01: The Glarus overthrust is readily discernible from afar. Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano *(top)* and flysch. Photograph: H. Rhyner, Elm.

3.b Proposed Statement of Outstanding Universal Value

The mountains of the Glarnerland, Sarganserland and Graubünden Vorderrheintal offer what is surely the most complete and spectacular insight into nappe structure and development. Embedded in this landscape that is impressive and of major geological interest, the phenomena Glarus overthrust is the dominant, formative element. The deeply carved valleys make it possible to follow almost the entire course of a nappe from its site of origin to its front. The topography of the Glarus overthrust is also unique. The dome-like uparching in the southern part of the property (Vorab–Ringelspitz), succeeded by a trough-like depression in the north (Walensee), makes it possible to follow the course of the overthrust over a distance of more than 50 km (Vorderrhein-Säntis). As the path of the thrust sheet crosses peaks or mountainsides, it can be directly observed at many points. In addition, although the nominated property is readily accessible via the neighbouring villages, the core landscapes have remained largely untouched. Thanks to the excellent exposures and accessibility of the Glarus overthrust, numerous eminent geologists have visited this region since the early nineteenth century to carry out research. Many revolutionary discoveries concerning the formation of mountains have been based on observations made at this site. As a result of earlier studies, the geology of the site is very well known, which provides a sound basis for contemporary and future research.

Fig. 03-02: The Glarus overthrust below the Graue Hörner, viewed from the east. Photograph: D. Kalberer, Heiligkreuz.

Outstanding Universal Value of Thrust Faults

Thrust faults are faults in the Earth's crust where one rock unit is moved on top of another unit over distances of tens or hundreds of kilometers. Thrust faults are a direct expression of the dynamics of convergent tectonic plates. They are also directly responsible for the formation of mountain belts. Their outstanding universal value is based on the direct relationship to plate tectonics and on the origin of mountain belts.

Plate tectonics shape the interior and the surface of our planet Earth and explain not only the distribution of oceans and land, but also the water depth of the oceans and the elevations of land areas. Mountain ranges, including volcanoes, are the principal features on land that are directly related to plate tectonics. At boundaries between converging plates, the Earth's crust is undergoing horizontal compression. The ensuing contractional deformation leads to narrow belts of high elevations that straddle the plate boundary. Examples include the Andes of South America, the North American Cordillera or the Alpine-Himalayan system.

The uplift of the land surface to a narrow mountain range is mainly caused by horizontal shortening and stacking of the rock units in the contact zone between the two plates. The single most important features responsible for moving blocks of rock units upward toward the surface are thrust faults. These faults originate at depths of more than 10 km beneath the surface and usually reach upward to breach the surface. Downward, major thrust faults merge into the interface between the two converging plates, a contact referred to as Wadati-Benioff zone. It is in this zone that major earthquakes are triggered. Examples include the Alaska earthquake of 1964 or the Sumatra earthquake of 2004 that caused a devastating tsunami.

In a few and rare cases, deformation at the plate interface deforms the plate boundary and associated thrust faults. Through this process, their deeper levels, once located more than 15 kilometers deep in the crust, as well as higher levels become directly accessible to observation at the surface. These thrust faults, including the Glarus thrust, are thus singular witnesses of the processes that are going on at depth at plate interfaces and processes that give rise to the formation of mountain belts.

3.c Comparative analysis (including state of conservation of similar properties)

The Glarus overthrust is a major fault in the Earth's crust that can be followed in the field over tens of kilometers. Besides the fault itself, there are a number of structural features like folds, imbricate thrust sheets and highly deformed rocks that outcrop beneath and above the fault. These structures can be observed in an area of impressive relief, where rivers and glaciers carved out deep valleys running in various directions. As a consequence these structural features are exposed in three dimensions.

Thrust faults are recognized in most orogens, i.e. mountain ranges formed by convergence between tectonic plates. They correspond to crustal blocks moving up along the fault plane in response to horizontal shortening caused by the convergence of two plates. The exposure or visibility of thrust faults depend much on local climatic conditions and on the elevations of the mountain range. The Glarus overthrust is an example of a thrust fault that exhibits the fault plane and the mechanism how the rocks reacted to the motion of the plates in a particularly instructive and grandiose way.

The comparative study accompanying this document (Suppl. S03) discusses the arguments for considering the Glarus overthrust to be a feature of Outstanding Universal Value. For this purpose, a direct comparison has to be made with other thrust faults and comparable structures. The various sites are assessed and compared as objectively as possible. This is done by comparing the well-known thrust faults in mountain ranges worldwide using a number of objective criteria in a transparent manner. As requested by Dingwall et al. (2005), properties already inscribed in the World Heritage List, which have some features in common with the proposed property “Glarus overthrust”, are included. This particular type of comparison is rendered difficult by the circumstances given by the perimeter of the properties. For existing properties, the exact definition of the perimeter is not part of the protection regulations, whereas for the nominated property “Glarus overthrust” this is the case.

The criteria used are (PFIFFNER et al. 2006):

- The Scientific Value of the object concerning the process of overthrusting associated with the convergence of tectonic plates, and the process of mountain building in general.
- The Scenic Value (natural beauty) of the object, including beauty and outcrop quality of structural features (overthrusts and folds beneath and above the Glarus thrust).
- The Geomorphic Expression in the landscape by spectacular and visually striking phenomena.
- The Educational Value, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

To assess these four criteria, subcriteria are defined in each case, permitting an objective evaluation: a subcriterion is fulfilled if the object evaluated is judged “excellent”. The sum of these evaluations is then used to rate the four main criteria. The rating “excellent” is given only if most of the subcriteria were evaluated as “excellent”. The ratings for the four main criteria are given in Tab. 03-01.

Results of the Comparative Study

Scientific value

The scientific value was evaluated based on properties of thrust faults with regard to (1) the direct relationship to plate motions, (2) the process of mountain building, (3) the magnitude of displacement, (4) the deformation of the rocks beneath and above the faults and (5) the deformation mechanisms active along the fault surface.

Several of the examples discussed in the descriptive part of this study fulfill most, but not all of the criteria (1) through (5).

Subcriteria (1) through (3) are met more or less entirely by the basal thrusts of the Helvetic, Penninic and Austroalpine nappes in the Western Alps, the Swiss Alps and the Eastern Alps. The same holds for the Moine and Jotun thrusts of the Caledonides, the Main Central Thrust in the Himalayas, thrusts in the Andes, the Purcell and Lewis thrusts of the North American Cordillera, the Pine Mountain thrust in the Appalachians, the Arltunga nappe complex in Australia and the South Alpine Fault in New Zealand.

On the other hand, subcriteria (4) and/or (5) are not fulfilled in the very same cases, because deformation structures in the footwall (beneath) and/or the hanging wall (above) of the faults cannot be observed in a direct way, or that deformation mechansisms in the fault zone are not directly accessible to observation. The Glarus thrust, however, meets all these subcriteria simultaneously!

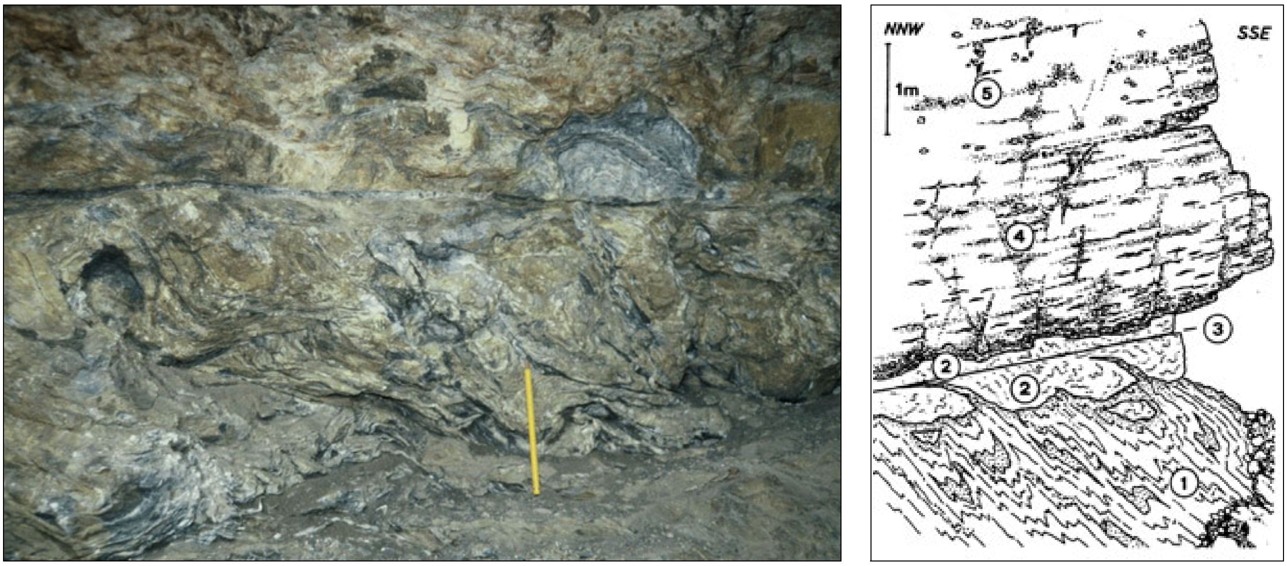

Fig. 03-03: Horizontal late thrust surface *(middle of picture)* and mélange structures of ductile deformation in the footwall and hanging wall at Lochsite (Photograph: D. Imper, Heiligkreuz) with sketch of the Lochsite exposures *(1* Eocene flysch, *2* Lochseiten limestone, *3* late thrust surface, *4* green Verrucano conglomerates, *5* red Verrucano conglomerates). From: R. TRÜMPY (1980).

Scenic value

The scenic value may be assessed by (6) the natural beauty of the thrust fault, (7) the beauty and quality of the structures beneath and above the thrust fault, and (8) the three-dimensionality of exposure. Subcriterion (6) is fullfilled by the Glarus thrust, the Säntis and Drusberg thrusts, the basal thrust of the Austroalpine nappes (Matterhorn and Graubünden area), the Gavarnie thrust in the Pyreneees, the Moine thrust in Scotland, thrust faults in the Western Cordillera of the Peruvian Andes, the Lewis (and McConnell) thrust, and the Livingstone thrust in the North American Cordillera.

Subcriterion (7) is not quite met by the basal thrust of the Australpine nappes, Moine thrust, the thrusts in the Western Cordillera of Peru and the Lewis and Livinstone thrusts.

Subcriterion (8) is not completely fullfilled by the Säntis and Drusberg thrusts, the Moine thrust and the thrust faults in the Western Cordillera of Peru. The Glarus thrust and the Gavarnie thrust the meet all these subcriteria simultaneously and unequivocally!

Fig. 03-04: On the Foostock, the Glarus overthrust dips gently to the north. Photograph: D. Imper, Heiligkreuz.

Geomorphic expression

For the geomorphic expression we used (9) the geomorphic expression of the fault in the landscape and (10) the presence of spectacular and visually striking phenomena as subcriteria. Subcriterion (9) is met my many thrust faults even if the fault surface itself is not directly exposed at the surface. For example, the Lewis thrust is outlined at varous locations by cliff forming rocks in the hanging wall rocks (Proterozoic rocks of Paleozoic carbonates) and Cretaceous strata in the footwall that form gentle slopes covered with vegetation. Other faults do not meet subcriterion (9) because they are not associated with a particular geomorphological “anomaly”. Examples include the Roselend thrust, the Wildhorn, the Doldenhorn and the Morcles thrust in the Alps, the Main Central Thrust in the Himalayas (for most of its length), the faults in the Atlas mountains and the Naukluft mountains, the thrust faults in the Eastern Cordillera of the Peruvian Andes, the faults in the Omineca Belt of the North American Cordillera, the basal thrust of the Arltunga nappe complex in Australia and the Alpine Fault in New Zealand.

Subcriterum (10) requires the presence of spectacular abrupt color changes or a sharp contact manifested by small scale geomorphic features. Of all the many thrust faults analyzed, it is the Livingstone thrust, the Gavarnie thrust and the Glarus thrust which clearly meet this subcriterion, and all three also meet subcriterion (9).

Fig. 03-05: As the Glarus overthrust exposures on the Tristelhorn are situated at around 3000 m a.s.l., they are particularly suitable for study. Photograph: D. Imper, Heiligkreuz.

Educational value

The educational value is evaluated on the basis of (11) the historic geological context of the object, (12) the potential of public awareness of the object. In subcriterion (11) it is the question around the history of science (recognition of thrust faults) that plays an important role. In the (Southern) Appalachians (Rogers and Rogers 1843, and Rodgers 1949) the discussion turned around thick-skinned tectonics (folds in the sedimentary strata that also involve crystalline basement rocks) and thin-skinned tectonics (folds carried by thrust faults involving only the sedimentary strata or thin slices of crystalline basement rocks). In Scandinavia, Törnebohm (1896) recognized thrust faults in the Sparagmite nappe. Both these examples meet subcriterion (11), but none of the other subcriteria. The most famous controversies regarding subcriterion (11) were fought out around the Moine thrust and the Glarus thrust and the basal thrust of the Penninic nappes in the Prealps (Swiss Alps).

Subcriterion (12) is important for the policy of protection (does the first-time-visitor leave the place with the conviction that the site must be safeguarded for future generations?); it is also related to the accessibility of the site. Examples that meet subcriterion (12) include the Lewis thrust in the Waterton Glacier International Peace Park (Canada/USA), the Gavarnie thrust in the Pyrenees' Mont Perdu (France/Spain) and the Alpine Fault (although it is not a thrust fault) in Te Wahipounamu (New Zealand) to name protected areas. A number of other thrust faults from non-protected areas could be added to this list. Hower, it seems to us that only the Moine thrust, the basal thrust of the Penninic nappes in the Swiss Prealps and the Glarus thrust really meet both subcriteria unevoqually and simultaneously.

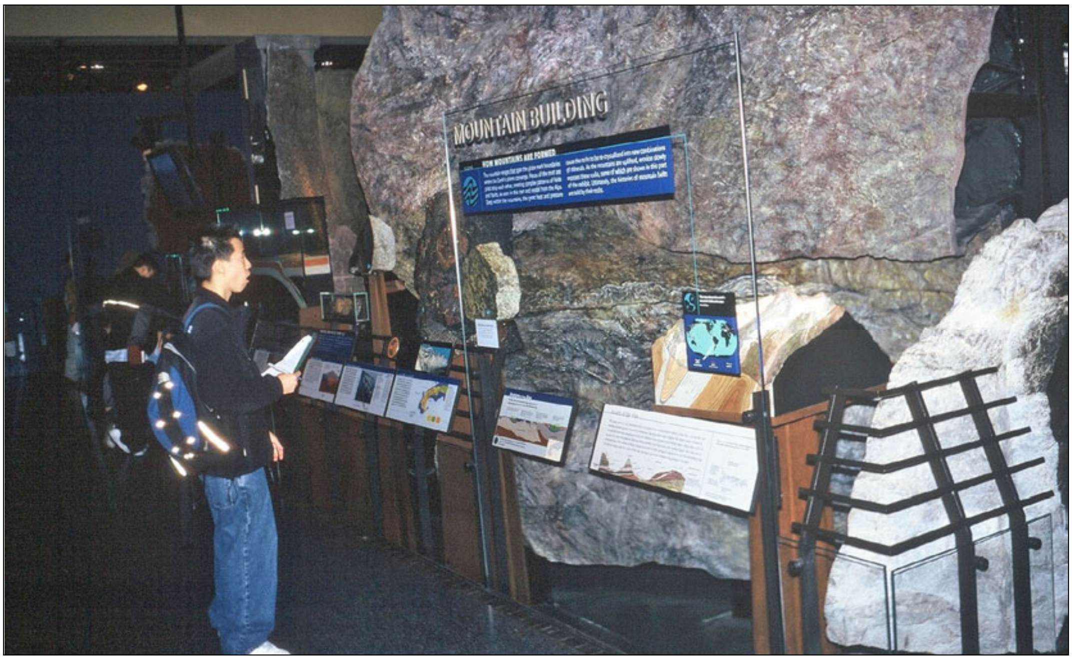

Fig. 03-06: The Lochsite has been reconstructed at the American Museum of Natural History in New York. Photograph: S. Hesske, Pfäfers.

Conclusion

The Comparative Study suggests that the Glarus thrust reaches the ranking "excellent" regarding all four criteria and thus fulfills the condition of "Outstanding Universal Value". It is the only object evaluated that simultaneously fulfills the conditions of all the subcriteria considered in the comparative analysis. Moreover, it ranks first amongst all the objects in the great majority of the subcriteria. This comparative analysis clearly indicates that the nominated property "Glarus overthrust" merits to be inscribed in the World Heritage List. (PFIFFNER et al. 2006).

Tab. 03-01: Result of the "Comparative Study on Thrust Faults" (PFIFFNER et al. 2006, Suppl. S03).

		Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	Roselend thrust	2	3	2	3	10	7
	Digne thrust	3	3	1	2	9	6
Swiss Alps	Glarus thrust	1	1	1	1	4	**1**
	Drusberg-Säntis thrust	2	1	2	3	8	5
	Axen thrust	2	2	2	3	9	6
	Wildhorn thrust	2	2	2	3	9	6
	Morcles & Doldenhorn thrusts	2	3	3	3	11	8
	Base Préalpes Médianes	1	2	2	2	7	4
	Matterhorn / Base Austroalpine	1	1	2	2	6	**3**
	Rätikon / Base Austroalpine	1	1	3	3	8	5
	Engadine / Base Austroalpine	1	2	3	3	9	6
Eastern Alps / Austria	Inntal thrust	3	3	2	3	11	8
	Hohe Tauern / Penn & Austroalpine	1	2	3	2	8	5
Pyrenees	Gavarnie thrust	2	1	2	2	7	4
Caledonides	Moine thrust / Scotland	1	1	2	1	5	**2**
	Jotun thrust / Bygdin, Norway	1	2	2	2	7	4
Himalayas	Main Central thrust	1	2	3	3	9	6
Atlas Mountains / Morocco	High Atlas & Anti-Atlas	3	3	3	3	12	9
Naukluft Mountains	Namibia	3	3	3	3	12	9
Andes	Western Cordillera Peru	2	1	2	3	8	5
	Eastern Cordillera Peru	1	4	3	4	12	9
	Subandine Zone Bolivia	2	2	3	3	10	7
Rocky Mountains	Omineca Belt	1	3	3	2	9	6
	Foreland Belt / Lewis thrust	1	1	2	2	6	**3**
	Livingstone thrust	2	1	1	2	6	**3**
Appalachians	Pine Mountain thrust	1	3	3	2	9	6
Alice Springs / Australia	Arltunga nappe	1	3	3	3	10	7
Southern Alps New Zealand	Southalpine fault	2	3	3	2	10	7

Ranking: excellent = 1, very good = 2, good = 3, fair = 4

Review

The comparative study was reviewed by Professor Jonas Kley of the University of Jena (Germany) and Professor S. Wojtal of the University of Oberlin (United States of America).

Having acknowledged the authors' expertise – "All three authors are internationally renowned experts in the fields of Alpine tectonics and structural geology in general" (Prof. J. Kley) and "All three authors are among the most highly respected geoscientists conducting research on the character of thrust faults, on their tectonic setting, and on their significance in the formation of maountain belts (Prof. S. Wojtal) – the reviewers conclude their detailed analysis as follows (Suppl. S03): "In summary, the conclusion reached in Pfiffner et al.'s 'Comparative study on thrust faults' is sound: the Glarus thrust is a truly outstanding example of a large-scale thrust-fault matched by very few, if any, other fault in the world. I fully agree with the authors that this property deserves to be inscribed in the UNESCO World Natural Heritage list." (Prof. J. Kley) and "Their *Comparative Study on Thrust Faults* is, in my view, an excellent example of objective scientific analysis of the significance of thrust faults as structural features in mountain belts and of the assessment of the significance of the Glarus overthrust as one of the classic 'type' example of a thrust fault … As the authors have made very clear in their *Comparative Study on Thrust Faults,* the proposed property readily meets the criteria outlined for outstanding universal value required to be inscribed on the World Heritage List." (Prof. S. Wojtal). This assessment is shared by various internationally recognized experts and Swiss institutions that have sent letters of support, confirming the outstanding universal value of the Glarus overthrust (Suppl. S03):

Internationally recognized experts: Prof. Rafael Ferreiro Mählmann (Germany), PD Dr. Meinert Rahn (Germany), Prof. Eugen Seibold (Germany), Prof. Bernhard Stöckhert (Germany), Prof. Giorgio V. Dal Piaz (Italy), Prof. Andrew McCaig (United Kindom), Prof. David Gee (Sweden), Prof. Victor Efremovitch Khain (Russia), Prof. Hejing Wang (People's Republic of China), PD Dr. Julia Kramer (South Africa), Prof. William S. Fyfe (Canada), Prof. Albert W. Bally (USA), Prof. Terry Engelder (USA) and Prof. William A. Thomas (USA).

Swiss Geoscience Institutions: Swiss Geological Society (Prof. S. Schmid), Swiss Geological Commission (Prof. H. Weissert), IUGS Switzerland (Prof. H. Stünitz), Scnat, GEOforumCH – platform of the Swiss Academy of Sciences (Prof. W. Häberli) and GEOforumCH and Swiss Geotop Working Group (Prof. E. Reynard).

3.d Integrity and/or Authenticity

The Glarus overthrust exposures are mainly situated between the Rhine, Seez/ Walensee and Linth valleys, i.e. within the nominated property. The Glarus overthrust is exposed from Pizol to Lochsite near Sool/Schwanden over a distance of 30 km, running from west to east, and from Flims to Schwendi in the Weisstannental over a distance of 20 km from north to south. It is also the key scenic element of the landscape.

The nominated property encompasses the most important exposures of the Glarus overthrust, all of which developed naturally, as a result of erosion, rather than being artificially created by human influences. Particularly fine exposures of the Glarus overthrust within the proposed site are to be found at the following localities:

- Ringelspitz group (Ringelspitz, Glaserhorn, Tristelhorn; Figs. 03-05, 05-02)
- Pizol region (Figs. 03-02)
- Foostock, eastern and southern sides, Weisstannental (Figs. 02-03, 03-04)
- Lochsite near Schwanden, Sernftal (Figs. 03-03, 05-05)
- Tschingelhoren (Figs. 02-07, 02-11, 03-01)
- Sardona group (Gross Schibe, Piz Sardona, Piz Segnas, Piz Atlas, Piz Dolf (Figs. 02-05, 02-14, 02-16)
- Fil de Cassons – Crap da Flem (Figs. 02-24)

At outcrop, the geological phenomena are very well exposed and visible. The importance of these exposures is underlined by the fact that the American Museum of Natural History in New York had a cast of the Lochsite outcrop (Fig. 03.06) made so that a full-scale reconstruction of this geologically and historically significant site could be carried out abroad. To understand phenomena and processes such as the course and formation of the overthrust, large-scale deformation features, metamorphic grade or isotope composition, it is however indispensable to study the exposures over a wide area.

Sources CLOUTIER, R. & LELIEVRE, H. (1998), DINGWALL, P., WEIGHELL, T. & BADMAN, T. (2005), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2004), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2005), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2006), IMPER, D. (2003a), IMPER, D. (2003b), IMPER, D. (2004a), IUCN (2005), PFIFFNER, O. A., BURKHARD, M. & SCHMID, S. M. (2006), PHILIPS, A. (2002), SAEFL (2003), THORSELL, J. (2005), UNESCO WORLD HERITAGE CENTER (2005).

Annexes A01, A04.1, A04.2, A05, A06, A07

Supplements S01, S02, S03, S04, S05.1, S05.2, S08, S10.2, S11, S12

4 State of Conservation and factors affecting the Property

4.a Present state of conservation

Details of the legal situation regarding protection of the property and of planning instruments are given in Sections 5.b, 5.c and 5.d. The fact that there are slight differences in the legal framework between the three cantons involved could potentially be a source of confusion. For this reason, an agreement (Suppl. S02) was elaborated between the 19 communes concerned and the relevant cantonal and federal authorities, including a Development Plan and a list of objectives for the various types of land use. This is, however, without prejudice to higher-level legislation, and additional regulations concerning protection – especially those specified in cantonal master plans – remain in force.

The entire property is protected by legislation at one or more levels (national, cantonal, regional). In our estimation, the property enjoys adequate legal protection; threats are neither apparent nor foreseeable. Population pressure on the natural environment is low (Section 4.b). No change in this situation is to be expected, as the property is largely undeveloped and uninhabited and subject to a variety of protective regulations.

Among the impacts of protected status are those on the creation of infrastructure. Upgrading of infrastructure is banned inside the area or made subject to stringent requirements relating to landscape protection and conservation. Existing infrastructure in the nominated World Heritage property (extract):

- 1 private cable railway
- shelters and guesthouses: 9
- Underground tunnels for the power stations and water reservoir Gigerwald
- Alpine huts, barns and stalls
- Hiking paths
- Forestry roads and paths

Fig. 04-01:
The *Niederenbahn* is the only mountain railway within the boundary of the proposed World Heritage site. Photograph: H. Brühwiler, Elm.

The protection status of the region ensures that the aim of protecting and maintaining biodiversity is achieved. This includes mainly the following (cf. Section 2):

- specialised habitats at colline, montane, sub-alpine and alpine levels
- over 800 vascular plants
- Fauna of the sub-alpine and alpine levelshe present protected status of the area will not change by the extension.

4.b Factors affecting the property

(i) Development Pressures (e.g., encroachment, adaptation, agriculture, mining)

Thanks to its topography and elevation, the nominated property largely enjoys natural protection. For centuries, it has been subject to extensive agricultural and forestry management. Throughout the year, large parts of the property are barely accessible without appropriate equipment and the necessary physical condition.

Most of the property lies above the treeline. The aim of current forest management efforts is to prevent the decline of stands by means of near-natural regeneration measures and to promote stabilization (Section 2.b). The forest may be adversely affected by avalanche damage, föhn storms, game browsing and the use of land for mountain farming. Since the 1980s, net profits per cubic metre of timber have declined sharply. Within the boundary of the property, given the lack of infrastructure and the economic constraints, commercial exploitation of the forest is confined to a few well-developed areas such as the Mülibachtal (Glarus canton). The maintenance and renovation of legitimate existing buildings and infrastructure is permissible and consistent with conservation objectives.

Within the boundary of the proposed World Natural Heritage site, agriculture and mountain farming have a long tradition (Section 2.b). Agricultural produce is of a high quality and characteristic of the region. Agricultural use is in line with natural yield potentials. This type of land use is confined to individual areas. The maintenance and renovation of legitimate existing buildings and infrastructure is permissible and consistent with conservation objectives, but is to be optimized with regard to nature and landscape. Appropriate measures are to be taken to prevent overuse, particularly as a result of sheep farming.

On the nominated property, hunting has a long tradition and is well accepted and adequately regulated (Section 2.b). Hunting practice is based on planning principles derived from wildlife biology. The game reserves and conservation areas within the property represent important core habitats for game species. Species that are threatened either locally or throughout the Alpine region are not hunted. Most of the streams within the boundary of the nominated property are fishing waters and valuable aquatic habitats. Angling is adequately regulated by cantonal laws and ordinances.

Neither ores nor construction materials have been extracted for several decades. The property does not contain any workable deposits of rocks, ores or other minerals. It is not an attractive site for collecting crystals or fossils, with the exception of the Calfeisental, where crystal hunting is prohibited, as is the removal of rocks from the historically important outcrop of Lochsite (Sool).

Outflows from the upper Weisstannental, Calfeisental and Taminatal are channelled by Kraftwerke Sarganserland AG into the Gigerwald reservoir for hydropower generation. The conveyance of water from the upper Weisstannental into the Calfeisental is regulated by a concession valid until 2040, so that the resultant depletion of the Seez river is restricted to an acceptable level. Given the water flows available in the watercourses within the nominated property, the construction of further large-scale hydropower plants would scarcely be possible or economically viable. According to the Development Plan (Annex A04.2), new plants may only be constructed to enable cabins to meet their own energy needs.

In recent years, military use has once again been sharply reduced: the Swiss Army has closed 3 of the 4 firing ranges in the nominated property. The final remaining facility on Alp Siez is now scarcely used and is also to be abandoned. Expansion of existing military use is prohibited.

Pressures arising from tourism are described in Section 4.b.iv.

(ii) Environmental pressures (e.g., pollution, climate change, desertification)

It is now well known that the world's climate has been heating up since the mid-19th century. A related phenomenon is the retreat of glaciers everywhere, including the nominated World Heritage area.

The effects of the rise in global temperatures that has occurred since the mid-nineteenth century, and in particular the retreat of glaciers, are also apparent in the Glarus overthrust region: between 1850 and 1973, the total length of the sixteen glaciers was reduced by 54 %, the total area by 53 % and the total volume by no less than 59 %.

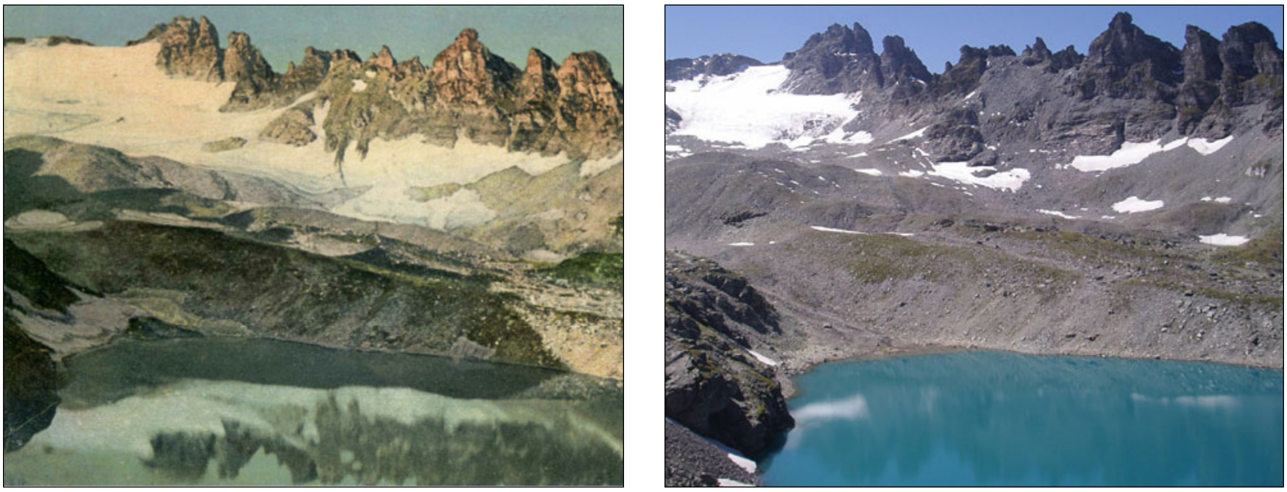

Fig. 04-02: The Pizolgletscher serves as an example of glacial retreat: a postcard from around 1920 compared with the current state of the glacier. In 1850, the Pizolgletscher still extended as far as the Wildsee. Photograph: D. Imper, Heiligkreuz.

However, the increased rate of warming affects not only the total glaciated area but also the permafrost boundary and hence also slope stability. The rise in the permafrost boundary and the decrease in slope stability will lead to an increase in mass movements of soil and rock material.

The prolonged periods of intense precipitation observed in recent years, probably associated with global warming, lead to waterlogging and, consequently, to landslides and debris flows. In the long term, changes in the hydrologic balance cannot be ruled out.

Warming of the climate will also have an impact on plant life. Vegetation boundaries will shift to higher elevations, and there will be changes in the altitude distribution of individual species.

These developments defy planning of any kind. Their causes are global, and they are not amenable to local control. Conceivably, certain aesthetic features or vegetation patterns may be altered in such a way that their value is destroyed. At the same time, new values may be created as a result of the changes.

(iii) Natural disasters and risk preparedness (earthquakes, floods, fires, etc.)

What human beings regard as catastrophic events are, from the viewpoint of nature, not catastrophes but environmental factors of the ecosystems involved. Extreme precipitation and storm events, avalanches, debris flows, landslides, rockfalls and forest fires are ever-present possibilities. As long as they do not directly threaten human life and property, they are accepted as “natural” phenomena.

The risk of damage within the boundary is relatively low. Assets exposed to hazards are the infrastructure of power plants and small funicular railways, mountain roads and buildings, and cabins. Possible natural hazards originating in the nominated property present only a low risk for the valley-dwelling population. Population centres lying on alluvial fans, such as Vättis, Bad Ragaz, Mels, Flums, Murg, Ennenda, Mollis, Engi or Matt, could be at risk from debris flows or flooding. Equally, individual sites of interest could be damaged by avalanches, storms, landslides or rockfalls. These problems have less to do with planning inside the property than outside (demarcation of hazard zones and adoption of suitable practices).

The local community has become accustomed to natural hazards. In the choice of sites and designs for buildings, these hazards have generally been taken into account or plans are adapted to the natural conditions. The authorities have been instructed to designate hazard zones (cantonal hazard maps are in preparation) and to take appropriate measures (Section 4.b.ii).

(iv) Visitor/tourism pressures

At various points (Flims, Pizol, Flumserberg, Kerenzerberg), areas heavily used by tourists, particularly in the winter, adjoin the boundary of the nominated property. However, with the exception of the Niederenbahn east of Elm (a simple freight railway), the ski lifts and mountain railways lie outside the boundary. Possible interventions such as additional tourist developments and facilities would not be compatible with applicable legislation, development plans, or federal policy on the granting of concessions.

Within the alpine and high alpine region of the Glarus overthrust, tourism pressure is limited by the topography and by the available access routes and infrastructure. This will ensure that the landscape is preserved more or less unspoilt and intact. Accordingly, modern sports such as hang-/paragliding and mountain-biking are not practised to a significant extent within the boundary of the nominated property. The property is, however, suitable for hikers, mountain walkers and experienced summer and winter climbers.

Inscription in the World Heritage List would be expected to raise public awareness of the site, leading to an increase in the number of visitors, mainly in the summer months. During the winter, given the harsh seasonal conditions, visitor pressure is unlikely to be increased. Visitors will be guided from the mountain railway stations onto the nominated property, following directions on notice boards along well-developed hiking paths. The absence of infrastructure (paths, notice boards, etc.) should deter visitors from entering sensitive areas, and elsewhere a well-maintained infrastructure should facilitate visitor management. This kind of control, together with appropriate educational efforts and supervision, can help to minimize damage or at any rate keep it to present levels.

Fig. 04-03:
Visitors are to be managed with the aid of well-maintained hiking trails and information resources. Photograph: Y. Willi, Mels.

Accommodation is available exclusively in the form of simple cabins and mountain pasture establishments. At present, there is no need for any expansion of the network of cabins or catering facilities. If required, however, the cabin network can be expanded, with due consideration of spatial planning and environmental protection regulations.

There are three SAC shelters within the nominated property: Martinsmad (sleeping accomodation for 60), Sardona (43) and Schräa. The latter ist of minor importance, there is no keeper and the overnight stays are not registered. Just outside the nominated property, there are the SAC shelters Ringelspitz (40) and Spitzmeilen (42). Therefor the overnight stays at these shelters are included in the data below.

During the past 20 years up to 2000 persons annually stayed overnight in the SAC sehlters Sardona and Martinsmad, respectively up to 5000 persons if the overnight stays at SAC Shelters Spitzmeilen and Ringelspitz are included (see Fig. 04-04). Disposal of sewage is a problem at some of the most-frequented shelters; this is less an ecological problem than an aesthetic one, but high altitude and associated low temperatures make it difficult to solve. Efforts toward a technical solution are under way.

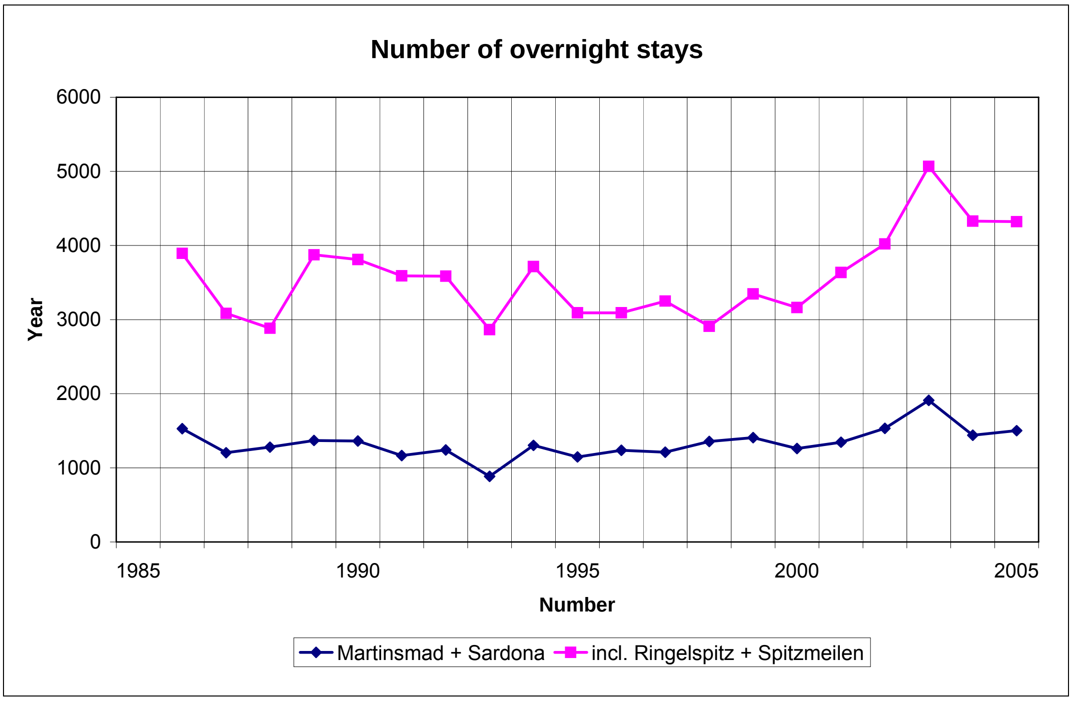

Fig. 04-04: Number of overnight stays in SAC shelters within the proposed World Heritage site, 1986–2005. (Source: SAC shelter statistics).

(v) Number of inhabitants within the property

The nominated property does not have any permanent inhabitants. The seasonal population numbers about 100, mainly consisting of people working in the mountain cabins or on the mountain pastures.

Sources IMPER, D. (2004a), IUCN (2005), MAISCH, M. (1992), MÜLLER, F., CAFLISCH, T. & MÜLLER, G. (1973), PHILIPS, A. (2002), SAEFL (2003), SAEFL (2005), SCHWITTER, R., TSCHIRKY, R., WEIDMANN, P. & GOOD, A. (Hrsg.) (2004), VAW ETH Zürich (2004), UNESCO WORLD HERITAGE CENTER (2005).

Annexes A01, A04.1, A04.2, A05, A06, A07

Supplements S01, S02, S04, S06.1, S06.2, S06.3, S07

5 Protection and Management of the Property

5.a Ownership Indicate the major categories of land ownership (including State, Provincial, private, community, traditional, customary and non-governmental ownership, etc.)

The communes having part of their area inside the nominated property are home to some 41,300 persons.

The following table gives details of the distribution of territory among the cantons of St. Gallen, Glarus and Graubünden, and of population figures and distribution in the communes concerned, by canton.

Tab. 05-01: Area of the nominated property (Summary of the Tables 05-02 to 05-04).

Canton	Area (km²)	Proportion of total area of site (%)	Population	Proportion of total population (%)
St. Gallen	155.45	47.3	26,042	63.0
Glarus	127.48	38.8	9,300	22.5
Graubünden	45.57	13.9	5,974	14.5
Total	329.34	100.0	41,316	100.0

The following table gives details of the distribution of territory and population* among the 19 communes concerned.

Tab. 05-02: Distribution of territory and population among the participated communes concerning St. Gallen canton (Population figures according to the Swiss census of 5 December 2000).

Commune	Area (km²)	Proportion of total area of site (%)	Population	Proportion of total population (%)
Pfäfers	55.58	16.9	1754	4.3
Bad Ragaz	1.00	0.3	4929	11.9
Vilters-Wangs	6.25	1.9	3891	9.4
Mels	64.09	19.5	7837	19.0
Flums	11.28	3.4	4882	11.8
Quarten	17.25	5.3	2749	6.6

Tab. 05-03: Distribution of territory and population among the participated communes concerning Glarus canton (Population figures according to the Swiss census of 5 December 2000).

Commune	Area (km²)	Proportion of total area of site (%)	Population	Proportion of total population (%)
Mühlehorn	2.85	0.9	441	1.1
Obstalden	18.75	5.7	434	1.1
Filzbach	6.37	1.9	542	1.3
Mollis	1.68	0.5	2974	7.2
Ennenda	12.38	3.8	2808	6.8
Sool	9.35	2.9	303	0.7
Engi	21.83	6.6	656	1.6
Matt	24.39	7.4	381	0.9
Elm	29.88	9.1	761	1.8

Tab. 05-04: Distribution of territory and population among the participated communes concerning Graubünden canton (Population figures according to the Swiss census of 5 December 2000).

Commune	Area (km²)	Proportion of total area of site (%)	Population	Proportion of total population (%)
Laax	0.23	0.1	1150	2.8
Flims	20.29	6.2	2549	6.2
Trin	21.48	6.5	1108	2.7
Tamins	3.57	1.1	1167	2.8

Most of the territory is owned by alpine corporations *(Alpkorporationen)* in the canton of St. Gallen, by citizens' associations *(Bürgergemeinden)* in Graubünden, and by the communes in Glarus. Privately held land is only found in the agricultural zones on the margins of the nominated property.

5.b Protective designation

The proposed World Natural Heritage site straddles the borders of three different cantons and is protected at three separate levels, although the territory covered is demarcated differently in each case. Protective instruments are in place at the federal, cantonal and communal levels.

The multiplicity of legal instruments affording protection is reflected by a variety of means of implementation. As the protective force of the Federal Inventory of Landscapes and Natural Monuments of National Importance (IFP) is primarily applicable in connection with federal tasks, responsibility for implementation rests primarily with the federal authorities and subsidiarily with the cantons. Implementation measures include the assessment of projects for compliance with the relevant provisions of the Federal Law on the Protection of Nature and Cultural Heritage (LPN) and the IFP – for which the Federal Office for the Environment (FOEN) is responsible – and the preparation of expert opinions, on a mandatory or discretionary basis, by the Federal Commission for the Protection of Nature and Cultural Heritage (ENHK). Responsibility for implementation of the remaining Federal Inventories lies with the cantonal authorities, who are free to choose appropriate instruments (cantonal protection decree, contracts, etc.).

In general, the cantons are responsible for protection, upkeep and enhancement measures. Technical support is provided by the federal authorities, who also bear a substantial proportion of the costs.

The cantons are also responsible for monitoring compliance with the regulations. In the case of Federal Game Reserves, the canton concerned is required to appoint one or more gamekeepers for each district, with the status of cantonal officials (Art. 11 of the Ordinance concerning Federal Game Reserves/ODF, RS 922.31). The implementation of communal protection zones is a matter for the communal authorities, with the cantons exercising a supervisory function.

Annexes A04.1, A04.2, A05 and A06 and supplement S06.1, S06.2 and S06.3 contain maps of the protected areas, and the key parts of the relevant legislation are to be found in the supplements (Suppl. S06.1, S06.2, S06.3 and S07).

Legal instruments (selection of the most important)

1. Federal Inventory of Landscapes and Natural Monuments of National Importance (IFP)

Legal foundations

Federal Law on the Protection of Nature and Cultural Heritage, 1 July 1966 (SR 451.0).

Ordinance concerning the Federal Inventory of Landscapes and Natural Monuments of National Importance, 10 August 1977 (SR 451.11).

Inventory Sites

The nominated site includes

2 Landscapes and Natural Monuments of National Importance:
- 1602 Murgtal–Mürtschental (Quarten, Obstalden; Fig. 05-01)
- 1611 Lochsite bei Schwanden (Sool; Figs. 03-03, 05-05)

The Federal Inventory of Landscapes and Natural Monuments of National Importance (IFP) is based on Article 5 of the Federal Law of 1 July 1966 on the Protection of Nature and Cultural Heritage (LPN, RS 451) and the Ordinance concerning the Federal Inventory of Landscapes and Natural Monuments (OIFP, RS 451.11). According to Article 6 of the LPN, the inclusion of a site in a federal inventory indicates that it particularly deserves to be preserved undiminished, or in any case to be managed with the greatest possible care, including the application of restoration or appropriate compensation measures. In fulfilling a federal task, departures from the principle that sites are to be preserved undiminished may only be considered if opposing interests, also of national importance, carry equal or greater weight. Federal tasks are considered to include the planning, erection and alteration of works and installations by the Confederation or federal enterprises; the issuing of licences and authorizations, e.g. for the construction and operation of transport infrastructure and facilities; and the provision of subsidies for planning, works and installations, e.g. for structural improvement projects, watercourse alterations, etc. As the property's ecological and landscape values are indisputably outstanding, the protective force of the IFP Inventory– albeit merely relative in principle – is substantial.

Responsibility for enforcement

Federal government, Federal Commission for the Protection of Nature and Cultural Heritage (ENHK), cantons.

Performance review

Under development.

Fig. 05-01: Unter Murgsee: a glacial cirque stairway landscape of national importance, with a raised bog of national importance and the northernmost extensive stands of arolla pine. Photograph: P. Donatsch, Bad Ragaz.

2. Federal hunting reserves

Legal foundations

- Federal Law on Hunting and the Protection of Wild Mammals and Birds, 20 June 1986 (SR 922.0).
- Federal Law on the Protection of Nature and Cultural Heritage, 1 July 1966 (SR 451.0).
- Ordinance on the Regulation of the Alpine Ibex Population, 31 April 1990 (SR 922.27).
- Ordinance on Federal Game Reserves, 30 September 1991 (SR 922.31)

Inventory sites

The nominated site includes

2 Federal game reserves:
- 13 Schilt (partly within the boundary) (Ennenda, Sool)
- 15 Graue Hörner (almost entirely within the boundary) (Pfäfers, Mels)

3 Ibex colonies:
- 119 Oberalp–Tödi–Calanda
- 129 Foostock
- 130 Graue Hörner (Fig. 06-01)

Goal	In federal game reserves, not only is hunting prohibited, but the areas concerned are to be preserved as a habitat for wild mammals and birds. This is to be achieved via a series of measures, such as a prohibition on disturbing animals, and appropriate agriculture and forestry. In addition, the reserves are to be taken into account in cantonal and communal master plans and land-use plans.
Responsibility for enforcement	Federal government, cantons.
Performance review	Game-keeping authorities of cantons and federal government.

3. Mire Landscape of national importance

Legal foundations	Federal Law on the Protection of Nature and Cultural Heritage, 1 July 1966 (SR 451.0). Ordinance concerning the Protection of Mire Landscapes of National Importance, 1 May 1996 (SR 451.35).
Inventory site	The nominated site includes 1 Mire Landscape of National Importance: • 359 Plaun Segnas Sut (Flims; Fig. 02-23)
Goal	In general, the total area and quality of mire landscapes are to be preserved. Specifically, therefore, the Plaun Segnas Sut is to be conserved in its semi-natural state; with very few exceptions, no installations of any kind may be erected, and use of the site for tourist and military purposes has to be reconciled with conservation objectives.
Responsibility for enforcement	Federal government, cantons.
Performance review	System established.

4. Biotopes of national importance

Legal foundations	Federal Law on the Protection of Nature and Cultural Heritage, 1 July 1966 (SR 451.0). Ordinance concerning the Protection of Raised and Transition Bogs of National Importance, 21 January 1991 (SR 451.32). Ordinance concerning the Protection of Fens of National Importance, 7 September 1994 (SR 451.33). Ordinance concerning the Protection of Alluvial Sites of National Importance, 28 October 1992 (SR 451.31). Ordinance concerning the Protection of Amphibian Spawning Areas of National Importance (SR 451.34).

Inventory sites The nominated site includes

3 alluvial zones and glacier forelands of national importance:
- 1262 Glatschiu dil Segnas (Glacier foreland, Flims; Fig. 02-17)
- 1316 Plaun Segnas Sut (Glacier foreland, Flims; Fig. 02-23)
- 216 Chrauchbach: Haris (Alluvial zone, Matt)

3 bogs of national importance:
- 426 Rietlichopf im Murgtal (Quarten)
- 428 Unter Murgsee (Quarten; Fig. 05-01)
- 441 Mürtschen (Obstalden)

5 fenlands of national importance:
- 1918 Mürtschen (Obstalden)
- 1919 Ober Mürtschen (Obstalden)
- 1926 Murgsee (Quarten)
- 1933 Gnappetriet (Matt)
- 3698 Plaun Segnas Sut (Flims)

1 Amphibian spawning area of national importance:
- GL18 Talsee (Filzbach)

4 dry grasslands (inventory in preparation):
- GR 8736 Tschanenca (mapped, but yet to be evaluated) (Trin)
- GR 8737 Schneca (mapped, but yet to be evaluated) (Trin)
- GR 8858 Vadre (mapped, but yet to be evaluated) (Trin)
- GR 8859 Vadre (mapped, but yet to be evaluated) (Trin)

Goal Mires have to be preserved undiminished; this principle may not be overridden by any other interests. Alluvial sites and amphibian spawning areas should be preserved undiminished. Departure from this protection goal is only permissible for projects dependent on a specific site that serve to protect human life or serve some other overriding public interest also of national importance.

Responsibility for enforcement Federal government, cantons.

Performance review System established for mires, under development for alluvial sites.

5. Geotopes of national and international importance

A geotope protection plan was developed at the federal level in recent years, it does not have any independent legal force. The Inventory of Geotopes of National Importance, prepared by the Working Group for the Protection of Geotopes and published in 1999, has been adopted by the federal authorities as an indicative inventory.

Within its boundary, the proposed World Natural Heritage site includes not only the Glarus overthrust geotope, but many other structural, sedimentological, palaeontological, geohistorical, petrographical, geomorphological and hydrogeological geotopes of cantonal, national or international importance. Most of these geotopes are not threatened.

A cantonal geotope inventory was drawn up in St. Gallen in 2002 and in Glarus an inventory of this kind is still being prepared. The canton of Graubünden has included geotopes in the cantonal nature and cultural heritage protection inventory and has compiled a special inventory of geological sites within the boundary of the nominated property. At the cantonal level, these inventories are binding on the authorities or serve to provide guidance. At the communal level, geotope protection provisions are included in inventories and ordinances or in land use plans that are binding on land owners.

Inventory sites

The following geotopes of national or international importance are to be found within the boundary of the property (Annex A06).

- Geotope complex Glarus overthrust with
  - Geotope complex Foostock–Tschingelhoren–Ofen/Piz Sardona–Piz Segnas–Piz Atlas/Piz Dolf (SG 17 / GL 26 / GR 1): Glarus overthrust and alpine glacier complex (Mels, Matt, Elm, Flims; Figs. 01-01, 02-03, 02-05, 02-07, 02-11, 02-14, 02-16, 03-01, 03-04, 04-03).
  - Geotope complex: Tschepp–Ringelspitz–Tristelhorn (SG 276 / GR 2): Glarus overthrust and alpine glacier complex (Pfäfers, Trin, Tamins; Figs. 02-20, 03-05, 05-02).
  - Geotope complex Pizol–Graue Hörner (SG 19): Glarus overthrust and alpine glacier complex (Pfäfers, Mels, Bad Ragaz, Vilters-Wangs; Figs. 03-02, 04-02).
  - Individual geotope Lochsite (GL 2): Glarus overthrust (Sool; Figs. 03-03, 05-05).
  - Individual geotope Crap da Flem – Il Fil (GR 3): Glarus overthrust (Flims; Fig. 02-24)
  - Individual geotope Piz Aulta/Tegia sura (Crap da Flem, GR 4): Glarus overthrust (Flims)
- Geotope complex Mürtschenalp–Hochmättli (SG 183 / GL 3): copper/silver/uranium ore deposits, copper mine/smelting works (Quarten, Obstalden)
- Geotope landscape Murgsee–Rietlichopf (SG 18 / GL 3): cirque stairway landscape (Quarten, Engi; Fig. 05-01)
- Geotope landscape Segnas Sura (GR 22): outwash plain and glacier foreland (Flims; Fig. 02-17)
- Geotope landscape Segnas Sut (GR 23): outwash plain and mire landscape (Flims; Fig. 02-23)
- Individual geotope Chrüzbachtobel (SG 71): Vättis window (Pfäfers; Fig. 02-02).
- Individual geotope Martin's Gap (GL 89 / GR 21), (Elm, Flims; Figs. 02-11, 02-19, 03-01)

Goal Geotope protection is site-specific. Depending on the type of geotope, the sites are to be preserved undiminished or at least their characteristic features are to be preserved.

Responsibility for enforcement Cantons, communes.

Performance review Varies.

Fig. 05-02: The Glarus overthrust on the Ringelspitz/Piz Barghis, the highest peak within the proposed World Heritage site (3247 m a.s.l.). Photograph: D. Imper, Heiligkreuz.

6. Cantonal nature reserves

Legal foundations

Cantonal nature protection laws and protection decrees of cantons St. Gallen, Glarus and Graubünden.

In the canton of St. Gallen, the conservation of habitats, landscapes and natural monuments is regulated on the basis of the cantonal master plan, the cantonal Construction Law (sGS 731.1), the cantonal Nature Protection Ordinance (sGS 671.1) and the relevant federal legisation (federal inventories, LPN, etc.). At the communal level, conservation provisions binding on landowners are included in local ordinances.

In the canton of Glarus, the conservation of landscapes, habitats and natural monuments is based partly on cantonal nature and cultural heritage protection legislation (Nature and Cultural Heritage Protection Law IV G/1, Nature and Cultural Heritage Protection Ordinance IV G/2) and partly on spatial planning regulations (Spatial Planning and Construction Law VII B 1/1).

In the canton of Graubünden, cantonal protection is generally implemented with the aid of spatial planning instruments, in particular the cantonal master plan, under Art. 46ff of the Spatial Planning Law of 20 May 1973 for the canton of Graubünden (801.100). At the local level, this is to be implemented by means of communal land use planning (local planning, KRG Art. 4ff).

Inventory sites

The nominated site includes:

Landscape and habitat areas subject to cantonal protection

Core habitat areas (SG master plan)
- Weisstannental–Vermii–Graue Hörner–Valtnov (Fig. 04-02)
- Calfeisen–Taminatal (Figs. 02-16, 02-33)

Wildlife refuges (SG master plan)
- Calfeisen–Taminatal
- Foo–Obersiez–Spitzmeilen
- Murgtal–Chammen (Fig. 05-01)

Protected landscape areas (GL master plan)
- Mülibachtal (inventory no. 11)
- Nüen-Britteren (inventory no. 3)

Exclusion zones for tourist facilities (GL master plan)
- Segnes (inventory no. 13.8)
- Chrauchtal (inventory no. 13.9)
- Schilt (inventory no. 13.10; Figs. 02-15, 02-21, 05-04)
- Mürtschenstock (inventory no. 13.11; Fig. 02-04)

Protected landscape areas (GR master plan)

- Ringelspitz (01.LS.07R; Fig. 05-02)
- Segnas–Flimserstein/Crap da Flem–Bargis/Fil de Cassons–Ils Lags (02.LS.34R; Figs. 02-17, 02-23)

Alluvial zones of cantonal importance

- Weisstannen/Seez (Mels)
- 1227 Bargis (Flims, Trin)

Raised bogs of cantonal importance

- 27002 Im Grüenen (Engi)

Fenlands of cantonal importance

- 595 Gamidaurchamm (Vilters-Wangs)
- 1892 Ober Heubützli (Mels; Fig. 05-03)
- 1893 Unter Heubützli (Mels)
- 1931 Rietboden (Flums)
- 2165 Chli Sächser–Sächserseeli (Flums)
- 2166 Chli Sächser–Sächserseeli (Flums)
- 1927 Murgtal/Seitenhänge: Chammseen (Quarten)
- 1928 Schattenchamm/Wasserboden (Quarten)
- 1002 Rietboden–Rietlibüel (Mühlehorn)
- 1004 Gspon (Mühlehorn)
- 2008 Feldriet (Obstalden)
- 2011 Tschermannen (Obstalden)
- 3916 Rietloch (Filzbach)
- 14001 Auf der Wässeri (Sool)
- 27002 Im Grüenen (Engi)
- 27007 Glattmatt (Engi)
- 27008 Lüsermatt (Engi)
- 28006 Winggel (Matt)
- 28007 Unter Winggel (Matt)
- 28010 Bruch (Matt)
- 29001 Morgedweid (Elm)
- 29002 Chrumm (Elm)
- 29003 Gamperdunwald (Elm)

Fig. 05-03: In addition to the mires of national importance, there are numerous smaller areas of moorland. e.g. on Heubützli in the Weisstannental, of cantonal importance.

Amphibian spawning areas of cantonal importance

- 3609 Unterer Murgsee (Quarten; Fig. 05-01)

Dry grasslands likely to be deemed to be of cantonal importance (draft)

- 2009 Mürtschen–Grosse Friz (Obstalden)
- 2006 Hüttenberg (Obstalden)
- 8008 Mulleren (Mollis)
- 12002 Vögeliboden (Ennenda)
- 12003 Ennetrösligen (Ennenda)
- 12004 Ätzgen (Ennenda)
- 12006 Brand–Beglingen (Ennenda)
- 12007 Riegen (Ennenda)
- 14005 Fessis (Sool; Figs. 02-15, 05-04)
- 27007 Glattmatt (Engi)
- 28010 Bruch (Matt)
- 28011 Geissstafel (Matt)
- 29006 Tschinglenbach (Elm)
- 29007 Nideren (Elm)
- 29008 Böden (Elm)
- 29009 Lauben (Elm)

Geotopes of cantonal importance

- Geotope complex Tristli–Siwellen–Schilt (GL 114, Ennenda): Tristli and Siwellen klippen and Schilt nappe structure, Schilt type locality, copper ore deposit.
- Geotope complex Siwellen–Mürtschenstock–Fronalpstock (GL 132, Obstalden, Filzbach und Ennenda): karst, tectonic and stratigraphic features.
- Geotope complex Mürtschenstock (GL 85, Obstalden): folded stucture, Mürtschen Gap, iron ore deposit.
- Geotope complex Fursch–Bäll (SG 140, Flums): glacier erosion landscape.
- Geotope complex Batöni (SG 426, Mels): Erosional crater + tectonic window (Mels).
- Geotope complex Platta Grischa (GR 12, Flims): tectonic, stratigraphic and karstic features.

- Geotope landscape Nüenchamm (GL 137, Filzbach) sequence stratigraphy.
- Geotope landscape Heustöckli (GL 148, Ennenda): overthrust zone.
- Geotope landscape Gufelstock (GL 102.1, Ennenda and Sool): Verrucano–Triassic cirque stairway landscape with lakes (Figs. 02-15, 05-04).
- Geotope landscape Magerrain–Wissmeilen–Spitzmeilen (SG 223 / GL 33, Flums, Engi und Matt): Triassic/Liassic series with gypsum (Fig. 02-30).
- Geotope landscape Hinteres Schilstal (SG 353, Flums): glacier/karst landscape.
- Geotope landscape Ritschli–Heubützli (SG 231, Mels): alpine flysch landscape, mire landscape (Fig. 05-03).
- Geotope landscape Elm landslide (GL 19.1, Elm): landslide.

- Individual geotope Helloch doline (GL 132.2, Filzbach): doline.
- Individual geotope Rottor (GL 84, Engi): stratigraphic hiatus.
- Individual geotope Fuggstock (GL 87, Matt): volcanic rocks.
- Individual geotope Drachenloch (SG 142, Pfäfers): prähistoric used carst cave.
- Individual geotope Raschaglius (GR 11, Flims and Trin): Assilina greensand.

Goal The characteristic biocoenoses and underlying abiotic factors are to be preserved.

Responsibility for enforcement Cantons.

Performance review Varies.

Fig. 05-04: In the Gufelstock region above the Upper Murgsee light-coloured Triassic units are overlain by an (older) Verrucano imbricate structure. Photograph: D. Imper, Heiligkreuz.

7. Others

Protective instruments at the Communal level

In the canton of St. Gallen, communal protective ordinances are based on the provisions of the cantonal master plan, the cantonal Construction Law (sGS 731.1), the cantonal Nature Protection Ordinance (sGS 671.1) and the Communes Law (sGS151.2), as well as on the relevant federal laws and ordinances.

In the canton of Glarus, communal protective ordinances are based on the Spatial Planning and Construction Law VII B 1/1, the cantonal Nature and Cultural Heritage Protection Law IV G/1 and the relevant construction regulations.

In the canton of Graubünden, protected landscape zones are regulated at the local level by communal construction laws on the basis of the Spatial Planning Law of 20 May 1973 for the canton of Graubünden (801.100).

In 1974, the Ordinance on the Protection of the Calfeisental was passed by the commune of Pfäfers. In the same commune, the collection of rock crystals is governed by regulations issued on 24 May 1973.

5.c Means of implementing protective measures

As has been noted, the nominated property is protected on three levels, although the protected areas differ. The protection provisions are based on clear goals (compare Suppl. S01) and are binding on the authorities and users concerned.

Just as the protective instruments are diverse, so is their implementation.

- Inventory of Landscapes and Natural Monuments of National Importance (IFP): The protective functions of the IFP lie primarily in the framework of federal tasks (those in the jurisdiction of the federal government) and must be implemented primarily at the federal level. Among the practices by which these functions are exerted are the following: a) assessment of projects for compatibility with protective requirements of the Law on the Protection of Nature and Cultural Heritage and its implementing regulations, performed by the respective departments of the Federal Office for the Environment, as well as b) mandatory assessment by the Federal Commission for the Protection of Nature and Cultural Heritage (ENHK).
- Federal game reserves: Compliance with regulations is monitored by the cantons. To this end the canton appoints one or more game-keepers for each area. These are cantonal officers who supplement the existing cantonal game-keeping service.
- Other federal inventories (mire landscapes, mires, alluvial areas): Implementation of these inventories is under cantonal jurisdiction, and the cantons are free to choose what instruments are suitable (protective decrees, contracts, etc.).
- Cantonal protection areas: Federal legislation obliges the cantons to protect and maintain inventoried areas of national importance as well as biotopes of regional and local importance. How to do so is left to them.

In general, protection, maintenance and enhancement measures are cantonal tasks. The communes are responsible for implementing commune-level protection zones; the canton has an oversight role in this respect. The federal government extends specialist support to the cantons and bears a substantial proportion of the costs.

5.d Existing plans related to municipality and region in which the proposed property is located (e.g., regional or local plan, conservation plan, tourism development plan)

The nominated area has been integrated into various cantonal, regional and communal plans in cantons St. Gallen, Glarus and Graubünden. Protection rests on three main pillars: protection of nature and cultural heritage, implementation of land-use plans, and building codes. In terms of land-use planning, the area is covered at the master plan level. Master plans are approved by the federal government and are binding on all authorities.

The agreement on joint protection of the World Heritage site includes a Development Plan that assigns to the communes responsibility for preserving the property and its assets.

The master plan lists protected areas that are considered to be of particular value from a cantonal viewpoint. These so-called nature and landscape priority areas are either particularly valuable habitats for animals and plants, or landscapes distinguished by their original character, diversity and beauty or their geohistorical significance. At the same time, many of these areas have also been designated by the federal authorities as sites of national importance.

In fulfilling their tasks, the cantonal and communal authorities take account of the conservation objectives for the nature and landscape priority areas specified in the master plan. Measures that would destroy or degrade these areas may only be approved if it can be demonstrated that the conservation interest is overridden by an important need. In such cases, the substantial need in opposition to the conservation objectives specified in the master plan must also be of cantonal importance.

Forest plans or forest development plans – in which forest reserves are also designated near settled areas – are an important new instrument. This binding working tool provides agencies and technical offices with instructions for all forest-related activities and decisions.

St. Gallen

The master plan for the canton of St. Gallen (*http://www.sg.ch/bauen_raum_umwelt/raumentwicklung/richtplanung.html*, Suppl. S06.1) is based on the content of the master plan from 1987 and the supplement from 1997. It was issued by the government on 23 April 2002 and approved by the Federal Council on 15 January 2003.

Within the nominated property, the following types of protected area are distinguished in the master plan for the canton of St. Gallen:

- Cantonal and national nature reserves
- Cantonally protected landscape areas
- Habitats of threatened species (wildlife refuges and core areas)
- Aquatic/alluvial habitats

Glarus

The Cantonal Landscape Directory dated 16.01.1996 *(www.gl.ch)* is based on the cantonal master plan dated 14.12.1988 *(www.gl.ch).* Under the cantonal Nature and Cultural Heritage Protection Ordinance, this inventory, compiled by the former Department for Agriculture, Forests and Environment of Glarus canton, provides the basis for the development plan. The new master plan *(www.gl.ch,* Suppl. S06.2) was partly adopted by the cantonal parliament in May 2006.

Within the nominated property, the following types of protected area are distinguished in the new master plan for the canton of Glarus:

- Cantonally and nationally protected habitat areas
- Cantonally and nationally protected landscape areas
- Other important habitats or wildlife refuges
- Exclusion zones for tourist facilities

The new master plan for the canton of Glarus includes the boundary of the proposed World Heritage site and requires compliance with the provisions of the communes' agreement at the cantonal level.

Graubünden

The master plan for the canton of Graubünden *(http://www.richtplan.gr.ch*, Suppl. S06.3) was issued by the cantonal government on 19 November 2002 and approved by the Federal Council on 19 September 2003.

Within the nominated property, the following types of protected area are distinguished in the master plan for the canton of Graubünden:

- The national mire landscape
- Cantonal and national nature reserves
- Cantonally protected landscape areas

5.e Property management plan or other management system

The Management Plan (Suppl. S01) describes the natural, cultural and economic conditions currently existing within the boundary of the proposed World Natural Heritage site "Glarus overthrust", defines goals for sustainable development and proposes measures for implementation.

The Management Plan was prepared by the management of the IG UNESCO World Heritage site Glarus overthrust. It is based on the development planning in the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"* (Suppl. S02), which was prepared in cooperation with all parties concerned.

In the areas concerned, the idea of establishing the Glarus overthrust property as a UNESCO World Natural Heritage site was taken up in a Regio Plus project entitled "GeoPark Sarganserland-Walensee-Glarnerland" and first presented at a regional hearing on 27 May 2000. In view of the favourable response, a Working Group was set up, comprising representatives of local conservation and tourist bodies, and the necessary exploratory studies were initiated in the autumn of 2000. Within this Working Group, the difficulties of balancing the interests of conservation and tourist development already emerged. The centrepiece of the Working Group's efforts was an agreement including a Development Plan. In the spring of 2001, the authorities and landowners concerned were duly informed. The individual communes and landowners were then given an opportunity to submit written comments. To become legally valid, the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"* including the boundary, Development Plan and funding arrangements (Suppl. S02) had to be approved by the communal authorities or citizens' assemblies, depending on the individual cantonal regulations. By May 2003, after the necessary amendments had been made, the agreement had been approved by all of the 19 communes concerned and by the three cantons, thus making it possible for the nomination to be submitted.

The Plan is designed to

- indicate in concrete terms how the proposed World Natural Heritage site is to be conserved and sustainably developed;
- consider the "Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"" (Suppl. S02) including the Development Plan and list of acceptable/unacceptable uses and specify how these provisions and goals are to be implemented;
- provide information for interested parties.

The Management Plan prepared for the World Heritage nomination in 2004 has been revised and updated, also taking into account the suggestions made by IUCN.

The goals formulated for the proposed World Heritage site are based on the provisions of existing law and seek to ensure improved implementation and monitoring. The following binding goals have been stated for the site [Article 1 ("Purpose") of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust",* signed by the 19 communes concerned (Suppl. S02)]:

- Joint action is to be taken to conserve and manage the natural monument "Glarus overthrust" as a UNESCO World Heritage site, together with the surrounding landscape and habitats.
- Sites of geological importance ("geotopes"), biotopes and the landscape within this natural monument are to be conserved over the long term.
- As far as is consistent with the conservation of the geotopes, biotopes and landscape, the region and its natural aesthetic features are to be accessible to visitors and available for sustainable, appropriate use.

Additional goals are as follows:

- The property's diversity, unique character and beauty and the full diversity of the natural and semi-natural ecosystems and ecosystem complexes are to be preserved for present and future generations, including the area's significance as a recreational and economic resource.

- All of the wild plant and animal species indigenous to the property, together with their biological communities, are to be conserved, and if necessary nurtured, in populations that are viable over the long term.
- The cultural and traditional elements of the various man-made landscapes are to be preserved.
- Commercial use is to be aligned with the carrying capacity of the natural ecosystem.
- Bearing in mind the natural hazards and taking account of the sensitivity and need for conservation of the natural resources, people are welcome to visit the property. Appropriate infrastructure is to be maintained and if necessary expanded in line with the capacity of the natural ecosystem to tolerate use.
- Awareness of the property's value, unique character and aesthetic features is to be promoted among visitors and the local community.

Along with goals and policies for protection and sustainable development, the management plan also sets out the structure of a research platform and informational activities.

Sarganserland–Walensee–Glarnerland GeoPark

The local population is aware of the region's major significance in terms of geology and mining history. The question of how this can be preserved, enhanced and developed has been considered for some years now. Thus, just under ten years ago, preparatory work was already initiated for a Sarganserland-Walensee-Glarnerland Geopark. Contacts were established with UNESCO (in 2000), the Swiss and German Geological Societies, and the European Geoparks Network (Section 3).

The existing Sarganserland–Walensee–Glarnerland GeoPark, which comprises the Sarganserland–Walensee region (the most southerly part of St. Gallen canton) and the canton of Glarus (eastern Switzerland), covers an area of almost 1300 km². Following the planned extension of the GeoPark into the canton of Graubünden, the considerably smaller territory of the nominated property "Glarus overthrust" will lie wholly within the Sarganserland-Walensee-Glarnerland GeoPark. The region's unique mountainous landscape includes an unusually high concentration of sites bearing witness to the earth's history (geotopes), such as the Engi slate workings, the Gonzen iron mine, the Tamina gorge and thermal baths, or the Churfirsten mountain range, and of course the most significant element – the Glarus overthrust. The surviving relics, products and documents that testify to the region's mining and industrial heritage make it possible for visitors to experience historical installations and processes in situ. More than 30 attractions are currently offered (guided tours of geotopes, disused mines, quarries and the Hagerbach Test Gallery, as well as Geo-trails, Geo-cruises, museums and exhibitions; *www.geopark.ch,* Supplements S09.1, S09.2, S09.3, S10.1 and S10.2). In addition, there have been significant educational efforts (explanatory charts, booklets, website, conferences, etc.) and publications in the earth sciences field (HESSKE & FUX 2002, IMPER 2003a, IMPER & DUROT 2003).

The foundations for the nomination of the Glarus overthrust as a World Heritage site were laid in the course of the Sarganserland-Walensee-Glarnerland GeoPark project. Fundamental synergies have thus already been exploited. It will be possible for graduated protection provisions to be established: the core area with the best-preserved natural assets, within the boundary of the future World Heritage site, will be subject to more stringent protection requirements, with the remainder of the Sarganserland-Walensee-Glarnerland GeoPark serving as a buffer zone. In 2004, to ensure that the respective functions of the Geopark and the future World Heritage site can be optimally developed, clearly defined structures and a clear division of responsibilities between the two entities were established. These have been incorporated into the Management Plan (Suppl. S01).

Fig. 05-05: In the Sarganserland-Walensee-Glarnerland GeoPark offers guided tours and information material. Photograph: D. Kalberer, Heiligkreuz.

5.f Sources and levels of finance

The financing model is based on the principle of public-private partnership: public and private-sector (sponsorship, labelling, business circles) entities are to be responsible for financing the activities associated with the nominated property. Private funding in particular is to be tied to the UNESCO World Heritage label.

A large proportion of the property is either extensively managed or unused land. The federal, cantonal and communal authorities are directly involved in the protection process, e.g. through gamekeeping, provision of grants to compensate for grassland management efforts, or monitoring the conservation of mires and alluvial zones of national importance. The associated costs, borne at the federal and cantonal level, have thus been integrated.

The communes and cantons have undertaken to provide funding of CHF 50,000–100,000 for management, and federal support for projects designed to protect the property will probably amount to CHF 160,000 per year.

The Sarganserland-Walensee-Glarnerland GeoPark and the tourism organizations will contribute around CHF 150,000 in the form of services for joint marketing efforts and educational support.

The costs of fulfilling the tasks arising are expected to total CHF 1,000,000 (Suppl. S01).

5.g Sources of expertise and training in conservation and management techniques

Cantonal and federal officials responsible for nature and landscape protection at the agencies concerned are academically trained, generally holding university degrees in the disciplines of biology, forestry engineering, geography or geology.

Advice on scientific matters relating to the conservation and use of the natural monument is to be provided by the Scientific Advisory Committee, which is also responsible for offering scientific support in the event of conflicts and maintaining contacts with the leading Swiss research centres. The responsibilities of the Scientific Advisory Committee, which includes representatives from the most important Swiss research centres, are defined in the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"* (Suppl. S02) and in the Management Plan (Suppl. S01).

5.h Visitor facilities and statistics

No visitor centre exists as such. The management performs various visitor information functions (including through the website *www.glarusoverthrust.org* / *www.glarnerhauptueberschiebung.ch)* and supports other regional groups interested in communications and environmental education. Public understanding of the natural and cultural heritage of the Glarus overthrust is to be promoted by means of permanent exhibitions at the existing scientific museums – the Graubünden Museum of Nature, Chur, Glarus Cantonal Scientific Collection, Engi, and Sarganserland Museum, Sargans. The commune of Flims proposes to establish a new visitor centre dedicated to the site in the event of the Glarus overthrust being inscribed on the World Heritage List.

In addition, numerous Geo-sites (museums, mines, guided tours, etc.) have already been established which, like the World Natural Heritage property nomination, form part of the RegioPlus Walensee-Sarganserland-Glarnerland GeoPark project (Section 3, Supplements S09.1, S09.2, S09.3, S10.1 and S10.2).

Subsidiary centres are to be established in all of the cantons concerned. In setting up these centres, synergies with GeoPark are to be exploited as far as possible. The subsidiary centres will support the management (Secretariat) in the areas of public relations and communication. The individuals responsible within the various subsidiary centres will function as interfaces with the management. At least in the initial phase, no provision is made for compensation of these individuals from the budget of the World Natural Heritage site.

The subsidiary centres will assist the management with communication and public relations at the local level and also with marketing efforts, liaising between the public and the management.

A number of establishments offering meals and accommodation are to be found on the property, together with mountain cabins primarily designed for climbers. At present, sufficient facilities are available. Should the number of visitors increase, the network of cabins could be expanded, although no new hotel or restaurant-type facilities would be permitted under the existing conservation regulations.

5.i Policies and programmes related to the presentation and promotion of the property

Under the Swiss Federal Constitution, the cantons are responsible for nature and cultural heritage protection. Nevertheless, various sites within the nominated property have been designated by the federal authorities as nationally protected landscape or habitat areas or as game reserves. These areas are subject to a national monitoring and evaluation programme. In the case of the Glarus overthrust, the cantons have fulfilled their responsibility by designating the entire property as protected landscape or habitat areas in their master plans. Since no inventory of protected geotopes exists at the national level, the numerous geotopes of national and international importance within the nominated property have been integrated into existing legislation. The World Heritage nomination has prompted the promoters to raise public awareness of the impressive overthrust phenomenon (“magic line”) and the international importance of the site both locally and nationally. In these efforts, an important contribution is made by the Sarganserland-Walensee-Glarnerland GeoPark, which comprises the nominated property itself and an extensive surrounding region. The existing information campaigns and educational programmes (involving the Geopark’s own guides) are to be pursued and expanded in future, with a concept tailored to the World Heritage and jointly supported by the federal, cantonal and communal authorities.

5.j Staffing levels (professional, technical, maintenance)

The area is monitored in the usual way by cantonal officials with special education and advanced training for this task (e.g. gamekeepers and fishing wardens). Rangers are to be deployed in order to help preserve the natural and cultural landscape and existing infrastructure within the boundary of the site, and also to implement visitor management measures. The rangers will have the necessary expertise to answer visitors' queries and possibly also to assume responsibilities in the areas of monitoring/evaluation/quality assurance.

The deployment of rangers is largely to be developed on the basis of existing organizations, primarily including gamekeeping/forestry personnel and staff employed by the local authorities, who already have broad expertise. They are to receive additional instructions concerning the activities that are permissible within the World Natural Heritage site and the procedure for dealing with any infringements by visitors.

From 2005, so-called GeoGuides will be trained within GeoPark Sarganserland-Walensee-Glarnerland. These GeoGuides should also be capable of being deployed as rangers.

Path and road maintenance is to be managed, as hitherto, by tourist operators, road owners, and the communal and cantonal authorities.

Sources ARBEITSGRUPPE GEOTOPSCHUTZ SCHWEIZ (1999), DR. VON MOOS AG (2004), DUELLI, P. (Red.) (1994), FACHGEMEINSCHAFT OEKOLOGIE UND NATURSCHUTZ (1995), FEBIO (2000), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2004), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2005), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2006), GLHELD, S. (2003), HESSKE, S. & FUX, S. (2002), IMPER, D. (2003a), IMPER, D. (2003b), IMPER, D. (2004a), IMPER, D. (2004b), IMPER, D. & DUROT, S. (2003), IUCN (2005), JORDAN, P., HEINZ, R., HEITZMANN, P., HIPP, R. & IMPER, D. (2003), MOSER, D., GYGAX, A., BÄUMLER, B., WYLER, N. & PALESE, R. (2002), PHILIPS, A. (2002), RUHLÉ, C., ACKERMANN, G., EHRBAR, R., TSCHIRKY, R. und WALZ, P. (1997), SAEFL (1998), SAEFL (2000), SAEFL (2002), SAEFL (2003), SAEFL (2005), SAEFL & AUENBERATUNGSSTELLE (2000), SCHWITTER, R., TSCHIRKY, R., WEIDMANN, P. & GOOD, A. (Hrsg.) (2004), STÜRM, B., HEINZ, R. & KELLER, O. et al. (2002), THIELEN R., TOGNOLA M., ROULIER C., TEUSCHER F. (2002), THORSELL, J. (2005), UNESCO WORLD HERITAGE CENTER (2005).

Annexes A01, A03, A04.1, A04.2, A05, A06, A07

Supplements S01, S02, S03, S04, S06.1, S06.2, S06.3, S07, S08, S10.1, S10.2

6 Monitoring

6.a Key indicators for measuring state of conservation

The nominated property is to be monitored at regular intervals with the aid of the evaluation measures specified in the Management Plan (Suppl. S01). Monitoring is to be based on existing national and cantonal programmes.

Under Article 27 of the Ordinance on the Protection of Nature and Cultural Heritage (RS 451.1), the Federal Office for the Environment (FOEN) is responsible for the monitoring of biological diversity (Swiss Biodiversity Monitoring project). In addition, FOEN is to carry out follow-up investigations to check that the legally required measures have been implemented and to assess their suitability. Evaluation procedures have already been established in the area of mire conservation, and programmes are being prepared for the other federal inventories. Other sources include the National Forest Inventory, game censuses, the National Soil Monitoring Network, etc.

Unless goals and measures are subjected to reviews, they are of little value. Reviews should cover various areas, including in particular the evaluation of goals and outcomes. In certain areas, evaluation processes are already under way.

Tab. 06-01: Proposed key indicators, possible frequency of determination (Y = annually; S = after several years; R = running record), and place of data retention (Management: Management has data from different sources, goal: all data are available at the Management centre).

Indicator	Frequency	Data held at
Geological indicators:		
State of the most important and most frequent visited outcrops of the Glarus overthrust	Y	Management
State of the most important and most frequent visited geotopes	S	Management
Biological indicators:		
Size and reproduction rate of lynx population (probable number of individuals at present: 0)	S	Canton
Size and reproduction rate of wolf population (probable number of individuals at present: 0)	S	Canton
Sizes of populations of hoofed animals (Alpine ibex, red deer, chamois)	Y	Canton
Hunting statistics	S	Canton
Catch statistics	S	Canton
Size and reproduction rate of bearded vulture population	S	Canton
Size and reproduction rate of golden eagle population	S	Canton
Density of certain bird populations (e.g., grouse)	S	Canton
Ecosystem indicators:		
Quantity and quality of protected areas	S	Canton/federal
Approach of forests to natural state	S	Canton
Mountain pasture livestock density	Y	Canton
Sociocultural indicators:		
Number of overnight stays	Y	Management
Quality of supplies and disposal	S	Management
Mechanical interventions	Y	Management
Length of hiking trails	Y	Management
Length of via ferrata	Y	Management
Length of forest and alpine roads	Y	Management
Number of high-altitude landing facilities	Y	Management
Expansion of existing shelters	Y	Management
Construction of new shelters	Y	Management
Planning indicators:		
Implementation of area in master plans	S	Canton
Implementation of area in zoning plans	S	Canton
Indicators from national monitoring networks:		
MeteoSwiss network: climatological and meteorological parameters	R	MeteoSwiss
National Air Pollution Monitoring Network	R	Federal
Swiss Glacier Monitoring Network	R	Federal
Red Lists	S	Federal
Swiss Biodiversity Monitoring	S	Federal

6.b Administrative arrangements for monitoring property

In recent years the federal government has made intensive efforts at both strategic and operational levels in the area of performance monitoring, having undertaken to develop standardized monitoring policies for the federal inventories, so that actions taken and their impacts could be assessed (new Art. 27a in the Ordinance on Nature and Cultural Heritage Protection (RS 451.1), in force since 1 August 2000).

Under a federal government mandate, the IFP is currently undergoing a comprehensive effectiveness review. A monitoring system will be established so that the impact of the IFP can be evaluated for Switzerland as a whole and longitudinally over time.

The performance review system is already in operation for mire protection. Mires of national importance within the area are also included.

For alluvial zones of national importance, a performance review system is in place and the first phase of information gathering is complete (including for sites inside the nominated area). Assessments, however, will only be carried out after a second phase of information gathering in a few years' time.

Sector-by-sector performance reviews are carried out in federal game reserves. Gamekeepers prepare annual reports for the FOEN, including estimates of wildlife populations in the reserves.

Ibex colonies are specially monitored. Under the Ordinance of 30 April 1990 on the Regulation of Ibex Populations, the cantons carry out annual surveys to determine populations, sex and age breakdowns, gains and losses, and population development.

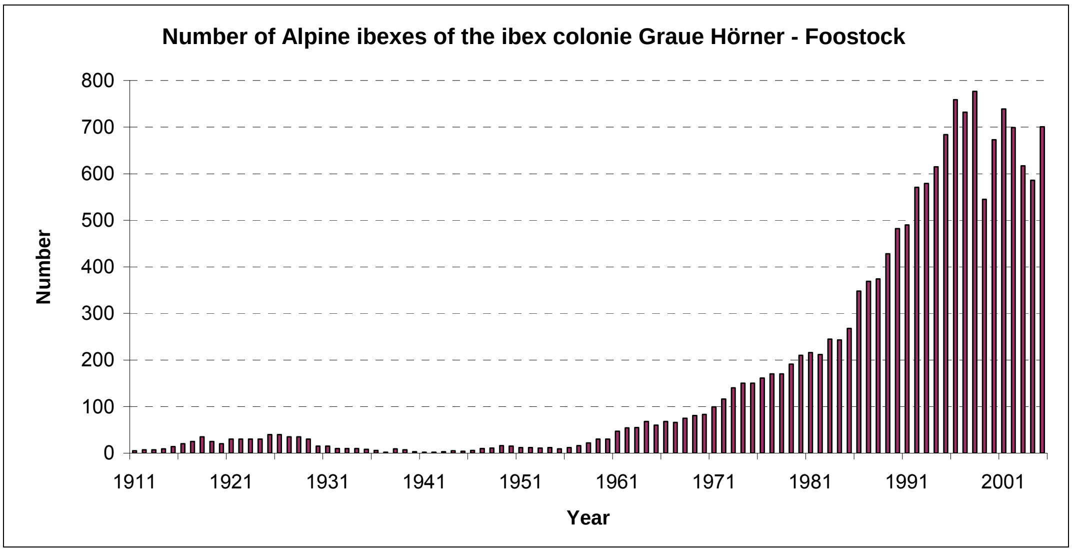

Fig. 06-01: Development of Switzerland's longest-standing ibex colony, in the Graue Hörner game reserve. Source: Wildhut (gamekeeping authority) St. Gallen.

Changes in the lengths of some glaciers are already being measured, generally every year, although this is not done to gauge performance but as a contribution to environmental monitoring. Glaciers in the nominated area that are included in the measurement network are the Chligletscher and the Pizolgletscher.

The Swiss Biodiversity Monitoring Programme involves on-the-ground censuses of animal and plant species in specified areas. These sites are systematically distributed over the entire country, including some within the nominated property. The resulting data series will support conclusions about the development of fauna and flora.

6.c Results of previous reporting exercises

Reports concerning the area as a whole have not yet been prepared. It will be a task of management to compile such reports.

Sources IUCN (2004), RUHLÉ, C., ACKERMANN, G., EHRBAR, R., TSCHIRKY, R. & WALZ, P. (1997), SAEFL (1998), VAW ETH Zürich (2004), UNESCO/AIHS (1970), UNESCO WORLD HERITAGE CENTER (2005).

Annexes A04.1, A04.2, A05, A06, A07, A08, A09, A10, A11, A12

Supplements S01, S02, S04, S07

7 Documentation

7.a Photographs, slides, image inventory and authorization table and other audiovisual materials

A collection of photographs, including legends, is to be found on the attached CD-ROM.

Table 07-01: Image inventory and photograph and audiovisual authorization form

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer/ Director of the video	Copyright owner (if different than photographer / director of video)	Contact details of copyright owner (Name, address, tel/fax, and email)	Non exclusive cession of rights[1]
01-01	slide/print Fig. 01-01	View of the Piz Sardona group from the East.	2000	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-02	slide/print Fig. 02-02	The unconformity between the crystalline basement and the overlying sedimentary series at Chrüzbachtobel (Vättner window).	2006	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-03	slide/print Fig. 02-03	The Mesozoic Lochseiten limestone immediately below the Glarus overthrust on the Foostock in the Weisstannental.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-04	slide/print Fig. 02-04	The extensively folded Mesozoic limestones on the Mürtschenstock.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-05	slide/print Fig. 02-05	The Verrucano above the Glarus overthrust forms a tectonic klippe on the Piz Dolf/Trinserhorn.	2005	B. Walder		Bruno S. Walder Embergrain 38 CH-3612 Steffisburg *walderbst@bluewin.ch* Tel: 0041 33 438 88 03	Yes
02-06	slide/print Fig. 02-06	A wide variety of soil types developed, depending on the climatic conditions and the substrate (Flimserstein, 2700 m a.s.l. on Verrucano).	2005	B. Walder		Bruno S. Walder Embergrain 38 CH-3612 Steffisburg *walderbst@bluewin.ch* Tel: 0041 33 438 88 03	Yes
02-07	slide/print Fig. 02-07	The contrasting colours are particularly striking on the Tschingelhoren. Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano (top) and flysch.	2003	G. Danuser	Flims Laax Falera Tourismus AG	CH–7017 Flims Dorf *info@flimslaaxfalera.ch* Tel: 0041 921 21 00	Yes
02-08	slide/print Fig. 02-08	Geological section through the Glarus Alps: The Glarus overthrust is arcuate in form and can be followed from the root zone in the Graubünden Rhine Valley up to the front of the nappe.	1994	A. Pfiffner		Prof. A. Pfiffner Baltzerstrasse 1 CH–3012 Bern *pfiffner@geo.unibe.ch* Tel: 0041 31 631 87 57	Yes

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer/ Director of the video	Copyright owner (if different than photographer / director of video)	Contact details of copyright owner (Name, address, tel/fax, and email)	Non exclusive cession of rights[1]
02-09	slide/print Fig. 02-09	Mélange structures of ductile deformation at Sardona.	2003	D.Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-10	slide/print Fig. 02-10	Fine structures in cut and polished Lochseiten limestone.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-11	slide/print Fig. 02-11	One of the oldest depictions of the Glarus overthrust is the famous watercolour executed in 1812 by H. C. ESCHER von der Linth: The Tschingelhoren, with Martin's Gap, viewed from the south-east (HCE A IX 180a)	1812	H. C. Escher	ETH Zurich Library	ETH-Bibliothek ETH Zentrum Rämistrasse 101 CH–8092 Zürich info@library.ethz.ch Tel: 0041 44 632 21 35	Yes
02-14	slide/print Fig. 02-14	The Glarus overthrust on the western side of the Sardona group.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-15	slide/print Fig. 02-15	The glacially formed lake landscape of Fessis.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-16	slide/print Fig. 02-16	More extensive glaciated areas are to be found in the central part of the proposed World Heritage site – in the Piz Sardona/Piz Segnes group.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
02-17	slide/print Fig. 02-17	Plaun Segnas Sura: the glacier foreland of the Glatschiu dil Segnas, which is also an alluvial zone of national importance.	2006	H. Conrad		Hans Conrad Vorderdorf CH– 8892 Berschis *hc.conrad@bluewin.ch* Tel: 0041 81 733 25 54	Yes
02-18	slide/print Fig. 02-18	Karst phenomenas in Bargis and the Alp Mora.	2003	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-19	slide/print Fig. 02-19	View throug the spectacular Martin's Gap, which has a diameter of almost 20 metres.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-20	slide/print Fig. 02-20	The Ringelspitz/Piz Barghis is the highest peak within the proposed World Heritage site (3247 m a.s.l.).	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer/ Director of the video	Copyright owner (if different than photographer / director of video)	Contact details of copyright owner (Name, address, tel/fax, and email)	Non exclusive cession of rights[1]
02-21	Slide/print Fig. 02-21	Dry grasslands Alpeli (Ennenda)	2006	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-22	slide/print Fig. 02-22	A section of the Chrauchtal fen.	2005	F. Marti		Fridli Marti Büchelstrasse 7 CH–8753 Mollis *marti@quadragmbh.ch* Tel: 0041 55 622 21 70	Yes
02-23	slide/print Fig. 02-23	Plaun Segnas Sut: a mire landscape and alluvial zone of national importance.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
02-24	slide/print Fig. 02-24	At Cassonsgrat, acidic and alkaline soils are directly adjacent to each other on account of the Glarus overthrust.	2005	B. Walder		Bruno S. Walder Embergrain 38 CH-3612 Steffisburg *walderbst@bluewin.ch* Tel: 0041 33 438 88 03	Yes
02-25	slide/print Fig. 02-25	Lady's slipper orchid (Cypripedium calceolus) is a rare species growing in sparse mountain forests on a base-rich substrate.	2005	O. Good		Othmar Good Haldenstrasse 6 CH– 8887 Mels *othmar.good@gmx.net* Tel: 0041 81 723 88 18	Yes
02-26	slide/print Fig. 02-25	Having been completely eradicated from Switzerland, the ibex was first reintroduced within the proposed World Heritage site "Glarus overthrust" in 1911, and populations have since flourished.	2005	O. Good		Othmar Good Haldenstrasse 6 CH– 8887 Mels *othmar.good@gmx.net* Tel: 0041 81 723 88 18	Yes
02-27	slide/print Fig. 02-27	The capercaillie (Tetrao urogallus) is a threatened species characteristic of untouched mountain forests (Walabütz, Weisstannental).	2005	O. Good		Othmar Good Haldenstrasse 6 CH– 8887 Mels *othmar.good@gmx.net* Tel: 0041 81 723 88 18	Yes
02-28	slide/print Fig. 02-28	The Small Apollo (Parnassius phoebus) is a characteristic alpine species found along seeps and streams, and in mires.	2003	P. Weidmann		Peter Weimann Bahnhofstr. 20 CH– 7000 Chur *weidmann@atragene.ch* Tel: 0041 81 253 52 05	Yes
02-29	slide/print Fig. 02-29	The Walser settlement of St. Martin (1350 m a.s.l.), which was occupied all year round until 1652, has been preserved and restored.	2005	P. Donatsch		Peter Donatsch Elestastr. 18 CH–7310 Bad Ragaz *info@peterdonatsch.ch* Tel: 0041 79 517 98 06	Yes
02-30	slide/print Fig. 02-30	Gypsum deposits at Wissmeilen.	2000	D.Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer/ Director of the video	Copyright owner (if different than photographer / director of video)	Contact details of copyright owner (Name, address, tel/fax, and email)	Non exclusive cession of rights[1]
02-31	slide/print Fig. 02-31	There is a centuries-old tradition of mountain farming. Within the proposed World Heritage site, the rare and now threatened breed of mountain goat known as the booted goat (Stiefelgeiss) is still farmed.	2005	B. Walder		Bruno S. Walder Embergrain 38 CH-3612 Steffisburg *walderbst@bluewin.ch* Tel: 0041 33 438 88 03	Yes
02-32	slide/print Fig. 02-32	In 1911 the alpine ibex (Capra ibex), previously eradicated from Switzerland, was first reintroduced in the Graue Hörner game reserve.	1911	Wildhut SG		Amt für Jagd & Fischerei Davidstr. 35 9000 St. Gallen *info.ajf@sg.ch* Tel.: 0041 71 229 39 53	Yes
02-33	slide/print Fig. 02-33	The Gigerwald reservoir is used to produce renewable energy.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
03-01	Slide/print Fig. 03-01	The Glarus overthrust is readily discernible from afar. Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano (top) and flysch.	2005	H. Rhyner		Hans Rhyner Sporthaus CH– 8767 Elm *rhyner-sport@bluewin.ch* Tel: 0041 55 642 13 41	Yes
03-02	Slide/print Fig. 03-02	The Glarus overthrust below the Graue Hörner, viewed from the east.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
03-03	Slide/print Fig. 03-03	Horizontal late thrust surface (middle of picture) and mélange structures of ductile deformation in the footwall and hanging wall at Lochsite.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
03-04	Slide/print Fig. 03-04	On the Foostock, the Glarus overthrust dips gently to the north.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
03-05	Slide/print Fig. 03-05	As the Glarus overthrust exposures on the Tristelhorn are situated at around 3000 m a.s.l., they are particularly suitable for study.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
03-06	Slide/print Fig. 03-06	The Lochsite has been reconstructed at the American Museum of Natural History in New York.	2004	S. Hesske		Dr. S. Hesske Wart CH–7312 Pfäfers *shesske@bluemail.ch* Tel: 0041 81 302 87 59	Yes
04-01	Slide/print Fig. 04-01	The Niederenbahn is the only mountain railway within the boundary of the proposed World Heritage site.	2005	H. Brühwiler	Elm Sernftal Tourismus	Elm Sernftal Tourismus CH– 8767 Elm *info@elm.ch* Tel: 0041 55 642 52 52	Yes

Id. No	Format (slide/ print/ video)	Caption	Date of Photo (mo/yr)	Photographer/ Director of the video	Copyright owner (if different than photographer / director of video)	Contact details of copyright owner (Name, address, tel/fax, and email)	Non exclusive cession of rights[1]
04-02a	Slide/print Fig. 04-02a	The Pizolgletscher on a postcard from around 1920.	ca. 1920		IG UNESCO Welterbe Glarner Hauptüberschiebung	c/o David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@geopark.ch* Tel: 0041 81 723 59 13	Yes
04-02b	Slide/print Fig. 04-02b	The Pizolgletscher 2005.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
04-03	Slide/print Fig. 04-03	Visitors are to be managed with the aid of well-maintained hiking trails and information resources.	2005	Y. Willi	IG UNESCO Welterbe Glarner Hauptüberschiebung	c/o David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
05-01	Slide/print Fig. 05-01	Unter Murgsee: a glacial cirque stairway landscape of national importance, with a raised bog of national importance and the northernmost extensive stands of arolla pine.	2005	P. Donatsch		Peter Donatsch Elestastr. 18 CH–7310 Bad Ragaz *info@peterdonatsch.ch* Tel: 0041 79 517 98 06	Yes
05-02	Slide/print Fig. 05-02	The Glarus overthrust on the Ringelspitz/Piz Barghis, the highest peak within the proposed World Heritage site (3247 m a.s.l.).	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
05-03	Slide/print Fig. 05-03	In addition to the mires of national importance, there are numerous smaller areas of moorland. e.g. on Heubützli in the Weisstannental, of cantonal importance.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
05-04	Slide/print Fig. 05-04	In the Gufelstock region above the Upper Murgsee light-coloured Triassic units are overlain by an (older) Verrucano imbricate structure.	2006	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
05-05	Slide/print Fig. 05-05	In the Sarganserland-Walensee-Glarnerland GeoPark guided tours and information material are offered.	2005	D. Kalberer		Daniel Kalberer Kürschnengasse 16a CH-8888 Heiligkreuz *info@nogravity.ch* Tel: 0041 79 424 62 56	Yes
0X-01	Slide/print 0X-01	On the Piz Sardona at 2800 m a.s.l. the structure of the ‘magic line’ Glarus overthrust is particularly clear. Mylonitized Lochseiten limestone separates the coarse-grained Verrucano from the flysch.	2005	D. Imper		David Imper Untergasse 19 CH–8888 Heiligkreuz *imper@impergeologie.ch* Tel: 0041 81 723 59 13	Yes
0X-02	Slide/print 0X-02	Glarus overthrust on the Ringelspitz (3247 m a.s.l.)	2005	R. Schwitter		Raphael Schwitter Ausserdorf CH-7312 Pfäfers *ar.schwitter@bluewin.ch* Tel.: 0041 81 302 43 18	Yes

[1] The copyright owners want to be informed, in the case of using the photos.

7.b Texts relating to protective designation, copies of property management plans or documented management systems and extracts of other plans relevant to the property

List of the relevant federal legislations
The most important are attached in the supplement.
All are available online under *http://www.admin.ch/ch/f/rs/45.html*.

Loi fédérale du 1$^{\text{er}}$ juillet 1966 sur la protection de la nature et du paysage (LPN, RS 451).	Suppl. S07
Ordonnance du 10 août 1977 concernant l'inventaire fédéral des paysages, sites et monuments naturels (OIFP, RS 451.11) + Annexe "Inventaire fédéral des paysages, sites et monuments d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_11.html*	Suppl. S07
Ordonnance du 28 octobre 1992 sur la protection des zones alluviales d'importance nationale (RS 451.31) + Annexe "Inventaire fédéral des zones alluviales d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_31.html*	Suppl. S07
Ordonnance du 21 janvier 1991 sur la protection des hauts-marais et des marais de transition d'importance nationale (RS 451.32) + Annexe "Inventaire fédéral des hauts-marais et des marais de transition d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_32.html*	Suppl. S07
Ordonnance du 7 septembre 1994 sur la protection des bas-marais d'importance nationale (RS 451.33) + Annexe "Inventaire fédéral des bas-marais d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_33.html*	Suppl. S07
Ordonnance du 15 juin 2001 sur la protection des sites de reproduction de batraciens d'importance nationale (RS 451.34) + Annexe "Inventaire fédéral des sites de reproduction de batraciens d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_34.html*	Suppl. S07
Ordonnance du 1er mai 1996 sur la protection des sites marécageux d'une beauté particulière et d'importance nationale (RS 451.35) + Annexe "Inventaire fédéral des sites marécageux d'une beauté particulière et d'importance nationale"; *http://www.admin.ch/ch/f/rs/c451_35.html*	Suppl. S07
Loi fédérale du 1er juillet 1966 sur la protection de la nature et du paysage (LPN, RS 451); *http://www.admin.ch/ch/f/rs/c451.html*	Suppl. S07
Loi fédérale du 20 juin 1986 sur la chasse et la protection des mammifères et oiseaux sauvages (LChP, RS 922.0); *http://www.admin.ch/ch/f/rs/c922_0.html*	Suppl. S07
Ordonnance du 30 avril 1990 sur la régulation des populations de bouquetins (ORB, RS 922.27)	Suppl. S07
Ordonnance du 30 septembre 1991 concernant les districts francs fédéraux (ODF, RS 922.31); *http://www.admin.ch/ch/f/rs/c922_31.html* *http://www.admin.ch/ch/f/rs/c922_31.html*	Suppl. S07

List of relevant cantonal and communal legislations, contracts and plans

The following relevant cantonal and communal legislation is available online or can be supplied on request.

St. Gallen Kanton	Kantonaler Richtplan St. Gallen (2003); *http://www.sg.ch/bauen_raum_umwelt/raumentwicklung/richtplanung.html*	Suppl. S06.1
	Gemeindegesetz vom 23. August 1979 (sGS 151.2); *http://www.gallex.ch/gallex/1/fs151.2.html*	
	Gesetz über die Raumplanung und das öffentliche Baurecht (Baugesetz) vom 6. Juni 1972 (sGS 731.1); *http://www.gallex.ch/gallex/7/fs731.1.html*	
	Verordnung über den Schutz wildwachsender Pflanzen und freilebender Tiere (Naturschutzverordnung) vom 17. Juni 1975 (sGS 671.1); *http://www.gallex.ch/gallex/6/fs671.1.html*	
Glarus Kanton	Kantonaler Richtplan Glarus (as of autumn 2003); *http://www.richtplan-gl.ch/htm/richt.htm*	Suppl. S06.2
	Verzeichnis der Landschaften von regionaler und nationaler Bedeutung im Kanton Glarus (Kantonales Landschaftsverzeichnis). Direktion für Landwirtschaft, Wald und Umwelt, Kanton Glarus (1999); *www.gl.ch*	
Graubünden Kanton	Kantonaler Richtplan Graubünden (2003); *http://www.richtplan.gr.ch*	Suppl. S06.3
	Raumplanungsgesetz für den Kanton Graubünden vom 20. Mai 1973 (801.100); *http://www.gesetzessammlung.ch/gr/lpext.dll/br/ofhauptkapitel200490/* ofhauptkapitel300491/ofhauptkapitel400495/ofgesetz00496.htm? f=templates&fn=document-frame.htm&2.0#JD_GR_801.100JD_GR_801.100	
Communes	Politische Gemeinde Pfäfers: Verordnung zum Schutz des Calfeisentales vom 6. Juni 1974	
	Politische Gemeinde Pfäfers: Reglement über das Strahlen vom 24. Mai 1973	

Management

Management Plan for the proposed World Natural Heritage site “Glarus overthrust” (Document attached)	Suppl. S01
Agreement on joint protection of the UNESCO World Natural Heritage site “Glarus overthrust”, dated 26 November 2003, including Development Plan	Suppl. S02

7.c Form and date of most recent records or inventory of property

The protected areas are in the appendices to the respective national and cantonal ordinances and government decisions.	Section 5.b
Lists of the federal inventories are located in the appendices of the corresponding ordinances	Section 5.b
Maps of areas designated for national and cantonal landscape protection	Annex A05
Map of geotopes of international, national and cantonal importance”	Annex A05
Fauna and flora data:	
List of recorded plant species protected at the national level in Switzerland	Annex A08
List of mammal species recorded or considered likely to occur	Annex A09
List of recorded breeding bird species	Annex A10
List of recorded amphibian and reptile species	Annex A11
List of recorded butterfly species	Annex A12

7.d Address where inventory, records and archives are held

Information concerning federal inventories, fauna and flora

Federal Office for the Environment (FOEN)
Department of Nature and Landscape / Species Management Department
CH–3003 Bern
Switzerland

Information concerning visitors facilities and statistics, management and information

IG UNESCO World Heritage site Glarus overthrust
Untergasse 19
CH–8888 Heiligkreuz
Switzerland
e-mail: *imper@geopark.ch*
Website: *http://www.glarusoverthrust.com*

Museums with inventories and archievs

Naturmuseum St. Gallen
Museumstrasse 32
CH–9000 St. Gallen
Switzerland

Naturwissenschaftliche Sammlungen des Kantons Glarus
Bergen
CH–8765 Engi
Switzerland

Bündner Natur-Museum
Masanserstrasse 31
CH–7000 Chur
Switzerland

ETH Zürich
Geologisches Institut ETH
ETH-Zentrum
CH–8092 Zürich
Switzerland

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8.d Official Web address

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9 Signature on behalf of the State Party

Berne, August 31, 2006

Federal office for the Environment

Franz-Sepp Stulz

Head of Division Nature and Landscape

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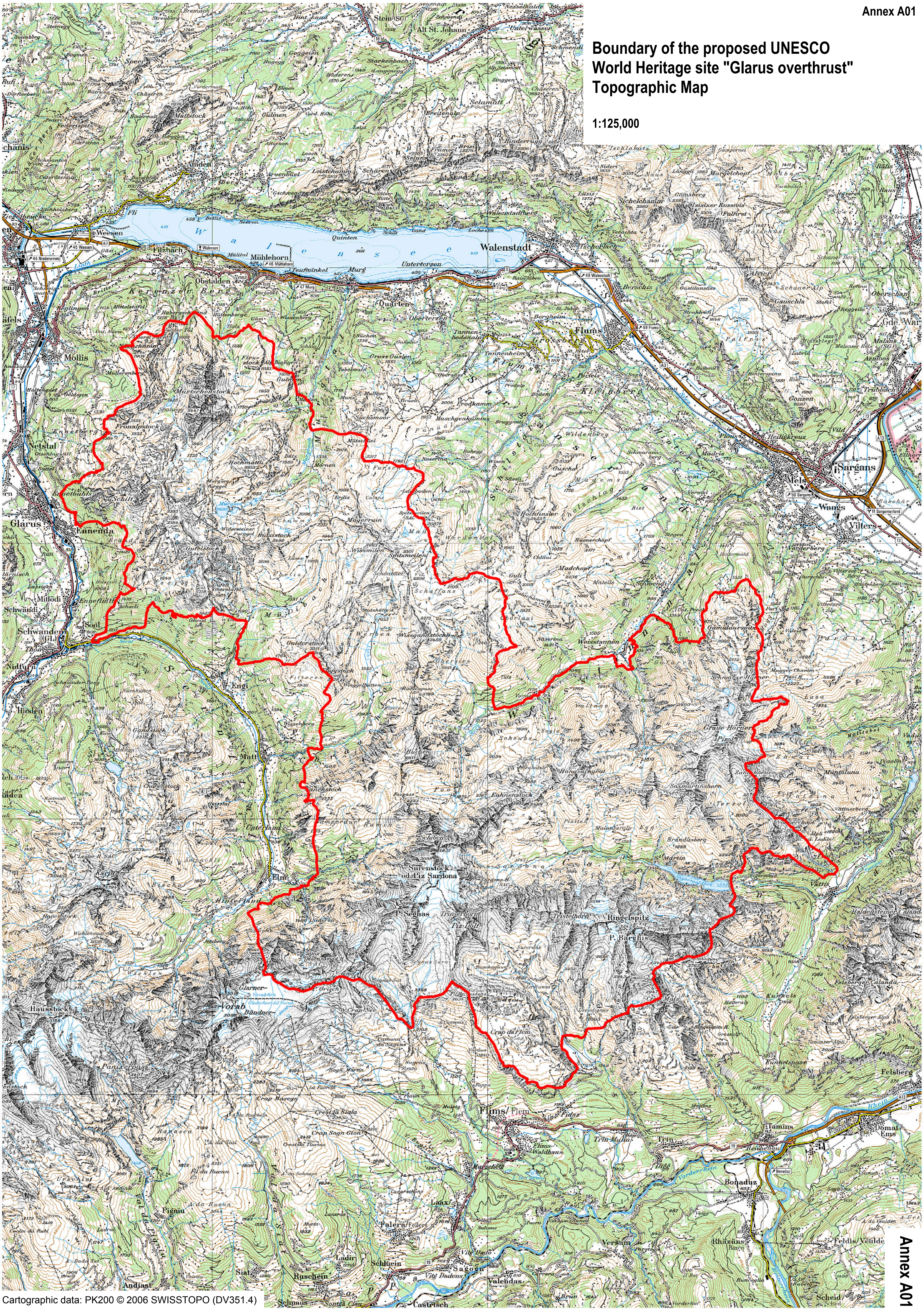
Boundary of the proposed UNESCO World Heritage site "Glarus overthrust" Topographic Map

1:125,000

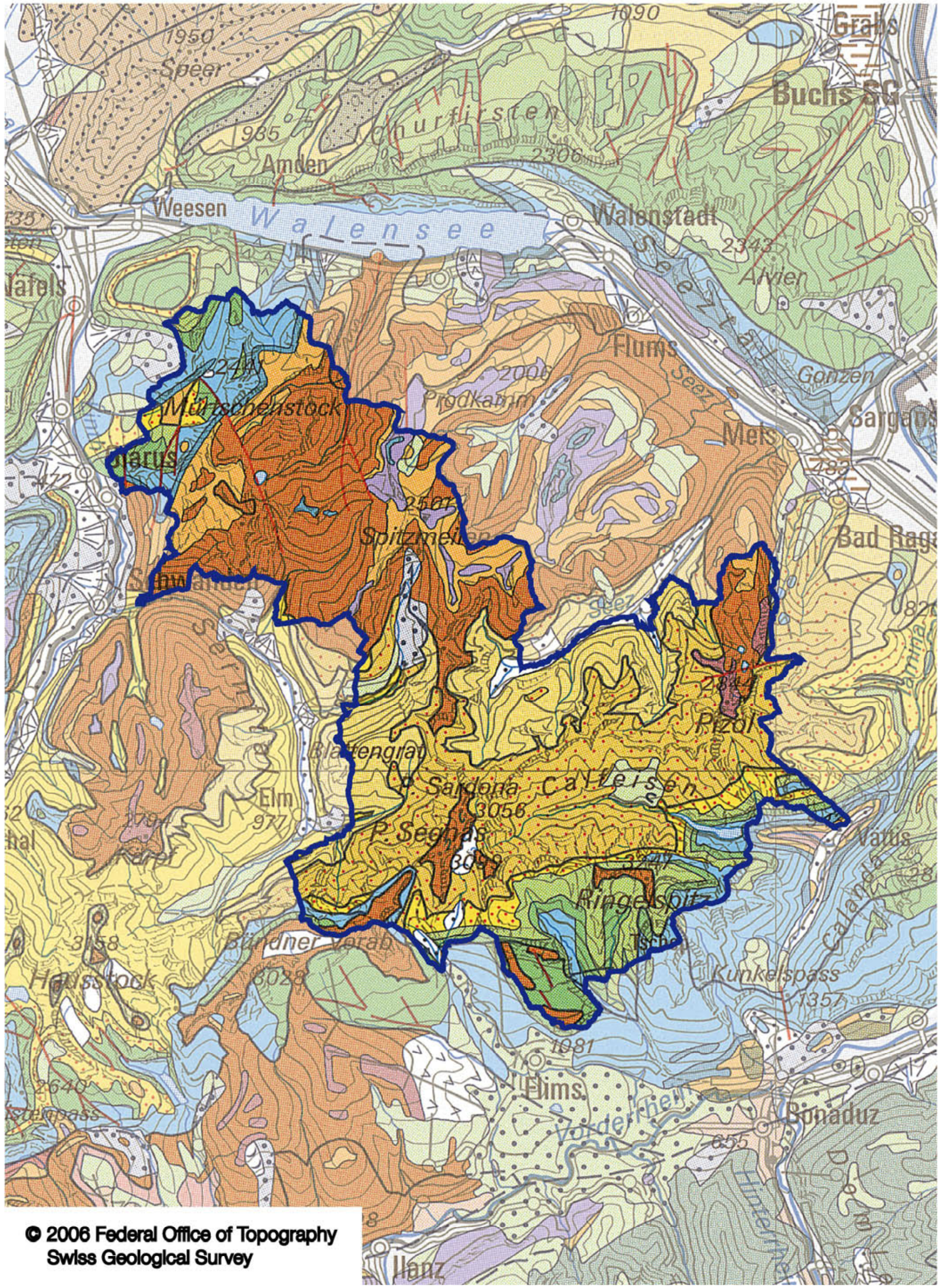


Cartographic data: PK200 © 2006 SWISSTOPO (DV351.4)

Annex A01

Geological map of the nominated UNESCO World Natural property „Glarus overthrust“

1 : 200 000



Middle Penninic

(Briançonnais ridge s.l.)

Tertiary
- Flysch in general
- Flysch of the Breccia nappe (Paleocene–?Early Eocene)
- Flysch of the Tasna and the Préalpes Median nappes (Eocene)

Cretaceous–Eocene
- Aptian–Early Eocene
- Berriasian–Barremian

Jurassic
- Late Jurassic resp. Jurassic in general
- Middle Jurassic (Dogger)
- Late Jurassic (Lias)

Triassic
- Triassic

Paleozoic
- Permo-Triassic
- Permian
- Permo-Carboniferous
- Late Carboniferous

- Jurassic–Early Cretaceous of the Breccia nappe
- Triassic–Cretaceous (partly up to Eocene) of the Siviez-Mischabel, Tambo, Suretta and Monte-Rosa nappes
- Permian–Cretaceous Frilihorn and Cimes-Blanches nappes
- Jurassic–Cretaceous of the Schams nappes

North Penninic

(Distal european continental margin and Valais trough)

Late Cretaceous–Early Eocene
- Flysch in general
- Niesen Flysch
- Wildflysch of the Zone Submédiane
- Tomül and Prättigau Flysch, Flysch of the Roz-Champatsch zone

Cretaceous ? Cretaceous
- Tertiary — Pierre Avoi and Cols units
- Liechtenstein and Vorarlberg Flysch
- Roignais-Versoyen Flysch
- «Complexe antéflysch» et «formation basale»
- Schists of the Ferret unit (Late Cretaceous and/or Tertiary)
- Jurassic–Cretaceous — Bündnerschiefer — Grava and Tomül nappes
- Jurassic of the Zone Submédiane, Niesen and Aul nappes

Lower Jurassic – ?
- Low-carbonate metaconglomerates of the Lebendun nappe
- Mesozoic of the external Northern Penninic

- Triassic
- Permian
- Carboniferous

Helveticum s.l.

(Continental margin)

Late Cretaceous–Tertiary

Ultrahelvetic–?Penninic

Late Cretaceous–Eocene
- Meilleret Flysch, Sardona Flysch, Feuerstätt nappe
- Wildflysch (Gros-Plané, Habkern, Liebenstein et.al.)
- Ultrahelvetic Flysch in general

South Helvetic

Cretaceous–Eocene
- Sheared and involuted Southern Helveticum (Melange of Einsiedeln and Wildhaus, Blattengrat complex, Ragaz Flysch, substrate of Fähnernspitz, Melange of Liebenstein)
- Subalpine Flysch (partly northern helvetic)

North Helvetic

Oligocene
- Northn Helvetic Flysch (Matt formation, Engi slate, Altdorf, Grès du Val d'Illiez and Taveyannaz sandstones)

Paleo-?Oligocene
- Globigerina shale
- Neritic sandstones and limestones (Nummulite and Lithothamnium limestones)

Paleozoic and Mesozoic

Cretaceous
- Late Cretaceous
- Early Cretaceous

Jurassic
- Jurassic
- Bathonian–Oxfordian
- Middle Jurassic (Dogger)
- Lower Jurassic (Liassic)

Triassic
- Triassic–Middle Jurassic (Dogger)
- Triassic

Paleozoic
- Permian («Verrucano»)
- Early Carboniferous (?–Early Perm)
- Devonian–Early Carboniferous

Quartenary

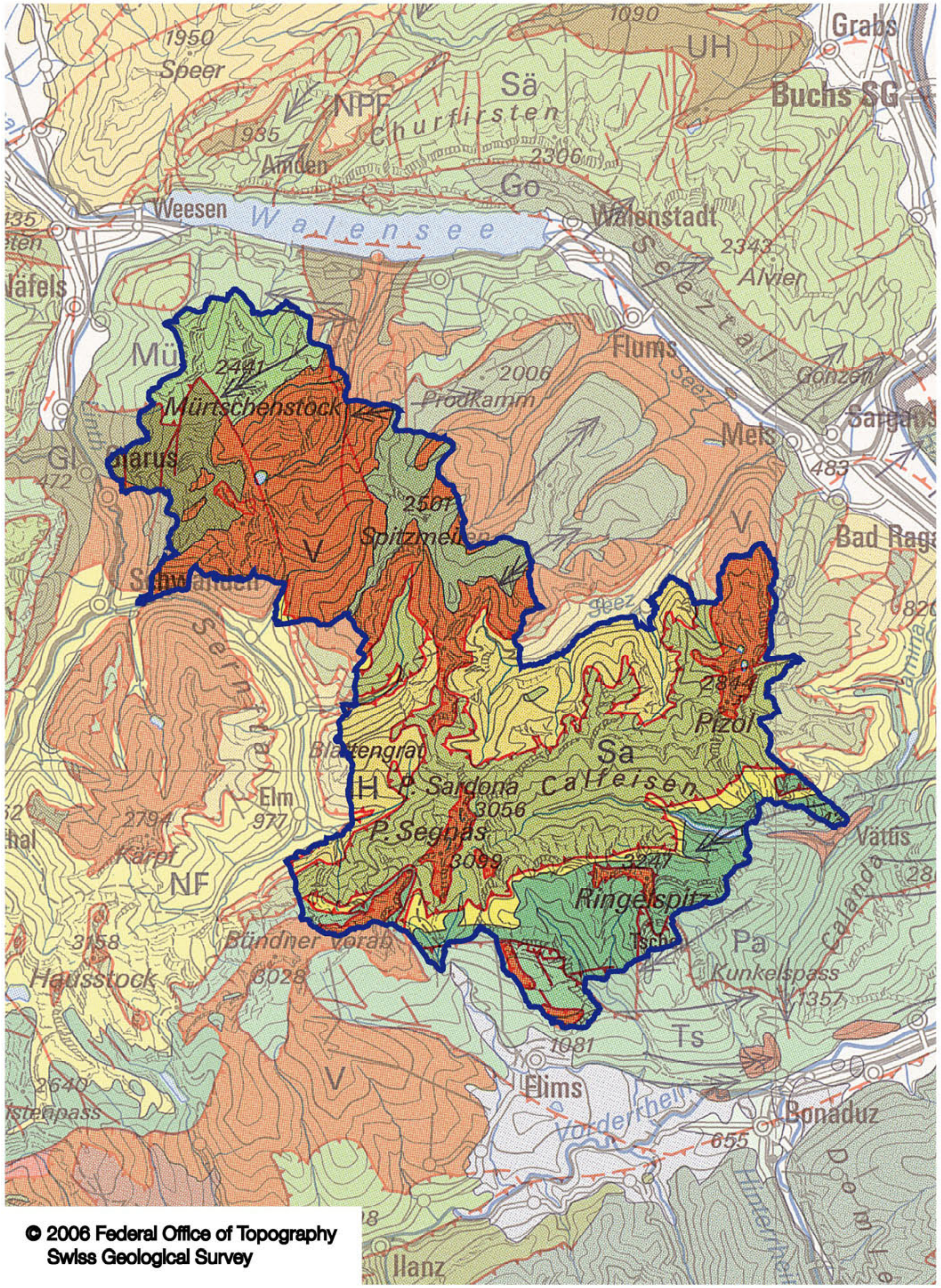
Holocene
- Alluvial planes
- Peat
- Alluvial fan
- Debris
- Postglacial rock avalanche deposits
- Rock-slide deposits
- Landslide deposits
- Late to postglacial gravels in the Alps

Middle and Late Pleistocene
- Late Pleistocene rock avalanche deposits
- Loess, loess loam, residual loam
- Fluvioglacial and glaciolacustrine gravel — Hoch- und Niederterrassen
- Moraine, with ridge; incl. recent moraines
- Submerged moraine ridge

Plio-Pleistocene
- Older fluvioglacial gravels — Deckenschotter

Tectonic Map of the nominated UNESCO World Natural property „Glarus overthrust“

1 : 200 000



European continental platform

Molasse basin

- M Plateau Molasse
- Folded and inclined Plateau Molasse
- SM Subalpine Molasse

European continental margin

Autochtonous-Parautochtonous, Infrahelvetic nappes

- NH Allochthonous units — Ardon, Gellihorn, Plammis and Jägerchrüz nappes
- NH Allochthonous units — Griessstock, Clariden(-Kammlistock), Gitschen and Cavistrau nappes, Klausenpass Melange
- NF Tertiary sediments and Northern Helvetic flysch
- Autochthonous [A] und Parautochthonous [Pa] Mesozoic
- Chaines subalpines [Su], Morcles [Mo], Doldenhorn [Do] and Tschep nappes [Ts]
- Paleozoic sediments
- Variscan granites and volcanic rocks
- Old crystalline basement of the external massifs

} Belledonne [Be], Aiguilles-Rouges [AR], Mont-Blanc [MB], Aar [Aa] and Gastern [Ga] massifs

Helvetic sediment nappes s.str.

- Wi Wildhorn nappe incl. border chain
- Roselette [Ro] and Diablerets nappes [Di]
- Ax Axen nappe (incl. Bundstock element)
- Sä Säntis-Drusberg nappe
- Go Mélange Gonzen-Walenstadt
- Mü Mürtschen nappe
- Wa Wageten slice
- Gl Glarus nappe
- Ve Verrucano of the Glarus and the Mürtschen nappes

Southern Helvetic to Ultrahelvetic sediment nappes and slices

- IH Units in infrahelvetic position (Anzeinde and Blattengrat nappes)
- UH Allochthonous Melange (Préalpes externes, zone des Cols, melanges of Einsiedeln and Wildhaus etc.)
- SF Subalpine flysch (Northern and southern elements in infrahelvetic position)
- GMM Allochthonous Mesozoic of the Gotthard massif
- Sa Sardona nappe (in infrahelvetic position)

Allochthonous «massifs» and infrapennine crystalline nappes (partly with sediment cover)

- MC Mont-Chétif massif
- Sediment cover (Parautochthonous, Termen [Te], Furka-Urseren-Garvera and Nufenen zones [Nu]; Ilanz verrucano)
- Crystalline «massifs» (Goms [Gm] and Tavetsch intermediate massifs [Ta], Gotthard massif [Go])
- Sediments, Mesozoic "nappe separator"
- Crystalline nappe core

} Leventina [Lev], Lucomagno [Lu], Verampio [Ve], Simano [Si] nappes; Antigorio nappe complex [An], Lebendun [Le] and Monte-Leone nappes [ML]

Valais trough (distal continental margin and partly oceanic)

Lower Penninic sediment nappes and slices, ophiolites

- SC Zone of Sion-Courmayeur
- ZSM Zone Submédiane
- Ni Niesen nappe
- NPF Northern Penninic Flysch nappes — Rhenodanubian, Tomül, Arblatsch, Ramosch, Roz-Champatsch and Prättigau flysches; Liechtenstein and Vorarlberg flysches etc
- Bü Bündnerschiefer nappes (Grava, Tomül, Aul nappes, Vals slices; Engadin window)
- Oph Chiavenna ophiolite

Alpine structures

- Fault in general
- Tertiary normal fault
- Mesozoic normal fault
- Thrust, nappe boundary
- Tectonic line — Insubric (IL) and Judicarian lines (JL), Engandin (ES), Centovalli (CS), Rhone-Simplon (SS) and Aosta-Ranzola faults (ARS)
- Fold axis in the folded Jura Mountains and the Molasse basin
- Horizontal fold axis, in th Alps (certain, supposed)
- Inclined fold axis, in the Alps
- Lineations of minerals in the Alps
- Isohypses of the basis of the Triassic sediments underneath the Molasse basin

Quartenary

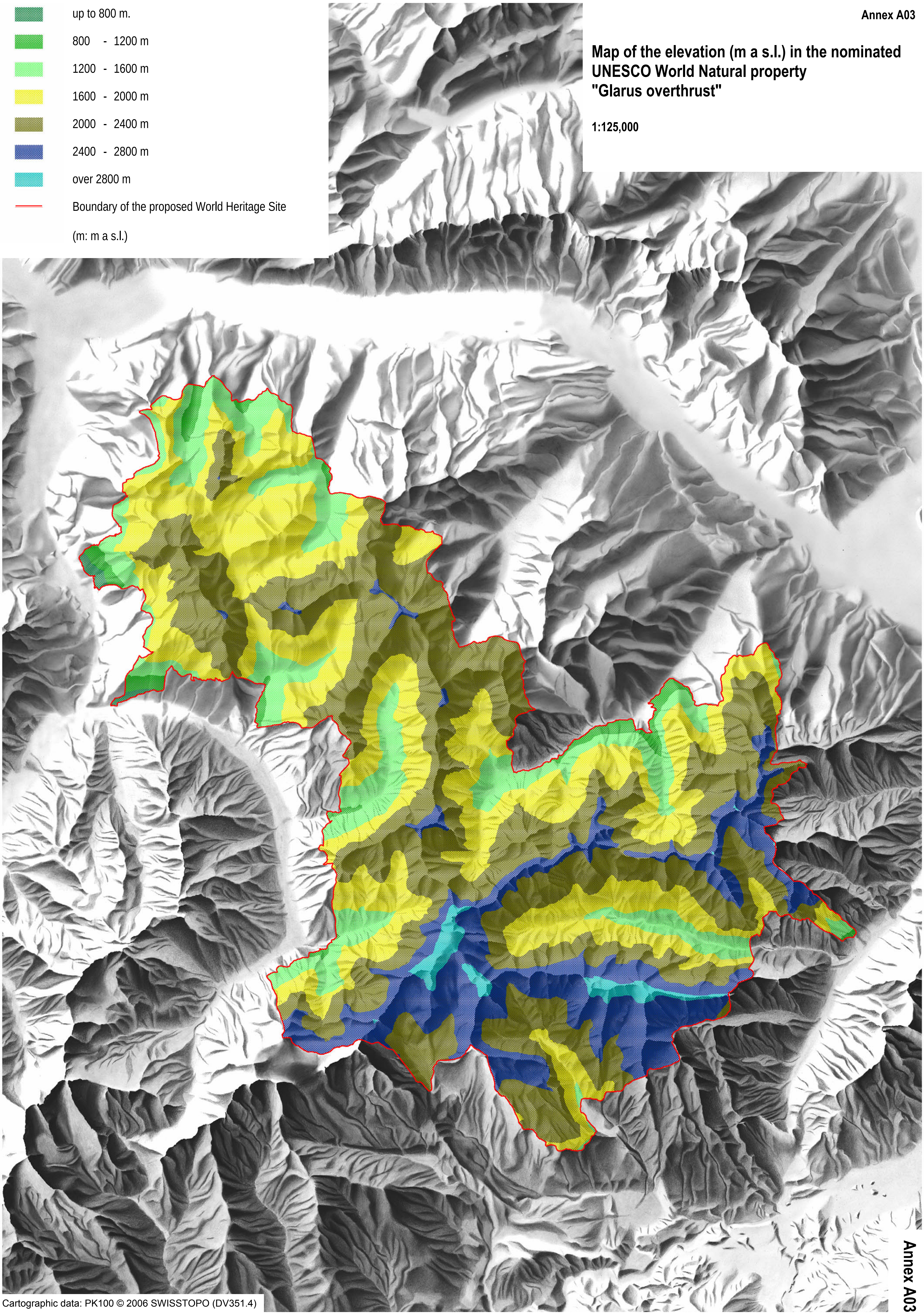
- Alluvial plains
- Late Pleistocene to Holocene rock avalanche deposits
- Major Quartenary deposits in general

Mineral zones of the alpine metamorphosis

- Staurolite-Disthene isograde
- Diopside-Calcite isograde
- Tremolite-Calcite isograde

Map of the elevation (m a s.l.) in the nominated UNESCO World Natural property "Glarus overthrust"

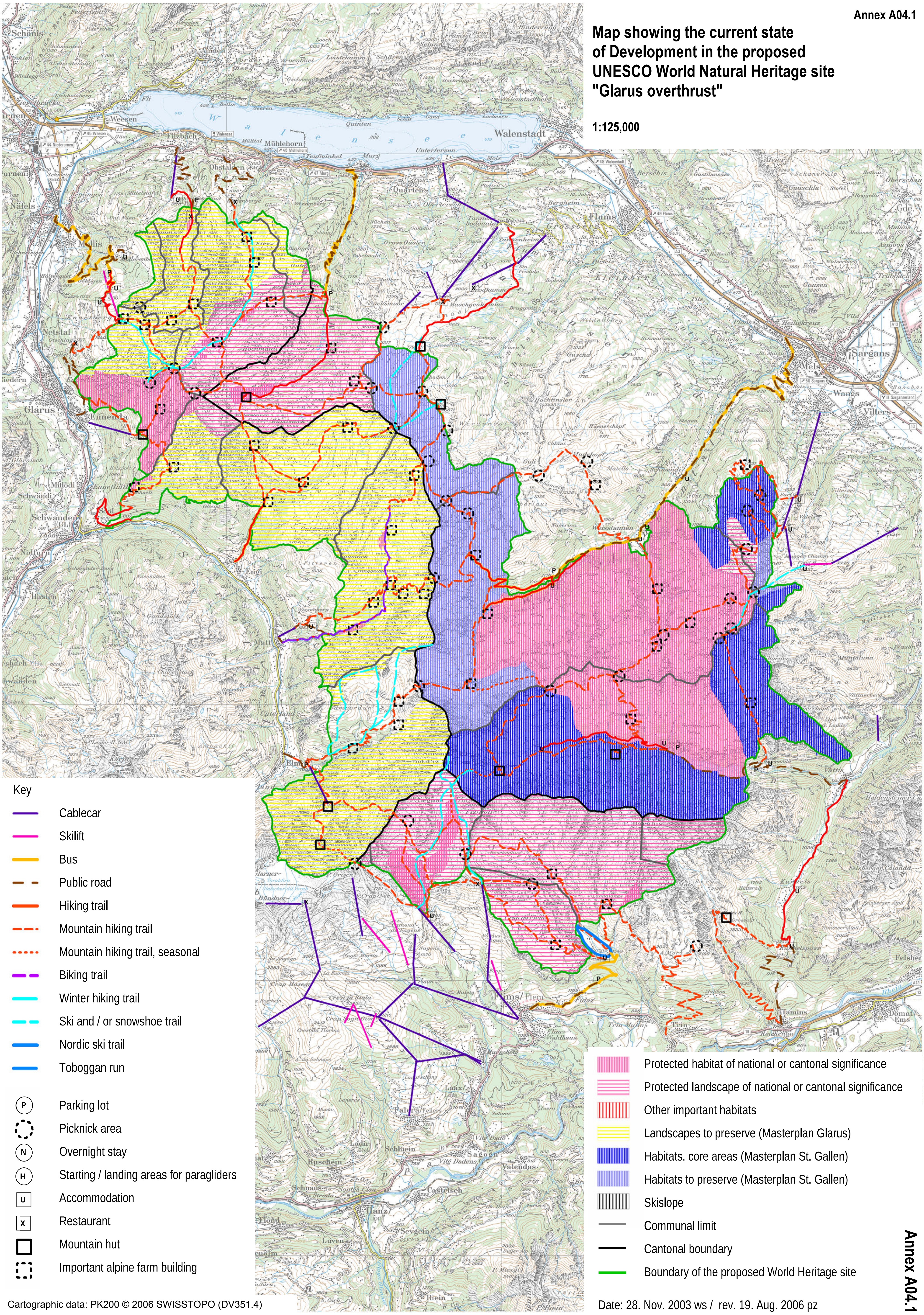
1:125,000



Annex A03

Map showing the current state of Development in the proposed UNESCO World Natural Heritage site "Glarus overthrust"

1:125,000



Date: 28. Nov. 2003 ws / rev. 19. Aug. 2006 pz

Development plan for the proposed UNESCO World Natural Heritage site "Glarus overthrust"

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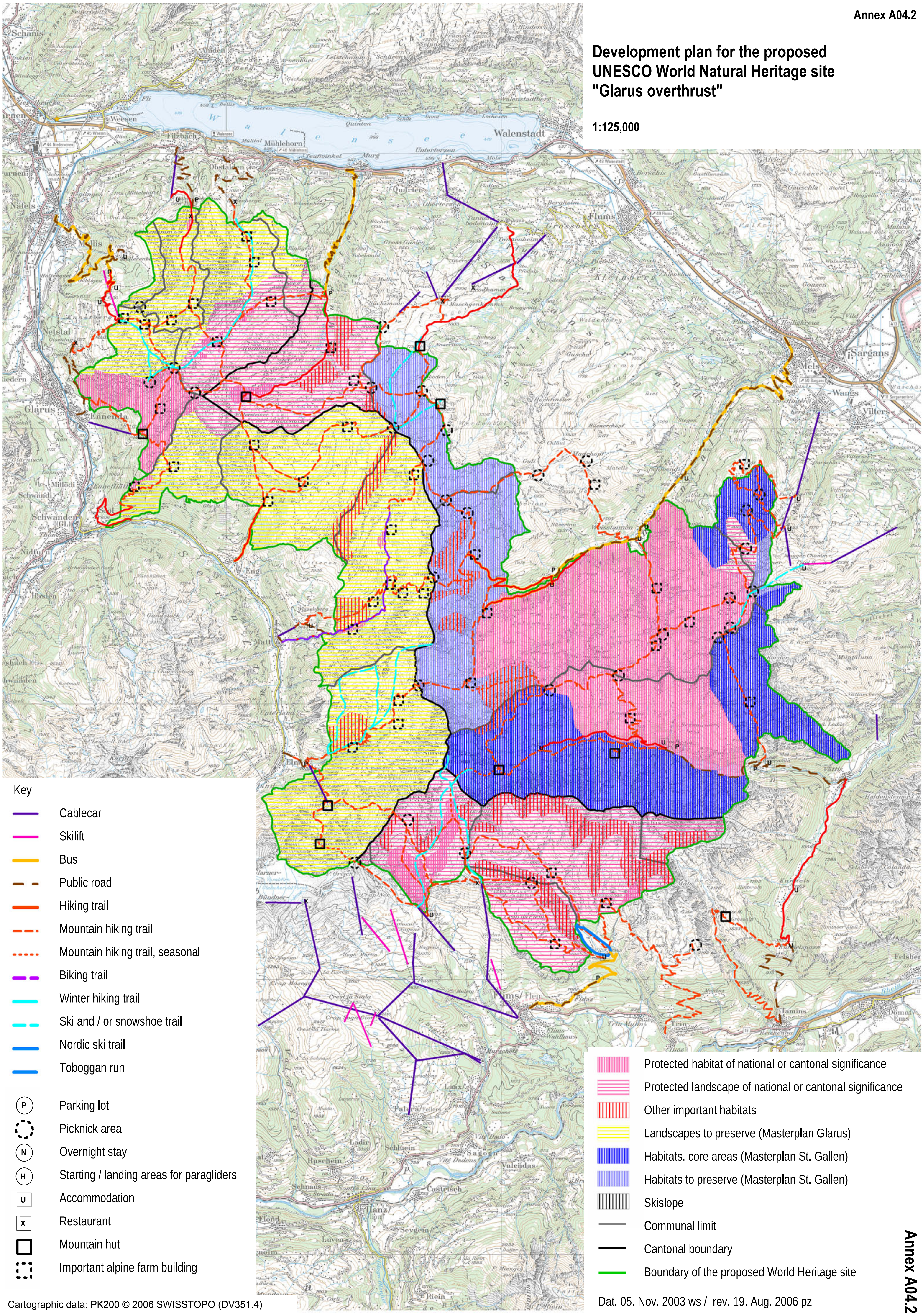


Dat. 05. Nov. 2003 ws / rev. 19. Aug. 2006 pz

Annex A04.2

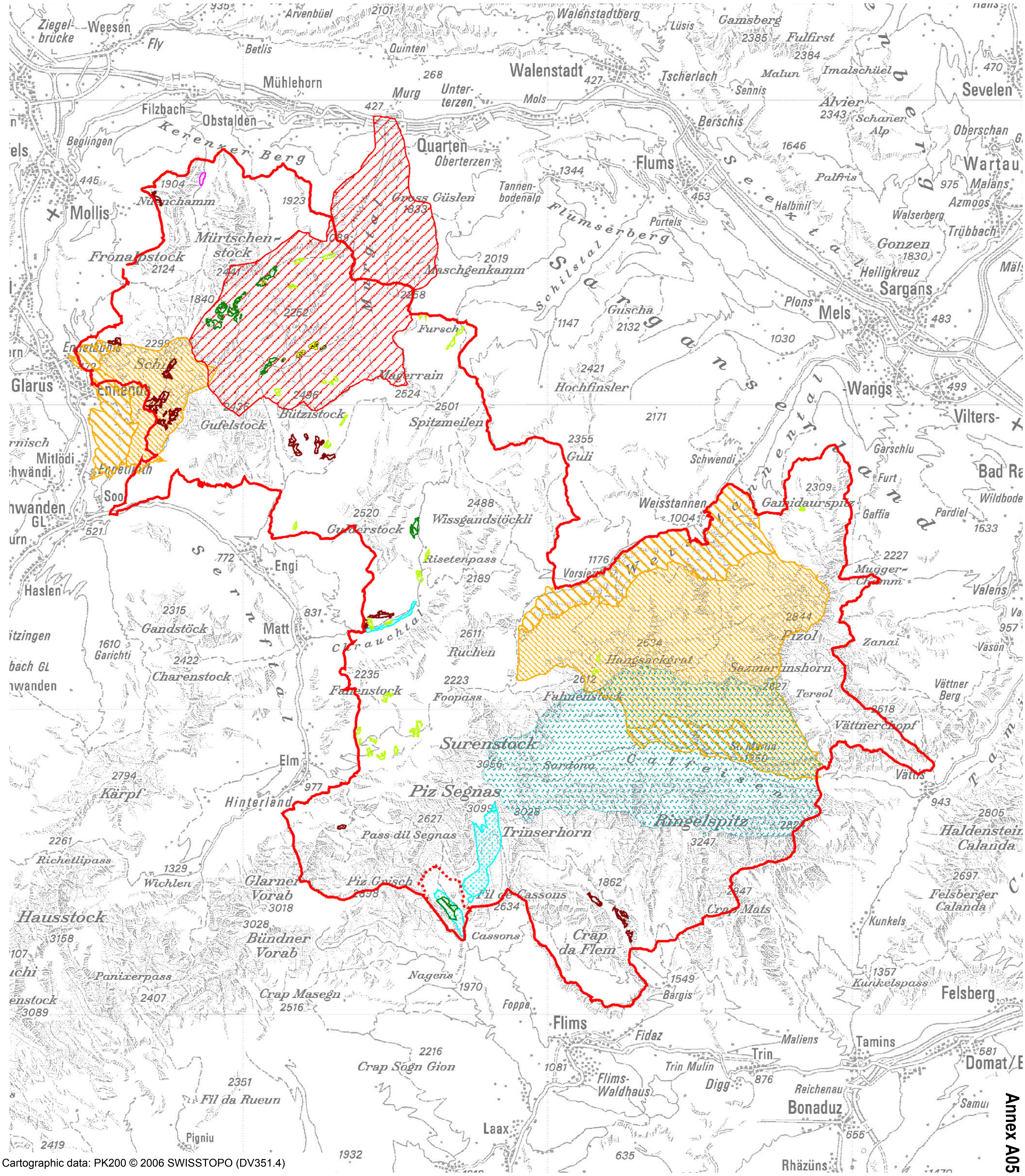
Mire landscapes
Raised bogs
Fenlands, national
Fenlands, regional
Alluvial zones

Game sanctuaries
Integral protection
Partial protection

Amphibian spawning areas
Dry grasslands
Landscapes of national significance
Cantonal protected areas

Map showing showing areas subject to national or cantonal protection

1:125'000



Annex A05

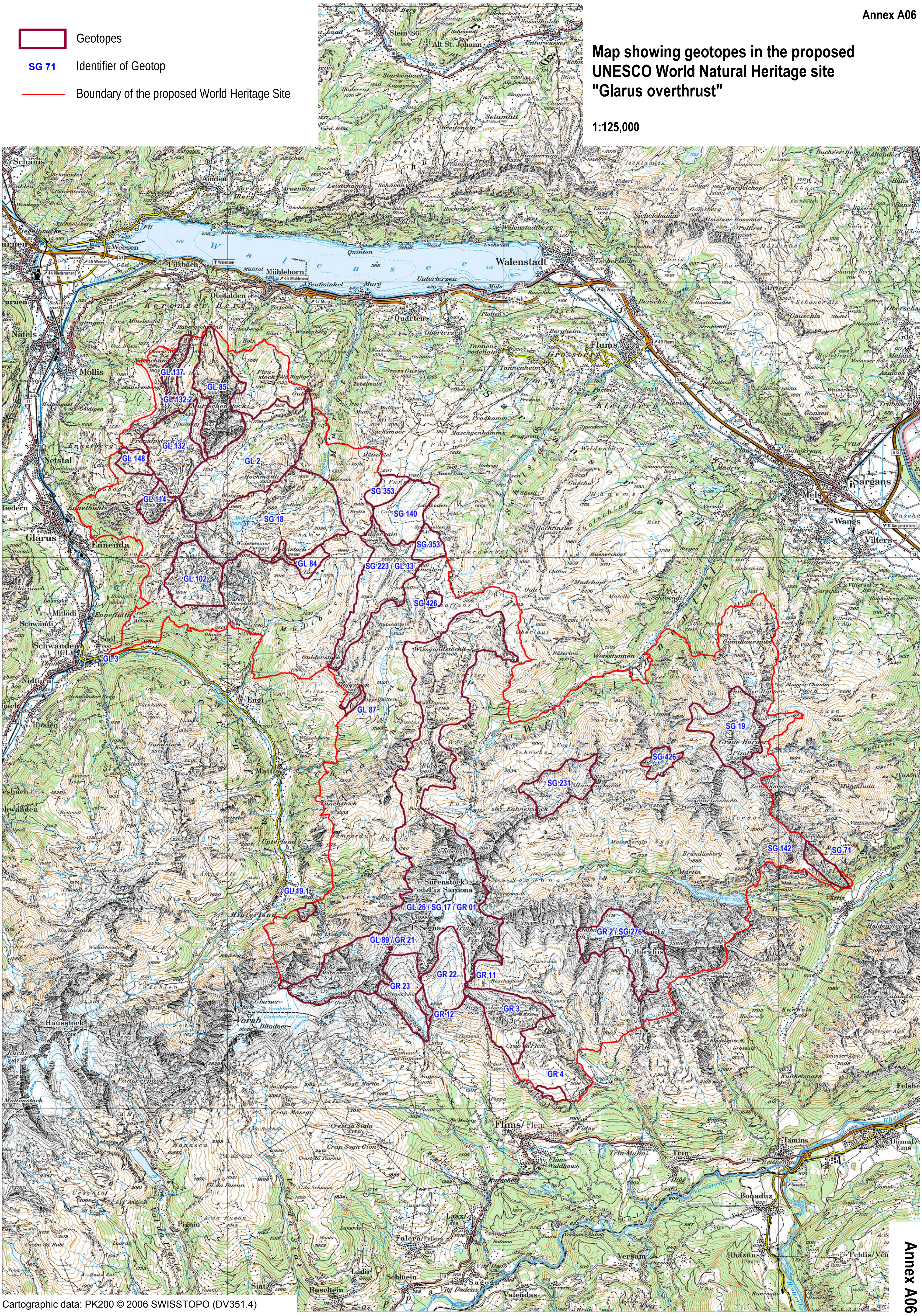
Geotopes

SG 71 Identifier of Geotop

Boundary of the proposed World Heritage Site

Map showing geotopes in the proposed UNESCO World Natural Heritage site "Glarus overthrust"

1:125,000

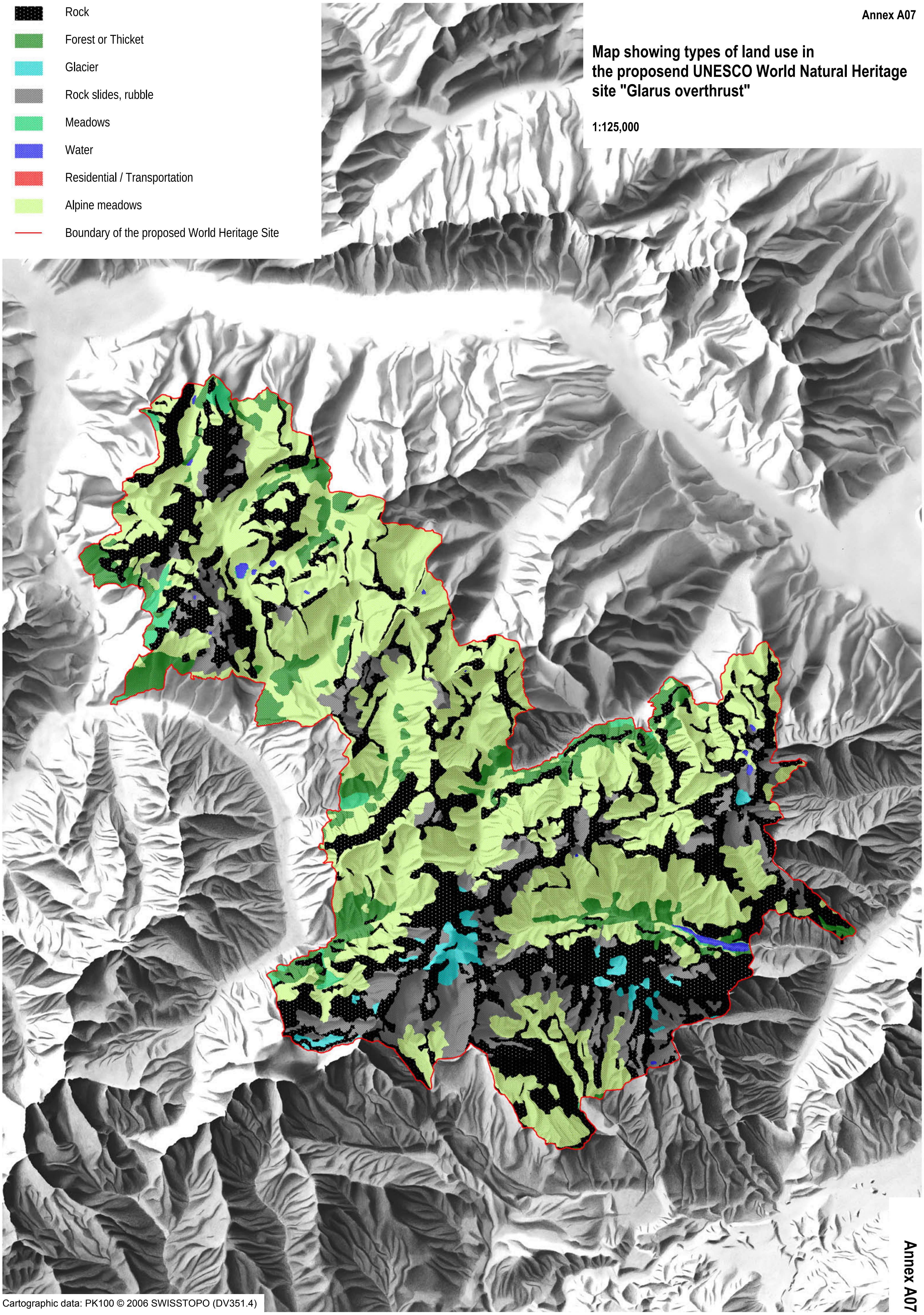


Cartographic data: PK200 © 2006 SWISSTOPO (DV351.4)

Annex A07

Map showing types of land use in the proposend UNESCO World Natural Heritage site "Glarus overthrust"

1:125,000



Annex A08: List of recorded plant species protected at the national level in Switzerland

Scientific Name	German Name
Androsace alpina	Alpenmannsschild
Androsace chamaejasme	Zwergmannsschild
Androsace helvetica	Schweizer Mannsschild
Androsace obtusifolia	Stumpfblättriger Mannsschild
Androsace pubescens	Weichhaariger Mannsschild
Aquilegia alpina	Alpenakelei
Artemisia genipi	Schwarze Edelraute
Artemisia umbelliformis	Echte Edelraute
Cephalanthera longifolia	Langblättriges Waldvögelein
Chamorchis alpina	Alpenzwergorchis
Coeloglossum viride	Grüne Hohlzunge
Corallorrhiza trifida	Dreispaltige Korallenwurz
Cynoglossum officinale	Echte Hundszunge
Cypripedium calceolus	Frauenschuh
Dactylorhiza incarnata	Fleischfarbige Orchis
Dactylorhiza maculata	Gefleckte Orchis
Dactylorhiza majalis (fistulosa)	Breitblättrige Orchis
Daphne mezereum	Zilande, Gew. Seidelbast
Daphne striata	Steinröschen
Delphinium elatum	Hoher Rittersporn
Dracocephalum ruyschiana	Bergdrachenkopf
Drosera rotundifolia	Rundblättriger Sonnentau
Drosera anglica	Langblättriger Sonnentau
Epipactis atrorubens	Dunkelrote Sumpfwurz
Epipactis helleborine	Breitblättrige Sumpfwurz
Epipogium aphyllum	Blattloser Widerbart
Gentiana purpurea	Purpurenzian
Goodyera repens	Moosorchis
Gymnadenia conopsea	Mückennacktdrüse
Gymnadenia odoratissima	Wohlriechende Nacktdrüse
Leontopodium alpinum	Edelweiss
Lilium bulbiferum	Feuerlilie
Lilium martagon	Türkenbundlilie
Listera cordata	Herzblättrige Listere
Listera ovata	Einblättrige Listere
Malaxis monophyllos	Einblatt
Neottia nidus-avis	Vogelnestwurz
Nigritella nigra	Schwarzblütiges Männertreu
Nigritella rubra	Rotes Männertreu
Orchis mascula	Männliche Orchis
Orchis pallens	Blasse Orchis

Scientific Name	German Name
Orchis ustulata	Angebrannte Orchis
Platanthera bifolia	Zweiblättriges Breitkölbchen
Platanthera chlorantha	Grünliches Breitkölbchen
Pseudorchis albida	Weissorchis
Traunsteinera globosa	Kugelorchis

Annex A09:
List of mammal species recorded or considered likely to occur

Scientific Name	German Name
Capra ibex	Alpensteinbock
Capreolus capreolus	Reh
Cervus elaphus	Rothirsch
Chinonomys nivalis	Schneemaus
Clethrionomys glareolus	Rötelmaus
Eliomys quercinus	Gartenschläfer
Lepus timidus	Schneehase
Marmota marmota	Alpenmurmeltier
Martes foina	Steinmarder
Martes martes	Baummarder
Meles meles	Eurasischer Dachs
Microtus arvalis	Feldmaus
Mustela erminea	Hermelin
Mustela nivalis	Mauswiesel
Pitymys subterraneus	Kleinwühlmaus
Rupicapra rupicapra	Gemse
Sciurus vulgaris	Eichhörnchen
Sorex alpinus	Alpenspitzmaus
Sorex araneus	Waldspitzmaus
Sorex minutus	Zwergspitzmaus
Vulpes vulpes	Rotfuchs

Annex A10: List of recorded breeding bird species

Scientific Name	German Name
Accipiter gentilis	Habicht
Accipiter nisus	Sperber
Aegithalos caudatus	Schwanzmeise
Aegolius funereus	Rauhfusskauz
Alectoris graeca	Steinhuhn
Anthus spinoletta	Bergpieper
Anthus trivialis	Baumpieper
Aquila chrysaetos	Steinadler
Bonasa bonasia	Haselhuhn
Bubo bubo	Uhu
Buteo buteo	Mäusebussard
Carduelis cannabina	Hänfling
Carduelis carduelis	Stieglitz
Carduelis chloris	Grünfink
Carduelis flammea	Birkenzeisig
Carduelis spinus	Erlenzeisig
Certhia brachydactyla	Gartenbaumläufer
Certhia familiaris	Waldbaumläufer
Cinclus cinclus	Wasseramsel
Coccothraustes coccothraustes	Kernbeisser
Columba palmbus	Ringeltaube
Corvus corax	Kolkrabe
Corvus corone corone	Rabenkrähe
Cuculus canorus	Kuckuck
Delichon urbica	Mehlschwalbe
Dendrocopos major	Buntspecht
Dendrocopos minor	Kleinspecht
Dryocopus martius	Schwarzspecht
Erithacus rubecula	Rotkehlchen
Falco peregrinus	Wanderfalke
Falco tinnunculus	Turmfalke
Ficedula hypoleuca	Trauerschnäpper
Fringilla coelebs	Buchfink
Garrulus glandarius	Eichelhäher
Glaucidium passerinum	Sperlingskauz
Lagopus mutus	Alpenschneehuhn
Loxia curvirostra	Fichtenkreuzschnabel
Monticola saxatilis	Steinrötel
Montifringilla nivalis	Schneesperling
Motacilla alba	Bachstelze
Motacilla cinerea	Bergstelze
Muscicapa striata	Grauschnäpper

Scientific Name	German Name
Nucifraga caryocatactes	Tannenhäher
Oenanthe oenanthe	Steinschmätzer
Parus ater	Tannenmeise
Parus caeruleus	Blaumeise
Parus cristatus	Haubenmeise
Parus major	Kohlmeise
Parus montanus	Mönchsmeise
Parus palustris	Sumpfmeise
Passer domesticus	Haussperling
Passer montanus	Feldsperling
Phoenicurus ochruros	Hausrotschwanz
Phylloscopus bonelli	Berglaubsänger
Phylloscopus collybita	Zilpzalp
Phylloscopus sibilatrix	Waldlaubsänger
Picoides tidactylus	Dreizehenspecht
Picus viridis	Grünspecht
Prunella collaris	Alpenbraunelle
Prunella modularis	Heckenbraunelle
Ptyonoprogne rupestris	Felsenschwalbe
Pyrrhocorax graculus	Alpendohle
Pyrrhula pyrrhula	Gimpel
Regulus ignicapillus	Sommergoldhähnchen
Regulus regulus	Wintergoldhähnchen
Saxicola rubetra	Braunkehlchen
Scolopax rusticola	Waldschnepfe
Serinus citrinella	Zitronengirlitz
Serinus serinus	Girlitz
Sitta europaea	Kleiber
Strix aluco	Waldkauz
Sturnus vulgaris	Star
Sylvia atricapilla	Mönchsgrasmücke
Sylvia borin	Gartengrasmücke
Sylvia communis	Dorngrasmücke
Sylvia curruca	Klappergrasmücke
Tetrao tetrix	Birkhuhn
Tetrao urogallus	Auerhuhn
Tichodroma muraria	Mauerläufer
Troglodytes troglodytes	Zaunkönig
Turdus merula	Amsel
Turdus philomelos	Singdrossel
Turdus pilaris	Wacholderdrossel
Turdus torquatus	Ringdrossel
Turdus viscivorus	Misteldrossel

Annex A11: List of recorded amphibian and reptile species

Scientific Name	German Name
Anguis fragilis	Blindschleiche
Bufo bufo	Erdkröte
Coronella austriaca	Schlingnatter
Lacerta vivipara	Bergeidechse
Rana temporaria	Grasfrosch
Salamandra atra	Alpensalamander
Triturus alpestris	Bergmolch
Vipera berus	Kreuzotter

Annex A12: List of recorded butterfly species

Scientific Name	German Name
Aglais urticae	Kleiner Fuchs
Agriades glandon	Dunkler Alpenbläuling
Agrodiaetus damon	Grünblauer Bläuling
Albulina orbitulus	Heller Alpenbläuling
Anthocharis cardamines	Aurorafalter
Aphantopus hyperantus	Brauner Waldvogel
Aporia crataegi	Baumweissling
Aricia artaxerxes	Grosser Sonnenröschenbläuling
Argynnis paphia	Kaisermantel
Boloria napaea	Ähnlicher Perlmutterfalter
Boloria pales	Hochalpenperlmutterfalter
Boloria titania	Natterwurzperlmutterfalter
Brenthis ino	Violetter Silberfalter
Callophrys rubi	Brombeerzipfelfalter
Carterocephalus palaemon	Gelbwürfliger Dickkopffalter
Clossiana dia	Hainveilchenperlmutterfalter
Clossiana euphrosyne	Veilchenperlmutterfalter
Clossiana selene	Braunfleckiger Perlmutterfalter
Clossiana thore	Alpenperlmutterfalter
Clossiana titania	Natterwurzperlmutterfalter
Coenonympha gardetta	Alpenwiesenvögelchen
Coenonympha glycerion	Rostbraunes Wiesenvögelchen
Coenonympha pamphilus	Kleines Wiesenvögelchen
Colias crocea	Postillon
Colias palaeno	Moorgelbling
Colias alfacariensis	Hufeisenkleegelbling
Colias phicomone	Alpengelbling
Cupido minimus	Zwergbläuling
Cyaniris semiargus	Violetter Waldbläuling
Cynthia cardui	Distelfalter
Erebia aethiops	Waldteufel
Erebia epiphron	Kleiner Hochalpenmohrenfalter
Erebia eriphyle	Ähnlicher Mohrenfalter
Erebia euryale isarica	Zweijähriger Waldmohrenfalter
Erebia gorge	Felsenmohrenfalter
Erebia ligea	Milchfleck
Erebia manto ssp. mantoides	Gelbgefleckter Mohrenfalter
Erebia melampus	Kleiner Mohrenfalter
Erebia meolans	Gelbbindenmohrenfalter
Erebia oeme	Doppelaugenmohrenfalter
Erebia pandrose	Graubrauner Mohrenfalter
Erebia pharte	Unpunktierter Mohrenfalter

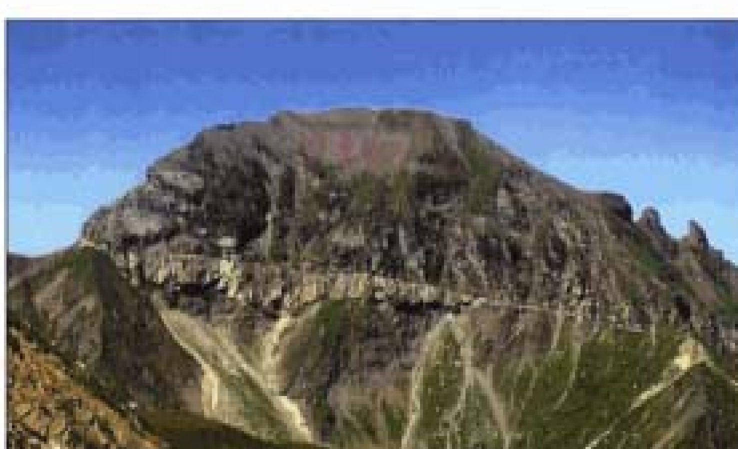
Scientific Name	**German Name**
Erebia pluto	Eismohrenfalter
Erebia pronoe	Später Mohrenfalter
Erebia tyndarus	Schillernder Mohrenfalter
Erynnis tages	Dunkler Dickkopffalter
Eumedonia eumedon	Schwarzbrauner Bläuling
Euphydryas aurinia	Skabiosenschneckenfalter
Eurodryas aurinia debilis	Enzianscheckenfalter
Fabriciana adippe	Märzveilchenfalter
Fabriciana niobe	Bergperlmutterfalter
Gonepteryx rhamni	Zitronenfalter
Hamearis lucina	Frühlingsscheckenfalter
Hesperia comma	Weissfleckiger Kommafalter
Inachis io	Tagpfauenauge
Hypodryas cynthia	Veilchenscheckenfalter
Lasiommata maera	Braunauge
Lasiommata petropolitana	Braunscheckenauge
Lycaena hippothoe	Kleiner Ampferfeuerfalter
Lycaena phlaeas	Kleiner Feuerfalter
Lycaene tityrus	Dunkler Feuerfalter
Lysandra bellargus	Himmelblauer Hufeisenkleebläuling
Maculinea arion	Schwarzgefleckter Bläuling
Maculinea rebeli	Enzianbläuling
Manjola jurtina	Grosses Ochsenauge
Melanargia galathea	Schachbrettfalter
Melitaea diamina	Silberscheckenfalter
Mellicta athalia	Wachtelweizenscheckenfalter
Mellitaea phoebe	Flockenblumenscheckenfalter
Mesoacidalia aglaja	Grosser Perlmutterfalter
Nymphalis antiopa	Trauermantel
Papilio machaon	Schwalbenschwanz
Pararge aegeria	Waldbrettspiel
Parnassius appolo	Apollo
Parnassius mnemosyne	Schwarzer Apollo
Parnassius phoebus	Alpenapollo
Pieris brassica	Grosser Kohlweissling
Pieris napi	Rapsweissling
Pieris rapae	Kleiner Kohlweissling
Pieris bryoniae	Bergweissling
Plebejus argus	Geisskleebläuling
Polygonia c-album	C-Falter
Polyommatus eros	Spitzkielbläuling
Polyommatus icarus	Hauhechelbläuling
Pontia callidice	Alpenweissling
Vacciniina optilete	Rauschbeerbläuling
Vanessa atalanta	Admiral

Glarus canton

St. Gallen canton

Graubünden canton

Agreement on joint protection of the UNESCO World Heritage site "Glarus Overthrust"



UNESCO-World Heritage site "Glarus Overthrust"

Projekt the communes of Laax, Flims, Trin, Tamins, Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt and Elm

Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust", 26.11.2003

The communes of Laax, Flims, Trin, Tamins, Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt and Elm

hereby agree as follows:

I. General provisions

Art. 1 Purpose

1) The purpose of this agreement is to ensure that joint action is taken to conserve and manage the natural monument "Glarus Overthrust" as a UNESCO World Heritage site, together with the surrounding landscape and habitats.

2) The boundary of this natural monument is defined with the aid of a perimeter in Appendix 1a/b, which forms an integral part of the present agreement.

3) Sites of geological importance ("geotopes"), biotopes and the landscape within this natural monument are to be conserved over the long term.

4) As far as is consistent with the conservation of the geotopes, biotopes and landscape, the region and its natural aesthetic features are to be accessible to visitors and available for sustainable, appropriate use.

5) A declaratory listing of uses that are permissible under current legislation is to be found in Appendix 2. This Appendix will be updated in the event of changes to legislation.

Art. 2 Parties

The communes that are parties to the present agreement are hereinafter referred to as "Contracting Parties". Whenever rights or obligations are shared by the Contracting Parties under the present agreement, the phrase "Community of Contracting Parties" will be used hereinafter.

Art. 3 Development Plan

1) The Development Plan describes the initial position and the development desired within the natural monument. It forms part of the present agreement (Appendix 1) and is to be revised periodically, taking account of master plans, communal land use plans and the relevant regulations at the cantonal and federal level.

2) The Development Plan is binding on the Contracting Parties' authorities.

3) Amendments to the Development Plan are to be made in accordance with Art. 7 Para. 4 c below and require the agreement of two thirds of all the Contracting Parties. The Contracting Parties in the canton concerned hold a joint veto; i.e. if the delegates of the canton concerned are unanimously opposed to a decision, it may not be implemented against the wishes of the communes in question.

Art. 4 Financial Plan

1) The Financial Plan quantifies the costs expected to arise in fulfilling the purpose of the agreement over the following four years.

2) The Financial Plan may be revised subject to approval by a two-thirds majority of the votes cast by the Contracting Parties represented.

II. Implementation

Art. 5 Cooperation

In accordance with the purpose of the agreement and within the framework of the Financial Plan, the Community of Contracting Parties may cooperate with third parties who are not Contracting Parties. In the process, it may conclude legal transactions (agreements concerning services, purchase or sale of assets, etc.) arising from the purpose specified in the present agreement.

Art. 6 Organs

The responsibilities and powers defined by the present agreement are to be exercised by the following bodies:

a) Delegates' Assembly;

b) Committee;

c) Chair;

d) Secretariat;

e) Auditing Body;

f) Scientific Advisory Committee.

Art. 7 Delegates' Assembly

1) The Delegates' Assembly consists of one representative nominated by each of the Contracting Parties.

2) The following are invited to attend meetings of the Delegates' Assembly as permanent guests: the affected regions Glarner Hinterland-Sernftal and Sarganserland-Walensee, the communal associations Churer Rheintal and Surselva, the cantons of St. Gallen, Glarus and Graubünden, and the Swiss Agency for the Environment, Forests and Landscape (SAEFL).

3) In the Delegates' Assembly, the Contracting Parties involved have at least one vote. For each complete 20 km^2 unit of territory forming part of the natural monument and for every 4000 inhabitants each Contracting Party is entitled to an additional vote, up to a maximum of four votes. The resultant distribution of votes is specified in Appendix 3.

4) The Delegates' Assembly is responsible for the following:

a) fundamental and major decisions, within the framework of the Financial Plan, concerning ways and means of achieving the purpose of the agreement [Art. 1];

b) decisions on the budget, accounts and balance sheet;

c) approval of the Financial Plan and of amendments to the Development Plan;

d) approval of projects arising from the assigned responsibilities and for which funding has been secured;

e) election of the Chair, and of members of the Committee and the Scientific Advisory Committee;

f) supervision of the Committee's activities;

g) establishment of regulations concerning the obligations and powers of the Chair, the Secretariat, the Committee and the Scientific Advisory Committee;

h) appointment of the Auditing Body;

i)granting of funds for the conclusion of transactions with third parties [Art. 5];

j)decisions on the admission of new Contracting Parties and the appropriate revision of the present agreement;

k) decisions on the exclusion of Contracting Parties and the appropriate revision of the present agreement;

l)other tasks not expressly assigned to some other body by the present agreement.

5) The Delegates' Assembly is to convene at the invitation of the Chair and at the request of the Committee or of at least five communes.

6) Invitations to meetings of the Delegates' Assembly, including the agenda, are to be sent to the Contracting Parties at least three weeks in advance.

7) Decisions are to be taken on the basis of a simple majority of the votes represented, except for amendments to the Development Plan [Art. 3 Para. 3], the Financial Plan [Art. 4 Para. 2], and the present agreement [Art. 21]. In the event of a tied vote, the Chair holds a casting vote. The communes of a canton concerned hold a joint veto.

Art. 8 Committee

1) The Committee consists of the following members:

a) the Chair;

b) a representative of the Contracting Parties from the canton of Glarus;

c) a representative of the Contracting Parties from the canton of Graubünden;

d) a representative of the Contracting Parties from the canton of St. Gallen;

e) a SAEFL representative with an advisory vote;

f) a representative of the cantons with an advisory vote;

g) if possible an additional person, who may also be elected as Chair.

2) The Committee is responsible in particular for the following:

a) preparation of business and submission of motions to the Delegates' Assembly;

b) fulfilment of tasks assigned to it by the Delegates' Assembly under the regulations or on an ad hoc basis;

c) appointment of the Secretariat.

d) supervision of the Secretariat.

3) It is to convene as often as is required for the conduct of business, or at the request of a member or of the Auditing Body.

4) In the event of a tied vote, the Chair holds a casting vote.

5) The representatives of SAEFL and the cantons are appointed by these agencies, and the remaining members are elected by the Delegates' Assembly. Office holders are elected for a period of four years, and may be re-elected twice.

Art. 9 Chair

1) The Chair is a voting member of the Committee.

2) The Chair presides over meetings of the Delegates' Assembly and of the Committee.

3) The Chair is elected by the Delegates' Assembly for a period of four years, and may be re-elected twice.

4) The Chair represents the Community of Contracting Parties vis-à-vis third parties.

Art. 10 Secretariat

1) The Secretariat reports to the Chair and is responsible for the preparation of the Committee's business. It supports the Chair in the fulfilment of the latter's responsibilities.

2) It performs the tasks assigned to it by the Committee or the Chair.

3) The Secretariat is appointed by the assignment of this function to a Contracting Party or a third party [Art. 8 Para. 2 c].

Art. 11 Scientific Advisory Committee

1) The Scientific Advisory Committee provides the Delegates' Assembly and the Committee with advice on scientific matters relating to the conservation and use of the natural monument.

2) The Scientific Advisory Committee is entitled to submit motions to the Committee.

Art. 12 Financial administration

The Secretariat is responsible for the management of assets and cash, and also for bookkeeping and payments.

Art. 13 Auditing Body

1) The auditing body examines the Secretariat's accounts and bookkeeping and submits a report to the Delegates' Assembly. It may comment on the budget and on future Financial Plans.

2) The functions of the Auditing Body are exercised by one or more Contracting Parties or external third parties.

Art. 14 Funding

1) Expenditure primarily consists of payments made for personnel and material resources in pursuit of the goals of the agreement and in accordance with the Financial Plan and the annual budget. Responsibility for the maintenance of paths and roads continues to lie with the existing funding authorities.

2) Measures requiring considerable outlays are to be governed by contractual agreements involving special financial arrangements. These agreements are to be approved by the Delegates' Assembly.

3) Income consists of federal and cantonal contributions and third-party payments.

4) The operating costs remaining after the deduction of income are to be apportioned among the Contracting Parties according to the number of votes held, as specified in Appendix 3. Contributions to costs are to be paid in cash by the Contracting Parties.

5) The Contracting Parties are to be informed of the budget and accounts in good time, to enable them to include their contributions in their own respective budgets and accounts.

6) During the financial year (calendar year), the Contracting Parties may be requested to make advance payments. The Delegates' Assembly sets the level of such payments as a percentage of the budgeted cash flows. The final settlement of accounts with the Contracting Parties takes place after publication of the approved annual accounts.

III. Judicial procedure

Art. 15 Arbitral tribunal

1) Disputes between the Contracting Parties arising from the present agreement are to be settled by an arbitral tribunal, with the legal venue being Glarus. Prior to arbitration, a mutual agreement procedure is to be conducted within the Delegates' Assembly.

2) Within 30 days after referral of a dispute to arbitration, the Contracting Parties' communal authorities are each to appoint an arbitrator. Within 15 days, the arbitrators are jointly to appoint an additional member as Chair of the tribunal, with a casting vote.

3) The arbitration proceedings are to be governed, mutatis mutandis, by the Administrative Law Procedure Act of the Canton of Glarus. The Arbitration Agreement (KSG) of 27 March 1969 (SR 279) is applicable.

4) The decision of the arbitral tribunal is binding on the Contracting Parties and is not subject to appeal, except where this is mandated by overriding legislation.

IV. Transitional and final provisions

Art. 16 Initial capital

When the agreement comes into force, the Contracting Parties undertake to make available to the Community initial capital amounting to CHF 30,000 in cash, according to the distribution of votes within the Delegates' Assembly [Art. 7].

Art. 17 New Financial Plans

At least 12 months before the expiry of the Financial Plan for a given term of office, the Financial Plan for the following term is to be presented. This provision applies likewise for subsequent periods.

Art. 18 Liability

The Contracting Parties are collectively liable vis-à-vis third parties within the framework of the Financial Plan and in accordance with the Contracting Parties' respective voting rights. Joint and several liability is expressly excluded. Provisions of this kind are to be included in all contracts concluded with third parties by the bodies responsible under the present agreement.

Art. 19 Term of agreement

1) This agreement is concluded for a period of ten years. Unless notice of termination is given, it will be renewed for a further five years.

2) A Contracting Party may give notice that the agreement is to be terminated with effect from the end of a year until no later than 24 months before the expiry of the agreement. Even if a Contracting Party withdraws, the agreement will remain in force for the other Contracting Parties.

Art. 20 Dissolution; termination

1) If the present agreement is dissolved, surpluses and material resources remaining after the completion of the liquidation process are to be allocated to the Contracting Parties in accordance with the number of votes held, as specified in Appendix 3. These resources are to be earmarked for use in the protection of nature and landscape.

2) In the event of termination by individual Contracting Parties, any surpluses and material resources are to be transferred to the Community of Contracting Parties. Departing Contracting Parties or the Community of Contracting Parties are only liable to make special payments if this has been stipulated by the Delegates' Assembly in decisions relating to special financial arrangements.

Art. 21 Amendments

Amendments to the present agreement require the consent of the Contracting Parties in the form mandated by applicable law. Amendments may also be subject to approval by cantonal authorities in accordance with the relevant cantonal legislation.

Art. 22 Entry into force

The present agreement will enter into force upon a decision by UNESCO to inscribe the property in the organization's World Heritage List.

Appendices:

Appendix 01a:	Current state of development in the proposed UNESCO World Heritage site "Glarus overthrust"
Appendix 01b:	Development Plan for the proposed UNESCO World Heritage site "Glarus overthrust"
Appendix 02:	Types of land use within the boundary of the UNESCO World Heritage site "Glarus overthrust"
Appendix 03:	Distribution of population, territory and votes in the proposed World Heritage site "Glarus overthrust"

Current state of development in the proposed UNESCO World Heritage site "Glarus overthrust"

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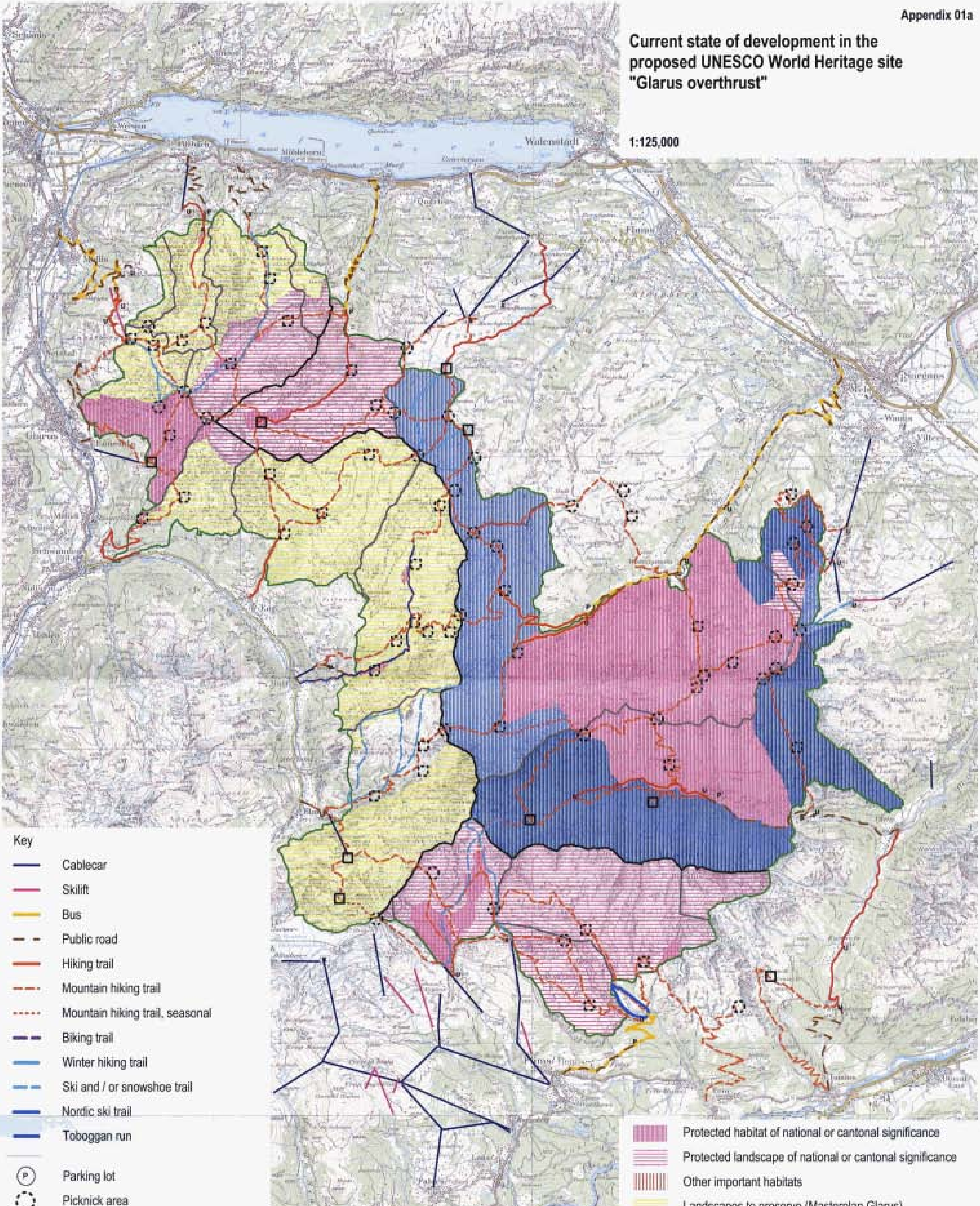

Cartographic data: PK200 © 2006 SWISSTOPO (DV351.4)

Date: 28. Nov. 2003 ws / rev. 19. Aug. 2006 pz

Appendix 01a

Development plan for the proposed UNESCO World Natural Heritage site "Glarus overthrust"

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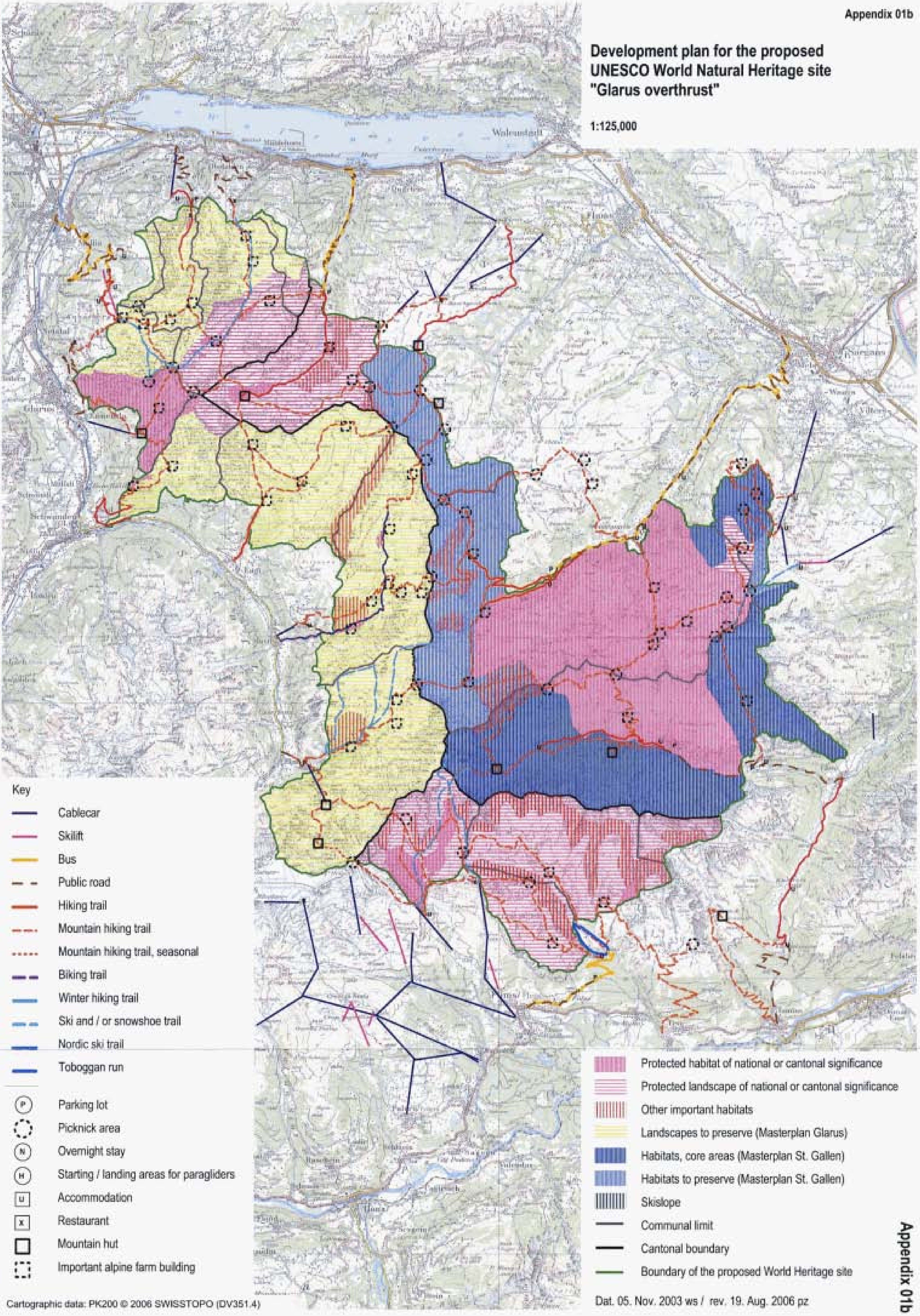

Cartographic data: PK200 © 2006 SWISSTOPO (DV351.4)

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Appendix 01b

Appendix 02: Types of land use within the boundary of the UNESCO World Heritage site "Glarus overthrust"

N.B.: This list is issued without prejudice to higher-level legislation. Additional federal, cantonal and communal regulations concerning protection, especially those specified in cantonal master plans, will take precedence.

In the assessment, types of use were rated as follows: desirable – permissible – not desirable – not permissible

Non-tourist-related uses

Forest management	Permissible
Biotope management and upkeep	Desirable
Hazard prevention	Permissible
Appropriate mountain farming use	Permissible
Mountain farming and forestry access roads	Permissible where required for appropriate mountain farming use and forest management
Hunting (except in game reserves)	Permissible
Fishing	Permissible
Gathering berries	Permissible
Gathering mushrooms	Permissible
Military use	Permissible at present levels
New military facilities	Not desirable
Extraction of materials	Not permissible
Terrain modifications	Not desirable
Collection of rock crystals	In accordance with communal regulations
Depositing of materials	Not permissible
Power generation	New plants are not desirable unless they are designed merely to enable cabins to meet their own energy needs
New above-ground high-voltage power lines	Not permissible
Above-ground pipelines	Not permissible

Tourist-related uses

Public information	Desirable
Notice boards	Desirable
Resting/picnic areas	In accordance with the Development Plan
Bivouac areas	In accordance with the Development Plan
Campsites	Not permissible
New hiking paths	In accordance with the Development Plan
Simple accommodation/catering facilities	In accordance with the Development Plan
New tourist transport facilities and buildings	Not permissible
Structures and equipment that do not have to be sited within the property for operational reasons	Not permissible (in accordance with Spatial Planning Law)
Construction zones	Not permissible
New tourist access roads	Not permissible
Vehicular traffic	Use of private cars on existing roads is not desirable
New parking facilities	Not desirable
Parking outside designated areas	Not desirable
Minibus and taxi services	For licensed operators in accordance with the Development Plan
Hiking	Permissible
Mountaineering/climbing	Permissible
Littering	Not permissible
Access for dogs under owners' control	Permissible
Winter hiking paths	In accordance with the Development Plan
Snowshoeing routes	In accordance with the Development Plan
Snowshoeing	In accordance with the Development Plan
Cross-country skiing	In accordance with the Development Plan
Tobogganing	In accordance with the Development Plan
Skiing and snowboarding	In accordance with the Development Plan
Off-piste skiing/off-piste snowboarding	Not desirable
Ski touring	In accordance with the Development Plan
Heli-skiing	Not permissible
Aircraft landing sites	Not permissible
Hang-gliding launching and landing areas	In accordance with the Development Plan
Mountain biking	In accordance with the Development Plan
Motorized water sports	Not permissible
Sporting events	In accordance with the Development Plan

Appendix 03: Distribution of population, territory and votes in the proposed World Heritage site "Glarus overthrust"

Confederation

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
TOTAL	**41316**	**100%**	**328.5**	**100%**	**31**	**100%**	**50.0%**	**SFr. 50,000**

Cantons

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
Glarus	9300	22.5%	127.48	38.8%	12	38.7%	10.0%	SFr. 10,000
St. Gallen	26042	63.0%	155.45	47.3%	13	41.9%	10.0%	SFr. 10,000
Graubünden	5974	14.5%	45.57	13.9%	6	19.4%	5.0%	SFr. 5,000
TOTAL	**41316**	**100%**	**328.5**	**100%**	**31**	**100%**	**25.0%**	**SFr. 25,000**

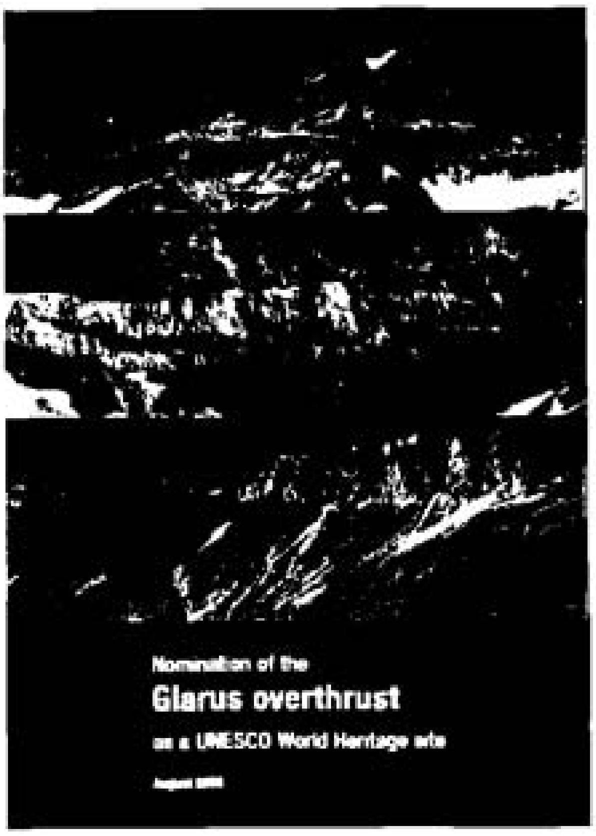
Communes

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
Mühlehorn	434	1.1%	2.85	0.9%	1	3.2%	0.81%	SFr. 810
Obstalden	542	1.3%	18.75	5.7%	1	3.2%	0.81%	SFr. 810
Filzbach	441	1.1%	6.37	1.9%	1	3.2%	0.81%	SFr. 810
Mollis	2974	7.2%	1.68	0.5%	1	3.2%	0.81%	SFr. 810
Ennenda	2808	6.8%	12.38	3.8%	1	3.2%	0.81%	SFr. 810
Sool	303	0.7%	9.35	2.9%	1	3.2%	0.81%	SFr. 810
Engi	381	0.9%	21.83	6.6%	2	6.5%	1.61%	SFr. 1620
Matt	656	1.6%	24.39	7.4%	2	6.5%	1.61%	SFr. 1620
Elm	761	1.8%	29.88	9.1%	2	6.5%	1.61%	SFr. 1620
Total GL	**9300**	**22.5%**	**127.48**	**38.8%**	**12**	**38.7%**	**9.68%**	**SFr. 9720**
Pfäfers	1754	4.2%	55.58	16.9%	3	9.7%	2.42%	SFr. 2430
Bad Ragaz	4929	11.9%	1.00	0.3%	2	6.5%	1.61%	SFr. 1620
Vilters-Wangs	3891	9.4%	6.25	1.9%	1	3.2%	0.81%	SFr. 810
Mels	7837	19.0%	64.09	19.5%	4	12.9%	3.23%	SFr. 3240
Flums	4882	11.8%	11.28	3.4%	2	6.5%	1.61%	SFr. 1620
Quarten	2749	6.7%	17.25	5.3%	1	3.2%	0.81%	SFr. 810
Total SG	**26042**	**63.0%**	**155.45**	**47.3%**	**13**	**41.9%**	**10.48%**	**SFr. 10,530**
Laax	1150	2.8%	0.23	0.1%	1	3.2%	0.81%	SFr. 810
Flims	2549	6.2%	20.29	6.2%	2	6.5%	1.61%	SFr. 1620
Trin	1108	2.7%	21.48	6.5%	2	6.5%	1.61%	SFr. 1620
Tamins	1167	2.8%	3.57	1.1%	1	3.2%	0.81%	SFr. 810
Total GR	**5974**	**14.5%**	**45.57**	**13.9%**	**6**	**19.4%**	**4.84%**	**SFr. 4860**
TOTAL	**41316**	**100.0%**	**328.50**	**100.0%**	**31**	**100.0%**	**25.00%**	**SFr. 25,110**

Inhabitants: Population figures according to the Swiss census of 5 December 2000.

Supplement S07

Relevant federal legislations



All federal legislations are available online under http://www.admin.ch/ch/f/rs/45.html

Loi fédérale du 1er juillet 1966 sur la protection de la nature et du paysage (LPN, RS 451); http://www.admin.ch/ch/f/rs/c451.html

Ordonnance du 10 août 1977 concernant l'inventaire fédéral des paysages, sites et monuments naturels (OIFP, RS 451.11) + Annexe "Inventaire fédéral des paysages, sites et monuments d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_11.html

Ordonnance du 28 octobre 1992 sur la protection des zones alluviales d'importance nationale (RS 451.31) + Annexe "Inventaire fédéral des zones alluviales d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_31.html

Ordonnance du 21 janvier 1991 sur la protection des hauts-marais et des marais de transition d'importance nationale (RS 451.32) + Annexe "Inventaire fédéral des hauts-marais et des marais de transition d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_32.html

Ordonnance du 7 septembre 1994 sur la protection des bas-marais d'importance nationale (RS 451.33) + Annexe "Inventaire fédéral des bas-marais d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_33.html

Ordonnance du 15 juin 2001 sur la protection des sites de reproduction de batraciens d'importance nationale (RS 451.34) + Annexe "Inventaire fédéral des sites de reproduction de batraciens d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_34.html

Ordonnance du 1er mai 1996 sur la protection des sites marécageux d'une beauté particulière et d'importance nationale (RS 451.35) + Annexe "Inventaire fédéral des sites marécageux d'une beauté particulière et d'importance nationale"; http://www.admin.ch/ch/f/rs/c451_35.html

Loi fédérale du 20 juin 1986 sur la chasse et la protection des mammifères et oiseaux sauvages (LChP, RS 922.0); http://www.admin.ch/ch/f/rs/c922_0.html

Ordonnance du 30 avril 1990 sur la régulation des populations de bouquetins (ORB, RS 922.27) ; http://www.admin.ch/ch/f/rs/c922_27.html

Ordonnance du 30 septembre 1991 concernant les districts francs fédéraux (ODF, RS 922.31); http://www.admin.ch/ch/f/rs/c922_31.html

Loi fédérale sur la protection de la nature et du paysage (LPN)[1]

du 1er juillet 1966 (Etat le 3 mai 2005)

L'Assemblée fédérale de la Confédération suisse,

vu l'art. 24sexies de la constitution[2],[3]

vu le message du Conseil fédéral du 12 novembre 1965[4],

arrête:

Art. 1[5]

But

Dans les limites de la compétence conférée à la Confédération par l'article 24sexies, al. 2 à 5, de la constitution[6], la présente loi a pour but:

a. De ménager et de protéger l'aspect caractéristique du paysage et des localités, les sites évocateurs du passé, les curiosités naturelles et les monuments du pays, et de promouvoir leur conservation et leur entretien;

b. De soutenir les cantons dans l'accomplissement de leurs tâches de protection de la nature, de protection du paysage et de conservation des monuments historiques, et d'assurer la collaboration avec eux;

c. De soutenir les efforts d'organisations qui œuvrent en faveur de la protection de la nature, de la protection du paysage ou de la conservation des monuments historiques;

d.[7] de protéger la faune et la flore indigènes, ainsi que leur diversité biologique et leur habitat naturel;

RO **1966** 1694

1 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
2 [RS **1** 3; RO **1962** 783, **1988** 352]. A la disposition mentionnée correspond actuellement l'art. 78 de la Constitution du 18 avril 1999 (RS **101**).
3 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
4 FF **1965** III 93
5 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
6 [RS **1** 3, RO **1962** 783, **1988** 352]. Actuellement «l'art. 78, al. 2 à 5 de la Constitution du 18 avril 1999» (RS **101**).
7 Nouvelle teneur selon le ch. 2 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).

e. D'encourager l'enseignement et la recherche dans les domaines de la protection de la nature, de la protection du paysage et de la conservation des monuments historiques, ainsi que la formation et le perfectionnement de spécialistes.

Chapitre premier: Protection de la nature, protection du paysage et conservation des monuments historiques dans l'accomplissement des tâches de la Confédération[8]

Art. 2

Accomplissement de tâches de la Confédération

[1] Par accomplissement d'une tâche de la Confédération au sens de l'art. 24sexies, al. 2, de la constitution[9], il faut entendre notamment:[10]

a.[11] L'élaboration de projets, la construction et la modification d'ouvrages et d'installations par la Confédération, ses instituts et ses établissements, par exemple les bâtiments et les installations de l'administration fédérale, les routes nationales, les bâtiments et installations des Chemins de fer fédéraux;

b. L'octroi de concessions et d'autorisations, par exemple pour la construction et l'exploitation d'installations de transport et de communications (y compris l'approbation des plans), d'ouvrages et d'installations servant au transport d'énergie, de liquides ou de gaz, ou à la transmission de messages, ainsi que l'octroi d'autorisation de défrichements;

c. L'allocation de subventions pour des mesures de planification, pour des installations et des ouvrages, tels que les améliorations foncières, l'assainissement de bâtiments agricoles, les corrections de cours d'eau, les installations de protection des eaux et les installations de communications.

[2] Les décisions des autorités cantonales concernant les projets qui, selon toute vraisemblance, ne seront réalisés qu'avec les subventions visées à l'al. 1, let. c, sont assimilées à l'accomplissement de tâches de la Confédération.[12]

8 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

9 [RS **1** 3; RO **1962** 783]. Actuellement «l'art. 78, al. 2 de la Constitution du 18 avril 1999» (RS **101**).

10 Nouvelle teneur selon le ch. 2 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).

11 Nouvelle teneur selon le ch. 7 de l'appendice à la loi du 30 avril 1997 sur l'entreprise de télécommunications, en vigueur depuis le 1er janv. 1998 (RS **784.11**).

12 Introduit par le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

Art. 3

Devoirs de la Confédération et des cantons[13]

[1] Les autorités, services, instituts et établissements fédéraux ainsi que les cantons doivent, dans l'accomplissement des tâches de la Confédération, prendre soin de ménager l'aspect caractéristique du paysage et des localités, les sites évocateurs du passé, les curiosités naturelles et les monuments historiques et, lorsque l'intérêt général prévaut, d'en préserver l'intégrité.[14]

[2] Ils s'acquittent de ce devoir:

a. En construisant et en entretenant de manière appropriée leurs propres bâtiments et installations ou en renonçant à construire (art. 2, let. a);

b. En attachant des charges ou des conditions aux autorisations et aux concessions, ou en refusant celles-ci (art. 2, let. b);

c. En n'allouant des subventions que sous conditions ou en refusant d'en allouer (art. 2, let. c).

[3] Ce devoir existe quelle que soit l'importance de l'objet au sens de l'art. 4. Une mesure ne doit cependant pas aller au-delà de ce qu'exige la protection de l'objet et de ses environs.

[4] Les autorités fédérales consultent les cantons concernés avant de rendre leur décision. L'Office fédéral de l'environnement, des forêts et du paysage (OFEFP), l'Office fédéral de la culture (OFC), l'Office fédéral des routes (OFROU)[15] et les autres autorités fédérales concernées collaborent à l'exécution de la présente loi conformément aux articles 62*a* et 62*b* de la loi du 21 mars 1997 sur l'organisation du gouvernement et de l'administration[16].[17]

Art. 4

Catégories d'objets

S'agissant des paysages et des localités caractéristiques, des sites évocateurs du passé, des curiosités naturelles ou des monuments selon l'art. 24[sexies], al. 2, de la constitution[18], il faut distinguer:

13 Nouvelle teneur selon le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

14 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

15 La désignation de l'ensemble des unités administratives concernées a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**). Il a été tenu compte de cette modification dans tout le présent texte.

16 RS **172.010**

17 Introduit par le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

18 [RS **1** 3; RO **1962** 783]. Actuellement «l'art. 78, 2e al. de la Constitution du 18 avril 1999» (RS **101**).

a. Les objets d'importance nationale;

b. Les objets d'importance régionale et locale.

Art. 5

Inventaires fédéraux d'objets d'importance nationale

[1] Le Conseil fédéral établit, après avoir pris l'avis des cantons, des inventaires d'objets d'importance nationale; il peut se fonder à cet effet sur des inventaires dressés par des institutions d'Etat ou par des organisations œuvrant en faveur de la protection de la nature, de la protection du paysage ou de la conservation des monuments historiques.[19] Les critères qui ont déterminé le choix des objets seront indiqués dans les inventaires. En outre, ceux-ci contiendront au minimum:

a. La description exacte des objets;

b. Les raisons leur conférant une importance nationale;

c. Les dangers qui peuvent les menacer;

d. Les mesures de protection déjà prises;

e. La protection à assurer;

f. Les propositions d'amélioration.

[2] Les inventaires ne sont pas exhaustifs. Ils seront régulièrement réexaminés et mis à jour; le Conseil fédéral décide de l'inscription, de la modification ou de la radiation d'objets, après avoir pris l'avis des cantons. Les cantons peuvent, de leur propre chef, proposer un nouvel examen.

Art. 6

Importance de l'inventaire

[1] L'inscription d'un objet d'importance nationale dans un inventaire fédéral indique que l'objet mérite spécialement d'être conservé intact ou en tout cas d'être ménagé le plus possible, y compris au moyen de mesures de reconstitution ou de remplacement adéquates.[20]

[2] Lorsqu'il s'agit de l'accomplissement d'une tâche de la Confédération, la règle suivant laquelle un objet doit être conservé intact dans les conditions fixées par l'inventaire ne souffre d'exception, que si des intérêts équivalents ou supérieurs, d'importance nationale également, s'opposent à cette conservation.

19 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

20 Nouvelle teneur selon le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

Art. 7[21]

Expertise de la commission

[1] Si l'accomplissement d'une tâche de la Confédération incombe à la Confédération, L'OFEFP ou l'OFC, ou l'OFROU, selon le domaine de compétence, détermine s'il est nécessaire qu'une expertise soit établie par la commission visée à l'art. 25, al. 1. Si le canton est compétent, c'est le service cantonal visé à l'article 25, al. 2, qui détermine la nécessité d'une expertise.

[2] Si l'accomplissement de la tâche de la Confédération peut altérer sensiblement un objet inscrit dans un inventaire fédéral en vertu de l'article 5 ou soulève des questions de fond, la commission établit une expertise à l'intention de l'autorité de décision. Cette expertise indique si l'objet doit être conservé intact ou de quelle manière il doit être ménagé.

Art. 8[22]

Expertise facultative

Dans des cas importants, une commission au sens de l'art. 25, al. 1, peut effectuer une expertise de son propre chef à tous les stades de la procédure, sur la manière de ménager des objets ou d'en préserver l'intégrité. Le cas échéant, elle le fait, mais le plus tôt possible. Sur demande, tous les documents nécessaires sont mis à sa disposition.

Art. 9[23]

Autres expertises

Le service fédéral compétent peut aussi demander une expertise au service cantonal (art. 25, al. 2), à la commission cantonale chargée de la protection de la nature, de la protection du paysage ou de la conservation des monuments historiques ou à un autre organe désigné par le canton, ou encore consulter des organisations œuvrant en faveur de la protection de la nature, de la protection du paysage ou de la conservation des monuments historiques.

Art. 10[24]

Avis des gouvernements des cantons

Dans les cas prévus aux art. 7, 8 et 9, l'avis des gouvernements des cantons doit toujours être requis. Ceux-ci invitent les communes concernées à donner leur avis.

21 Nouvelle teneur selon le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

22 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

23 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

24 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

Art. 11

Réserve concernant les ouvrages militaires

Pour les constructions et ouvrages militaires qui ne sont pas soumis à autorisation en vertu de l'art. 126, al. 4, de la loi fédérale du 3 février 1995 sur l'armée et l'administration militaire[25], l'autorité fédérale compétente n'a pas l'obligation de demander une expertise.[26] Elle n'est pas tenue non plus de remettre des documents pour les expertises facultatives.

Art. 12[27]

Voies de droit des communes et des organisations reconnues

[1] Les communes et les organisations d'importance nationale à but non lucratif qui existent depuis dix ans au moins et se vouent à la protection de la nature, à la protection du paysage, à la conservation des monuments historiques ou à des tâches semblables ont qualité pour recourir contre les décisions du canton ou des autorités fédérales si ces décisions peuvent, en dernière instance, faire l'objet d'un recours au Conseil fédéral ou d'un recours de droit administratif au Tribunal fédéral.

[2] Le Conseil fédéral désigne les organisations qui ont qualité pour recourir.

[3] Les communes et les organisations reconnues sont en outre habilitées:

a. A faire usage des voies de droit cantonales;

b. A faire opposition et à formuler des demandes en vertu des art. 9, 35 et 55 de la loi fédérale du 20 juin 1930 sur l'expropriation[28].

[4] Le recours contre une décision portant octroi d'une subvention fédérale n'est pas recevable lorsque les mesures de planification, les ouvrages ou les installations ont par ailleurs fait l'objet, dans l'accomplissement d'une tâche de la Confédération, d'une décision au sens de l'al. 1.

[5] Le recours contre une décision portant octroi d'une subvention fédérale n'est en outre pas recevable lorsque les communes et les organisations qui avaient qualité pour recourir n'ont pas formé de recours contre la première décision notifiée conformément à l'ar. 12*a*, al. 1, et qui ne répondait pas à leurs demandes dans une procédure cantonale relative aux mesures de planification, aux ouvrages et aux installations.

25 RS **510.10**
26 Nouvelle teneur selon le ch. 6 de l'annexe à la LF du 3 fév. 1995 sur l'armée et l'administration militaire, en vigueur depuis le 1er janv. 1996 (RS **510.10**).
27 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
28 RS **711**

Art. 12a[29]

Communication de la décision et intervention

[1] Lorsque la procédure comporte un droit de recours au sens de l'art. 12, al. 1, l'autorité communique sa décision aux communes et aux organisations reconnues par une notification écrite ou par une publication dans la Feuille fédérale ou dans l'organe officiel du canton. En règle générale, la durée de l'enquête publique est de 30 jours.[30]

[2] Lorsque le droit fédéral ou cantonal prévoit une procédure d'opposition antérieure à la prise de décision, les communes et les organisations n'ont qualité pour recourir que si elles sont intervenues dans la procédure d'opposition à titre de partie. Dans ce cas, la demande doit être publiée conformément aux règles énoncées à l'al. 1.

[3] Les communes et les organisations qui n'ont pas formé de recours ne peuvent intervenir comme partie dans la suite de la procédure que si la décision est modifiée en faveur d'une autre partie et qu'elle leur porte atteinte.

[4] Les al. 1 et 3 ne sont pas applicables lorsque la décision sur le projet est rendue dans la procédure prévue par la loi fédérale du 20 juin 1930 sur l'expropriation[31].

Art. 12b[32]

Voies de droit des cantons et de l'office fédéral compétent

[1] Les cantons ont qualité pour recourir contre les décisions d'autorités fédérales au sens de l'art. 12, al. 1.

[2] L'office fédéral compétent a qualité pour recourir contre les décisions cantonales au sens de l'art. 12, al. 1; il peut faire usage des voies de droit fédérales et cantonales.

29 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

30 Phrase introduite par le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision, en vigueur depuis le 1er janv. 2000 (RO **1999** 3071 3124; FF **1998** 2221).

31 **RS 711**

32 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

Chapitre 2: Soutien accordé par la Confédération à la protection de la nature, à la protection du paysage et à la conservation des monuments historiques, et mesures de la Confédération[33]

Art. 13

Subventions pour la conservation d'objets dignes de protection

[1] La Confédération peut soutenir la protection de la nature et du paysage et la conservation des monuments historiques par l'allocation de subventions; celles-ci s'élèvent au plus à 35 % des frais imputables à la conservation, à l'acquisition et à l'entretien des paysages, des localités caractéristiques, des sites évocateurs du passé, des curiosités naturelles et des monuments dignes de protection, ainsi qu'aux travaux d'exploration et de documentation liés à ces activités.[34] Ces subventions ne sont accordées que si le canton participe aussi aux frais dans une mesure équitable. Leurs taux se détermine d'après l'importance de l'objet à protéger; (art. 4), la somme des frais et la capacité financière du canton.[35]

[1bis] Le taux de subvention peut s'élever au plus à 45 % des frais s'il est établi que le taux prévu à l'al. 1 ne permet pas de financer les mesures dont l'exécution est indispensable.[36]

[2] Les subventions peuvent être liées à des conditions concernant la conservation et l'entretien de l'objet et de ses environs.

[3] Les mesures de protection et d'entretien prescrites constituent des restrictions de droit public à la propriété (art. 702 CC[37]). Elles engagent les propriétaires fonciers intéressés; les cantons doivent les faire mentionner au registre foncier. Le Conseil fédéral fixe les cas où il peut être dérogé à cette obligation.[38]

[4] Les cantons examinent les projets, les évaluent et les échelonnent dans le temps. Sur cette base, la Confédération et les cantons établissent un plan de financement commun. Le Conseil fédéral règle la procédure et la participation des cantons à l'exécution de mesures qu'il a décidées.[39]

33 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
34 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
35 Nouvelle teneur selon le ch. I 421 de la LF du 5 mai 1977 instituant des mesures propres à équilibrer les finances fédérales, en vigueur depuis le 1er janv. 1978 (RO **1977** 2249; FF **1977** I 809).
36 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
37 RS **210**
38 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
39 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

Art. 14[40]

Subventions accordées à des organisations

La Confédération peut accorder des subventions à des organisations d'importance nationale qui se vouent à la protection de la nature, à la protection du paysage ou à la conservation des monuments historiques pour les frais occasionnés par les activités d'intérêt public qu'elles exercent.

Art. 14*a*[41]

Recherche, formation, relations publiques

[1] La Confédération peut allouer des subventions pour promouvoir:

a. Des projets de recherche;

b. La formation et le perfectionnement de spécialistes;

c. Les relations publiques.

[2] Lorsqu'il existe un intérêt national, la Confédération peut assumer elle-même ces tâches ou les faire exécuter à ses frais.

Art. 15

Achat et sauvegarde d'objets dignes de protection

[1] La Confédération peut procéder par voie contractuelle ou, si c'est impossible, par voie d'expropriation pour acquérir ou sauvegarder des sites naturels, des curiosités naturelles, des sites évocateurs du passé ou des monuments d'importance nationale. Elle peut en confier l'administration à des cantons, à des communes ou à des organisations.[42]

[2] La loi fédérale du 20 juin 1930 sur l'expropriation[43] est applicable.

Art. 16

Mesures conservatoires

Si un danger imminent menace un site naturel selon l'art. 15, un site évocateur du passé ou un monument d'importance nationale, le Département fédéral de l'environnement, des transports, de l'énergie et de la communication ou le Département fédéral de l'intérieur[44] peuvent, par des mesures temporaires, placer l'objet sous la protection de la Confédération et ordonner que les dispositions nécessaires à sa conservation soient prises.[45]

40 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
41 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
42 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
43 RS **711**
44 Nouvelle teneur selon le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
45 La désignation de l'ensemble des unités administratives concernées a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**).

Art. 16a[46]

Octroi de subventions

L'Assemblée fédérale fixe dans le budget le volume maximal des subventions qui peuvent être allouées durant l'exercice.

Art. 17[47]

Restitution de subventions

Si un objet ne mérite plus d'être protégé, la restitution, tout ou partie, de la subvention allouée peut être requise.

Art. 17a[48]

Expertises spéciales

Le Conseil fédéral définit les cas dans lesquels une commission peut, avec l'accord du canton, procéder à une expertise de son propre chef ou à la demande de tiers.

Chapitre 3: Protection de la faune et de la flore du pays

Art. 18

Protection d'espèces animales et végétales

[1] La disparition d'espèces animales et végétales indigènes doit être prévenue par le maintien d'un espace vital suffisamment étendu (biotopes), ainsi que par d'autres mesures appropriées. Lors de l'application de ces mesures, il sera tenu compte des intérêts dignes de protection de l'agriculture et de la sylviculture.

[1bis] Il y a lieu de protéger tout particulièrement les rives, les roselières et les marais, les associations végétales forestières rares, les haies, les bosquets, les pelouses sèches et autres milieux qui jouent un rôle dans l'équilibre naturel ou présentent des conditions particulièrement favorables pour les biocénoses.[49]

[1ter] Si, tous intérêts pris en compte, il est impossible d'éviter des atteintes d'ordre technique aux biotopes dignes de protection, l'auteur de l'atteinte doit veiller à prendre des mesures particulières pour en assurer la meilleure protection possible, la reconstitution ou, à défaut, le remplacement adéquat.[50]

46 Introduit par le ch. 9 de l'annexe à la loi du 5 oct. 1990 sur les subventions, en vigueur depuis le 1er avril 1991 (RS **616.1**).
47 Nouvelle teneur selon le ch. 9 de l'annexe à la loi du 5 oct. 1990 sur les subventions, en vigueur depuis le 1er avril 1991 (RS **616.1**).
48 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
49 Introduit par l'art. 66 ch. 1 de la loi du 7 oct. 1983 sur la protection de l'environnement, en vigueur depuis le 1er janv. 1985 (RS **814.01**).
50 Introduit par l'art. 66 ch. 1 de la loi du 7 oct. 1983 sur la protection de l'environnement, en vigueur depuis le 1er janv. 1985 (RS **814.01**).

[2] Dans la lutte contre les ravageurs, notamment dans la lutte au moyen de substances toxiques, il faut éviter de mettre en danger des espèces animales et végétales dignes de protection.

[3] La Confédération peut favoriser la réacclimatation en des lieux appropriés d'espèces ne vivant plus à l'état sauvage en Suisse ou menacées d'extinction.

[4] La législation fédérale sur la chasse et la protection des oiseaux ainsi que sur la pêche est réservée.

Art. 18*a*[51]

Biotopes d'importance nationale

[1] Le Conseil fédéral, après avoir pris l'avis des cantons, désigne les biotopes d'importance nationale. Il détermine la situation de ces biotopes et précise les buts visés par la protection.

[2] Les cantons règlent la protection et l'entretien des biotopes d'importance nationale. Ils prennent à temps les mesures appropriées et veillent à leur exécution.

[3] Le Conseil fédéral peut, après avoir pris l'avis des cantons, fixer des délais pour la mise en place des mesures de protection. Si, malgré les avertissements, un canton ne prescrit pas à temps les mesures de protection, le Département fédéral de l'environnement, des transports, de l'énergie et de la communication[52] peut prendre à sa place les mesures nécessaires et mettre à sa charge une part équitable des frais correspondants.

Art. 18*b*[53]

Biotopes d'importance régionale et locale et compensation écologique

[1] Les cantons veillent à la protection et à l'entretien des biotopes d'importance régionale et locale.

[2] Dans les régions où l'exploitation du sol est intensive à l'intérieur et à l'extérieur des localités, les cantons veillent à une compensation écologique sous forme de bosquets champêtres, de haies, de rives boisées ou de tout autre type de végétation naturelle adaptée à la station. Ce faisant, ils tiennent compte des besoins de l'agriculture.

51 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
52 La désignation de l'unité administrative a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**).
53 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).

Art. 18c[54]

Situation des propriétaires fonciers et des exploitants

[1] La protection des biotopes et leur entretien seront, si possible, assurés sur la base d'accords conclus avec les propriétaires fonciers et les exploitants et par l'adaptation des modes d'exploitation agricole et sylvicole.

[2] Les propriétaires fonciers ou les exploitants qui, par souci de garantir la protection visée, limitent leur exploitation actuelle ou assurent une prestation sans avantage lucratif correspondant, ont droit à une juste indemnité.[55]

[3] Si, contrairement à ce qui serait indispensable à la réalisation des buts visés par la protection, un propriétaire néglige d'exploiter son bien-fonds, il doit en tolérer l'exploitation par des tiers ordonnée par les autorités.

[4] Pour autant que les buts visés par la protection exigent l'acquisition de terres, les cantons ont la compétence de recourir à l'expropriation. Dans leurs dispositions d'exécution, ils peuvent déclarer applicable la loi fédérale du 20 juin 1930 sur l'expropriation[56], la décision sur les oppositions restées en litige revenant au gouvernement cantonal. La loi fédérale du 20 juin 1930 sur l'expropriation est applicable lorsque l'objet à placer sous protection s'étend sur le territoire de plusieurs cantons.

Art. 18d[57]

Financement

[1] La Confédération finance l'inventaire des biotopes d'importance nationale et participe au financement des mesures de protection et d'entretien par une indemnité couvrant de 60 à % des frais. Elle peut, exceptionnellement, prendre à sa charge la totalité des frais.

[2] Les cantons supportent les coûts de la protection et de l'entretien des biotopes d'importance régionale et locale et ceux des mesures de compensation écologique. La Confédération participe à leur couverture sous la forme d'indemnités allant jusqu'à 50 % des frais.

[3] Pour le calcul des indemnités visées aux al. 1 et 2, la Confédération tient compte de la capacité financière des cantons et de la charge globale que leur occasionne la protection des sites marécageux et des biotopes.

54 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
55 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
56 RS **711**
57 Introduit par le ch. I de la LF du 19 juin 1987 (RO **1988** 254; FF **1985** II 1449). Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

Art. 19

Récolte de plantes sauvages et capture d'animaux; autorisation obligatoire

Une autorisation de l'autorité cantonale compétente est nécessaire pour récolter des plantes sauvages et capturer des animaux vivant en liberté à des fins lucratives. L'autorité peut la limiter à certaines espèces, contrées, saisons et quantités, ou d'une autre manière, et interdire la récolte ou la culture organisées ainsi que la publicité à cet effet. La présente disposition ne concerne pas les produits ordinaires de l'agriculture et de la sylviculture, ni la cueillette de champignons, de baies et de plantes utilisées en herboristerie, effectuée dans une mesure conforme à l'usage local, sauf s'il s'agit de plantes protégées.

Art. 20

Protection de plantes et d'animaux rares

1 Le Conseil fédéral peut interdire totalement ou partiellement la cueillette, la déplantation, l'arrachage, le transport, la mise en vente, la vente, l'achat ou la destruction de plantes rares. Il peut également prendre des mesures adéquates pour protéger les espèces animales menacées ou dignes de protection.[58]

2 Les cantons peuvent édicter des interdictions semblables pour d'autres espèces.

3 Pour des raisons inhérentes à la protection des espèces, le Conseil fédéral peut subordonner à certaines conditions, limiter ou interdire la production, la mise en circulation, l'importation, l'exportation et le transit de plantes ou de produits végétaux.[59]

Art. 21[60]

Végétation des rives

1 La végétation des rives (roselières et jonchères, végétation alluviale et autres formations végétales naturelles riveraines) ne doit pas être essartée ni recouverte ou détruite d'une autre manière.

2 Dans la mesure du possible, les cantons veillent à ce que les rives soient couvertes d'une végétation suffisante ou du moins à ce que soient réalisées les conditions nécessaires à son développement.[61]

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58 Nouvelle teneur de la phrase selon le ch. 2 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).

59 Introduit par le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO **1997** 1152 1153; FF **1995** IV 621).

60 Nouvelle teneur selon l'art. 66 ch. 1 de la loi du 7 oct. 1983 sur la protection de l'environnement, en vigueur depuis le 1er janv. 1985 (RS **814.01**).

61 Introduit par l'art. 75 ch. 2 de la LF du 24 janv. 1991 sur la protection des eaux (RS **814.20**). Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

Art. 22

Exceptions autorisées

[1] L'autorité cantonale compétente peut, à des fins scientifiques, pédagogiques et thérapeutiques, et sur des territoires déterminés, permettre des exceptions pour la récolte et la déplantation de plantes protégées ainsi que pour la capture d'animaux.

[2] Elle peut autoriser la suppression de la végétation existant sur des rives dans le cas de projets qui ne peuvent être réalisés ailleurs et qui ne contreviennent pas à la législation en matière de police des eaux et de protection des eaux.[62]

[3] Si une autre norme juridique attribue à une autorité fédérale la compétence de décider au sujet d'un projet, l'autorisation exceptionnelle est octroyée par cette autorité. ...[63]

Art. 23[64]

Espèces animales et végétales étrangères; autorisation obligatoire

L'acclimatation d'espèces, sous-espèces et races d'animaux et végétaux étrangères au pays ou à certaines régions nécessite une autorisation du Conseil fédéral. Cette disposition ne concerne pas les enclos, les jardins et les parcs, ni les exploitations agricoles et forestières.

Chapitre 3*a*:[65] Marais et sites marécageux d'une beauté particulière et d'importance nationale

Art. 23*a*

Protection des marais

Les art. 18*a*, 18*c* et 18*d* s'appliquent à la protection des marais d'une beauté particulière et d'importance nationale.

Art. 23*b*

Définition et délimitation des sites marécageux

[1] Par site marécageux, on entend un paysage proche de l'état naturel, caractérisé par la présence de marais. Une étroite relation écologique, visuelle, culturelle ou historique unit les marais au reste du site.

[2] Un site marécageux est d'une beauté particulière et d'importance nationale lorsqu'il:

62 Nouvelle teneur selon l'art. 75 ch. 2 de la LF du 24 janv. 1991 sur la protection des eaux, en vigueur depuis le 1er nov. 1992 (RS **814.20**).

63 Phrase abrogée par le ch. I 3 de la LF du 18 juin 1999 sur la coordination et la simplification des procédures de décision (RO **1999** 3071; FF **1998** 2221).

64 Nouvelle teneur selon l'art. 27 ch. 2 de la loi du 20 juin 1986 sur la chasse, en vigueur depuis le 1er avril 1988 (RS **922.0**).

65 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

a. Est unique en son genre ou

b. Fait partie des sites marécageux les plus remarquables, dans un groupe de sites comparables.

[3] Le Conseil fédéral désigne les sites marécageux d'une beauté particulière et d'importance nationale et en détermine la situation en tenant compte de l'utilisation du sol et des constructions existantes. Ce faisant, il travaille en étroite collaboration avec les cantons qui, pour leur part, prennent l'avis des propriétaires fonciers concernés.

[4] La Confédération finance l'inventaire des sites marécageux d'une beauté particulière et d'importance nationale.

Art. 23*c*

Protection des sites marécageux

[1] La protection a pour but général de sauvegarder les éléments naturels et culturels des sites marécageux qui leur confèrent leur beauté particulière et leur importance nationale. Le Conseil fédéral fixe des buts de protection adaptés aux particularités des sites marécageux.

[2] Les cantons veillent à la concrétisation et à la mise en œuvre des buts de la protection. Ils prennent à temps les mesures de protection et d'entretien qui s'imposent. Les art. 18*a*, al. 3, et 18*c* sont applicables par analogie.

[3] La Confédération participe au financement des mesures de protection et d'entretien par une indemnité couvrant de 60 à 90 pour cent des frais. Pour le calcul de l'indemnité, elle tient compte de la capacité financière des cantons et de la charge globale que leur occasionne la protection des sites marécageux et des biotopes.

Art. 23*d*

Aménagement et exploitation des sites marécageux

[1] L'aménagement et l'exploitation des sites marécageux sont admissibles, dans la mesure où ils ne portent pas atteinte aux éléments caractéristiques des sites marécageux.

[2] Sont en particulier admis à la condition prévue à l'al. 1:

a. L'exploitation agricole et sylvicole;

b. L'entretien et la rénovation de bâtiments et d'installations réalisés légalement;

c. Les mesures visant à protéger l'homme contre les catastrophes naturelles;

d. Les installations d'infrastructure nécessaires à l'application des let. a à c ci-dessus.

Chapitre 4: Dispositions pénales

Art. 24[66]

Délits

[1] Sera puni de l'emprisonnement jusqu'à un an ou de l'amende jusqu'à 100 000 francs celui qui, intentionnellement et sans autorisation, aura:[67]

a.[68] Détruit ou endommagé sérieusement une curiosité naturelle ou un monument protégés en vertu de la présente loi, un site protégé évocateur du passé, un site naturel protégé ou un biotope protégé;

b. Essarté, recouvert ou anéanti d'une autre manière la végétation riveraine au sens de l'art. 21;

c.[69] détruit ou endommagé sérieusement des curiosités naturelles ou des antiquités enfouies qui offrent un intérêt scientifique[70] (art. 724, al. 1, CC[71]);

d.[72] Importé ou exporté, transporté ou détenu des plantes ou des produits végétaux au sens des annexes I à III de la Convention du 3 mars 1973[73] sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction, en violation de ses dispositions.

[2] Si le délinquant agit par négligence, il est passible d'arrêts ou d'une amende jusqu'à 40 000 francs.

Art. 24*a*[74]

Contraventions

Sera puni d'une amende jusqu'à 20 000 francs celui qui:[75]

a. Nonobstant le renvoi à la présente disposition pénale, n'aura pas respecté une condition ou une charge à laquelle a été lié l'octroi d'une subvention fédérale;

66 Nouvelle teneur selon le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
67 Nouvelle teneur selon le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO **1997** 1152 1153; FF **1995** IV 621).
68 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
69 Introduite par le ch. I de la LF du 24 mars 1995 (RO **1996** 214; FF **1991** III 1137). Nouvelle teneur selon l'art. 32 ch. 4 de la loi du 20 juin 2003 sur le transfert des biens culturels, en vigueur depuis le 1er juin 2005 (RS **444.1**).
70 Rectifié par la Commission de rédaction de l'Ass. féd. (art. 58, al. 1, LParl – RS **171.10**).
71 **RS 210**
72 Introduite par le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO **1997** 1152 1153; FF **1995** IV 621).
73 **RS 0.453**
74 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
75 Nouvelle teneur selon le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO 1997 1152 1153; FF **1995** IV 621).

b.[76] Aura enfreint une disposition d'exécution édictée en vertu des art. 16, 18, 18*a*, 18*b*, 18*c*, 19, 20, 23*c*, 23*d*, et 25*a* et dont la violation a été déclarée punissable;

c. Se sera livré sans droit à un acte soumis à une autorisation en vertu des articles 19, 22, al. 1, ou 23.

Art. 24*b*[77]

Application aux personnes morales et aux sociétés commerciales

Les articles 6 et 7 de la loi fédérale du 22 mars 1974 sur le droit pénal administratif[78] sont applicables.

Art. 24*c*[79]

Confiscation

L'art. 58 du code pénal suisse[80] sur la confiscation d'objets et d'avantages pécuniaires obtenus illicitement est applicable.

Art. 24*d*[81]

Poursuite pénale

1 La poursuite pénale incombe aux cantons.

2 Les infractions visées à l'art. 24, al. 1, let. d, sont poursuivies et jugées par l'Office vétérinaire fédéral[82] dans les conditions définies par la loi fédérale du 22 mars 1974 sur le droit pénal administratif[83]. S'il s'y ajoute une infraction à la législation douanière, il appartient à l'Administration des douanes de mener l'enquête et de décerner un mandat de répression selon une procédure abrégée.[84]

Art. 24*e*[85]

Remise en état

Indépendamment d'une procédure pénale, celui qui porte atteinte à une curiosité naturelle ou à un monument protégés en vertu de la présente loi, à un site protégé évocateur du passé, à un site naturel pro-

76 Nouvelle teneur selon le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO **1997** 1152 1153; FF **1995** IV 621).
77 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
78 RS **313.0**
79 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
80 RS **311.0**
81 Introduit par le ch. I de la LF du 19 juin 1987, en vigueur depuis le 1er fév. 1988 (RO **1988** 254 258; FF **1985** II 1449).
82 La désignation de l'unité administrative a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**).
83 RS **313.0**
84 Introduit par le ch. I de la LF du 21 juin 1996, en vigueur depuis le 1er juillet 1997 (RO **1997** 1152 1153; FF **1995** IV 621).
85 Introduit par le ch. I de la LF du 19 juin 1987 (RO **1988** 254; FF **1985** II 1449). Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

tégé, à un biotope protégé ou à la végétation protégée des rives peut être tenu:

a. D'annuler les effets des mesures prises illicitement;

b. De prendre à sa charge les frais occasionnés par la réparation du dommage;

c. De fournir une compensation appropriée lorsque le dommage ne peut être réparé.

Chapitre 5: Organisation et information[86]

Art. 25[87]

Organisation[88]

[1] Le Conseil fédéral nomme une ou plusieurs commissions consultatives pour la protection de la nature, la protection du paysage et la conservation des monuments historiques.

[2] Les cantons désignent des services chargés de la protection de la nature, de la protection du paysage et de la conservation des monuments historiques.

Art. 25*a*[89]

Information et conseils

[1] La Confédération et les cantons veillent à informer et à conseiller les autorités et le public sur l'état et l'importance de la nature et du paysage.

[2] Ils recommandent des mesures de protection et d'entretien appropriées

86 Nouvelle teneur selon le ch. I de l'annexe à la LF du 21 déc. 1995, en vigueur depuis le 1er juillet 1997 (RO **1997** 1155 1176; FF **1993** II 1337).

87 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).

88 Introduit par le ch. I de l'annexe à la LF du 21 déc. 1995, en vigueur depuis le 1er juillet 1997 (RO **1997** 1155 1176; FF **1993** II 1337).

89 Introduit par le ch. I de l'annexe à la LF du 21 déc. 1995, en vigueur depuis le 1er juillet 1997 (RO **1997** 1155 1176; FF **1993** II 1337).

Chapitre 6: Dispositions finales[90]

Art. 25*b*[91 92]

Rétablissement de marais et de sites marécageux

[1] Les cantons désignent les installations, les bâtiments et les modifications de la configuration du terrain réalisés après le 1er juin 1983 dans les marais et les sites marécageux d'une beauté particulière et d'importance nationale, qui sont contraires aux buts visés par la protection et qui n'ont pas été autorisés avec force de chose jugée sur la base de zones d'affectation conformes à la loi fédérale du 22 juin 1979 sur l'aménagement du territoire[93].

[2] Dans le site marécageux de Rothenthurm, les cantons de Schwyz et de Zoug désignent les installations, les bâtiments et les modifications de la configuration du terrain réalisés après le 1er juin 1983 et qui tombent sous le coup de la disposition transitoire de l'art. 24sexies, al. 5, de la constitution[94].

[3] L'autorité cantonale ou fédérale compétente pour prendre les décisions concernant les autorisations et l'exécution des projets décide du rétablissement de l'état initial. Lors du rétablissement de l'état initial, on tient compte du principe de la proportionnalité.

Art. 25*c*[95]

Voies de droit

[1] La procédure de recours est régie par la loi fédérale du 20 décembre 1968 sur la procédure administrative[96] et l'organisation judiciaire du 16 décembre 1943[97].

[2] Un recours peut être formé devant la commission de recours DETEC contre les décisions prises en application de la présente loi par l'OFEFP ou par des tiers assumant des tâches d'exécution incombant à l'OFEFP.

[3] Les autorités de recours de première instance consultent l'office fédéral concerné avant de rendre leur décision.

90 Nouvelle teneur selon le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
91 Anciennement art. 25*a*.
92 Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
93 RS **700**
94 [RS 1 3; RO **1962** 783, **1988** 352]. Actuellement "l'art. 78 al. 5 de la Constitution du 18 avril 1999" (RS **101**).
95 Introduit par le ch. 2 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).
96 RS **172.021**
97 RS **173.110**

Art. 26

Entrée en vigueur[99]

Le Conseil fédéral fixe la date de l'entrée en vigueur de la présente loi. Il édicte les dispositions d'exécution nécessaires.

Date de l'entrée en vigueur: 1er janvier 1967[99]

[98] Introduit par le ch. I de la LF du 24 mars 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 214 224; FF **1991** III 1137).
[99] ACF du 27 déc. 1966 (RO **1966** 1702)

Ordonnance concernant l'inventaire fédéral des paysages, sites et monuments naturels (OIFP)

du 10 août 1977 (Etat le 10 mars 1998)

Le Conseil fédéral suisse,

vu l'art. 5 de la loi fédérale du 1er juillet 1966[1] sur la protection de la nature et du paysage (LPN),

arrête:

Art. 1

[1] L'inventaire fédéral des paysages, sites et monuments naturels d'importance nationale (IFP), au sens de l'art. 5 LPN, comprend les objets énumérés dans l'annexe.

[2] ...[2]

Art. 2

La description et la représentation cartographique des divers objets portés à l'IFP, ainsi que les critères selon lesquels ces objets ont été reconnus d'importance nationale seront publiés séparément; cette publication relève des attributions du Département fédéral de l'environnement, des transports, de l'énergie et de la communication[3]. Il mentionnera dans le commentaire accompagnant l'inventaire les autres principes et indications dont celui-ci doit faire état conformément à l'art. 5, al. 1, LPN.

Art. 3

La présente ordonnance entre en vigueur le 21 novembre 1977.

RO **1977** 1962

1. RS **451**
2. Abrogé par le ch. I de l'O du 15 déc. 1997 (RO **1998** 788).
3. La désignation de l'unité administrative a été adaptée selon l'art. 4a de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

Annexe 1[4]
(art. 1[er])

Paysages, sites et monuments d'importance nationale

		Inscription	Révisions
1001	Linkes Bielerseeufer	1977	
1002	Le Chasseral	1977	
1003	Tourbière des Ponts-de-Martel	1977	
1004	Creux du Van et gorges de l'Areuse	1977	
1005	Vallée de la Brévine	1977	
1006	Vallée du Doubs	1977	1983
1007	La Dôle	1977	1998
1008	Franches-Montagnes	1977	1983
1009	Gorges du Pichoux	1977	1983
1010	Weissenstein	1977	1996
1011	Lägerengebiet	1977	
1012	Belchen-Passwang-Gebiet	1983	
1013	Les Roches de Châtoillon	1983	1996
1014	Chassagne	1983	1998
1015	Pied sud du Jura proche de La Sarraz	1983	1998
1016	Aarewaage Aarburg	1996	
1017	Aargauer und östlicher Solothurner Faltenjura	1996	
1018	Aareschlucht Brugg	1996	
1019	Wasserschloss (Zusammenfluss Aare/Reuss/Limmat)	1996	
1020	Ravellenflue und Chluser Roggen bei Oensingen	1996	
1021	Gorges de Moutier	1996	
1022	Vallée de Joux et Haut-Jura vaudois	1998	
1023	Le Mormont	1998	
1101	Etangs de Bonfol et de Vendlincourt	1977	1983
1102	Randen	1977	
1103	Koblenzer Laufen	1977	
1104	Tafeljura nördlich Gelterkinden	1983	
1105	Baselbieter und Fricktaler Tafeljura	1983	1996
1106	Chilpen bei Diegten	1983	1996
1107	Gempenplateau	1983	
1108	Aargauer Tafeljura	1996	
1109	Aarelandschaft bei Klingnau	1996	
1110	Wangen- und Osterfingertal	1996	
1201	La Côte	1977	1998
1202	Lavaux	1977	1998
1203	Grèves vaudoises de la rive gauche du lac	1977	1998

4 Nouvelle teneur selon le ch. II de l'O du 15 déc. 1997, en vigueur depuis le 1[er] avril 1998 (RO **1998** 788).

		Inscription	Révisions
	de Neuchâtel		
1204	Le Rhône genevois-Vallons de l'Allondon et de La Laire	1977	1996
1205	Bois de Chênes	1977	
1206	Coteaux de Cortaillod et de Bevaix	1977	
1207	Marais de la haute Versoix	1977	1998
1208	Rive sud du lac de Neuchâtel	1983	1998
1209	Mont Vully	1983	
1210	Chanivaz delta de l'Aubonne	1996	
1301	St. Petersinsel-Heidenweg	1977	
1302	Alte Aare/Alte Zihl	1977	1996
1303	Hallwilersee	1977	
1304	Baldeggersee	1977	
1305	Reusslandschaft	1977	
1306	Albiskette-Reppischtal	1983	
1307	Glaziallandschaft zwischen Lorzentobel und Sihl mit Höhronenkette	1993	
1308	Moorlandschaft Rothenthurm-Altmatt-Biberbrugg	1983	
1309	Zugersee	1983	
1310	Gletschergarten Luzern	1983	
1311	Napfbergland	1983	
1312	Wässermatten in den Tälern der Langete, der Rot und der Önz	1983	1996
1313	Steinhof-Steinenberg-Burgäschisee	1983	
1314	Aarelandschaft Thun-Bern	1983	
1315	Amsoldinger- und Uebeschisee	1983	
1316	Stausee Niederried	1983	
1317	Endmoränenzone von Staffelbach	1996	
1318	Wauwilermoos-Hagimoos-Mauensee	1996	
1319	Aareknie Wolfwil-Wynau	1996	
1320	Schwarzenburgerland mit Sense- und Schwarzwasser-Schluchten	1996	
1321	Emmentallandschaft mit Räbloch, Schopfgraben und Rämisgummen	1996	
1401	Drumlinlandschaft Zürcher Oberland	1977	
1402	Irnenberg	1977	
1403	Glaziallandschaft zwischen Thur und Rhein mit Nussbaumer Seen und Andelfinger Seenplatte	1977	1983
1404	Glaziallandschaft Neerach-Stadel	1977	
1405	Frauenwinkel-Ufenau-Lützelau	1977	
1406	Zürcher Obersee	1977	1996
1407	Katzenseen	1977	
1408	Unteres Fällander Tobel	1977	
1409	Pfäffikersee	1977	

		Inscription	Révisions
1410	Irchel	1977	
1411	Untersee-Hochrhein	1983	
1412	Rheinfall	1983	
1413	Thurgauisch-fürstenländische Kulturlandschaft mit Hudelmoos	1983	
1414	Thurlandschaft Lichtensteig-Schwarzenbach	1983	1996
1415	Böllenbergtobel bei Uznach	1983	
1416	Kaltbrunner Riet	1983	
1417	Lützelsee-Seeweidsee-Uetziker Riet	1983	
1418	Espi-Hölzli	1983	
1419	Pfluegstein ob Erlenbach	1983	
1420	Hörnli-Bergland (Quellgebiete der Töss und der Murg)	1996	
1501	Gelten-Iffigen	1977	
1502	Les Grangettes	1977	1998
1503/1713	Diablerets-Vallon de Nant-Derborence (partie ouest)	1977	1998
1504	Vanil Noir	1977	1996/98
1505	Hohgant	1977	
1506	Chaltenbrunnenmoor-Wandelalp	1977	
1507/1706	Berner Hochalpen und Aletsch-Bietschhorn-Gebiet (nördlicher Teil)	1983	1996
1508	Weissenau	1983	
1509	Luegibodenblock	1983	
1510	La Pierreuse-Gummfluh-Vallée de l'Etivaz	1983	1998
1511	Giessbach	1996	
1512	Aareschlucht Innertkirchen-Meiringen	1996	
1513	Engstligenfälle mit Engstligenalp	1996	
1514	Breccaschlund	1996	
1515	Tour d'Aï-Dent de Corjon	1998	
1601	Silberen	1977	
1602	Murgtal-Mürtschental	1977	
1603	Maderanertal-Fellital	1977	
1604	Lauerzersee	1977	
1605	Pilatus	1977	
1606	Vierwaldstättersee mit Kernwald, Bürgenstock und Rigi	1983	
1607	Bergsturzgebiet von Goldau	1983	
1608	Flyschlandschaft Hagleren-Glaubenberg-Schlieren	1983	
1609	Schrattenflue	1983	
1610	Scheidnössli bei Erstfeld	1983	
1611	Lochseite bei Schwanden	1983	
1612	Säntisgebiet	1996	
1613	Speer-Churfirsten-Alvier	1996	
1614	Taminaschlucht	1996	

		Inscription	Révisions
1615	Melser Hinterberg-Flumser Kleinberg	1996	
1701	Binntal	1977	
1702	Lac de Tanay	1977	
1703	Val de Bagnes	1977	
1704	Mont d'Orge près de Sion	1977	
1705	Valère et Tourbillon	1977	
1706/1507	Berner Hochalpen und Aletsch-Bietschhorn-Gebiet (südlicher Teil)	1983	1998
1707	Dent Blanche-Matterhorn-Monte Rosa	1983	1998
1708	Pyramides d'Euseigne	1983	
1709	Blocs erratiques au-dessus de Monthey et de Collombey	1983	
1710	Rhonegletscher mit Vorgelände	1996	
1711	Raron-Heidnischbiel	1996	1998
1712	Les Follatères-Mont du Rosel	1996	
1713/1503	Diablerets-Vallon de Nant-Derborence (partie est)	1996	
1714	Bergij-Platten	1998	
1715	Gorges du Trient	1998	
1716	Pfynwald-Illgraben	1998	
1717	Laggintal-Zwischbergental	1998	
1718	Val de Réchy-Sasseneire	1998	
1801	Piora-Lucomagno-Dötra	1977	
1802	Delta del Ticino e della Verzasca	1977	
1803	Monte Generoso	1977	
1804	Monte San Giorgio	1977	
1805	Monte Caslano	1977	
1806	Ponte Brolla-Losone	1977	
1807	Val Verzasca	1983	
1808	Val Bavona	1983	
1809	Campolungo-Campo Tencia-Piumogna	1983	
1810	San Salvatore	1983	
1811	Arbòstora-Morcote	1983	
1812	Gandria e dintorni	1983	
1813	Denti della Vecchia	1983	
1814	Paesaggio fluviale e antropico della Valle del Sole (Blenio)	1996	
1901	Lag da Toma	1977	
1902	Ruinaulta	1977	
1903	Auenlandschaft am Unterlauf des Hinterrheins	1977	
1904	Val di Campo	1977	
1905	Kesch-Ducan-Gebiet	1977	
1906	Trockengebiet im unteren Domleschg	1977	
1907	Quellgebiet des Hinterrheins und San Bernardino Passhöhe	1977	
1908	Oberengadiner Seenlandschaft und	1983	

		Inscription	Révisions
	Berninagruppe		
1909	Piz Arina	1983	
1910	Silvretta-Vereina	1983	
1911	Tomalandschaft bei Domat/Ems	1983	
1912	Paludi del San Bernardino	1996	
1913	Greina-Piz Medel	1996	
1914	Plasseggen-Schijenflue	1996	
1915	Schweizerischer Nationalpark und Randgebiete	1996	
1916	Val Bondasca-Val da l'Albigna	1998	

Ordonnance sur la protection des zones alluviales d'importance nationale

(Ordonnance sur les zones alluviales)

du 28 octobre 1992 (Etat le 2 décembre 2003)

Le Conseil fédéral suisse,

vu l'art. 18*a*, al. 1 et 3, de la loi fédérale du 1er juillet 1966[1] sur la protection de la nature et du paysage (LPN),

arrête:

Art. 1 Inventaire fédéral

L'Inventaire fédéral des zones alluviales d'importance nationale (Inventaire des zones alluviales) comprend les objets énumérés à l'annexe 1.

Art. 2 Description des objets

[1] La description des objets est publiée séparément. En tant qu'annexe 2, elle fait partie intégrante de la présente ordonnance.

[2] La publication peut être consultée en tout temps à l'Office fédéral de l'environnement, des forêts et du paysage (office fédéral) et auprès des cantons.[2] Ceux-ci désignent les services concernés.

Art. 3 Délimitation des objets

[1] Les cantons, après avoir pris l'avis des propriétaires fonciers et des exploitants, fixent les limites précises des objets. Ils délimitent des zones-tampon suffisantes du point de vue écologique en tenant compte, notamment, d'autres biotopes attenants.

[2] Lorsque les limites précises n'ont pas encore été fixées, l'autorité cantonale compétente prend, sur demande, une décision de constatation de l'appartenance d'un bien-fonds à un objet. Le requérant doit pouvoir fonder sa demande sur l'existence d'un intérêt digne de protection.

RO **1992** 2080

1 RS **451**

2 Nouvelle teneur selon le ch. I 1 de l'O du 15 janv. 2003 concernant la modification de la réglementation sur la consultation dans les ordonnances en matière de biotopes selon l'art. 18*a* LPN (RO **2003** 249).

Art. 4 But visé par la protection

[1] Les objets doivent être conservés intacts. Font notamment partie de ce but:

a. la conservation et le développement de la flore et de la faune indigènes typiques des zones alluviales et des éléments écologiques indispensables à leur existence;

b. la conservation et, pour autant que ce soit judicieux et faisable, le rétablissement de la dynamique naturelle du régime des eaux et du charriage;

c. la conservation des particularités géomorphologiques des objets.[3]

[2] On n'admettra de dérogation du but visé par la protection que pour des projets dont l'emplacement s'impose directement par leur destination et qui sont destinés à assurer la sécurité de l'homme face aux effets dommageables de l'eau ou qui servent un autre intérêt public prépondérant d'importance nationale également. L'auteur de l'atteinte doit être tenu de prendre toutes mesures possibles pour assurer la protection, la reconstitution ou, à défaut, le remplacement adéquat de la zone alluviale.

Art. 5 Mesures de protection et d'entretien

[1] Les cantons, après avoir pris l'avis des propriétaires fonciers et des exploitants, prennent les mesures de protection et d'entretien adéquates pour conserver les objets intacts. Une importance particulière est accordée à la conservation et à la valorisation d'une exploitation agricole et sylvicole durable et adaptée.[4]

[2] Ils veillent notamment à ce que:

a. les plans et les prescriptions qui règlent le mode d'utilisation du sol au sens de la législation en matière d'aménagement du territoire soient conformes à la présente ordonnance;

b. les zones alluviales ayant un régime des eaux et de charriage intact ou peu altéré soient intégralement protégées;

c. les exploitations existantes ou futures, notamment l'agriculture et la sylviculture, l'utilisation des forces hydrauliques, l'exploitation des eaux souterraines et de graviers, la navigation et les activités de loisirs, y compris la pêche, soient en accord avec le but visé par la protection;

d. le développement des espèces végétales et animales rares et menacées soit favorisé, de même que celui de leur biocénoses;

e. la qualité de l'eau et du sol s'améliore grâce à une réduction des apports de substances nutritives et de polluants.

[3] Les dispositions des al. 1 et 2 sont aussi applicables aux zones-tampon dans la mesure où le but visé par la protection l'exige.

3 Nouvelle teneur selon le ch. I de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4131).

4 Nouvelle teneur selon le ch. I de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4131).

Art. 6 Délais

[1] Les mesures prévues à l'art. 3, al. 1, et à l'art. 5 doivent être prises dans un délai de trois ans.

[2] Pour les cantons à faible et à moyenne capacité financière, pour lesquels la protection des zones alluviales représente une charge considérable, ce délai est six ans au maximum lorsqu'il s'agit d'objets dont la conservation n'est pas menacée. Le Département fédéral de l'environnement, des transports, de l'énergie et de la communication[5] désigne ces cantons.

Art. 7 Protection transitoire

Tant que les cantons n'ont pas pris de mesures de protection et d'entretien, ils veillent, par des mesures immédiates et appropriées, à ce que l'état des objets ne se dégrade pas.

Art. 8[6] Réparation des atteintes

Les cantons veillent, chaque fois que l'occasion se présente, à ce que les atteintes portées aux objets, notamment à la dynamique naturelle du régime des eaux et du charriage, soient réparées dans la mesure du possible.

Art. 9 Devoirs de la Confédération

[1] Dans leur activité, les autorités, services, instituts et établissements fédéraux sont tenus de conserver les objets conformément au but visé par la protection.

[2] Ils prennent les mesures prévues aux art. 5, 7 et 8 dans les domaines relevant de leur compétence en vertu de la législation fédérale spéciale y relative.

Art. 10 Compte rendu

[1] Tant qu'ils n'ont pas pris les mesures nécessaires selon l'art. 3, al. 1, et l'art. 5, les cantons rendent compte à l'office fédéral à la fin de chaque année de l'état de la protection des zones alluviales situées sur leur territoire.

[2] Au plus tard dans leur dernier rapport, ils indiquent à l'office fédéral les atteintes au sens de l'art. 8 qu'ils envisagent de réparer et dans quel délai.

5 La désignation de l'unité administrative a été adaptée selon l'art. 4a de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

6 Nouvelle teneur selon le ch. I de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4131).

Art. 11 Prestations de la Confédération

[1] La Confédération conseille et soutient les cantons dans l'accomplissement des tâches prévues par la présente ordonnance.

[2] Les indemnités de la Confédération pour les mesures prévues aux art. 3, 5 et 8 de la présente ordonnance sont régies par les art. 17 et 19 de l'ordonnance du 16 janvier 1991[7] sur la protection de la nature et du paysage.

Art. 12 Entrée en vigueur

La présente ordonnance entre en vigueur le 15 novembre 1992.

7 RS 451.1

Annexe 1[8]
(art. 1er)

Liste des zones alluviales d'importance nationale

N°	Localité	Commune(s)	Inscription	Révision
	Canton de Zurich			
5	Eggrank–Thurspitz	Andelfingen, Flaach, Kleinandelfingen, Marthalen[9]	1992	
92	Still Rüss–Rickenbach	Obfelden, Ottenbach[10]	1992	2003
95	Ober Schachen–Rüssspitz	Obfelden[11]	1992	2003
343	Freienstein–Tössegg	Eglisau, Freienstein-Teufen, Rorbas	2003	
344	Dättlikon–Freienstein	Dättlikon, Embrach, Freienstein-Teufen, Rorbas	2003	
345	Oberglatt	Oberglatt, Rümlang	2003	
	Canton de Berne			
44	Oberburger Schachen	Burgdorf, Hasle bei Burgdorf, Heimiswil, Rüegsau	1992	2003
46	Utzenstorfer Schachen	Utzenstorf	1992	
47	Altwässer der Aare und der Zihl	Büren an der Aare, Dotzigen, Meienried, Meinisberg, Safnern, Scheuren, Schwadernau	1992	
48	Alte Aare: Lyss–Dotzigen	Büetigen, Busswil bei Büren, Dotzigen, Kappelen, Lyss, Schwadernau, Studen, Worben	1992	2003
49	Alte Aare: Aarberg–Lyss	Aarberg, Kappelen, Lyss	1992	2003
53	Niederried–Oltigenmatt	Golaten, Mühleberg, Niederried bei Kallnach, Radelfingen, Wileroltigen	1992	
55	Senseauen	Albligen, Guggisberg, Köniz, Neuenegg, Wahlern[12]	1992	
58	Teuffengraben–Sackau	Rüeggisberg, Rüschegg, Wahlern	1992	

8 Nouvelle teneur selon le ch. II de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4131).
9 L'objet est situé dans les communes: Buchberg, Rüdlingen SH/ Andelfingen, Flaach, Kleinandelfingen, Marthalen ZH.
10 L'objet est situé dans les communes: Aristau, Jonen, Merenschwand, Oberlunkhofen, Rottenschwil, Unterlunkhofen AG/Obfelden, Ottenbach ZH.
11 L'objet est situé dans les communes: Merenschwand, Mühlau AG/Hünenberg ZG/ Obfelden ZH.
12 L'objet est situé dans les communes: Albligen, Guggisberg, Köniz, Neuenegg, Wahlern BE/ Alterswil, Heitenried, Plaffeien, St. Antoni, Ueberstorf, Zumholz FR.

N°	Localité	Commune(s)	Inscription	Révision
59	Laupenau	Ferenbalm, Laupen, Mühleberg	1992	
69	Belper Giessen	Allmendingen, Belp, Berne, Kehrsatz, Köniz, Münsingen, Muri bei Bern, Rubigen	1992	
70	Chandergrien	Spiez	1992	
71	Augand	Reutigen, Spiez, Wimmis	1992	2003
72	Heustrich	Aeschi bei Spiez, Reichenbach im Kandertal, Wimmis	1992	2003
74	Gastereholz	Kandersteg	1992	
75	Brünnlisau	Diemtigen, Erlenbach im Simmental, Wimmis	1992	
76	Wilerau	Diemtigen, Erlenbach im Simmental	1992	
77	Niedermettlisau	Därstetten, Erlenbach im Simmental	1992	
78	Engstlige: Bim Stei–Oybedly	Frutigen	1992	
79	Weissenau	Unterseen	1992	
80	Chappelistutz	Gsteigwiler, Wilderswil	1992	
81	In Erlen	Grindelwald	1992	
83	Jägglisglunte	Brienz	1992	
84	Sytenwald	Meiringen	1992	
86	Sandey	Innertkirchen	1992	2003
209	Seewald–Fanel	Gampelen, Ins[13]	1992	
221	Aare bei Altreu	Arch, Leuzigen[14]	1992	
222	Heidenweg/St. Petersinsel	Erlach, Twann	1992	
223	Hagneckdelta	Hagneck, Lüscherz, Täuffelen	1992	
224	Rohr–Oey	Lauenen	1992	
314	Kalte Sense	Guggisberg[15]	2003	
315	Rotenbach	Guggisberg, Rüschegg	2003	
319	Emmeschlucht	Eggiwil, Schangnau	2003	
321	Harzisboden	Habkern, Oberried am Brienzersee	2003	
322	Rezliberg	Lenk	2003	
323	Hornbrügg	Adelboden	2003	
324	Lochweid	Adelboden	2003	
325	Gastere bei Selden	Kandersteg	2003	
326	Tschingel	Reichenbach im Kandertal	2003	
327	Ganzenlouwina	Grindelwald	2003	
1121	Kanderfirn	Kandersteg	2001	
1132	Rezligletscher	Lenk	2001	

13 L'objet est situé dans les communes: Gampelen, Ins BE/Marin-Epagnier NE.
14 L'objet est situé dans les communes: Arch, Leuzigen BE/Bettlach, Selzach SO.
15 L'objet est situé dans les communes: Guggisberg BE/Plaffeien FR.

N°	Localité	Commune(s)	Inscrip-tion	Révision
1139	Geltengletscher	Lauenen	2001	
1206	Gauligletscher	Innertkirchen	2001	
1214	Diechtergletscher	Guttannen	2001	
1216	Rosenlauigletscher	Schattenhalb	2001	
1327	Bächlisboden	Guttannen	2001	
1352	Engstligenalp	Adelboden	2003	
1354	Spittelmatte	Kandersteg[16]	2001	
1401	Gamchigletscher	Reichenbach im Kandertal	2001	
	Canton de Lucerne			
98	Ämmenmatt	Doppleschwand, Entlebuch, Wolhusen	1992	2003
338	Unterer Schiltwald	Buchrain, Emmen, Eschenbach	2003	
339	Badhus–Graben	Doppleschwand, Romoos	2003	
340	Entlental	Entlebuch, Hasle	2003	
341	Flühli	Flühli	2003	
	Canton d'Uri			
105	Reussdelta	Flüelen, Seedorf	1992	2003
107	Stössi	Silenen	1992	2003
108	Widen bei Realp	Hospental, Realp	1992	2003
349	Grosstal	Isenthal	2003	
351	Unterschächen–Spiringen	Spiringen, Unterschächen	2003	
352	Alpenrösli–Herrenrüti	Attinghausen[17]	2003	
353	Altboden	Wassen	2003	
354	Gorneren	Gurtnellen	2003	
355	Stäuberboden	Silenen	2003	
356	Unteralp	Andermatt	2003	
1008	Hüfifirn	Silenen	1992	2001
1010	Brunnifirn	Silenen	2001	
1218	Tiefengletscher	Realp	2001	
1219	Dammagletscher	Göschenen	2001	
1221	Chelengletscher	Göschenen	2001	
1228	Kartigelfirn	Wassen	2001	
1229	Wallenburfirn	Göschenen	2001	
	Canton de Schwyz			
104	Tristel	Muotathal	1992	
110	Biber im Ägeriried	Einsiedeln, Rothenthurm[18]	1992	
225	Aahorn	Lachen	1992	

16 L'objet est situé dans les communes: Kandersteg BE/Leukerbad VS.
17 L'objet est situé dans les communes: Engelberg OW/Attinghausen UR.
18 L'objet est situé dans les communes: Einsiedeln, Rothenthurm SZ/Oberägeri ZG.

N°	Localité	Commune(s)	Inscrip-tion	Révision
	Canton d'Obwald			
99	Schlierenrüti	Alpnach	1992	
100	Städerried	Alpnach	1992	
101	Laui	Giswil	1992	
102	Steinibach	Giswil, Sarnen	1992	
352	Alpenrösli–Herrenrüti	Engelberg[19]	2003	
	Canton de Nidwald			
	Sans objet			
	Canton de Glaris			
109	Hinter Klöntal	Glaris	1992	2003
216	Chrauchbach: Haris	Matt	1992	2003
1302	Oberstafelbach	Linthal	2001	
	Canton de Zoug			
95	Ober Schachen–Rüssspitz	Hünenberg[20]	1992	
97	Frauental	Cham	1992	2003
110	Biber im Ägeriried	Oberägeri[21]	1992	
	Canton de Fribourg			
52	Les Iles de Villeneuve	Villeneuve[22]	1992	2001
55	Senseauen	Alterswil, Heitenried, Plaffeien, St. Antoni, Ueberstorf, Zumholz[23]	1992	
60	Bois du Dévin	Hauterive, Marly	1992	
61	Ärgera: Plasselb–Marly	Giffers, Marly, Pierrafortscha, Plasselb, St. Silvester, Tentlingen, Villarsel-sur-Marly	1992	
62	La Sarine: Rossens–Fribourg	Arconciel, Corpataux-Magnedens, Fribourg, Hauterive, Marly, Pierrafortscha, Pont-la-Ville, Rossens, Treyvaux, Villars-sur-Glâne	1992	2003
64	Broc	Botterens, Broc, La Tour-de-Trême, Morlon	2003	

19 L'objet est situé dans les communes: Engelberg OW/Attinghausen UR.
20 L'objet est situé dans les communes: Merenschwand, Mühlau AG/Hünenberg ZG/Obfelden ZH.
21 L'objet est situé dans les communes: Einsiedeln, Rothenthurm SZ/Oberägeri ZG.
22 L'objet est situé dans les communes: Villeneuve FR/Granges-près-Marnand VD.
23 L'objet est situé dans les communes: Albligen, Guggisberg, Köniz, Neuenegg, Wahlern BE/Alterswil, Heitenried, Plaffeien, St. Antoni, Ueberstorf, Zumholz FR.

N°	Localité	Commune(s)	Inscrip-tion	Révision
65	Les Auges d'Estavannens	Enney, Estavannens, Grandvillard, Gruyères	1992	
66	Les Auges de Neirivue	Grandvillard, Haut-Intyamon, Villars-sous-Mont	1992	
203	Les Grèves d'Yvonand–Cheyres	Cheyres[24]	1992	2001
204	Les Grèves de Cheyres–Font	Châbles, Cheyres, Font	1992	
205	Les Grèves d'Estavayer-le-Lac–Chevroux	Autavaux, Estavayer-le-Lac, Forel[25]	1992	2001
206	Les Grèves de Chevroux–Portalban	Gletterens, Portalban[26]	1992	2001/03
207	Les Grèves de Portalban–Cudrefin	Delley[27]	1992	2001
217	La Neirigue et la Glâne	Autigny, Le Glèbe, Massonnens, Villaz-Saint-Pierre, Villorsonnens	1992	2003
307	Le Chablais	Bas-Vully, Galmiz, Muntelier	2003	
310	Lac de Montsalvens	Charmey	2003	
313	Muscherensense	Plaffeien	2003	
314	Kalte Sense	Plaffeien[28]	2003	
	Canton de Soleure			
45	Emmenschachen	Luterbach, Zuchwil	1992	
221	Aare bei Altreu	Bettlach, Selzach[29]	1992	
	Canton de Bâle-Ville			
	Sans objet			
	Canton de Bâle-Campagne			
	Sans objet			
	Canton de Schaffhouse			
4	Seldenhalde	Schleitheim	1992	2003
5	Eggrank–Thurspitz	Buchberg, Rüdlingen[30]	1992	
342	Bibermüli	Hemishofen, Ramsen	2003	

24 L'objet est situé dans les communes: Cheyres FR/, Yvonand VD.
25 L'objet est situé dans les communes: Autavaux, Estavayer-le-Lac, Forel FR/ Chevroux VD.
26 L'objet est situé dans les communes: Gletterens, Portalban FR/Chevroux VD.
27 L'objet est situé dans les communes: Delley FR Chabrey, Cudrefin VD.
28 L'objet est situé dans les communes: Guggisberg BE/Plaffeien FR.
29 L'objet est situé dans les communes: Arch, Leuzigen BE/ Bettlach, Selzach SO.
30 L'objet est situé dans les communes: Buchberg, Rüdlingen SH/Andelfingen, Flaach, Kleinandelfingen, Marthalen ZH.

N°	Localité	Commune(s)	Inscription	Révision
	Canton d'Appenzell Rhodes-Extérieures			
371	Ampferenboden	Urnäsch[31]	2003	
	Canton d'Appenzell Rhodes-Intérieures			
	Sans objet			
	Canton de Saint-Gall			
12	Ghöggerhütte	Niederbüren[32]	1992	
14	Glatt nordwestlich Flawil	Flawil, Oberbüren, Oberuzwil	1992	
16	Gillhof–Glattburg	Niederhelfenschwil, Oberbüren, Uzwil, Zuzwil	1992	
18	Thurauen Wil-Weieren	Uzwil, Wil, Zuzwil	1992	
19	Thur und Necker bei Lütisburg	Bütschwil, Ganterschwil, Lütisburg, Mogelsberg	1992	2003
219	Altenrhein	Thal	1992	
369	Goldachtobel	Goldach, Mörschwil, St. Gallen, Untereggen	2003	
371	Ampferenboden	Krummenau[33]	2003	
373	Schilstal / Sand	Flums	2003	
374	Rheinau / Cholau	Sevelen, Wartau	2003	
376	Sarelli–Rosenbergli	Bad Ragaz	2003	
	Canton des Grisons			
27	Rhäzünser Rheinauen	Bonaduz, Domat/Ems, Rhäzüns, Rothenbrunnen	1992	2003
28	Cumparduns	Fürstenau, Scharans, Sils im Domleschg, Thusis	1992	2003
29	Cauma	Castrisch, Sagogn, Schluein	1992	2003
30	Plaun da Foppas	Ilanz, Rueun, Schnaus	1992	2003
31	Cahuons	Sumvitg, Trun	1992	2003
32	Disla–Pardomat	Disentis/Mustér, Sumvitg	1992	2003
33	Fontanivas–Sonduritg	Disentis/Mustér	1992	2003
34	Gravas	Tujetsch	1992	2003
35	Ogna da Pardiala	Breil/Brigels, Rueun, Waltensburg/Vuorz	1992	2003
157	Isola	San Vittore[34]	1992	
158	Ai Fornas	Roveredo, San Vittore	1992	2003

31 L'objet est situé dans les communes: Urnäsch AR/Krummenau SG.
32 L'objet est situé dans les communes: Niederbüren SG/Bischofszell TG.
33 L'objet est situé dans les communes: Urnäsch AR/Krummenau SG.
34 L'objet est situé dans les communes: San Vittore GR/Lumino TI.

N°	Localité	Commune(s)	Inscription	Révision
160	Pascoletto	Grono, Leggia	1992	
161	Rosera	Lostallo	1992	2003
162	Pomareda	Lostallo, Soazza	1992	2003
164	Canton	Mesocco, Soazza	1992	
166	Pian di Alne	Cauco, Rossa	1992	2003
174	Strada	Tschlin	1992	2003
176	Plan-Sot	Ramosch	1992	2003
177	Panas-ch–Resgia	Ramosch, Sent	1992	2003
181	Lischana–Suronnas	Scuol	1992	
185	Sotruinas	Susch	1992	
187	Blaisch dal Piz dal Ras	Susch	1992	
188	San Batrumieu	Madulain, Zuoz	1992	
190	Isla Glischa–Arvins–Seglias	Bever, La Punt-Chamues-ch, Samedan	1992	
194	Flaz	Celerina/Schlarigna, Samedan	1992	
195	Il Rom Valchava-Graveras (Müstair)	Müstair, Santa Maria Val Müstair, Valchava	1992	2003
380	Alp Val Tenigia	Sumvitg	2003	
393	Isola / Plan Grand	Sils im Engadin/Segl, Stampa	2003	
394	Ova da Roseg	Pontresina	2003	
396	Ova dal Fuorn	Zernez	2003	
1006	Glatscher da Gavirolas	Andiast, Waltensburg/Vuorz	2001	
1013	Vadret Vallorgia	S-chanf	2001	
1017	Vadret da Grialetsch	Susch	2001	
1020	Silvrettagletscher	Klosters-Serneus	2001	
1044	Vadrec da la Bondasca	Bondo	2001	
1046	Vadrec del Forno	Stampa	2001	
1057	Tambogletscher	Medels im Rheinwald, Splügen	2001	
1061	Paradiesgletscher	Hinterrhein	2001	
1063	Canal Gletscher	Vals	2001	
1066	Fanellgletscher	Vals	2001	
1231	Vadrec da Fedoz	Stampa	2001	
1235	Vadret da Roseg	Samedan	2001	
1238	Vadret da Morteratsch	Pontresina	2001	
1246	Glatscher da Plattas	Medel (Lucmagn)	2001	
1247	Glatscher da Lavaz	Medel (Lucmagn)	2001	
1252	Vadret da Porchabella	Bergün/Bravuogn, S-chanf	2001	
1254	Vadret da Palü	Poschiavo	2001	
1258	Vadret da Fenga «Süd»	Ramosch, Sent	2001	
1262	Glatschiu dil Segnas	Flims	2001	
1301	Val Frisal	Breil/Brigels	2001	
1310	Rabiusa Engi	Safien	2001	
1315	Pradatsch, Val Plavna	Tarasp	2001	
1316	Plaun Segnas Sut	Flims	2001	
1320	Plaun la Greina	Vrin	1992	2001

N°	Localité	Commune(s)	Inscription	Révision
1323	Lampertschalp	Vals	2001	
1342	Bergalga	Avers	2001	
1347	Ragn d'Err	Tinizong-Rona	2001	
1348	Plaun Vadret, Val Fex	Sils im Engadin/Segl	2001	
1404	Aua da Fedoz	Stampa	2001	
1405	Glatscher Davos la Buora	Medel (Lucmagn)	2001	
	Canton d'Argovie			
2	Haumättli	Möhlin	1992	2003
3	Koblenzer Rhein und Laufen	Koblenz, Rietheim	1992	
36	Auenreste Klingnauer Stausee	Böttstein, Klingnau, Koblenz, Leuggern	1992	
37	Wasserschloss Brugg–Stilli	Brugg, Gebenstorf, Stilli, Untersiggenthal, Windisch	1992	2001
40	Umiker Schachen–Stierenhölzli	Brugg, Schinznach-Bad, Schinznach-Dorf, Umiken, Villnachern	1992	
51	Reussinsel Risi	Mellingen, Stetten, Tägerig	1992	
87	Rüsshalden	Mellingen, Wohlenschwil	1992	2003
88	Tote Reuss–Alte Reuss	Bremgarten, Eggenwil, Fischbach-Göslikon, Künten	1992	2003
91	Rottenschwiler Moos	Hermetschwil-Staffeln, Rottenschwil, Unterlunkhofen	1992	
92	Still Rüss–Rickenbach	Aristau, Jonen, Merenschwand, Oberlunkhofen, Rottenschwil, Unterlunkhofen[35]	1992	2003
95	Ober Schachen–Rüssspitz	Merenschwand, Mühlau[36]	1992	2003
220	Rossgarten	Leibstadt, Schwaderloch	1992	
337	Möriken–Wildegg	Möriken-Wildegg, Othmarsingen	2003	
	Canton de Thurgovie			
6	Schäffäuli	Neunforn	1992	2003
7	Wuer	Frauenfeld, Uesslingen-Buch, Warth-Weiningen	1992	2003
8	Hau–Äuli	Frauenfeld, Warth-Weiningen	1992	2003
9	Wyden bei Pfyn	Felben-Wellhausen, Hüttlingen, Pfyn	1992	2003

[35] L'objet est situé dans les communes: Aristau, Jonen, Merenschwand, Oberlunkhofen, Rottenschwil, Unterlunkhofen AG/Obfelden, Ottenbach ZH.
[36] L'objet est situé dans les communes: Merenschwand, Mühlau AG/Hünenberg ZG/ Obfelden ZH.

N°	Localité	Commune(s)	Inscription	Révision
11	Unteres Ghögg	Bischofszell	1992	2003
12	Ghöggerhütte	Bischofszell[37]	1992	2003
	Canton du Tessin			
146	Bosco dei Valloni	Bedretto	1992	
147	Soria	Bedretto	1992	
148	Geròra	Airolo	1992	2003
149	Albinasca	Airolo	1992	
150	Bolla di Loderio	Biasca, Malvaglia, Semione	1992	
151	Brenno di Blenio	Aquila, Castro, Corzoneso, Dongio, Largario, Leontica, Lottigna, Ludiano, Olivone, Ponto Valentino, Prugiasco, Torre	1992	
155	Campall	Olivone	1992	
156	Bessa	Lumino	1992	
157	Isola	Lumino[38]	1992	
167	Boschetti	Gudo, Sementina	1992	
168	Ciossa Antognini	Cadenazzo, Cugnasco, Gudo, Locarno	1992	
169	Bolle di Magadino	Gordola, Locarno, Magadino	1992	
170	Saleggio	Aurigeno, Gordevio, Maggia, Moghegno	1992	2003
171	Maggia	Bignasco, Cevio, Coglio, Giumaglio, Lodano, Maggia, Moghegno, Someo	1992	
172	Somprei–Lovalt	Broglio, Peccia, Prato-Sornico	1992	2003
227	Sonlèrt–Sabbione	Bignasco, Cavergno	1992	
228	Foce della Maggia	Ascona, Locarno	1992	
229	Madonna del Piano	Croglio, Monteggio	1992	
357	Ghirone	Ghirone	2003	
358	Chiggiogna–Lavorgo	Chiggiogna, Chironico	2003	
359	Biaschina–Giornico	Giornico	2003	
360	Fontane	Malvaglia	2003	
361	Madra	Malvaglia	2003	
362	Calnegia	Bignasco, Cavergno	2003	
363	Mött di Tirman	Campo (Vallemaggia)	2003	
364	Sonogno–Brione	Brione (Verzasca), Frasco, Gerra (Verzasca), Sonogno	2003	
365	Ruscada	Cresciano	2003	
366	Vezio–Aranno	Aranno, Breno, Fescoggia, Mugliegia	2003	

37 L'objet est situé dans les communes: Niederbüren SG/Bischofszell TG.
38 L'objet est situé dans les communes: San Vittore GR/Lumino TI.

N°	Localité	Commune(s)	Inscrip-tion	Révision
367	Caslano	Caslano, Magliaso	2003	
1079	Ghiacciaio del Basòdino W	Bignasco	2001	
	Canton de Vaud			
50	Sagnes de la Burtignière	Le Chenit	1992	2001
52	Les Iles de Villeneuve	Granges-près-Marnand[39]	1992	2001
68	La Sarine près Château-d'Oex	Château-d'Oex	1992	2001
118	Grand Bataillard	Chavannes-de-Bogis, Chavannes-des-Bois, Commugny	1992	2001
119	Embouchure de l'Aubonne	Allaman, Buchillon	1992	2001
120	Les Iles de Bussigny	Aclens, Bremblens, Bussigny-près-Lausanne, Echandens	1992	2001
121	La Roujarde	Gollion, Penthaz, Vufflens-la-Ville	1992	2001
122	Bois de Vaux	Lussery-Villars, Penthalaz	1992	2001
123	Les Grangettes	Noville	1992	2001
124	Iles des Clous	Yvorne	1992	
198	Les Grèves de Concise	Concise	1992	2001
200	Les Grèves de Grandson–Bonvillars–Onnens	Bonvillars, Grandson, Onnens	1992	2001
201	Les Grèves d'Yverdon–Les Tuileries	Grandson, Montagny-près-Yverdon, Yverdon-les-Bains	1992	2001
202	Les Grèves d'Yverdon–Yvonand	Cheseaux-Noréaz, Yverdon-les-Bains, Yvonand	1992	2001
203	Les Grèves d'Yvonand–Cheyres	Yvonand[40]	1992	2001
205	Les Grèves d'Estavayer-le-Lac–Chevroux	Chevroux[41]	1992	2001
206	Les Grèves de Chevroux–Portalban	Chevroux[42]	1992	2001
207	Les Grèves de Portalban–Cudrefin	Chabrey, Cudrefin[43]	1992	2001
208	Les Grèves du Chablais de Cudrefin	Cudrefin	1992	2001
211	Les Monod	Apples, Ballens, Mollens, Montricher, Pampigny	1992	2001
226	La Tornaresse à l'Etivaz	Château-d'Oex	1992	2001

39 L'objet est situé dans les communes: Villeneuve FR/Granges-près-Marnand VD.
40 L'objet est situé dans les communes: Cheyres FR/Yvonand VD.
41 L'objet est situé dans les communes: Autavaux, Estavayer-le-Lac, Forel FR/Chevroux VD.
42 L'objet est situé dans les communes: Gletterens, Portalban FR/Chevroux VD.
43 L'objet est situé dans les communes: Delley FR/Chabrey, Cudrefin VD.

N°	Localité	Commune(s)	Inscription	Révision
301	Les Iles de Bogis	Bogis-Bossey, Chavannes-de-Bogis	2003	
303	Solalex	Bex	2003	
304	Embouchure de la Broye	Bellerive	2003	
305	Embouchure du Chandon	Avenches, Faoug	2003	
	Canton du Valais			
125	Source du Trient	Trient	1992	
127	Lotrey	Evolène	1992	
128	Pramousse–Satarma	Evolène	1992	
129	La Borgne en amont d'Arolla	Evolène	1992	
130	Salay	Evolène	1992	
131	Ferpècle	Evolène	1992	
132	Derborence	Conthey	1992	
133	Pfynwald	Leuk, Salgesch, Sierre, Varen	1992	
134	Tännmattu	Blatten, Wiler (Lötschen)	1992	2003
135	Chiemadmatte	Blatten	1992	
138	Grund	Brig-Glis, Ried-Brig	1992	
139	Bilderne	Filet, Mörel	1992	
140	Zeiterbode	Grafschaft	1992	
141	Matte	Gluringen, Reckingen	1992	
142	Sand	Oberwald	1992	2003
1038	Glacier de Zinal	Ayer	2001	
1085	Ofental Gletscher	Saas Almagell	2001	
1115	Langgletscher/Jegigletscher	Blatten	1992	2001
1118	Üssre Baltschieder-gletscher	Baltschieder	2001	
1129	Wildstrubelgletscher	Leukerbad	2001	
1147	Triftgletscher VS	Zermatt	2001	
1148	Hohlichtgletscher	Randa, Täsch	2001	
1154	Feegletscher N	Saas Fee	2001	
1160	Abberggletscher	St. Niklaus	2001	
1161	Glacier de Valsorey	Bourg-Saint-Pierre	2001	
1163	Glacier d'Otemma	Bagnes	2001	
1165	Glacier du Brenay	Bagnes	1992	2001
1167	Glacier du Petit Combin	Bagnes	2001	
1168	Glacier de Corbassière	Bagnes	2001	
1170	Glacier de Cheilon	Hérémence	2001	
1175	Grand Désert	Nendaz	2001	
1215	Rhonegletscher	Oberwald	1992	2001
1354	Spittelmatte	Leukerbad[44]	2001	

[44] L'objet est situé dans les communes: Kandersteg BE/Leukerbad VS.

Nº	Localité	Commune(s)	Inscrip-tion	Révision
	Canton de Neuchâtel			
209	Seewald–Fanel	Marin-Epagnier[45]	1992	
	Canton de Genève			
112	Vallon de la Laire	Avusy, Chancy	1992	
113	Vallon de l'Allondon	Dardagny, Russin, Satigny	1992	
114	Moulin de Vert	Cartigny	1992	
115	Les Gravines	Collex-Bossy, Versoix	1992	
218	Vers Vaux	Chancy	1992	
	Canton du Jura			
144	La Réchesse	Epiquerez	1992	
145	La Lomenne	Montmelon, Saint-Ursanne	1992	

45 L'objet est situé dans les communes: Gampelen, Ins BE/ Marin-Epagnier NE.

Annexe 2[46]
(art. 2)

Description des zones alluviales d'importance nationale

[46] Non publiée au RO, cette annexe ne figure pas dans le présent recueil. Conformément à l'art. 2, al. 2, elle peut être consultée en tout temps, à l'Office fédéral de l'environnement, des forêts et du paysage et auprès des cantons (voir RO **2003** 4131).

Ordonnance sur la protection des hauts-marais et des marais de transition d'importance nationale
(Ordonnance sur les hauts-marais)

du 21 janvier 1991 (Etat le 12 juillet 2005)

Le Conseil fédéral suisse,

vu l'art. 18*a*, al. 1 et 3, de la loi fédérale du 1er juillet 1966 sur la protection de la nature et du paysage (LPN) [1],

arrête:

Art. 1 Inventaire fédéral

L'Inventaire fédéral des hauts-marais et des marais de transition d'importance nationale (Inventaire des hauts-marais) comprend les objets énumérés dans l'annexe 1. Ces objets satisfont en même temps à l'exigence de la beauté particulière au sens de l'art. 24sexies, al. 5, de la constitution fédérale[2].

Art. 2 Description des objets

[1] La description des objets est publiée séparément. En tant qu'annexe 2, cette publication fait partie intégrante de la présente ordonnance.

[2] La publication peut être consultée en tout temps à l'Office fédéral de l'environnement, des forêts et du paysage (office fédéral) et auprès des cantons.[3] Ceux-ci désignent les services concernés.

Art. 3 Délimitation des objets

[1] Les cantons, après avoir pris l'avis des propriétaires fonciers et des exploitants, fixent les limites précises des objets. Ils délimitent des zones-tampon suffisantes du point de vue écologique en tenant compte, notamment, de la zone de contact ainsi que des bas-marais attenants aux objets.

[2] Lorsque les limites précises n'ont pas encore été fixées, l'autorité cantonale compétente prend, sur demande, une décision de constatation de l'appartenance d'un bien-fonds à un objet. Le requérant doit pouvoir fonder sa demande sur l'existence d'un intérêt digne de protection.

RO **1991** 270

1 RS **451**
2 [RS **1** 3; RO **1988** 352]
3 Nouvelle teneur selon le ch. I 2 de l'O du 15 janv. 2003 concernant la modification de la réglementation sur la consultation dans les ordonnances en matière de biotopes selon l'art. 18*a* LPN (RO **2003** 249).

Art. 4 But visé par la protection

Les objets doivent être conservés intacts; dans les zones marécageuses détériorées, la régénération sera encouragée dans la mesure où elle est judicieuse. Font notamment partie de ce but la conservation et le développement de la flore et de la faune indigènes et des éléments écologiques indispensables à leur existence ainsi que la conservation des particularités géomorphologiques.

Art. 5 Mesures de protection et d'entretien

[1] Les cantons, après avoir pris l'avis des propriétaires fonciers et des exploitants, prennent les mesures de protection et d'entretien adéquates pour conserver intacts les objets. Ils veillent en particulier à ce que:

a. les plans et les prescriptions qui règlent le mode d'utilisation du sol au sens de la législation en matière d'aménagement du territoire soient conformes à la présente ordonnance;

b.[4] soient interdites toute installation ou construction et toute modification de terrain, notamment par l'extraction de tourbe, le labour de sols marécageux et l'apport de substances ou de préparations au sens de l'ordonnance du 18 mai 2005 sur les produits chimiques[5], ou encore de produits biocides au sens de l'ordonnance du 18 mai 2005 sur les produits biocides[6]; font uniquement exception, sous réserve de la let. c, les constructions, installations et modifications de terrain servant à assurer la protection conformément au but visé;

c. les installations ou constructions servant à la poursuite de l'exploitation agricole et toute modification de terrain dans le même but ne soient autorisées que lorsqu'elles n'entrent pas en contradiction avec le but visé par la protection;

d.[7] soit démantelée toute installation ou construction entreprise après le 1er juin 1983 et remis dans son état d'origine tout terrain modifié après cette date, aux frais du responsable, lorsque ces ouvrages ou modifications sont en contradiction avec le but visé par la protection et n'ont pas été autorisés par décision ayant force de chose jugée sur la base de zones d'affectation conformes à la loi fédérale du 22 juin 1979 sur l'aménagement du territoire[8]. S'il n'est pas possible de rétablir l'état du 1er juin 1983, il y a lieu de prévoir un remplacement ou une compensation adéquats.

e. le régime local des eaux soit maintenu et, si cela favorise la régénération du marais, amélioré;

[4] Nouvelle teneur selon le ch. II 2 de l'O du 18 mai 2005 sur l'abrogation et la modification du droit en vigueur du fait de la loi sur les produits chimiques, en vigueur depuis le 1er août 2005 (RO **2005** 2695)
[5] RS **813.11**
[6] RS **813.12**
[7] Nouvelle teneur selon le ch. II 3 de l'O du 18 déc. 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 225).
[8] RS **700**

f. la gestion forestière soit adaptée au but visé par la protection;

g. L'embroussaillement soit évité et la végétation marécageuse caractéristique conservée, si nécessaire par une exploitation appropriée;

h. Les fossés soient entretenus correctement et avec ménagement, pour autant qu'ils soient compatibles avec le but visé par la protection;

i. Les marais soient protégés contre les dégâts dus au piétinement;

k. L'exploitation à des fins touristiques et récréatives soit subordonnée au but visé par la protection.

2 Les dispositions de l'al. 1 sont aussi applicables aux zones-tampon dans la mesure où le but visé par la protection l'exige.

Art. 6 Délais

1 Les mesures prévues à l'art. 3, al. 1, et à l'art. 5 doivent être prises dans un délai de trois ans.

2 Pour les cantons à faible et à moyenne capacité financière, pour lesquels la protection des hauts-marais représente une charge considérable, ce délai est de six ans au maximum lorsqu'il s'agit d'objets dont la conservation n'est pas menacée. Le Département fédéral de l'environnement, des transports, de l'énergie et de la communication[9] désigne ces cantons.

Art. 7 Protection transitoire

Les constructions, installations et modifications de terrain ainsi que les changements notables du mode d'utilisation du sol sont interdits dans les objets tant que les cantons n'ont pas pris de mesures de protection et d'entretien. Les cantons peuvent autoriser des dérogations si elles sont compatibles avec l'art. 5.

Art. 8 Réparation des dommages

Les cantons veillent, chaque fois que l'occasion s'en présente, à la meilleure remise en état possible des objets déjà atteints.

Art. 9 Devoirs de la Confédération

1 Dans leur activité, les autorités, services, instituts et établissements fédéraux sont tenus de conserver intacts les objets.

2 Ils prennent les mesures prévues aux art. 5, 7 et 8 dans les domaines relevant de leur compétence en vertu de la législation fédérale spéciale y relative.

9 La désignation de l'unité administrative a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**).

Art. 10 Compte rendu

Tant qu'ils n'ont pas pris les mesures nécessaires selon l'art. 3, al. 1, et l'art. 5, les cantons rendent compte à l'office fédéral à la fin de chaque année de l'état de la protection des hauts-marais sur leur territoire.

Art. 11 Prestations de la Confédération

[1] La Confédération conseille et soutient les cantons dans l'accomplissement des tâches prévues par la présente ordonnance.

[2] Les indemnités de la Confédération pour les mesures prévues aux art. 3, 5 et 8 de la présente ordonnance sont régies par les art. 17 et 19 de l'ordonnance du 16 janvier 1991[10] sur la protection de la nature et du paysage.

Art. 12 Entrée en vigueur

La présente ordonnance entre en vigueur le 1er février 1991.

[10] RS **451.1**

Annexe 1[11]
(art. 1)

Liste des hauts-marais et des marais de transition d'importance nationale

No	Localité	Commune(s)[12]	Inscription	Révision
Canton de Zurich				
80	Räubrichseen	Kleinandelfingen	1991	
81	Gurisee	Dägerlen, Dinhard	1991	
97	Mettmenhasler See	Niederhasli	1991	
98	Chrüzenriet	Regensdorf	1991	
99	Chatzensee	Zürich	1991	
100	Wildert	Illnau-Effretikon	1991	
101	Weid	Fehraltorf	1991	
102	Torfriet	Pfäffikon	1991	
103	Robenhauseriet/ Pfäffikersee	Pfäffikon, Seegräben, Wetzikon	1991	
104	Ambitzgi/Böhnlerriet	Wetzikon	1991	
105	Oberhöfler Riet	Gossau Hinwil, Wetzikon	1991	
106	Hiwiler Riet	Hinwil, Wetzikon	1991	2003
109	Seeweidsee	Hombrechtikon	1991	
110	Egelsee	Bubikon	1991	
111	Schönbühl	Bubikon	1991	
112	Rütiwald	Rüti	1991	
114	Moor Rinderweiderhau/ Hinter Bisliken	Affoltern am Albis	1991	
115	Unterrifferswilermoos/ Chrutzlen/Oberrifferswiler-moos	Hausen am Albis, Rifferswil	1991	
116	Rorholz	Rifferswil	1991	
117	Hagenholz/Hagenmoos	Kappel am Albis, Rifferswil	1991	
118	Häglimoos	Kappel am Albis, Knonau[13]	1991	
119	Aegelsee	Knonau, Maschwanden	1991	
120	Vermoorungen um das Sagenhölzli	Schönenberg	1991	
121	Hinterbergried	Schönenberg	1991	
122	Gubelmoos	Schönenberg	1991	
123	Spitzenmoos	Hirzel, Wädenswil	1991	
124	Chrutzelenmoos	Hirzel	1991	

[11] Nouvelle teneur selon le ch. I 1 de l'O du 14 mars 2003, en vigueur depuis le 1er mai 2003 (RO **2003** 709)
[12] Liste des communes et des localités 2002
[13] L'objet est situé dans les communes Kappel am Albis, Knonau ZH/Steinhausen ZG.

No.	Localité	Commune(s)	Inscription	Révision
125	Grindelmoos	Horgen	1991	
132	Moos Schönenhof bei Wallisellen	Wallisellen	1991	

Canton de Berne

No.	Localité	Commune(s)	Inscription	Révision
1	La Sagne et les Tourbières de Bellelay	Saicourt	1991	
2	Etang de la Gruère	Tramelan[14]	1991	
3	La Tourbière de la Chaux-des-Breuleux	Mont Tramelan, Tramelan[15]	1991	
10	Tourbières de la Chaux d'Abel	Saint-Imier, Sonvilier	1991	
11	Les Pontins	Saint-Imier	1991	
41	La Tourbière/Ronde Sagne	Tramelan	1991	
42	Pâturage du Droit	Tramelan	1991	
55	Champ Meusel	Saint-Imier	1991	
70	Gänsenmoos	Wahlern	1991	
71	Lörmoos	Wohlen bei Bern	1991	
72	Büsselimoos	Kirchlindach	1991	
73	Heidmoos	Hindelbank	1991	
74	Meienmoos	Burgdorf, Lyssach	1991	
75	Sewelimoos (Hochmoor Seeliswald)	Reutigen	1991	
76	Chlepfimoos/Burgmoos	Niederönz, Oberönz[16]	1991	
180	Siehenmoos	Eggiwil	1991	
181	Flüegfääl/Steinmoos	Eggiwil	1991	
182	Pfaffenmoos	Eggiwil	1991	
183	Hängstmoor	Eriz	1991	
184	Rotmoos	Eriz	1991	
185	Vorderes Rotmösli	Eriz	1991	
186	Fischbachmoos/Obermoos	Oberlangenegg	1991	
187	Moos bei Wachseldorn/Untermoos	Wachseldorn	1991	
188	Wachseldornmoos	Buchholterberg	1991	
193	Moore nördlich Grünenbergpass	Eriz, Habkern	1991	
194	Moore südwestlich Grünenbergpass	Beatenberg, Habkern	1991	
195	Trogenmoos	Habkern	1991	
196	Moore im Schöpfewald	Habkern	1991	

[14] L'objet est situé dans les communes Tramelan BE/Le Bémont, Montfaucon, Saignelégier JU.

[15] L'objet est situé dans les communes Mont Tramelan, Tramelan, BE/ La Chaux-des-Breuleux, Saignelégier JU.

[16] L'objet est situé dans les communes Niederönz, Oberönz BE/Aeschi SO.

No.	Localité	Commune(s)	Inscription	Révision
197	Luegiboden	Habkern	1991	
198	Moore östlich Aellgäuli	Habkern	1991	
199	Möser östlich Widegg	Habkern	1991	
200	Moore im Steiniwald	Habkern	1991	
302	Turen/Chaltenbrunnen/Stäckewäldli	Meiringen, Schattenhalb	1991	2003
328	Witiwald/Dälenwald	Beatenberg	2003	
330	Lischboden	Rüschegg	1991	
331	Schalenberg	Rüschegg	1991	
332	Schwändlibachgraben	Rüeggisberg	1991	
333	Sortel	Guggisberg, Rüschegg	1991	
334	Grossfischbächen	Rüschegg	1991	
335	Ladengrat	Guggisberg	1991	
336	Hinters Läger	Habkern	1991	
337	Moorwald Hinters Läger	Habkern	1991	
338	Moor nördlich Oberes Hörnli	Sigriswil	1991	
339	Moor nordöstlich Oberes Hörnli	Horrenbach-Buchen, Sigriswil	1991	
340	Moor südwestlich Steinige Schöriz	Horrenbach-Buchen	1991	
341	Moor westlich Steinige Schöriz	Horrenbach-Buchen	1991	
342	Gmeine Schöriz	Horrenbach-Buchen	1991	
343	Stouffe	Horrenbach-Buchen	1991	
348	Moore westlich Bütler-schwandgraben	Schangnau	2003	
350	Grüöbiwald	Hasliberg	2003	
354	Harzisboden	Habkern	2003	
355	Moore bei Unter Hungerschwand	Eriz	2003	
501	Moor südlich Möser	Habkern	1991	
502	Moor nordöstlich Färrich am Bol	Habkern	1991	
503	Moore südöstlich Färrich am Bol	Habkern	1991	
504	Moor zwischen Flösch und Hälibach	Beatenberg	1991	
505	Moor oberhalb Burgfeldflüe	Beatenberg	1991	
506	Moore östlich Gemmenalp	Beatenberg	1991	
507	Moor im Unter-holz/Waldegg	Beatenberg	1991	
508	Moor bei Lombachalp	Habkern	1991	
509	Moor zwischen Lombachalp und Teufengraben	Habkern	1991	

No.	Localité	Commune(s)	Inscription	Révision
510	Esleren/Gummenalp	Hofstetten bei Brienz	1991	
511	Höhenschwandmoor	Hasliberg	1991	2003
512	Moore hinder der Egg	Hasliberg	1991	
513	Seelein bei der Mägisalp/ Seemad	Hasliberg	1991	
514	In Miseren	Gadmen	1991	
515	Feldmoos/Moore auf dem Feldmooshubel	Gadmen	1991	
516	Moor oberhalb Choli-schwand	Gadmen	1991	
517	Breitmoos	Grindelwald	1991	
518	Moore und Seen bei Bursthlätz	Grindelwald	1991	
519	Moor beim Fysteren Graben	Grindelwald	1991	
520	Moor bei Aelbi Flue	Grindelwald	1991	
521	Moor nordöstlich Hohchräjen	Grindelwald	1991	
522	Feldmoos	Grindelwald	1991	
523	Moor nordöstlich Mettlen	Grindelwald	1991	
524	Selenen	Rüschegg	1991	
525	Rotmoos	Rüti bei Riggisberg	1991	
526	Moor östlich Wissenbach/ Gurnigel	Rüschegg	1991	
527	Moor westlich Wissenbach/ Gurnigel	Rüschegg	1991	
528	Ägelsee-Moor auf dem Diemtigbergli	Diemtigen	1991	
529	Moor nördlich Toffelsweid	Boltigen	1991	
534	Zettenalp	Sigriswil	1991	
535	Moor östlich Unteres Hörnli	Horrenbach-Buchen, Sigriswil	1991	
541	Schluchhole	Eriz	1991	
542	Horneggwald	Horrenbach-Buchen	1991	
543	Moore zwischen Mirrenegg und Aeligäuli	Oberried am Brienzersee	1991	2003
557	Chuchifang	Boltigen	1991	
558	Sparemoos/Tots Mädli	Zweisimmen	1991	
559	Moore südwestlich Tolmoos	Boltigen, Zweisimmen	1991	
560	Saanenmöser/Dälweid	Saanen	1991	
561	Lauenensee	Lauenen	1991	
562	Moore auf Betelberg	Lenk	1991	
563	Moore südöstlich Haslerberg	Lenk	1991	
564	Dälmoos Achseten	Frutigen	1991	
565	Filfälle	Kandersteg	1991	
566	Chänelegg	Lauterbrunnen	1991	
567	Träjen	Innertkirchen	1991	

No.	Localité	Commune(s)	Inscription	Révision
571	Moor oberhalb Geilsbüel (Hahnenmoospass)	Adelboden	1991	
572	Bruchsee auf dem Jaunpass	Boltigen	1991	
606	Untersteinberg	Lauterbrunnen	1991	
607	Station Wengernalp	Lauterbrunnen	1991	
608	Dürrentännli	Rüschegg	1991	
609	Rüwlispass	St. Stephan	1991	
Canton Lucerne				
77	Hochmoor bei Etzelwil	Schlierbach	1991	
78	Ballmoos Lieli	Lieli	1991	
257	Zwischen Glaubenberg und Rossalp	Entlebuch[17]	1991	
259	Gürmschwald	Entlebuch	1991	
294	Ober Lauenberg	Entlebuch	1991	
295	Riedboden	Entlebuch[18]	1991	
296	Balmoos	Hasle	1991	
297	Rosswängenwald	Entlebuch	1991	
298	Unter Wasserfallen	Hasle	1991	
299	Zwischen Schwand und Gürmschbach	Entlebuch	1991	
301	Hagleren	Flühli	1991	
312	Stächelegg/Ghack	Flühli	1991	
313	Salwidili	Flühli	1991	
314	Zopf/Salwiden	Flühli	1991	
315	Laubersmadghack	Flühli	1991	
316	Türnliwald	Flühli	1991	
317	Gross Gfäl	Flühli	1991	
318	Husegg-Hurnischwand	Flühli	1991	
319	Husegg-Ochsenweid	Flühli	1991	
320	Rossweid	Flühli	1991	
322	Mittlerschwarzenegg	Flühli	1991	
362	Zopf	Flühli	2003	
400	Juchmoos	Hasle	1991	
401	Müllerenmösli	Hasle	1991	
402	Stächtenmösli	Hasle	1991	
403	Zwischen Guggenen und Unter Änggenlauenen	Flühli	1991	
404	Rüchiwald	Flühli	1991	
405	Zwischen Fürsteinwald und Blattli	Flühli	1991	
406	Tuetenseeli	Menznau	1991	

17 L'objet est situé dans les communes Entlebuch LU/Sarnen OW.
18 L'objet est situé dans les communes Entlebuch LU/Alpnach OW.

No.	Localité	Commune(s)	Inscription	Révision
407	Fuchserenmoos/ Geugelhusenmoos	Entlebuch	1991	
408	Mettilimoos	Entlebuch	1991	
409	Östlich Brandchnubel	Flühli, Schüpfheim	1991	
410	Tällenmoos	Escholzmatt	1991	
411	Wagliseichnubel	Flühli	1991	
412	Forrenmoos/Meienstoss-moos im Eigental	Schwarzenberg	1991	
414	Ehemaliger Pilatussee	Schwarzenberg	1991	
415	Follenwald im Krienser Hohwald	Horw, Kriens	1991	
416	Gibelegg	Kriens	1991	
417	Furenmoos bei der Krienseregg	Kriens	1991	
432	Zwischen Wagliseichnubel und Ghack	Flühli	1991	
435	Fuchseren	Entlebuch	1991	
436	Moos nordwestlich Gibelegg	Kriens	1991	
437	Ausfluss des Rotsees	Ebikon	1991	
443	Vorderes Steinetli	Flühli	1991	
448	Husegg	Flühli	1991	
449	Bärsel	Flühli	1991	
450	Südlich Ober Saffertberg	Flühli	1991	
451	Wagliseiboden	Flühli	1991	
452	Cheiserschwand	Flühli	1991	
453	Zwischen Schlund und Änzihütten	Flühli	1991	
455	Forenmoos im Sigiger Wald	Ruswil	1991	
457	Rischli	Flühli	1991	
464	Buholzer Schwändi	Horw	2003	
470	Ober Gründli	Entlebuch	2003	
471	Ähnistetten	Hasle	1991	
473	Guntlishütten	Flühli	1991	
495	Bründlen	Schwarzenberg	1991	
938	Südlich Grön	Flühli	1991	
939	Tällenmoos im Hilferental	Flühli	1991	

Canton d'Uri

No.	Localité	Commune(s)	Inscription	Révision
249	Urnerboden	Spiringen	1991	
250	Berg beim Göscheneralpsee	Göschenen	1991	
251	Rüti am Arnisee	Gurtnellen	1991	
438	Fulensee	Erstfeld	1991	
700	Unter Wängi	Bürglen	2003	

No.	Localité	Commune(s)	Inscription	Révision
Canton de Schwyz				
303	Altmatt-Biberbrugg	Einsiedeln, Rothenthurm[19]	1991	
304	Schwantenau	Einsiedeln	1991	
305	Breitried	Einsiedeln, Unteriberg	1991	
306	Hessenmoos	Einsiedeln	1991	
307	Roblosen	Einsiedeln	1991	
308	Hobacher	Oberiberg	1991	
309	Furenwald	Oberiberg	1991	
310	Chli Underbäch	Oberiberg, Schwyz	1991	
311	Gross Underbäch	Oberiberg	1991	
323	Witi	Feusisberg	1991	
324	Schönboden	Einsiedeln, Freienbach	1991	
325	Tierfäderen	Unteriberg	1991	
326	Tubenmoos	Oberiberg	1991	
386	Fuederegg	Oberiberg	2003	
430	Hinter den Weiden	Rothenthurm	2003	
444	Westlich Etzel	Einsiedeln, Feusisberg	1991	
445	Platten	Unteriberg	1991	
446	Inner und Usser Schnabel	Schwyz	1991	
454	Teufböni	Morschach	1991	
Canton d'Obwald				
203	Aelggäu	Alpnach	2003	
254	Rischi	Sarnen	1991	
256	Talhubel/Siterenmoos	Sarnen	1991	2003
257	Zwischen Glaubenberg und Rossalp	Sarnen[20]	1991	
258	Marchmettlen	Sarnen	1991	
260	Trogenwald	Sarnen	1991	
261	Gross Trogen	Sarnen	1991	2003
262	Chli Trogen	Giswil, Sarnen	1991	
263	Seeliwald	Sarnen	1991	
264	Münchenboden/Grund/ Ochsenalp	Giswil, Sarnen	1991	2003
265	Ober Sewen	Sarnen	1991	
266	Unter Sewen	Sarnen	1991	
267	Schwand	Sarnen	1991	
268	Schwendi Kaltbad	Sarnen	1991	
269	Unteres Schlierental	Sarnen	1991	
270	Hüenergütsch	Sarnen	1991	
271	Riedboden bei Zischlig	Sarnen	1991	
272	Fangboden	Sarnen	1991	

19 L'objet est situé dans les communes Einsiedeln, Rothenthurm SZ/Oberägeri ZG.
20 L'objet est situé dans les communes Sarnen OW/Entlebuch LU.

No.	Localité	Commune(s)	Inscription	Révision
Canton de Schwyz				
303	Altmatt-Biberbrugg	Einsiedeln, Rothenthurm[19]	1991	
304	Schwantenau	Einsiedeln	1991	
305	Breitried	Einsiedeln, Unteriberg	1991	
306	Hessenmoos	Einsiedeln	1991	
307	Roblosen	Einsiedeln	1991	
308	Hobacher	Oberiberg	1991	
309	Furenwald	Oberiberg	1991	
310	Chli Underbäch	Oberiberg, Schwyz	1991	
311	Gross Underbäch	Oberiberg	1991	
323	Witi	Feusisberg	1991	
324	Schönboden	Einsiedeln, Freienbach	1991	
325	Tierfäderen	Unteriberg	1991	
326	Tubenmoos	Oberiberg	1991	
386	Fuederegg	Oberiberg	2003	
430	Hinter den Weiden	Rothenthurm	2003	
444	Westlich Etzel	Einsiedeln, Feusisberg	1991	
445	Platten	Unteriberg	1991	
446	Inner und Usser Schnabel	Schwyz	1991	
454	Teufböni	Morschach	1991	
Canton d'Obwald				
203	Aelggäu	Alpnach	2003	
254	Rischi	Sarnen	1991	
256	Talhubel/Siterenmoos	Sarnen	1991	2003
257	Zwischen Glaubenberg und Rossalp	Sarnen[20]	1991	
258	Marchmettlen	Sarnen	1991	
260	Trogenwald	Sarnen	1991	
261	Gross Trogen	Sarnen	1991	2003
262	Chli Trogen	Giswil, Sarnen	1991	
263	Seeliwald	Sarnen	1991	
264	Münchenboden/Grund/ Ochsenalp	Giswil, Sarnen	1991	2003
265	Ober Sewen	Sarnen	1991	
266	Unter Sewen	Sarnen	1991	
267	Schwand	Sarnen	1991	
268	Schwendi Kaltbad	Sarnen	1991	
269	Unteres Schlierental	Sarnen	1991	
270	Hüenergütsch	Sarnen	1991	
271	Riedboden bei Zischlig	Sarnen	1991	
272	Fangboden	Sarnen	1991	

19 L'objet est situé dans les communes Einsiedeln, Rothenthurm SZ/Oberägeri ZG.
20 L'objet est situé dans les communes Sarnen OW/Entlebuch LU.

No.	Localité	Commune(s)	Inscription	Révision
Canton de Schwyz				
303	Altmatt-Biberbrugg	Einsiedeln, Rothenthurm[19]	1991	
304	Schwantenau	Einsiedeln	1991	
305	Breitried	Einsiedeln, Unteriberg	1991	
306	Hessenmoos	Einsiedeln	1991	
307	Roblosen	Einsiedeln	1991	
308	Hobacher	Oberiberg	1991	
309	Furenwald	Oberiberg	1991	
310	Chli Underbäch	Oberiberg, Schwyz	1991	
311	Gross Underbäch	Oberiberg	1991	
323	Witi	Feusisberg	1991	
324	Schönboden	Einsiedeln, Freienbach	1991	
325	Tierfäderen	Unteriberg	1991	
326	Tubenmoos	Oberiberg	1991	
386	Fuederegg	Oberiberg	2003	
430	Hinter den Weiden	Rothenthurm	2003	
444	Westlich Etzel	Einsiedeln, Feusisberg	1991	
445	Platten	Unteriberg	1991	
446	Inner und Usser Schnabel	Schwyz	1991	
454	Teufböni	Morschach	1991	
Canton d'Obwald				
203	Aelggäu	Alpnach	2003	
254	Rischi	Sarnen	1991	
256	Talhubel/Siterenmoos	Sarnen	1991	2003
257	Zwischen Glaubenberg und Rossalp	Sarnen[20]	1991	
258	Marchmettlen	Sarnen	1991	
260	Trogenwald	Sarnen	1991	
261	Gross Trogen	Sarnen	1991	2003
262	Chli Trogen	Giswil, Sarnen	1991	
263	Seeliwald	Sarnen	1991	
264	Mönchenboden/Grund/ Ochsenalp	Giswil, Sarnen	1991	2003
265	Ober Sewen	Sarnen	1991	
266	Unter Sewen	Sarnen	1991	
267	Schwand	Sarnen	1991	
268	Schwendi Kaltbad	Sarnen	1991	
269	Unteres Schlierental	Sarnen	1991	
270	Hüenergütsch	Sarnen	1991	
271	Riedboden bei Zischlig	Sarnen	1991	
272	Fangboden	Sarnen	1991	

[19] L'objet est situé dans les communes Einsiedeln, Rothenthurm SZ/Oberägeri ZG.
[20] L'objet est situé dans les communes Sarnen OW/Entlebuch LU.

No.	Localité	Commune(s)	Inscription	Révision
Canton de Schwyz				
303	Altmatt-Biberbrugg	Einsiedeln, Rothenthurm[19]	1991	
304	Schwantenau	Einsiedeln	1991	
305	Breitried	Einsiedeln, Unteriberg	1991	
306	Hessenmoos	Einsiedeln	1991	
307	Roblosen	Einsiedeln	1991	
308	Hobacher	Oberiberg	1991	
309	Furenwald	Oberiberg	1991	
310	Chli Underbäch	Oberiberg, Schwyz	1991	
311	Gross Underbäch	Oberiberg	1991	
323	Witi	Feusisberg	1991	
324	Schönboden	Einsiedeln, Freienbach	1991	
325	Tierfäderen	Unteriberg	1991	
326	Tubenmoos	Oberiberg	1991	
386	Fuederegg	Oberiberg	2003	
430	Hinter den Weiden	Rothenthurm	2003	
444	Westlich Etzel	Einsiedeln, Feusisberg	1991	
445	Platten	Unteriberg	1991	
446	Inner und Usser Schnabel	Schwyz	1991	
454	Teufböni	Morschach	1991	
Canton d'Obwald				
203	Aelggäu	Alpnach	2003	
254	Rischi	Sarnen	1991	
256	Talfubel/Siterenmoos	Sarnen	1991	2003
257	Zwischen Glaubenberg und Rossalp	Sarnen[20]	1991	
258	Marchmettlen	Sarnen	1991	
260	Trogenwald	Sarnen	1991	
261	Gross Trogen	Sarnen	1991	2003
262	Chli Trogen	Giswil, Sarnen	1991	
263	Seeliwald	Sarnen	1991	
264	Münchenboden/Grund/ Ochsenalp	Giswil, Sarnen	1991	2003
265	Ober Sewen	Sarnen	1991	
266	Unter Sewen	Sarnen	1991	
267	Schwand	Sarnen	1991	
268	Schwendi Kaltbad	Sarnen	1991	
269	Unteres Schlierental	Sarnen	1991	
270	Hüenergütsch	Sarnen	1991	
271	Riedboden bei Zischlig	Sarnen	1991	
272	Fangboden	Sarnen	1991	

19 L'objet est situé dans les communes Einsiedeln, Rothenthurm SZ/Oberägeri ZG.
20 L'objet est situé dans les communes Sarnen OW/Entlebuch LU.

No	Localité	Commune(s)	Inscription	Révision
273	Obere Schluecht/Untere Schluecht	Sarnen	1991	
274	Teilenboden	Sarnen	1991	
275	Wengli	Sarnen	1991	
276	Häsiseggboden	Sarnen	1991	
277	Meiengraben	Alpnach	1991	
278	Zwischen Horweli und der Grossen Schliere	Alpnach	1991	
279	Zwischen Horweli und Rossweid	Alpnach	1991	
280	Rischigenmatt-Rotibach	Alpnach	1991	
281	Längenfeldmoos	Alpnach	1991	
282	Moor nördlich First	Alpnach	1991	
283	Riedmattschwand	Giswil	1991	
284	Dälenboden	Giswil	1991	
285	Dörsmatt	Giswil	1991	
286	Ried unter dem Rämsiboden	Giswil	1991	
287	Totmoos	Giswil	1991	
288	Merliwald	Giswil	1991	
289	Gerzensee im Kernwald	Kerns	1991	
290	Gerschni	Engelberg	1991	
291	Feldmoos (Gerschni)	Engelberg	1991	
292	Oberer Rorwald	Giswil	1991	
293	Nollen	Giswil	1991	
295	Riedboden	Alpnach[21]	1991	
360	Unter dem Heidberistöckli	Giswil	2003	
361	Nördlich Haldimattstock	Giswil	2003	
461	Hüenergütsch	Sarnen	2003	
462	Witi	Sarnen	2003	
465	Bärmettlen	Sarnen	2003	
466	Lengenschwand	Sarnen	2003	
467	Nassboden	Sarnen	2003	
474	Loomettlen	Giswil	2003	
931	Obermattboden	Sarnen	1991	
932	Gross Lucht	Sarnen	1991	
933	Gerenstock	Sarnen	1991	
935	Riedzöpf	Alpnach	1991	
936	Rormettlen	Giswil	1991	
937	Rorwald	Giswil	1991	

Canton de Nidwald

No	Localité	Commune(s)	Inscription	Révision
107	Grossriet/Gnappiriet	Stans	1991	
413	Arven unter Fräkmünt	Hergiswil	1991	
433	Scheidegg im Choltal	Emmetten	1991	

[21] L'objet est situé dans les communes Alpnach OW/Entlebuch LU.

No.	Localité	Commune(s)	Inscription	Révision
434	Seeliboden im Choltal	Emmetten	1991	
491	Dürrenboden	Dallenwil	1991	

Canton de Glaris

245	Gross Moos im Schwenditał	Oberurnen	1991	
246	Boggenberg	Näfels, Oberurnen	1991	
247	Etzelhüsli	Haslen	1991	
248	Grotzenbüel (Braunwald)	Braunwald	1991	
422	Garichti	Schwanden	1991	
427	Matt oberhalb Stausee Garichti	Schwanden	1991	
441	Mürtschen	Obstalden	1991	
492	Längriet	Engi, Matt	2003	

Canton de Zoug

118	Häglimoos	Steinhausen[22]	1991	
170	Eigenried/Birchried/Kellersforen/Früebüelmoos	Walchwil, Zug	1991	
171	Vorderer Geissboden	Zug	1991	
172	Zigermoos	Unterägeri	1991	
173	Chnoden/Heumoos	Walchwil	1991	
174	Im Fang	Unterägeri	1991	
175	Moor zwischen Büel und Blattwald	Neuheim	1991	
176	Egelsee	Menzingen	1991	
177	Chälenmoor	Menzingen	1991	
178	Blimoos	Unterägeri	1991	
179	Chäsgaden	Unterägeri	1991	
189	Brämenegg/Furen	Oberägeri	1991	
190	Moore beim Chlausechappeli	Menzingen, Oberägeri	1991	
191	Breitried	Oberägeri	1991	
303	Altmatt-Biberbrugg	Oberägeri[23]	1991	
369	Wissenbach	Oberägeri	2003	
530	Tännlimoos/Hintercher-Moos/Muserholz	Menzingen	1991	
531	Moor nördlich Schwandegg/Twärfallen	Menzingen	1991	
532	Neugrundmoor/Würzgarten	Menzingen	1991	
533	Moor im Hürital	Unterägeri	1991	
540	Tubenloch/Hünggi	Unterägeri	1991	
573	Schindellegi	Zug	1991	

[22] L'objet est situé dans les communes Steinhausen ZG/Kappel am Albis, Knonau ZH.
[23] L'objet est situé dans les communes Oberägeri ZG/Einsiedeln, Rothenthurm SZ.

No.	Localité	Commune(s)	Inscription	Révision
Canton de Fribourg				
58	Les Gurles/Les Communs de Maules	Marsens, Sâles	1991	
59	Les Mosses-Rosez	Sâles (Gruyère), Vaulruz	1991	
60	Les Mosses de la Rogivue	Saint-Martin[24]	1991	
61	Les Tourbières	Fiaugères, Porsel	1991	
62	Les Grands Marais	Les Ecasseys	1991	
63	La Mosse d'en Bas	Le Crêt	1991	
64	Les Bouleyres	La Tour-de-Trême	1991	
65	Schwandholz	St. Ursen	1991	
66	Rotmoos	Rechthalten, St. Ursen	1991	
67	La Tourbière d'Echarlens	Echarlens	1991	
68	Entenmoos	Rechthalten	1991	
69	Düdingermoos	Düdingen	1991	
113	Gros Mont	Charmey	1991	
126	Tourbière des Alpettes	Semsales	1991	
127	Niremont, Arête ouest	Semsales	1991	
128	Niremont, Arête nord	Semsales	1991	
129	Tourbière au sud-est de Fruence	Châtel-Saint-Denis	1991	
130	Dévin des Dailles	Châtel-Saint-Denis	1991	2003
131	Lac de Lussy	Châtel-Saint-Denis	1991	2003
327	Marais au nord du Petit Niremont	Châtel-Saint-Denis	2003	
358	Pré aux Oies	Hauteville	2003	
359	Wusta	Plasselb	2003	
544	Tourbières dans la forêt du Frachy	Cerniat	1991	
545	Tourbière à l'ouest de la Joux d'Allière	Hauteville	1991	
546	Tourbière au Pâquier dessus	Hauteville	1991	
547	Pré Colard	Cerniat, Hauteville	1991	
548	La Spielmannda/Untertierliberg	Cerniat	1991	
555	Muschenegg	Plasselb	1991	
556	Rigeli	La Roche	1991	
570	Petit Sauvage	Vaulruz	1991	
576	Moore am Schwyberg (Einzugsgebiet des Rotenbaches)	Plaffeien	1991	2003
Canton de Soleure				
76	Chlepfimoos/Burgmoos	Aeschi[25]	1991	

[24] L'objet est situé dans les communes Saint-Martin FR/La Rogivue VD.

No.	Localité	Commune(s)	Inscription	Révision

Canton de Bâle-Ville

Sans objets

Canton de Bâle-Campagne

Sans objets

Canton de Schaffhouse

Sans objets

Canton d'Appenzell Rh.-Extérieures

No.	Localité	Commune(s)	Inscription	Révision
138	Moore auf dem Chräzerenpass	Hundwil[26]	1991	2003
139	Cholwald Schwägalp	Hundwil, Urnäsch	1991	
143	Forenmösli/Burketwald/Paradisli	Urnäsch	1991	
144	Bruggerenwald	Urnäsch	1991	
145	Stillert	Urnäsch	1991	
146	Potersalp	Hundwil[27]	1991	2003
165	Suruggen/Chellersegg	Trogen	1991	
166	Hofguetmoor	Gais	1991	
167	Hirschberg	Gais[28]	1991	
168	Forenmoos/Schachenmoos	Gais	1991	
537	Untere Fischeren	Urnäsch	1991	
580	Moor südöstlich Beldschwendi	Schwellbrunn	1991	
581	Guggenhalden	Urnäsch	1991	
582	Moor auf dem Schwarzenberg	Urnäsch	1991	
583	Moor nordwestlich Gisleren/Schönauwald	Urnäsch	1991	
592	Breitmoos	Urnäsch	1991	
596	Moore zwischen Alp Stöck und Gschwend	Urnäsch	1991	
597	Moor zwischen Telleren und Chli Langboden	Urnäsch	1991	

25 L'objet est situé dans les communes Aeschi SO/Niederönz, Oberönz BE.
26 L'objet est situé dans les communes Hundwil AR/Krummenau SG.
27 L'objet est situé dans lescommunes Hundwil AR/Schwende AI.
28 L'objet est situé dans les communes Gais AR/Rüte AI.

No.	Localité	Commune(s)	Inscription	Révision
Canton de Appenzell Rh.-Intérieures				
146	Potersalp	Schwende[29]	1991	2003
163	Gontenmoos	Gonten	1991	
164	Helchen	Appenzell, Schwende	1991	
167	Hirschberg	Rüte[30]	1991	
601	Nisplismoos	Appenzell, Rüte	1991	
602	Hütten	Gonten	1991	
603	Vordere Wartegg	Schwende	1991	
604	Löchli	Gonten	1991	
Canton de Saint-Gall				
134	Bergwis	Oberbüren	1991	
135	Hudelmoos	Muolen[31]	1991	
136	Moore auf dem Rickenpass	Ernetschwil	1991	
137	Unter Hüttenbüel	Ebnat-Kappel, Wattwil	1991	
138	Moore auf dem Chräzeren-pass (Schwarzegg, Lauch-riet, Witiriet)	Krummenau[32]	1991	2003
140	Gruen/Neuhüttli	Krummenau	1991	
141	Bilchenriet/ Unterwald/Schilt-moos	Krummenau	1991	
142	Lütisalp	Krummenau	1991	
147	Chelen/Allmeindswald/ Bendelried	Ebnat-Kappel	1991	
148	Salomonstempel	Ebnat-Kappel, Hemberg	1991	
149	Moore auf der Wolzenalp (Hännis/Allmen/Rietbach)	Nesslau	1991	
150	Gamperfin/Turben-riet/Tischenriet/Gapels	Grabs	1991	
151	Hirzenbäder/Sommerweid	Grabs	1991	
152	Schönenboden/ Sommerigchopf	Gams	1991	
153	Aelpli/Eggenriet	Grabs, Wildhaus	1991	
154	Schwendiseen	Alt St. Johann, Wildhaus	1991	
155	Gubelspitz	Rieden	1991	
156	Feldmoos	Nesslau	1991	
157	Dreihütten/Gamplüt	Wildhaus	1991	
158	Eggweid auf dem Ricken	Ernetschwil	1991	
159	Hinter Höhi/Bönisriet/ Stöcklerriet	Amden	1991	

29 L'objet est situé dans les communes Schwende AI/Hundwil AR.
30 L'objet est situé dans les communes Rüte AI/Gais AR.
31 L'objet est situé dans les communes Muolen SG/ Amriswil, Sitterdorf, Zihlschlacht TG.
32 L'objet est situé dans les communes Krummenau SG/Hundwil AR.

No.	Localité	Commune(s)	Inscription	Révision
160	Altstofel	Amden	1991	
161	Grossriet/Arvenbüel	Amden	1991	
162	Munzenriet	Wildhaus	1991	
169	Rotmoos	Degersheim	1991	
244	Prodriet	Flums	1991	
252	Madils	Flums, Quarten	1991	2003
375	Westlich Längenegg	Amden	2003	
423	Chapfensee	Mels	1991	
424	Märzental	Mels	1991	
425	Schwarzsee	Quarten	1991	
426	Rietlichopf im Murgtal	Quarten	1991	
428	Unter Murgsee	Quarten	1991	
440	Nüchenstöck	Quarten	1991	
442	Naserina	Quarten	1991	
456	Tobelwald/Guetental	Quarten	1991	
459	Obersäss	Vilters-Wangs	1991	
536	Vorderwängi	Kaltbrunn	1991	
538	Friessen	Nesslau	1991	
539	Hinter Engi	Ebnat-Kappel	1991	
578	Altschenchopf	Amden	1991	
579	Schärsboden-Moor	Amden	1991	
584	Moore im Trämelloch	Krummenau	1991	
585	Hinterschluchen	Krummenau	1991	
586	Chlosterwald-Moore/Ampferenbödeli	Krummenau	1991	
587	Moor zwischen Turn und Laub	Krummenau	1991	
588	Moore bei Steig und Schartegg	Krummenau	1991	
589	Au/Hinterlaad	Nesslau	1991	
590	Goldach	Nesslau	1991	
591	Moor nördlich Heeg	Gams	1991	
593	Unterloch /Grundlosen	Krummenau	1991	
594	Moore nördlich Guggeien	Hemberg	1991	
595	Ober Bad	Hemberg	1991	
Canton des Grisons				
89	Grossweid bei Laret	Davos	1991	
90	Mauntschas	St. Moritz	1991	
91	Stazer Wald	Celerina/Schlarigna	1991	
92	Lej da Staz	Celerina/Schlarigna	1991	
93	Plaun da las Mujas	Celerina/Schlarigna	1991	
216	Caischavedra	Disentis/Mustér	1991	
217	Palius (Val Mutschnengia)	Medel (Lucmagn)	1991	
218	Alp Nadels	Trun	1991	

No.	Localité	Commune(s)	Inscription	Révision
219	Tgiern Grond	Trun	1991	
220	Ufem Sand	Vals	1991	
221	Riederen	Obersaxen	1991	
222	Affeier/Pifal	Obersaxen	1991	
223	Suossa	Mesocco	1991	
224	Lagh Doss	Mesocco	1991	
225	Bosch de San Remo	Mesocco	1991	
226	Sass de la Golp (Lucomagno)	Mesocco	1991	
227	Pian Casuleta	Mesocco	1991	
228	Pian di Seignan	Castaneda	1991	
229	Rongg	Fuma, Jenaz	1991	
230	Choma Sur	Celerina/Schlarigna	1991	
231	Pè d'Munt/Pradè	Samedan	1991	
232	God Surlej	St. Moritz, Silvaplana	1991	
233	Bosch de la Furcela	Stampa	1991	
234	Passo del Maloja/ Aira da la Palza	Stampa	1991	
235	Lai Neir	Sur	1991	
236	Paleis	Sur	1991	
237	Usserberg	Parpan	1991	
238	Heidsee	Vaz/Obervaz	1991	
239	Sporz Davains	Vaz/Obervaz	1991	
240	Schwarzsee bei Arosa	Arosa	1991	
241	Fulried am Stelserberg	Schiers	1991	
242	Clavadeler Berg	Davos	1991	
243	Horn bei Tratza	Luzein	1991	
253	Choma Suot – Palüd Chapè	Celerina/Schlarigna	1991	
255	Zwischen Malojapass und Val da Pila (Malojariegel)	Stampa	1991	
421	Plansena (Val da Camp)	Poschiavo	1991	
476	Kristalloch	Vals	2003	
478	Pascumier See/Bischolsee	Flerden, Portein, Tschappina	2003	
480	Caritsch	Andeer	2003	
481	Nursera	Andeer	2003	
483	Son Roc	Sur	2003	
486	Muotta da Güvè	Stampa	2003	
488	Plustoma	Luzein	2003	
499	Alp de Mem – Bosch Mosghé	Buseno, San Vittore	2003	
917	Alp Flix	Sur	1991	
921	Lai Nair	Tarasp	1991	

No.	Localité	Commune(s)	Inscription	Révision
Canton d'Argovie				
82	Taumoos	Niederrohrdorf	1991	
83	Fischbacher Moos	Fischbach-Göslikon	1991	
Canton de Thurgovie				
133	Barchetsee	Oberneunforn	1991	
135	Hudelmoos	Amriswil, Sitterdorf, Zihlschlacht[33]	1991	
Canton du Tessin				
94	Cadagno di fuori	Quinto	1991	
95	Bedrina	Dalpe, Prato (Leventina)	1991	
96	Bolle di Piana Selva	Dalpe, Faido	1991	
202	Pian Secco	Airolo	1991	
204	Mottone di Garzonera	Quinto	1991	
205	Piano della Bolla	Airolo	1991	
206	Vél (Gribbio)	Chironico	1991	
207	Piano sopra Visletto	Bignasco, Cevio	1991	
208	Gola di Lago	Camignolo, Capriasca	1991	
209	Pian Segna	Intragna, Mosogno	1991	
210	Bolle di Pianazzora	Iragna, Personico	1991	
211	Alpe di Sceng	Biasca	1991	
212	Vall'Ambròsa	Olivone	1991	
213	Campra di là	Olivone	1991	
214	Pian Segno	Olivone	1991	2003
215	Frodalera	Olivone	1991	
458	Erbagni	Astano	1991	
702	Pièi Bachei	Vergeletto	2003	
Canton de Vaud				
22	Mouille de la Vraconne	Sainte-Croix	1991	
23	Mouille au Sayet	Sainte-Croix	1991	
24	Les Mouilles	Sainte-Croix	1991	
25	Les Araignys	Sainte-Croix	1991	
26	Mouille de la Sagne	Sainte-Croix	1991	
27	La Sagne du Séchey	Le Lieu	1991	
28	La Sagne au sud-ouest du Lieu	Le Lieu	1991	
29	Pontet	Le Chenit	1991	
30	Derrière la Côte, sud-est	Le Chenit	1991	
31	Derrière la Côte, sud-ouest	Le Chenit	1991	
32	La Thomassette	Le Chenit	1991	

33 L'objet est situé dans les communes Amriswil, Sitterdorf, Zihlschlacht TG/ Muolen SG.

No	Localité	Commune(s)	Inscription	Révision
33	Les Sagnes du Sentier	Le Chenit	1991	
34	La Sagne du Campe	Le Chenit	1991	
35	La Bursine	Le Chenit	1991	
36	Sagne de Pré Rodet	Le Chenit	1991	
37	Sagnes de la Burtignière	Le Chenit	1991	
38	Bois du Carre	Le Chenit	1991	2003
39	Petits Plats	Arzier	1991	
40	Bois du Marchairuz	Le Chenit	1991	
51	La Trélasse	Gingins, Saint-Cergue	1991	
52	Rière la Givrine	Saint-Cergue	1991	
53	Marais Rouge	Arzier	1991	
54	Creux du Croue	Arzier	1991	
60	Les Mosses de la Rogivue	La Rogivue[34]	1991	
85	Les Tenasses	Blonay, Saint-Légier-La Chiésaz	1991	
549	La Barme	Ormont-Dessous	1991	
550	Tourbière à l'est de la Lécherette	Château-d'Oex	1991	
551	Communs des Mosses, est	Ormont-Dessous	1991	
552	Communs des Mosses, ouest	Ormont-Dessous	1991	
553	Tourbière de Pra Cornet	Château-d'Oex	1991	
554	Col des Mosses	Ormont-Dessous	1991	2003
569	Tourbière sous les Plans	Château-d'Oex	1991	
600	Bois des Cent Toises	Arzier	1991	
701	Sèche de Gimel	Le Chenit	2003	

Canton du Valais

86	Gouille Verte	Martigny-Combe	1991	
87	Lac de Champex	Orsières	1991	
88	La Maraiche de Plex	Collonges	1991	
357	Barme	Champéry	2003	
419	Simplonpass/Hopschusee	Simplon	1991	
420	Flesch	Goppisberg	1991	
431	Boniger See	Törbel	1991	
439	Bärfel	Oberwald	1991	
941	Aletschwald	Ried bei Mörel	1991	

Canton de Neuchâtel

12	Les Chauchets	Le Cerneux-Péquignot	1991	
13	Vers le Maix Rochat	La Brévine, Le Cerneux-Péquignot	1991	
14	Les Sagnes-Rouges	Noiraigue	1991	

[34] L'objet est situé dans les communes La Rogivue VD/Saint-Martin FR.

No	Localité	Commune(s)	Inscription	Révision
15	Vallée des Ponts-de-Martel, (Bois des Lattes/Marais Rouge)	Brot-Plamboz, Les Ponts-de-Martel, Travers	1991	2003
16	Tourbières du Cachot (Le Marais/Marais Rouge)	La Chaux-du-Milieu, Le Cerneux-Péquignot	1991	2003
17	Marais de la Châtagne	La Brévine	1991	
18	Rond Buisson	La Brévine	1991	2003
19	Le Marais de la Joux du Plâne	Dombresson	1991	
20	Les Saignolis	La Chaux-de-Fonds, Le Locle, Les Brenets, Les Planchettes,	1991	2003
47	La Sagnette/Les Tourbières	Les Verrières	1991	
48	Tourbière près de la Cornée	La Brévine	1991	
49	Le Brouillet	La Brévine	1991	
50	Bémont/Chez Petoud	La Brévine	1991	2003
56	Le Marais/Les Bochats	Môtiers	1991	
57	Les Sagnettes sur Boveresse	Boveresse	1991	
568	Les Eplatures-Temple	La Chaux-de-Fonds	1991	
575	Marais de Pouillerel/ Marais Jean Colard	La Chaux-de-Fonds	1991	

Canton de Genève

Sans objets

Canton du Jura

2	Etang de la Gruère	Le Bémont, Montfaucon, Saignelégier[35]	1991	
3	La Tourbière de la Chaux-des-Breuleux	La Chaux-des-Breuleux, Saignelégier[36]	1991	
4	La Tourbière au sud des Veaux	Les Genevez	1991	
5	Les Embreux	Les Genevez	1991	
6	Plain de Saigne	Montfaucon	1991	
7	La Tourbière des Enfers	Le Bémont, Les Enfers	1991	
8	La Saigne à l'est des Rouges-Terres	Le Bémont, Montfaucon	1991	
9	Tourbières de Chanteraine	Le Noirmont	1991	
21	Creux de l'Epral	Le Noirmont	1991	
43	Tourbière à l'ouest de Prédame	Les Genevez	1991	

35 L'objet est situé dans les communes Le Bémont, Montfaucon, Saignelégier JU/ Tramelan BE.

36 L'objet est situé dans les communes La Chaux-des-Breuleux, Saignelégier JU/ Tramelan, Mont Tramelan BE.

No.	Localité	Commune(s)	Inscription	Révision
44	Derrière les Embreux	Lajoux	1991	
45	Forêt du Péché	Le Bémont	1991	
46	Les Royes	Le Bémont, Saignelégier	1991	
599	Tourbière à l'est des Neufs Prés	Montfaucon	1991	
605	La Couaye	Lajoux	1991	

Annexe 2
(art. 2)

Description des hauts-marais et marais de transition d'importance nationale[37]

[37] Non publiée au RO, cette annexe ne figure pas dans le présent recueil. Conformément à l'art. 2, al. 2, elle peut être consultée en tout temps à la Chancellerie fédérale, à l'Office fédéral de l'environnement, des forêts et du paysage et auprès des cantons (voir RO **1991** 270, **2003** 709 ch. I 2).

Ordonnance sur la protection des bas-marais d'importance nationale

(Ordonnance sur les bas-marais)

du 7 septembre 1994 (Etat le 12 juillet 2005)

Le Conseil fédéral suisse,

vu l'art. 18*a*, al. 1 et 3, de la loi fédérale du 1er juillet 1966[1] sur la protection de la nature et du paysage (LPN),

arrête:

Art. 1 Inventaire fédéral

L'Inventaire fédéral des bas-marais d'importance nationale (Inventaire des bas-marais) comprend les objets énumérés dans l'annexe 1. Ces objets satisfont en même temps à l'exigence de la beauté particulière au sens de l'art. 24sexies, al. 5, de la constitution fédérale[2].

Art. 2 Description des objets

1 La description des objets est publiée séparément. En tant qu'annexe 2, cette publication fait partie intégrante de la présente ordonnance.

2 La publication peut être consultée en tout temps à l'Office fédéral de l'environnement, des forêts et du paysage (office fédéral) et auprès des cantons.[3] Ceux-ci désignent les services concernés.

Art. 3 Délimitation des objets

1 Les cantons fixent les limites précises des objets et délimitent des zones-tampon suffisantes du point de vue écologique. Ils prennent l'avis des propriétaires fonciers et des exploitants, comme des agriculteurs et des sylviculteurs ainsi que des bénéficiaires de concessions et d'autorisations pour des installations et constructions.

2 Dans le secteur des conceptions et des plans sectoriels de la Confédération qui se réfèrent à des installations et constructions, les cantons prennent également l'avis des services fédéraux compétents.

RO **1994** 2092

1 RS **451**
2 [RS **1** 3, RO **1988** 352]
3 Nouvelle teneur selon le ch. I 3 de l'O du 15 janv. 2003 concernant la modification de la réglementation sur la consultation dans les ordonnances en matière de biotopes selon l'art. 18*a* LPN (RO **2003** 249).

[3] Lorsque les limites précises n'ont pas encore été fixées, l'autorité cantonale compétente prend, sur demande, une décision de constatation de l'appartenance d'un bien-fonds à un objet. Le requérant doit pouvoir fonder sa demande sur l'existence d'un intérêt digne de protection.

Art. 4 But visé par la protection

Les objets doivent être conservés intacts; dans les zones marécageuses détériorées, la régénération sera encouragée dans la mesure où elle est judicieuse. Font notamment partie de ce but la conservation et le développement de la flore et de la faune indigènes et des éléments écologiques indispensables à leur existence ainsi que la conservation des particularités géomorphologiques.

Art. 5 Mesures de protection et d'entretien

[1] Les cantons, après avoir pris l'avis des intéressés (art. 3, al. 1 et 2), prennent les mesures de protection et d'entretien adéquates pour conserver intacts les objets, en accordant une importance particulière au maintien et à l'encouragement d'une exploitation agricole adaptée.

[2] Ils veillent en particulier à ce que:

a. les plans et les prescriptions qui règlent le mode d'utilisation du sol au sens de la législation en matière d'aménagement du territoire soient conformes à la présente ordonnance;

b.[4] soient interdites toute installation ou construction et toute modification de terrain, notamment les drainages, le labour et l'apport de substances ou de préparations au sens de l'ordonnance du 18 mai 2005 sur les produits chimiques[5], ou encore de produits biocides au sens de l'ordonnance du 18 mai 2005 sur les produits biocides[6]; font uniquement exception, sous réserve des let. d et e, les constructions, installations et modifications de terrain servant à assurer la protection conformément au but visé;

c. l'entretien et la rénovation d'installations et de constructions réalisées légalement ne portent pas une atteinte supplémentaire au but visé par la protection;

d. les installations ou constructions servant à la poursuite de l'exploitation agricole, leur entretien et rénovation, et toute modification de terrain dans le même but ne soient autorisées que lorsqu'elles n'entrent pas en contradiction avec le but visé par la protection;

4 Nouvelle teneur selon le ch. II 3 de l'O du 18 mai 2005 sur l'abrogation et la modification du droit en vigueur du fait de la loi sur les produits chimiques, en vigueur depuis le 1er août 2005 (RO **2005** 2695).

5 RS **813.11**

6 RS **813.12**

e. les mesures visant à prévenir des dangers naturels et dont l'emplacement s'impose directement par leur destination soient prises en harmonie avec la nature et dans le seul but d'assurer la sécurité de l'homme; sont exclues les mesures pour assurer la protection de constructions et d'installations entreprises après le 1er juin 1983, dans des zones de dangers délimitées ou connues;

f. soit démantelée toute installation ou construction entreprise après le 1er juin 1983 et remis dans son état d'origine tout terrain modifié après cette date, aux frais du responsable, lorsque ces ouvrages ou modifications sont en contradiction avec le but visé par la protection et n'ont pas été autorisés avec force de chose jugée sur la base de zones d'affectation conformes à la loi fédérale du 22 juin 1979 sur l'aménagement du territoire[7]. S'il n'est pas possible de rétablir l'état au 1er juin 1983 ou si le rétablissement est disproportionné pour atteindre le but visé par la protection, il y a lieu de fournir un remplacement ou une compensation adéquats;

g. le régime local des eaux soit maintenu, si cela favorise la régénération du marais, amélioré;

h. la gestion forestière soit en accord avec le but visé par la protection;

i. l'embroussaillement soit évité en toute occasion et la végétation marécageuse caractéristique conservée;

k. les fossés soient entretenus correctement et avec ménagement, pour autant qu'ils soient compatibles avec le but visé par la protection;

l. les marais soient protégés contre les dégâts durables dus à un pacage inadapté et au piétinement;

m. l'exploitation à des fins touristiques et récréatives soit en accord avec le but visé par la protection.

[3] Les installations, constructions et modifications de terrain sont admissibles dans les zones-tampon pour autant qu'elles ne portent pas atteinte au but visé par la protection.

Art. 6 Délais

[1] Les mesures prévues à l'art. 3, al. 1, et à l'art. 5 doivent être prises dans un délai de trois ans.

[2] Pour les cantons à faible et à moyenne capacité financière, pour lesquels la protection des bas-marais représente une charge considérable, ce délai est de six ans au maximum lorsqu'il s'agit d'objets dont la conservation n'est pas menacée. Le Département fédéral de l'environnement, des transports, de l'énergie et de la communication[8] désigne ces cantons.

7 RS **700**
8 La désignation de l'unité administrative a été adaptée selon l'art. 16 al. 3 de l'O du 17 nov. 2004 sur les publications officielles (RS **170.512.1**).

Art. 7 Protection transitoire

Les constructions, installations et modifications de terrain ainsi que les changements notables du mode d'utilisation du sol sont interdits dans les objets tant que les cantons n'ont pas pris de mesures de protection et d'entretien. Les cantons peuvent autoriser des dérogations si elles sont compatibles avec l'art. 5.

Art. 8 Réparation des dommages

Les cantons veillent, chaque fois que l'occasion s'en présente, à la meilleure remise en état possible des objets déjà atteints.

Art. 9 Devoirs de la Confédération

1 Dans leur activité, les autorités, services, instituts et établissements fédéraux sont tenus de conserver intacts les objets.

2 Ils prennent les mesures prévues aux art. 5, 7 et 8 dans les domaines relevant de leur compétence en vertu de la législation fédérale spéciale y relative.

Art. 10 Compte rendu

Tant qu'ils n'ont pas pris les mesures nécessaires selon l'art. 3, al. 1, et l'art. 5, les cantons rendent compte à la fin de chaque année à l'office fédéral de l'état de la protection des bas-marais sur leur territoire.

Art. 11 Prestations de la Confédération

1 La Confédération conseille et soutient les cantons dans l'accomplissement des tâches prévues par la présente ordonnance.

2 Les indemnités de la Confédération pour les mesures prévues aux art. 3, 5 et 8 de la présente ordonnance sont régies par les art. 17 et 19 de l'ordonnance du 16 janvier 1991[9] sur la protection de la nature et du paysage (OPN).[10]

Art. 12[11]

Art. 13 Entrée en vigueur

1 La présente ordonnance entre en vigueur le 1er octobre 1994 à l'exception de l'art. 5, al. 2, let. f.

2 L'art. 5, al. 2, let. f, entrera en vigueur au moment de l'entrée en vigueur de la modification de la LPN[12] (selon message du 26 juin 1991[13]).

9 RS **451.1**
10 Nouvelle teneur selon le ch. II 4 de l'O du 18 déc. 1995, en vigueur depuis le 1er fév. 1996 (RO **1996** 225).
11 Abrogé par le ch. I de l'O du 25 fév. 2004, avec effet au 1er mai 2004 (RO **2004** 1799).
12 En vigueur depuis le 1er fév. 1996.
13 FF **1991** III 1137

Annexe 1[14]
(art. 1)

Liste des bas-marais d'importance nationale

No.	Localité	Communes	Inscription	Révisions
	Canton de Zurich			
4	Langnauer Berg	Langnau am Albis	1994	
6	Gmeimatt	Ottenbach	1994	
7	Bibelaas	Ottenbach	1998	
9	Lunnergrien	Obfelden	1994	
10	Lunnerallmend	Obfelden	1994	
13	Riede im Jonental	Affoltern, Mettmenstetten	1996	
14	Bislikerhau-Riede	Affoltern am Albis	1994	
18	Sennweid	Hausen am Albis	1994	
19	Hexengraben	Aeugst	1994	
20	Südlich Seehüsli	Aeugst	1994	1996
24	Schnabellücke	Hausen am Albis	1996	
26	Stumpenhölzlimoos	Oberrieden	1994	
27	Langmoos	Oberrieden	1994	
29	Gattikerweier	Thalwil	1994	
31	Ägelsee	Knonau, Maschwanden	1994	
34	Hägiimoos	Kappel am Albis, Knonau	1994	
36	Moos südlich Grünholz	Knonau	1994	
37	Arbach	Kappel am Albis, Rifferswil	1994	1996
38	Rorholz	Rifferswil	1994	
39	Brüggen	Rifferswil	1994	
43	Ägertenried	Hirzel	1994	
44	Chrutzelenmoos	Hirzel	1994	
46	Grindel	Horgen	1994	1996
47	Grindelmoos	Horgen	1994	
48	Östlich Ändenholz	Horgen	1994	
49	Geeristegried/Spitzenmoos	Hirzel, Wädenswil	1994	
51	Streuweid	Hirzel	1994	
52	Waldriede am Pfannenstiel	Herrliberg, Meilen	1994	1996
55	Hinter Guldenen	Herrliberg	1994	
56	Bergmeilen	Meilen	1994	
57	Ambitzgi	Wetzikon	1994	
58	Wetziker Riet/Oberhöfler Riet/Schwändi/Hiwiler Riet	Gossau, Hinwil, Wetzikon	1994	1996/ 2004
65	Freecht	Dürnten, Hinwil	1994	
68	Auen	Stäfa	1994	

14 Nouvelle teneur selon le ch. II al. 1 de l'O du 25 fév. 2004, en vigueur depuis le 1er mai 2004 (RO **2004** 1799).

No.	Localité	Communes	Inscription	Révisions
69	Ützikar Riet	Hombrechtikon	1994	
70	Seeweidsee	Hombrechtikon	1994	
71	Lutiker Ried	Hombrechtikon	1994	
73	Adletshuser Riet	Grüningen	1994	
75	Itziker Riet/Reitbacher Riet	Bubikon, Grüningen	1994	
76	Laufenriet	Bubikon	1994	
77	Bergli-Riet	Bubikon	1994	
78	Hüsliriet	Bubikon	1994	
79	Kämmoos	Bubikon	1994	
80	Egelsee	Bubikon	1994	
83	Turbenried im Rütiwald	Rüti	1994	
86	Sennhus	Wädenswil	1994	
87	Vorder Au	Wädenswil	1994	
88	Am Ausee	Wädenswil	1994	
91	Tüfiried/Katzentobel	Hombrechtikon, Stäfa	1994	
92	Feldbach	Hombrechtikon	1996	
149	Seelisberg	Fischenthal	1994	
154	Gmeindrüti-Ried/Moosried	Rüti	1996	
156	Grossweier	Rüti, Wald	1994	
211	Bichelsee	Turbenthal[15]	1994	
236	Seewadel	Gossau	1994	
432	Hofschür	Bäretswil	1994	
434	Wappenswiler Riet	Bäretswil	1994	
435	Fischenthaler Riet	Fischenthal	1996	
834	Neerer See	Neerach	1994	
836	Überg Mas	Hochfelden, Höri	1994	
838	Warpeltal	Embrach	1994	
839	Mettmenhasler See	Niederhasli	1994	
841	Steinmaurer Riet	Dielsdorf, Steinmaur	1994	
842	Klotener Riet	Kloten, Winkel, Oberglatt, Rümlang	1994	1996
845	Goldenes Tor/Rüti Allmend	Kloten, Winkel	1994	
846	Winkler Allmend	Winkel, Oberglatt	1994	1996
848	Chrüenriet	Regensdorf	1994	
849	Chatzensee	Regensdorf, Zürich	1994	
850	Hänsiried	Zürich	1994	
851	Allmend beim Chatzensee	Zürich	1994	
852	Gstöck/Ifang	Oberglatt, Rümlang	1994	
853	Schlosswinkel/Peterli	Oberglatt, Rümlang	1994	
856	Eigental-Riede	Kloten	1994	
859	Boppelser Weid	Boppelsen	1994	
862	Langenmoos	Weiningen	1994	
865	Schachen	Dietikon	1994	
868	Moos Schönenhof	Wallisellen	1994	

[15] L'objet est situé dans les communes Turbenthal ZH/Bichelsee TG.

No.	Localité	Communes	Inscription	Révisions
869	Hueb	Zürich	1994	
871	Beerimoos	Wettswil	1994	
981	Erztal	Schlatt, Zell	1994	
983	Rod	Wila, Wildberg	1994	
1146	Rechbergmoosbachriede	Schönenberg	1994	
1147	Chaltenboden	Schönenberg, Wädenswil	1994	
1151	Hinterbergried	Schönenberg	1994	
1152	Sagenhölzliriede	Schönenberg	1994	
1155	Mülibachried	Schönenberg	1994	
1156	Hüttner Seeli	Hütten[16]	1994	1996
1297	Neeracher Riet	Höri, Neerach, Niederglatt	1994	
1515	Oerlinger Riet	Kleinandelfingen	1994	
1516	Dachsenhuser Riet	Ossingen	1994	
1518	Husemersee	Ossingen	1994	
1519	Truttikerried	Truttikon	1996	
1521	Barchetsee	Waltalingen[17]	1996	1996
1527	Dürrenbiel	Hettlingen	1994	
1528	Baldisriet	Hettlingen	1994	
1529	Gurisee	Dägerlen, Dinhard	1994	
2168	Wollwisli	Wangen-Brüttisellen	1996	
2169	Örmis	Illnau	1994	
2170	Wildert	Illnau	1994	
2174	Russiker Riet	Russikon	1994	
2175	Madetswiler Riet	Russikon	1994	
2182	Schnäggenwald	Wila, Wildberg	1994	
2184	Ried Reinisbachtal	Wildberg	1994	
2186	Chrutzelried	Schwerzenbach, Volketswil	1994	
2187	Storen	Greifensee, Uster	1994	
2188	Böschen/Suelen/Stritgfänn	Fällanden, Greifensee, Schwerzenbach	1994	
2189	Hoperen/Hirzerenweid	Uster	1994	
2190	Glattenriet	Uster	1994	1996
2197	Bergholzriet/Ankenriet	Uster	1994	1996
2199	Seewisen/Hostig	Egg, Maur, Mönchaltorf, Uster	1994	1996
2201	Sackriet	Seegräben	1994	
2202	Seewadel	Uster	1996	
2203	Pfaffenbrunnen	Hittnau	1994	
2204	Zisetsriet	Bäretswil, Hittnau	1994	
2205	Grabenriet/Grossriet	Bäretswil	1994	
2207	Hüttenriet	Bäretswil	1998	
2209	Näppenacher	Bäretswil	1994	
2210	Hofhalden	Hittnau	1994	1996

16 L'objet est situé dans les communes Hütten ZH/Wollerau SZ.
17 L'objet est situé dans les communes Waltalingen ZH/Oberneunform TG.

No.	Localité	Communes	Inscription	Révisions
2211	Giwitzenried/Bächliried	Seegräben, Pfäffikon	1994	1996
2212	Robenhauserriet/Pfäffikersee	Seegräben, Wetzikon, Pfäffikon	1994	
2334	Weberzopf	Richterswil[18]	1996	
2616	Gubelried	Schönenberg	1994	
2779	Rüss-Spitz/Wannhüseren	Maschwanden[19]	1994	
3848	Hagenholz	Kappel am Albis	1996	
3849	Chrutzelen	Hausen am Albis, Rifferswil	1996	
	Canton de Berne			
245	Mederlouwenen	Guttannen	2004	
247	Träjen	Innertkirchen	1996	
252	Schärpfi	Meiringen	1994	1996
264	Turen/Chaltenbrunnen/ Stäckewäld	Meiringen, Schattenhalb	1996	
265	Feldmoos	Gadmen	1994	1996
267	Sytenvorsess	Hasliberg	1996	
268	Höhenschwandmoor	Hasliberg	1996	
269	Moore hinder der Egg	Hasliberg	1998	
280	Seemad	Hasliberg	1996	
326	Ueschisee	Amsoldingen, Höfen, Uebeschi	1996	
328	Dittligsee	Längenbühl	1994	1996
331	Gwattlischenmoos	Spiez, Thun	1994	1996
361	Moor südlich Vorderi Schneit	Saanen	1994	1996
364	Glawis Fäng	Saanen	1994	1996
367	Rossweidli/Horefäng	Saanen	1996	
371	Fidertschi	Zweisimmen	1994	1996
373	Füürbüel, Raafgarte	Zweisimmen, Saanen	1998	
374	Lischigi Weid/Vierschröti	Zweisimmen, Saanen	1996	
382	Am vordere Purwenge	St. Stephan	1996	
386	Albristmeder	St. Stephan	1996	
490	Tourbières de la Chaux d'Abel	Saint-Imier	1996	
491	Les Pontins	Saint-Imier	1996	
1178	Chuchifang	Boltigen	1996	
1183	Moore nördlich Toffelsweid	Boltigen	1996	
1190	Seeberg	Zweisimmen	1996	
1312	Etang de la Gruère	Tramelan	1994	1996
1314	Pâturage du Droit	Tramelan	1996	
1511	Oberste Gurbs	Diemtigen	1996	
1597	Zubenweid	Gsteig	1996	
1599	Reusch	Gsteig	1996	
1620	Tschärzis	Gsteig	1996	

18 L'objet est situé dans les communes Richterswil ZH/Wollerau SZ.
19 L'objet est situé dans les communes Maschwanden ZH/Cham, Hünenberg ZG.

No.	Localité	Communes	Inscription	Révisions
1735	Moore südwestlich Haslerberg	Lenk	1996	
1736	Moore südöstlich Haslerberg	Lenk	1996	
1739	Moore auf Betelberg	Lenk	1996	
1740	Portweid Golderne	Lenk	1994	1996
1741	Moore westlich Hubel	Lenk	1996	
1744	Grydmeder, Chaslepalgg	Lenk, Lauenen	1994	1996
1745	Lochberg	Lenk	1994	1996
1747	Klöpflisberg Moos	Lenk	1994	1996
1749	Cheerweid/Ufem Lähe	Lenk	1996	
1756	Schmidsfang/Satteleggbärgli	Gsteig	1996	
1757	Rohr Gsteig	Gsteig	1996	1998
1758	am ussere Saligrabe	Gsteig	1996	1998
1760	Moos	Saanen, Gsteig	1996	
1762	Sattel/Brüchi	Lauenen	1996	
1763	Falksmatte/Sodersegg/Dürri	Lauenen	1996	
1764	Rohr	Lauenen	1996	
1766	Rysch	Lauenen	1996	
1768	Färrich	Lauenen	1996	
1770	Moor östlich Trütlisbergpass	Lauenen	1996	
1771	Ustigwald	Lenk	1994	1996
1775	Pöris	Lenk	1996	
1777	Pöriswaldmedli	Lenk	1996	
1778	Lauenensee	Lauenen	1996	
2294	Le Fanel	Gampelen, Ins[20]	1994	1996
2376	Am See	Mörigen, Täuffelen	1994	1996
2377	Täuffeler Riet	Täuffelen	1994	1996
2383	Heidenweg	Erlach, Twann	1994	1996
2486	Wilermoos/Fräschelsweiher	Kallnach[21]	1994	1996
2489	Wengi Moos	Wengi	1994	1996
2620	Chänelegg	Lauterbrunnen	1996	
2626	Oltigenmatt	Golaten	1996	
2634	Au bei Märchligen	Muri bei Bern, Allmendingen	1994	1996
2635	Au bei Kleinhöchstetten	Rubigen	1994	1996
2638	Chessibidmer	Guttannen	1998	
3030	Rüti	Zweisimmen	1996	
3033	Sparemoos/Tots Mädli	Zweisimmen	1996	
3034	Schwarzesee	Zweisimmen	1996	
3035	Sparemoos	Zweisimmen	1994	1996
3036	Uf em Hubel	Boltigen, Zweisimmen	1996	
3038	Gammerschal	Zweisimmen	1994	1996
3040	Fäng/Hinder der Egg/Gööch	Saanen	1998	

20 L'objet est situé dans les communes Gampelen, Ins BE/Marin-Epagnier NE.
21 L'objet est situé dans les communes Kallnach BE/Fräschels FR

No.	Localité	Communes	Inscription	Révisions
3046	Lerchmatt/Schmittmoos	Thierachern	1994	1996
3048	Grundmoos	Rüti bei Riggisberg	1996	1998
3049	Büelberg/Würtnere	Lenk	1996	
3056	Moore oberhalb Geilsbüel	Adelboden	1998	
3058	Chlusi	Adelboden	1996	
3064	Spittelmatte	Kandersteg	1994	1996
3068	Dälmoos Achseten	Frutigen	1994	1996
3079	Filfalle	Kandersteg	1994	1996
3088	Schleifgraben	Rüschegg	1998	
3091	Sortel/Althuser	Guggisberg, Rüschegg	1996	
3092	Fischbächen	Rüschegg	1996	
3096	Moore südlich Ottenleuebad	Guggisberg	1996	
3097	Horbüelallmid/Schwanten-büelallmid	Guggisberg, Rüschegg	1996	
3099	Schwarzenbühl/Fettbeder	Rüschegg	1996	
3100	Ruuschi/Magerbad	Rüschegg	1996	
3101	Selital	Rüschegg	1998	
3105	Selibüel	Rüschegg	1996	
3106	Walenhütten/Lauchboden	Rüschegg	1996	
3108	Schwarzwasser/Bärgli	Rüschegg	1996	
3110	Dürrentännli	Rüschegg	1996	
3114	Schalenberg	Rüschegg	1996	1998
3115	Moor westl. Wissenbach/ Gurnigel	Rüschegg	1998	
3118	Stierenberg/Alp Brändli	Rüeggisberg, Rüti bei Riggisberg	1996	
3120	Chueberg/Schwändli	Rüeggisberg, Rüti bei Riggisberg	1996	
3121	Ladengrat/Stäckhüttenberg	Guggisberg	1996	
3135	Stierenmoos/Im lätzen Hengst	Rüschegg	1996	
3360	Schönisei/Harzisboden	Habkern, Oberried am Brienzersee[22]	1996	
3457	Schöriz	Horrenbach-Buchen, Sigriswil	1996	
3458	Moos	Horrenbach-Buchen	1996	
3459	Moore östlich Pfidertschegg	Horrenbach-Buchen	1996	
3460	Fuchser	Horrenbach-Buchen	1996	
3463	Horneggwald	Horrenbach-Buchen	1996	
3464	Hornmettlen/Ruer	Sigriswil	1996	
3468	Schwändli/Hungerschwand	Eriz, Horrenbach-Buchen	1998	
3469	Moore nordöstlich Ober Sol	Horrenbach-Buchen	1996	
3470	Ällgäu	Habkern	1996	
3474	Hintere und Vordere Nollen	Habkern	1996	

22 L'objet est situé dans les communes Habkern, Oberried am Brienzersee BE/Flühli LU.

No.	Localité	Communes	Inscription	Révisions
3476	Moor zwischen Lombachalp und Teufen	Habkern	1996	
3479	Dünzenegg/Tönimoos	Sigriswil	1996	
3482	Im Rüeggers	Sigriswil	1998	
3483	Moor östlich Unteres Hörnli	Sigriswil	1996	
3484	Untere und Obere Mäscher	Sigriswil	1996	
3485	Obere Zettenalp	Sigriswil	1996	
3486	Zettenalp	Sigriswil	1996	
3488	Hubelhörnli	Sigriswil	1996	
3491	Moore südwestlich Grünenbergpass	Beatenberg, Habkern	1996	
3496	Wagenmoos/Mittleres Seefeld	Beatenberg, Eriz	1996	
3503	Schwendli	Beatenberg	1996	
3504	Schluchhole	Beatenberg, Eriz	1994	1996
3505	Teuftal	Habkern	1996	
3506	Moore westlich Rotenschwand	Habkern	1996	
3507	Mad	Habkern	1996	
3512	Bolsitenallmi/Chuelibrunnen	Habkern	1996	
3516	In Erlen	Habkern	1996	
3518	Schwendallmi	Habkern	1996	
3520	Widmoos/Endorfallmi	Sigriswil	1996	
3525	Allmi westlich Läger	Habkern	1996	
3526	Bröndlisegg/Hinters Läger	Habkern	1996	
3527	Moore westlich Bröndlisegg	Habkern	1996	
3529	Waldeggallmi	Beatenberg	1998	
3530	Büelbach	Beatenberg, Habkern	1996	
3537	Vorderes Rotmösli	Eriz	1996	
3538	Moor östlich Ober Breitwang	Eriz	1996	
3542	Trogenmoos Süd	Habkern	1996	
3543	Trogenmoos Nord	Habkern	1996	
3544	Trogen	Habkern	1996	
3545	Moore nördl. Grünenbergpass	Habkern	1996	
3553	Chüematte	Beatenberg	1996	
3554	Moor östlich Gemmenalp	Beatenberg	1996	
3555	Moor bei Lombachalp	Habkern	1996	
3556	Bodmi	Habkern	1996	
3558	Luegiboden	Habkern	1996	
3562	Moore südlich Habchegg	Habkern	1996	
3563	Habchegg	Habkern	1996	
3564	Moor zwischen Mirrenegg und Ällgäu	Oberried am Brienzersee	1994	1996
3565	Schärpfenberg	Habkern	1996	
3580	Alte Stand/Wischbääch	Grindelwald	1996	

No	Localité	Communes	Inscription	Révisions
3586	Hambiel/Rossboden	Grindelwald	1998	
3590	Uf Brandsbort/Schopfweid	Grindelwald	1996	
3593	In Schroteggen	Grindelwald	1996	
3595	Breitenmoostor/Alpiglen	Grindelwald	1996	
3599	nordöstlich Oberläger	Grindelwald	1996	
3614	Feldmoos	Grindelwald	1998	
3615	Sattelegg/Am undren Brand	Grindelwald	1998	
3616	Breitmoos	Grindelwald	1996	
3625	Station Wengernalp	Lauterbrunnen	1996	
3626	Wengernalp	Lauterbrunnen	1996	1998
3636	Wachseldornmoos	Buchholterberg	1994	1996
3640	Pfaffernmoos	Eggiwil	1996	
3655	Rotmoos	Eriz	1996	
3658	Wimmisalp/Innerer Windbruch	Schangnau	1996	
3662	Oberes Roseggli	Schangnau	1998	
3663	Gustiweidli/Obere Mastweid	Schangnau	1996	
3667	Schwandweid/ Büelmeschwand	Schangnau	1996	
3671	Weissenau	Unterseen	1994	1996
3680	Fulwasser	Leissigen	1994	1996
3685	Höll	Büren an der Aare, Safnern	1994	1996
3688	Alte Zihl	Meienried, Safnern, Scheuren	1994	1996
4001	Garti	Lenk	1994	1996
4002	Trüthartsweid	Lenk	1994	1996
4003	Stigelbergmad	Lenk	1994	1996
4004	Stieretungel	Lauenen	1994	1996
4005	Obers-Plani	Saanen	1994	1996
4006	Rüwlisepass	St. Stephan	1994	1996
4007	Chatzberg	Lenk	1994	1996
4008	Uf de Schibene	Lenk	1994	1996
	Canton de Lucerne			
1238	Forenmoos/Langenried	Adligenswil, Meggen	1994	
1240	Moosweiher	Adligenswil, Udligenswil	1994	1996
1241	Rotseeried Abfluss	Ebikon	1994	
1244	Forrenmoos/Meienstossmoos	Schwarzenberg	1996	
1245	Furenmoos/Dorschnei	Kriens	1994	
1246	Grüebli/Hintergrüebli	Kriens	1994	
1247	Leitiboden	Kriens	1994	
1251	Steinibachried	Horw	1994	
1254	Röhrli	Kriens	1994	
2387	Seezopf/Seematt	Hitzkirch, Retschwil	1994	
2393	Ronfeld	Hochdorf, Römerswil	1994	1996

No	Localité	Communes	Inscription	Révisions
2395	Mettlenmoos	Eschenbach	1994	
2399	Unterallmend/Perlen	Root	1996	
2401	Uffikoner Moos	Buchs, Dagmersellen, Uffikon	1994	
2402	Wauwilermoos	Schötz	1994	
2403	Hagimoos	Kottwil	1994	
2405	Zällmoos	Sursee	1994	
2407	Juchmoos	Oberkirch	1994	
2409	Ostergau	Grosswangen, Willisau Land	1994	
2411	Schorenmoos	Nottwil	1994	
2480	Tuetenseeli	Menznau	1994	
2785	Altmoos	Aesch, Mosen	1994	
2913	Ärtig/Feldimoos	Schwarzenberg	1994	
2926	Riede um Boneren	Kriens, Schwarzenberg[23]	1994	
2928	Rotstock/Unter Honegg	Schwarzenberg	1994	
2931	Schofberg	Schwarzenberg	1994	
2938	Mülimäs	Kriens	1994	
2944	Breitried/Cholhütten/Hohrüti	Horw	1994	
2950	Rischigenmatt/Chrützliegg	Entlebuch[24]	1994	1996
3002	Weiherried	Udligenswil[25]	1996	
3253	Hefti/Salzboden	Escholzmatt, Flühli	1996	
3254	Tällenmoos im Hilferental	Flühli	1996	
3255	Hilferenpass	Flühli	1996	
3256	Toregg	Flühli	1996	
3257	Portenalp	Flühli	1996	
3258	Ahornenweid	Flühli	1996	
3261	Bleikenboden/Schitfilimoos	Flühli	1996	
3273	Trogenwald	Entlebuch[26]	1996	
3274	Glaubenberg/Hinter Rotbach	Entlebuch[27]	1996	
3279	Junkholz	Flühli	1996	
3280	Gloggenmatt	Flühli	1996	
3283	Stächelegg	Flühli	1996	
3285	Salwiden	Flühli	1994	1996
3286	Ochsenweid/Schwand/Gwün	Flühli	1994	
3289	Hagleren	Flühli	1996	
3296	Schwarzenegg/Steinetli	Flühli	1994	
3297	Laubersmadghack/Bärsel	Flühli	1994	
3300	Totmoos	Flühli[28]	1994	1996
3317	Egghütten	Flühli	1996	

23 L'objet est situé dans les communes Kriens, Schwarzenberg LU/Hergiswil NW.
24 L'objet est situé dans les communes Entlebuch LU/Alpnach OW.
25 L'objet est situé dans les communes Udligenswil LU/Küssnacht am Rigi SZ.
26 L'objet est situé dans les communes Entlebuch LU/Sarnen OW.
27 L'objet est situé dans les communes Entlebuch LU/Sarnen OW.
28 L'objet est situé dans les communes Flühli LU/Giswil OW.

No.	Localité	Communes	Inscription	Révision
3321	Schaftelenmoos/Stäldili/ Sattelpass	Flühli[29]	1996	
3324	Guggenen	Flühli	1996	
3328	Wasserfallenegg/Grön	Flühli	1996	
3352	Müseren	Escholzmatt	1994	
3353	Südlich Ober Saffertberg	Flühli	1996	
3354	Wagliseichnubel	Flühli	1996	
3357	Arnibergli	Flühli	1996	
3359	Schöniseischwand/Spierweid	Flühli	1994	
3360	Schönisei/Harzisboden	Flühli[30]	1996	
3362	Chadhus	Marbach	1996	
3371	Nesslenbrunnenboden/ Geugelhusenmoos	Entlebuch	1996	
3374	Spinnegg/Neuenmoos	Schwarzenberg	1994	
3379	Fuchserenmoos	Entlebuch	1996	
3385	Hindersandboden/ Stächtenmösli	Hasle	1996	
3386	Juchmoos/Angstboden	Hasle	1994	
3389	Ober-Längenberg	Hasle	1994	
3391	Stächtenmösli	Hasle	1996	
3394	Äbnistetten	Hasle	1994	
3398	Luchterlimoos, Schluck	Hasle	1996	
3400	Schwandmoos	Hasle	1996	
3406	Gfellen/Rossweid	Entlebuch	1996	
3407	Vorder Rotbach/Grundmoos	Entlebuch	1994	
3408	Mittler Risch	Entlebuch	1996	
3409	Ober Lauenberg	Entlebuch	1994	
3413	Tällenmoos Eschholzmatt	Escholzmatt	1994	
3414	östlich Brandchnubel	Flühli, Schüpfheim	1996	
3415	Brandmöser	Flühli	1996	
3417	Riede von Herrenmoos	Hasle, Schüpfheim	1996	
3418	Änggenlauenen/Grünholz	Schüpfheim	1996	
3420	Unter Wasserfallen	Entlebuch, Hasle	1996	
3423	Bärenboden	Entlebuch	1994	
3424	Gürmschmoos	Entlebuch	1996	
3426	Gugel	Entlebuch	1996	
3427	Gürmschwald/Gugelwald	Entlebuch	1996	
3443	Mettilimoos	Entlebuch	1996	
3446	Schimbrig/Hirsboden	Hasle	1996	
3448	Riedboden	Entlebuch[31]	1994	1996
3646	Marbachegg	Marbach	1996	
3649	Habchegg	Marbach	1996	

[29] L'objet est situé dans les communes Flühli LU/Giswil OW.
[30] L'objet est situé dans les communes Flühli LU/Habkern, Oberried am Brienzersee BE.
[31] L'objet est situé dans les communes Entlebuch LU/Alpnach OW.

No.	Localité	Communes	Inscription	Révisions
3651	Gustiweid	Marbach	1994	
3728	Hinterschild	Kriens, Schwarzenberg	1994	
3729	Oberer Fischerenboden	Kriens	1994	
3802	Hinter Rohren	Schwarzenberg	1994	
	Canton d'Uri			
1643	Oberalppass	Andermatt[32]	1998	
1860	Mättenwang Urnerboden	Spiringen	1994	
1862	Argseeli Urnerboden	Spiringen	1994	
2440	Berg beim Göscheneralpsee	Göschenen	1994	
2455	Auf den Lägern	Realp	1996	
2561	Zu den Staflen	Andermatt	1996	
2562	Sunnshiel	Andermatt	1996	
2592	Niemerstafel	Unterschächen	1996	
2671	Eggberge	Altdorf, Flüelen	1994	
2674	Selez	Bürglen	1996	
2693	Riedboden/Galtenäbnet	Bürglen	1994	
2740	Chneuwis/Gitschenen	Isenthal	1996	
2743	Flüeler Ried	Flüelen	1994	
2744	Seedorfer Ried	Seedorf	1994	
2760	Fulensee	Erstfeld	1994	
	Canton de Schwyz			
196	Bätzimatt	Tuggen	1994	
1126	Roblosen	Einsiedeln	1994	
1134	Giritz	Einsiedeln	1996	
1136	Trachslauer Moos	Einsiedeln	1996	
1137	Hessenmoos	Einsiedeln	1998	
1141	Sulzel	Einsiedeln	1996	
1143	Erlen/Hinterwis	Einsiedeln	1996	
1144	Sprädenegg	Einsiedeln	1996	
1156	Hüttner Seeli	Wollerau[33]	1996	1996
1217	Rotenflue Allmig	Arth	1996	
1221	Gersauer Alp	Gersau	1996	
1539	Brunnen	Vorderthal	1996	
1540	Langriet/Schneeloch	Vorderthal	1998	
1544	Gnossenweid/Mutzenwald	Vorderthal	1998	
1550	Lachen	Schübelbach, Reichenburg[34]	1998	
1551	Rossweid	Schübelbach	1996	
1552	Schwarzeneggehöchi/Hinter Gwürz	Innerthal	1996	
1555	Nöchen	Reichenburg	1996	

[32] L'objet est situé dans les communes Andermatt UR/Tujetsch GR.
[33] L'objet est situé dans les communes Wollerau SZ/Hütten ZH
[34] L'objet est situé dans les communes Schübelbach, Reichenburg SZ/Bilten GL.

No.	Localité	Communes	Inscription	Révisions
1719	nördlich Eggstofel	Innerthal	1996	
1720	Salzläcki	Innerthal	1996	
1731	Pragel	Muotathal	1996	
1832	Rüschenzopf	Tuggen	1996	
1838	Scheidegg	Innerthal[35]	1996	
1844	Nuoler Ried	Wangen	1994	
1951	Altmatt/Ägeriried	Rothenthurm[36]	1994	
2295	Obermoos	Feusisberg	1996	
2334	Weberzopf	Wollerau[37]	1998	
2335	Itlimoosweiher/Schöni	Feusisberg, Wollerau	1996	
2336	Schwantenau	Einsiedeln	1994	
2338	Brüschegg	Einsiedeln	1996	
2339	Ried bei Grossbach	Einsiedeln	1996	
2342	Hirzegg	Einsiedeln, Vorderthal	1996	
2344	Sattelegg	Vorderthal	1998	
2345	Beim Bannholz	Einsiedeln	1996	
2347	Moor westlich Etzel	Feusisberg	1996	
2350	Etzelweid	Feusisberg, Freienbach	1996	
2353	Langacher	Freienbach	1998	
2354	Moor westlich Unterdorf	Freienbach	1994	
2355	Frauenwinkel	Freienbach	1994	
2680	Teufböni	Morschach	1994	
2684	Guetentalboden	Muotathal	1996	
2689	Goldplangg	Muotathal, Riemenstalden	1994	
2690	Chrüzgütsch	Muotathal	1994	
2698	Charetalp	Muotathal	1994	
2709	Glattalp	Muotathal	1998	
2896	Schlänggli-Biberbrugg	Einsiedeln, Rothenthurm	1996	1998
2897	Witi	Feusisberg	1994	
2898	Ängiried	Feusisberg	1994	
2899	Erlen	Rothenthurm	1998	
2901	Grossblätz	Rothenthurm	1994	
2905	Hintere Wisstannenweid	Einsiedeln	1996	
2906	Hopfräben	Ingenbohl	1994	
2907	Ingenbohl	Ingenbohl	1996	
3001	Schlittenried	Küssnacht am Rigi	1998	
3002	Weiherried	Küssnacht am Rigi[38]	1996	
3017	Langerli/Riedhütte/Rohrboden	Lauerz	1998	
3020	Schornen	Schwyz	1994	
3021	Auw	Steinen	1994	
3023	Widen	Steinen	1994	

35 L'objet est situé dans les communes Innerthal SZ/Oberurnen GL.
36 L'objet est situé dans les communes Rothenthurm SZ/Oberägeri ZG.
37 L'objet est situé dans les communes Wollerau SZ/Hütten ZH.
38 L'objet est situé dans les communes Küssnacht am Rigi SZ/Udligenswil LU.

No.	Localité	Communes	Inscription	Révisions
3024	Sägel	Arth, Lauerz, Steinen	1994	
3140	Vord. Mäderen	Sattel	1998	
3153	Eigenrieter	Einsiedeln	1996	
3154	Chlösterliweid	Alpthal	1996	
3160	Stäubrig/Schrä	Einsiedeln, Unteriberg	1994	
3163	Euthal	Einsiedeln	1994	
3164	Breitried	Einsiedeln, Unteriberg	1994	
3165	Nätsch	Einsiedeln	1998	
3166	Rütiwijer	Einsiedeln	1996	
3185	Bannegg	Rothenthurm	1996	
3189	Hunds-Chotten	Rothenthurm	1996	
3190	Chessiloch	Alpthal	1996	
3191	Brüschrain	Alpthal, Schwyz	1996	
3193	Langeggried/Unter Heikentobel	Oberiberg	1994	
3196	Chli Seebli	Oberiberg	1998	
3197	Stockrietli	Oberiberg	1994	
3198	Gross Seebli	Oberiberg	1994	
3199	Ober Heikentobel	Oberiberg	1994	
3200	Regenegg/Lang Gschwänd	Oberiberg, Unteriberg	1994	
3201	Heitlenen	Einsiedeln	1996	
3204	Stöckweid/Wyer	Oberiberg, Unteriberg	1994	
3206	Platten	Unteriberg	1994	
3208	Tierfäderen	Unteriberg	1994	
3211	nordöstlich Schlund	Unteriberg	1996	
3213	Sennenried	Einsiedeln, Unteriberg	1994	
3216	Unteriberg/Ried	Unteriberg	1994	
3218	Gross Underbäch	Oberiberg, Schwyz	1994	
3219	Wüest Wald	Schwyz	1994	
3220	Furenwald	Oberiberg	1994	
3221	Rieter südl. Schwarzenstock	Alpthal	1998	
3222	Seiler/Zwäcken	Alpthal	1994	
3223	Chaspersboden	Alpthal	1994	
3224	Lünzelblätz/Cholhüttli	Alpthal	1994	
3226	Langried	Alpthal	1994	
3227	Rund Blätz	Alpthal	1994	
3228	Gleitboden/Streuneren	Alpthal	1994	
3229	Bueffen	Oberiberg	1998	
3230	Tubenmoos	Oberiberg	1994	
3234	Hobacher	Oberiberg	1994	
3241	Inner und Usser Schnabel	Illgau, Schwyz	1994	1996
3242	Ibergeregg-West	Schwyz	1996	
3243	Brestenburg/Rieter	Illgau	1998	
3244	Strit	Schwyz, Illgau	1998	
3246	Chaisten	Schwyz	1996	
3248	Seebli/Fuederegg	Oberiberg	1998	

No	Localité	Communes	Inscription	Révisions
	Canton d'Obwald			
281	Distelboden	Kerns	1996	
290	Melchsee	Kerns	1996	
297	Tannen	Kerns	1996	
1953	Städerried	Alpnach	1996	
2568	Riedboden bei Zischlig	Sarnen	1996	
2569	Gross Lucht	Sarnen	1996	
2579	Hanenried	Sachseln	1996	
2580	Usser Allmend	Giswil	1996	
2582	Siechenried	Kerns	1996	
2589	Sachsler Seefeld	Sachseln	1996	
2757	Feldmoos	Engelberg	1996	
2946	Gschwänt/Längenschwand	Alpnach	1996	
2947	Meien	Alpnach	1996	
2950	Rischigenmatt/Chrüzliegg	Alpnach[39]	1996	1996
2951	Rischigenmatt	Alpnach	1996	
2952	Rotibachried	Alpnach	1996	
2958	Steinstössi	Alpnach	1996	
2961	Blätz	Alpnach	1996	
2962	Mättli/Schoni	Alpnach	1996	
2963	Riedzöpf	Alpnach	1996	
2966	Längenfeldmoos	Alpnach	1996	
2969	Teilenboden	Sarnen	1996	
2973	Rossweid	Alpnach	1996	
2975	Häsiseggboden	Sarnen	1996	
2976	Gerenstock	Sarnen	1996	
2979	Rischi	Sarnen	1996	
2981	Wengli	Sarnen	1996	
3262	Schwand	Giswil, Sarnen	1996	
3263	Dörsmatt/Miesen	Giswil	1996	
3264	Miesenegg	Giswil	1996	
3266	Dörsmattgraben	Giswil	1996	
3267	Chesselsmatt	Giswil	1996	
3269	Riedmatt	Giswil	1996	
3270	Sewen	Sarnen	1996	
3271	Unter Sewen	Sarnen	1996	
3272	Ober Sewen	Sarnen	1996	
3273	Trogenwald	Sarnen[40]	1996	
3274	Glaubenberg/Hinter Rotbach	Sarnen[41]	1996	
3275	Chli Trogen	Giswil, Sarnen	1996	
3276	Münchenboden/Ochsenalp	Giswil, Sarnen	1996	

[39] L'objet est situé dans les communes Alpnach OW/Entlebuch LU.
[40] L'objet est situé dans les communes Sarnen OW/Entlebuch LU.
[41] L'objet est situé dans les communes Sarnen OW/Entlebuch LU.

No.	Localité	Communes	Inscription	Révisions
3288	Rormettlen	Giswil	1996	
3300	Totmoos	Giswil[42]	1996	1996
3301	Emmen	Giswil	1996	
3304	Alpoglen	Giswil	1996	
3321	Schaftelenmoos/Städili/ Sattelpass	Giswil[43]	1996	
3330	Heustettli/Bösen-Ritzenmatt	Sarnen	1996	
3333	Glatt-Allmend	Sarnen	1996	
3336	Mettlen	Giswil	1996	
3341	Zwirchi	Giswil	1996	
3343	Rossboden/Looegg	Giswil	1996	
3344	Dälenboden	Giswil	1996	
3429	Marchmettlen	Sarnen	1996	
3431	Unteres Schlierental	Sarnen	1996	
3433	Lochalp	Sarnen	1996	
3434	Nüwenalp	Sarnen	1996	
3436	Obermattboden	Sarnen	1996	
3437	Schwendi Kaltbad	Sarnen	1996	
3438	Lengenschwand	Sarnen	1996	
3448	Riedboden	Alpnach[44]	1996	1996
	Canton de Nidwald			
1957	Grossriet/Gnappiriet	Stans	1994	
2583	Eggen Rieter	Wolfenschiessen	1994	
2717	Chastenmatt	Beckenried	1996	
2725	Fäng/Rinderbüel	Emmetten	1996	
2726	Isital	Emmetten	1996	
2727	Hohberg	Emmetten	1994	
2728	Scheidegg im Choltal	Emmetten	1994	
2729	Seeliboden im Choltal	Emmetten	1994	
2745	Ried bei Altzellen	Wolfenschiessen	1994	
2747	Rieter bei Oberrickenbach	Wolfenschiessen	1994	
2926	Riede um Boneren	Hergiswil[45]	1994	
2939	Seewli/Riedboden	Hergiswil	1996	
2945	Schulried/Uertiried	Stansstad	1994	
2986	Litzli	Dallenwil	1994	
2987	Eggwaldried	Dallenwil	1994	
2991	Vorderegg	Dallenwil	1994	

42 L'objet est situé dans les communes Giswil OW/Flühli LU.
43 L'objet est situé dans les communes Giswil OW/Flühli LU.
44 L'objet est situé dans les communes Alpnach OW/Entlebuch LU.
45 L'objet est situé dans les communes Hergiswil NW/Kriens, Schwarzenberg LU.

No.	Localité	Communes	Inscription	Révisions
	Canton de Glaris			
627	Meur bei Britteren	Mollis	1994	
1550	Lachen	Bilten	1998	
1834	Niderriet	Bilten[46]	1994	
1838	Scheidegg	Oberurnen[47]	1996	
1840	Gross Moos im Schwendital	Oberurnen	1996	
1845	Boggenberg	Näfels, Oberurnen	1994	1996
1846	Türliboden	Näfels	1994	
1858	Etzelhüsli	Haslen	1994	
1868	Längriet	Engi, Matt	1996	
1869	Rossweid	Engi, Matt	1996	
1876	Garichti	Schwanden	1994	
1877	Matt	Schwanden	1994	
1882	Werbenrüsli	Haslen	1994	
1894	Unter Jetz	Elm	1994	
1918	Mürtschen	Obstalden	1994	
1919	Ober Mürtschen	Obstalden	1994	1996
1932	Gnappetriet	Matt	1996	
3697	Blossen	Niederurnen	1994	
	Canton de Zoug			
1223	Heumoos	Walchwil	1994	
1224	Chnoden	Walchwil	1994	
1225	Langmösli/Feldriedli	Walchwil	1994	
1231	Im Fang	Unterägeri	1994	
1233	Blimoos	Unterägeri	1994	
1236	Rieter/Sagen/Neselen	Oberägeri	1994	
1951	Altmatt/Ägeriried	Oberägeri[48]	1994	
2779	Rüss-Spitz/Wannhüseren	Cham, Hünenberg[49]	1994	
2789	Heiligchrüz	Baar	1994	
2790	Zimbel	Baar, Steinhausen	1994	
2795	Oberschwelli	Menzingen, Neuheim	1994	
2800	Muserholz	Menzingen	1994	
2803	Muserholz/Tännlimoos	Menzingen	1994	
2804	Sarbach	Neuheim	1994	
2808	Chälenhof	Menzingen	1994	
2813	Dersbach	Risch	1994	
2820	Schindellegi	Zug	1994	
2830	Zigermoos	Unterägeri, Zug	1994	
2839	Golperen/Girenmoos	Zug	1994	

46 L'objet est situé dans les communes Bilten GL/Schübelbach, Reichenburg SZ.
47 L'objet est situé dans les communes Oberurnen GL/Innerthal SZ.
48 L'objet est situé dans les communes Oberägeri ZG/Rothenthurm SZ.
49 L'objet est situé dans les communes Cham, Hünenberg ZG/Maschwanden ZH.

No.	Localité	Communes	Inscription	Révisions
2841	Birchriedli	Zug	1994	
2842	Eigenried	Walchwil, Zug	1994	
2843	Eigen/Elsisried	Unterägeri	1994	
2844	Tubenloch	Unterägeri	1994	
2846	Chnodenried	Unterägeri	1994	
2849	Erlenried	Walchwil	1994	
2851	Walchwiler Oberallmig	Walchwil	1994	
2853	Rainli	Unterägeri	1994	
2858	Geissmatt	Unterägeri	1994	
2861	Riederen I	Unterägeri	1994	
2862	Riederen II	Unterägeri	1994	
2866	Vorderes Hüribal	Unterägeri	1994	
2868	Frauental III	Cham	1994	
2869	Choller/Sumpf	Cham, Zug	1994	
2872	Twerfallen	Menzingen	1994	
2873	Neugrundmoor	Menzingen	1994	
2877	Chlausenchappeli	Menzingen, Oberägeri	1994	
2883	Zigerhüttli	Oberägeri	1994	
2887	Brämenegg	Oberägeri	1994	
2888	Hunntal	Oberägeri	1994	
2889	Giregg	Oberägeri	1994	
2892	Chrottenboden	Oberägeri	1994	
2893	Wissenbach	Oberägeri	1994	
2903	Breitried	Oberägeri	1994	
	Canton de Fribourg			
645	Grèves du lac	Delley[50]	1994	2001
647	Grèves du lac	Gletterens, Portalban[51]	1994	2001
648	Grèves du lac	Autavaux	1994	
649	Grèves du lac	Forel[52]	1994	
650	Grèves du lac	Châbles, Cheyres, Font	1994	
652	La Grève	Estavayer-le-Lac	1994	2001
657	Grèves du lac de Morat	Galmiz, Muntelier	1994	
1094	Les Gurles	Maules	1994	
1102	L'Ochère	Villaraboud	1994	1996
1104	La Mosse d'en Bas	Le Crêt	1994	1996
1105	Les Tourbières	Fiaugères, Porsel	1994	
1112	Grèves du lac	Cheyres[53]	1994	1996
1114	Lac de Seedorf	Corjolens, Noréaz	1994	
1118	Düdingermoos	Düdingen	1994	
1122	Fragnière-Moos	Schmitten	1994	

50 L'objet est situé dans les communes Delley FR/Chabrey, Champmartin, Cudrefin VD.
51 L'objet est situé dans les communes Gletterens, Portalban FR/Chevroux VD.
52 L'objet est situé dans les communes Forel FR/Chevroux VD.
53 L'objet est situé dans les communes Cheyres FR/Yvonand VD.

No.	Localité	Communes	Inscription	Révisions
1161	Rohrmoos	Plaffeien	1994	
1164	La Spielmannda/ Untertierli-berg	Cerniat	1994	
1203	Im Roten Herd	Jaun	1996	
1292	Grattavache	Charmey	1994	
1393	La Tourbière d'Echarlens	Echarlens	1994	
1399	Lac de Lussy	Châtel-Saint-Denis	1994	
1400	Les Mosses de la Rogivue	Saint-Martin[54]	1996	1996
1402	Les Alpettes	Semsales	1994	
1405	Rathevi	Châtel-Saint-Denis	1996	
1422	La Léchire	Enney	1994	
1423	Gros Mont	Charmey	1994	
1425	Fessu Derrière	Charmey[55]	1994	
1433	Le Penny	Gruyères	1994	
1481	Torry d'Arau	Cerniat	1994	
1503	Moore am Schwyberg	Plaffeien	1996	
2486	Wilermoos/Fräschelsweiher	Fräschels[56]	1994	1996
3701	Chablais-Nord	Galmiz	1994	
3711	Niremont, arête nord	Semsales	1996	
3712	Gros Niremont	Semsales	1996	

Canton de Soleure

Sans objets dans cette annexe

Canton de Bâle-Ville

Sans objets dans cette annexe

Canton Bâle-Campagne

Sans objets dans cette annexe

Canton de Schaffhouse

396	Weierwisen/Moos	Thayngen, Schaffhausen	1994	
397	Alteweier	Thayngen	1994	
408	Ramser Moos	Ramsen	1994	

Canton d'Appenzell Rh.-Extérieures

108	Höch Hirschberg	Gais[57]	1994	1996
111	Gross Moos/Rietlerwald	Gais	1994	
112	Langmoos/Foren	Gais	1994	1996
115	Hofguetmoor	Gais	1996	

54 L'objet est situé dans les communes Saint-Martin FR/La Rogivue VD.
55 L'objet est situé dans les communes Charmey FR/Rougemont VD.
56 L'objet est situé dans les communes Fräschels FR/Kallnach BE.
57 L'objet est situé dans les communes Gais AR/Appenzell, Rüte AI.

No.	Localité	Communes	Inscription	Révisions
145	Östl. Haumösli	Urnäsch	1994	
531	Potersalp	Hundwil[58]	1994	1996
880	Egg	Urnäsch	1994	
885	Moor nordwestlich Gisleren/Schönauwald	Urnäsch	1996	
888	Breitmoos	Urnäsch	1994	
889	Untere Fischeren	Urnäsch	1994	
891	Burket Wald	Urnäsch	1994	
892	Forenmösli/Burketwald/ Paradisli	Urnäsch	1994	
894	Moore zwischen Alp Stöck und Gschwend	Urnäsch	1996	
899	Stillert	Urnäsch	1994	
913	Moore im Trämelloch	Hundwil, Urnäsch[59]	1994	1996
914	Cholwald Schwägalp	Hundwil, Urnäsch	1994	1996
	Canton d'Appenzell Rh.-Intérieures			
108	Höch Hirschberg	Appenzell, Rüte[60]	1996	1996
120	Gontenmoos	Gonten	1996	
121	Gontenmoos	Gonten	1996	
122	Gontenmoos	Gonten	1996	
123	Gontenmoos	Gonten	1996	
124	Hüttenberg	Gonten	1996	
125	Hütten	Gonten	1996	
522	Vordere Wartegg	Schwende	1996	
523	Löchli	Gonten	1996	
524	Gschwend	Gonten	1996	
526	Rossweid	Schwende	1996	
531	Potersalp	Schwende[61]	1996	1996
532	Potersalp	Schwende	1996	
	Canton de Saint-Gall			
94	Busskircher Riet	Jona, Rapperswil	1996	
158	Mattliriet	Goldingen	1996	
161	Eggweid auf dem Ricken	Ernetschwil	1996	
162	östlich Hinter Schlümberg	Ernetschwil	1994	1996
163	Moore auf dem Rickenpass	Ernetschwil	1996	
164	Bodenwis	St. Gallenkappel	1994	1996
166	südöstlich Niderland	Wattwil	1994	
167	Hell	Wattwil	1996	
168	Ottenbach	Wattwil	1996	

58 L'objet est situé dans les communes Hundwil AR/Schwende AI.
59 L'objet est situé dans les communes Hundwil, Urnäsch AR/Krummenau SG.
60 L'objet est situé dans les communes Appenzell, Rüte AI/Gais AR.
61 L'objet est situé dans les communes Schwende AI/Hundwil AR.

No.	Localité	Communes	Inscription	Révisions
169	nordöstlich Reisenbach	Wattwil	1994	1996
170	Hüttenbüel	Gommiswald, Ebnat-Kappel, Wattwil	1996	
171	Unter Hüttenbüel	Wattwil	1994	
174	Usser Wald	Jona	1994	
175	Meilacher	Jona	1994	
178	Joner Allmend	Jona	1996	
179	Johannisberg	Jona	1994	
180	Joner Wald	Jona	1994	
183	Erlen	Jona	1996	
185	Wurmsbach	Jona	1994	1996
189	Chlosterwald	Jona	1994	
190	südlich Rüeggenschlee	Jona	1996	
192	Grosswisli	Eschenbach	1994	
193	Schwellbüel	Eschenbach	1996	
195	Schmerikoner Riet	Schmerikon	1994	
198	Benkner-, Burger- und Kaltbrunner Riet	Benken, Kaltbrunn, Uznach	1994	1996
201	Chamm	Gommiswald	1996	
205	Gärtensberg/Oberholz	Bronschhofen[62]	1996	
216	Hudelmoos	Muolen	1994	
218	Lenggenwiler Moos	Niederhelfenschwil	1996	
219	Zuzwiler Riet	Zuzwil	1994	
227	Rüeggetschwiler Moos	Gossau	1994	1996
229	Andwiler Moos	Andwil	1994	
237	Bleiken	Wattwil	1994	1996
238	Girenmoos	Flawil	1996	
389	Buriet/Buechsee	Thal	1994	
393	Huebermoos	Wittenbach, Berg	1996	
394	Schlossweier	Untereggen	1996	
426	Turpenriet/Torf-Riet	Kirchberg	1996	
427	Nördli Riet	Kirchberg	1996	
429	Vordersenis	Kirchberg	1994	
430	Riet bei Ganterschwil	Ganterschwil	1994	
431	Hinterbitzi	Mosnang	1996	
536	Mösli/Schachen	Sennwald	1994	1996
537	Tüfmoos	Sennwald	1994	
540	Galgenmad/Schribersmad	Sennwald	1994	1996
545	Dreihütten/Gamplüt	Wildhaus	1994	
546	Oberhag/Müselen/Langriet	Gams, Wildhaus	1994	
550	Schwendiseen	Alt St. Johann, Wildhaus	1994	
551	Munzenriet	Wildhaus	1994	
553	Älpli/Eggenriet	Grabs, Wildhaus	1994	
555	Hirzenbäder/Sommerweid	Grabs	1994	1996

62 L'objet est situé dans les communes Bronschhofen SG/Wuppenau TG.

No	Localité	Communes	Inscription	Révisions
556	Risiwald	Grabs	1996	
559	Loch	Grabs	1994	1996
560	Salegg/Chaltenbach/Rohr	Grabs	1994	1996
563	Grossriet	Walenstadt	1994	
568	Malunriet	Walenstadt	1994	
570	Sahrens	Wartau	1994	1996
572	Cholau	Wartau	1994	
579	Westlich Hobisbüel	Mels	1994	
580	Padüra	Flums	1994	
583	Fulriet/Mädems	Mels, Flums	1996	
584	Chapfensee	Mels	1994	
585	Tamons	Mels	1996	
593	Vilterser-Alp	Bad Ragaz, Vilters	1994	
597	Bodmen	Ebnat-Kappel	1996	
600	Goldach	Nesslau	1996	
603	Teuffenrohr/Stocklerriet	Amden	1994	
607	Ijental	Nesslau	1994	1996
608	Au/Hinterlaad	Nesslau	1996	
611	Schärsboden-Moor	Amden	1994	
612	Schönenboden	Amden	1994	
613	Altstofel	Amden	1994	1996
617	Espel	Alt St. Johann	1994	
624	Altschenchopf	Amden	1994	1996
625	Engenriet	Walenstadt	1996	
629	Steinacher	Walenstadt	1996	
873	Salomonstempel	Ebnat-Kappel, Hemberg, Wattwil	1996	
874	Unter-Schlatt	Hemberg	1996	
879	Ober Bad	Hemberg	1996	
901	Müslen	Ebnat-Kappel	1996	
905	Moore bei Steig und Schartegg	Krummenau	1994	
906	Unterloch/Grundlosen	Krummenau	1994	
908	Ruchweid	Ebnat-Kappel	1996	
909	Chellen/Allmeindswald	Ebnat-Kappel, Hemberg	1996	
910	Chlosterwald-Moore/Ampferenbödeli	Krummenau	1994	
913	Moore im Trämelloch	Krummenau[63]	1994	1996
918	Tanzboden-Guetental	Ebnat-Kappel	1996	
922	nordöstlich Chlieboden	Ebnat-Kappel	1996	
926	Feldmoos	Nesslau	1996	
930	Schneit	Nesslau	1996	
931	Schattenhalbriet/Zilmüslen	Krummenau, Nesslau	1994	1996
933	Friessen	Nesslau	1996	

[63] L'objet est situé dans les communes Krummenau SG/Hundwil, Urnäsch AR.

No.	Localité	Communes	Inscription	Révisions
936	Risipass	Krummenau, Stein (SG)	1996	
938	Hinterschluchen	Krummenau	1994	
939	Gruen/Neuhüttli	Krummenau	1994	
942	Palfris	Wartau	1994	
1830	Vorder Benkner Riet	Benken	1994	
1833	Gastermatt	Schänis	1996	
1901	Panüöler-Spigen	Flums	1996	
1903	Schwarzsee	Quarten	1994	
1909	Madils	Flums, Quarten	1996	
1911	Prodriet	Flums	1994	
1913	Schmalzlad	Flums	1994	1996
1926	Murgsee	Quarten	1994	
1934	Gräppelen	Alt St. Johann	1996	
1935	Wisenfurt	Buchs, Sennwald	1994	
1936	Moosanger	Diepoldsau	1994	
1937	Höchstern	Balgach, Widnau	1994	1996
1938	Spitzmäder	Oberriet	1994	
1939	Bannriet Nordost	Altstätten	1996	
1940	Bannriet	Altstätten	1996	
1943	Altenrhein	Thal	1994	
2162	Naserina	Quarten	1996	
2163	Tobelwald/Guetental	Quarten	1994	
2164	Nüchenstöck	Quarten	1996	
	Canton des Grisons			
438	Sältenüeb	Davos	1994	
453	Cani	Seewis im Prättigau	1994	
456	Palus	Seewis im Prättigau	1994	
461	Hintersäss	Seewis im Prättigau	1994	
462	Vorder Cavell	Schiers, Seewis im Prättigau	1994	
463	Hinter Cavell	Schiers, Seewis im Prättigau	1994	
467	Chrüzböden (Alp Ortasee)	Jenins, Maienfeld	1994	
470	Obersäss (Alp Ortasee)	Jenins	1994	
471	Nördlich Obersäss (Alp Ortasee)	Jenins, Maienfeld	1994	
472	Alpnova	Jenins, Seewis im Prättigau	1994	
474	Sadrein	Seewis im Prättigau	1994	
483	Soles	Fanas	1994	
485	Wal	Fanas	1994	
683	Tamangur	Scuol	1994	
684	Jufplaun	Tschierv	1994	
685	Buffalora	Tschierv	1994	
691	Palü Marscha	Sent	1994	
694	Naluns	Ftan, Scuol	1994	
698	Furmièrs	Ftan, Scuol	1994	

No.	Localité	Communes	Inscription	Révisions
700	Lai Nair	Tarasp	1994	
701	Palü Lunga	Ramosch	1994	
704	Salaaser Wisen	Samnaun	1994	
705	Val Fenga West	Ramosch, Sent	1994	
706	Val Fenga Ost	Sent	1994	
722	Bargaboden	Langwies	1994	
723	Gauderböden	Conters im Prättigau	1994	
731	Teilenmäder/Seebüelen	Conters im Prättigau, Langwies	1994	
732	Sapüner Mäder	Langwies	1994	
734	Faniner Galtihütte	Jenaz, Peist	1994	
735	Riedböden	Jenaz	1994	
738	Triemel/Cunggel	Pagig, St. Peter	1998	
742	Ried Faninpass	Peist	1994	
744	Fideriser Heuberge	Fideris	1994	
746	Clun	Fideris	1996	
751	Fondei	Langwies	1994	
760	Riede südlich Joch	Churwalden	1994	
761	Riede westlich Schwarzwald	Churwalden	1994	
762	Usserberg	Parpan	1994	
765	Unter Prätschsee	Peist	1994	
783	Heidsee, Pedra Grossa	Vaz/Obervaz	1994	
789	Lenzerheide	Vaz/Obervaz	1994	
790	Nordufer Heidsee	Vaz/Obervaz	1994	
797	Capelgin/Leng Ried	Luzein	1994	
804	Uf den Riederen	Conters im Prättigau	1994	
805	Birchenbüelen	Conters im Prättigau	1994	
807	Bi den Hüscheren	Klosters-Serneus	1994	
816	Girsch	Tamins	1994	
822	Weihermühle	Bonaduz, Rhäzüns	1996	
829	Alp dil Plaun	Scheid	1994	
949	Riet (Fadära)	Seewis im Prättigau	1994	
955	Stelsersee	Luzein, Schiers	1994	
958	Fulried am Stelserberg	Schiers	1994	
961	Loch	Valzeina	1994	
963	Rongg	Furna	1998	
964	Rongg	Furnaz, Jenaz	1998	
967	Güferlitzi	Furna	1994	
973	Geisswis/Gaschneida/ Plustorna	Luzein	1994	
974	Promisaun	Luzein	1994	
976	Tunail	Fideris	1994	
991	Alp Trida	Samnaun	1994	
992	Alp Bella	Samnaun	1994	
999	Alp da Schnaus	Schnaus	1994	
1000	Tschessas	Falera	1994	

No.	Localité	Communes	Inscription	Révisions
1001	Prau Grass	Luzein, Ruschein	1994	
1004	Paliu Marscha	Falera	1994	
1005	Tegia Sura	Falera	1994	
1011	Cavarschons	Falera	1996	
1028	Lag digl Oberst	Laax	1994	
1030	Cuolms da Breil	Breil/Brigels	1994	
1036	Alp Dado Sura	Waltensburg/Vuorz	1994	
1039	Val Frisal	Breil/Brigels	1996	
1040	Affeier/Pifal	Obersaxen	1998	
1043	Cuolm Sura	Surcuolm	1998	
1046	Prau Mitgiert	Surcuolm	1994	
1048	Moore nordwestlich Plitsches	Surcuolm	1994	
1050	Paliu Marscha	Luven	1998	
1053	Bosch	Luven	1994	
1054	Ruschneras	Surcuolm, Luven	1998	
1057	Ligneida	Luven	1998	
1060	Cuolm Sura	Castrisch, Valendas	1994	
1062	Alp Nova	Obersaxen	1994	
1068	Riederen	Obersaxen	1994	
1069	Bannwald	Obersaxen	1996	
1071	Wallengaden	Obersaxen	1994	
1077	Tschafanna	Obersaxen	1994	
1081	Kartitscha	Obersaxen	1994	
1083	Wuost	Obersaxen	1994	
1088	nordöstlich Lavadinas	Vella	1996	
1091	Murtes	Degen, Vella	1994	
1318	Rietboden (Tamboalp)	Medels im Rheinwald	1994	
1457	Isla Sut	Castrisch	1996	
1458	Quadras	Sagogn, Schluein	1994	
1626	Lagh Doss	Mesocco	1994	
1640	Bosch de San Remo	Mesocco	1998	
1643	Oberalppass	Tujetsch[64]	1996	
1644	Tgatlems	Tujetsch	1994	
1645	Plaun Pardatsch/Crest Darvun	Tujetsch	1994	
1651	Val Val	Tujetsch	1994	
1654	Plidutscha/Trutg Nurschalas	Tujetsch	1994	
1659	Liets	Tujetsch	1994	
1664	Palius	Medel (Lucmagn)	1994	
1668	Stavel da Maighels	Tujetsch	1994	
1672	Alp Tuma	Tujetsch	1994	
1688	Riedboden	Vals	1994	
1694	Tgiern Grond	Trun	1994	
1695	Alp Nadels	Trun	1994	
1699	Rossbodensee	Obersaxen	1996	

[64] L'objet est situé dans les communes Tujetsch GR/Andermatt UR.

No.	Localité	Communes	Inscription	Révisions
1704	Stavels Veders	Medel (Lucmagn)	1994	
1715	Crap la Crusch	Vrin[65]	1994	
1946	Alp Sura	Innerferrera	1994	
1954	Gletti/Hubelboda	Avers	1994	
1956	Plattner Berga	Avers	1994	
1963	Alp Anarosa I	Casti-Wergenstein	1994	
1969	Alp Stierva, Sigliots	Mon, Stierva	1994	
1975	Schatschas	Mon, Salouf	1994	
1980	Alp Anarosa II	Casti-Wergenstein	1994	
2013	Farreras/Scargneras	Riom-Parsonz	1998	
2042	Salignas/Combras	Portein, Flerden, Sarn	1998	
2045	Glaspass	Tschappina	1994	
2059	Engi	Safien	1994	
2072	Chilchalp	Hinterrhein	1994	
2082	Lai Neir	Sur	1998	
2085	Alp Flix	Sur	1994	
2086	Tga d'Meir	Sur	1994	
2089	Son Roc	Sur	1994	
2094	Val Savriez	Sur	1994	
2097	Muttariet	Marmorera, Sur	1994	
2100	Ransung	Marmorera	1994	
2101	Alp Ses	Marmorera	1994	
2102	Val da Natons	Marmorera	1994	
2122	Barscheinz	Bivio	1994	
2130	Jufer Alpa	Avers	1994	
2135	Alp Tgavretga	Bivio	1994	
2141	Am Eva dal Sett	Bivio	1994	
2145	Mot Scalotta	Bivio	1994	
2148	Cuolmens	Bivio	1996	
2151	Tgavretga	Bivio	1996	
2156	Passo del Maloja/Aira da la Palza	Stampa	1994	
2214	Prada da Tuoi	Guarda	1994	
2215	Prümarans	Ardez	1994	
2217	Clavadeler Berg	Davos	1994	
2222	Plansena	Poschiavo	1998	
2225	Munt da San Franzesch	Poschiavo	1994	
2237	Plan Nai/Marangun	Ramosch	1994	
2241	Güvè/Crasta	Sils i. E./Segl	1994	
2242	Muotta da Güvè/Chantunatsch	Stampa, Sils i. E./Segl	1994	
2243	Chalcheras	Sils i. E./Segl	1994	
2250	Val Fedoz	Stampa	1994	
2257	Val Fex, Alp Suot	Sils i. E./Segl	1994	

65 L'objet est situé dans les communes Vrin GR/Aquila TI.

No	Localité	Communes	Inscription	Révisions
2264	Val Madris, Preda	Soglio	1998	
2269	Palü Granda	Poschiavo	1994	
2279	Pè d'Munt/Pradè	Samedan	1998	
2284	Lej da Staz	Celerina/Schlarigna	1994	
2285	God da Staz	Celerina/Schlarigna	1998	
2286	Chona Suot - Palüd Chapè	Celerina/Schlarigna	1998	
2360	Alp Neaza	Pignia	1994	
2361	Plan Palé	Zillis-Reischen	1994	
2364	Alp Tobel	Andeer, Ausserferrera	1994	
2365	Lambegn	Andeer, Ausserferrera	1994	
3698	Plaun Segnas Sut	Flims	1996	
	Canton d'Argovie			
5	Rüssmatten	Jonen	1994	
306	Sibeneichen	Merenschwand	1994	
307	Schorengrindel	Merenschwand	1994	
309	Seematten	Aristau	1994	
311	Burenholz	Merenschwand	1994	
313	Bunau	Merenschwand	1994	
314	Rottenschwilermoos	Unterlunkhofen, Rottenschwil	1994	
315	Stille Reuss	Rottenschwil	1994	
316	Rottenschwiler Schachen	Rottenschwil	1994	
320	Obersee Althäusern	Aristau, Rottenschwil	1994	
322	Aristauer Schachen	Aristau	1994	
323	Schnäggenmatten	Rottenschwil	1994	
2370	Verlandung im Klingnauer Stausee	Böttstein	1994	
2371	Gippinger Grien	Leuggern	1994	
2763	Fronwald	Arni	1994	
2767	Tote Reuss	Fischbach-Göslikon	1994	
2768	Rüttermoos	Niederwil	1994	
2769	Fischbacher Moos	Fischbach-Göslikon	1994	
2774	Egelsee/Seematten	Bergdietikon	1994	
2777	Hagnauer Schachen	Merenschwand	1994	
2778	Schoren Schachen	Mühlau	1994	
2783	Rickenbacher Schachen	Merenschwand	1994	
2786	Schachen Oberlunkhofen	Oberlunkhofen, Rottenschwil	1994	
2787	Boniswiler-Seenger Ried	Boniswil, Seengen	1994	
	Canton de Thurgovie			
96	Bommer Weier	Alterswilen	1994	
97	Neuweier	Kreuzlingen	1996	

No	Localité	Communes	Inscription	Révisions
100	Weinmoos	Sulgen, Hessenreuti	1994	
205	Gärtensberg/Oberholz	Wuppenau[66]	1996	
210	Hagelriet	Aadorf	1998	
211	Bichelsee	Bichelsee[67]	1994	
212	Awiler Riet	Fischingen	1994	
213	Mooswangen	Fischingen, Wiezikon	1994	
214	Ägelsee	Wilen bei Wil, Busswil	1994	
215	Mettlen Moos	Schönholzerswilen, Mettlen	1994	
217	Hudelmoos	Amriswil	1994	
222	Wilener Moos/Hauptwiler Weiher	Gottshaus	1994	
400	Schaarenwis	Unterschlatt	1994	
402	Espi/Hölzli	Mett-Oberschlatt	1994	
406	Etzwiler Riet	Wagenhausen	1996	
421	Friltschener Riet/ Märwiler Riet	Buch bei Märwil, Märwil, Friltschen	1994	
985	Eschenzer Horn	Eschenz	1996	
988	Espen Riet bei Ziegelhof	Tägerwilen	1996	
989	Espen Riet/Ermatinger Riet	Ermatingen, Gottlieben	1996	
1521	Barchetsee	Oberneunforn[68]	1994	1996
2259	Luxburger Bucht	Egnach, Salmsach	1994	
	Canton du Tessin			
335	Alpe Gana	Olivone	1994	
336	Campo Solario	Olivone	1994	
342	Frodalera	Olivone	1994	
345	Val Scura (Alpe di Chièra)	Osco	1994	
351	Bolle di Cassina di Lago	Quinto	1994	
356	Bolle di Piana Selva	Dalpe	1994	
357	Vél (Gribbio)	Chironico	1994	1996
1258	Alpe Zaria	Fusio	1994	
1715	Crap la Crusch	Aquila[69]	1994	
2299	Bograsso/Bolette	Locarno	1994	
2301	Malcantone	Gudo	1994	
2302	Lanca Sant'Antonio	Sementina	1994	
2303	Isoletta	Cugnasco, Locarno	1994	
2304	Lanche al Pizzante	Locarno	1994	
2305	Vigna Lunga-Trebbione	Gudo	1994	
2306	Canale Demanio	Gudo, Sant'Antonio	1994	
2310	Ciossa Antognini	Cugnasco, Locarno	1994	
2312	Stagno Cugnoli Curti	Locarno, Magadino	1994	

66 L'objet est situé dans les communes Wuppenau TG/Bronschhofen SG.
67 L'objet est situé dans les communes Bichelsee TG/Turbenthal ZH.
68 L'objet est situé dans les communes Oberneunforn TG/Waltalingen ZH.
69 L'objet est situé dans les communes Aquila TI/Vrin GR.

No.	Localité	Communes	Inscription	Révisions
2314	Piattone-Lischedo	Locarno, Magadino	1994	
2324	Pian Casoro	Barbengo	1994	
2329	Pian Segna	Intragna	1994	
2330	Barbescio	Losone	1994	
2331	Stagno Piano di Arbigo 2	Losone	1994	
2333	Delta della Maggia	Ascona, Locarno	1994	
2430	Bolle di Paltano	Bedretto	1994	
2469	Alpe di Sceng	Biasca	1994	
2470	Larasèd	Biasca	1994	
2499	Pre Murin	Besazio, Ligornetto	1994	
2500	Lischetto Fossèe Seseglio	Chiasso	1994	
2501	Pra Coltello	Novazzano	1994	
2502	Colombera	Genestrerio, Stabio	1994	
2503	Molino	Genestrerio	1994	
2507	Monti di Medeglia est	Medeglia	1994	
2508	Monti di Medeglia ovest	Medeglia	1994	
2509	Gola di Lago	Camignolo	1994	1996
2512	Bolle di S. Martino	Vezia	1994	
2518	Lanche di Iragna nord	Iragna	1994	
2519	Lanche di Iragna sud	Iragna	1994	
2521	Alpe Corte Nuovo	Lavertezzo	1994	
2527	Pian Segno	Olivone	1994	1996
2528	Cassinal	Olivone	1994	
2534	Vall'Ambròsa est	Olivone	1994	1996
2535	Vall'Ambròsa ovest	Olivone	1994	
2537	Campra di là	Olivone	1994	
2543	Alpe di Vignone	Rossura	1994	
2549	Addi	Prugiasco	1994	
2551	Carà-Foppa	Leontica, Prugiasco	1994	
2553	Cò	Calonico	1994	
2654	Passo dell'Uomo	Quinto	1994	
2659	Cadagno di dentro	Quinto	1994	
2663	Cadagno di fuori	Quinto	1994	
2666	Pinett (Ritom)	Quinto	1994	
3704	Verengo	Chironico	1994	
3727	Piano di Arbigo 5	Losone	1994	
	Canton de Vaud			
500	Pontet	Le Chenit, Le Lieu	1994	1996
501	Lac Ter	Le Lieu	1994	
502	La Sagne du Séchey	Le Lieu	1994	
503	La Thomassette	Le Chenit	1994	
504	Tourbière de Derrière la Côte, sud-ouest	Le Chenit	1994	

No.	Localité	Communes	Inscription	Révisions
505	Tourbière de Derrière la Côte, sud-est	Le Chenit	1994	1996
506	Chez le Poisson	L'Abbaye, Le Chenit	1994	1996
507	Le Brassus	Le Chenit	1994	1996
508	La Burtignière	Le Chenit	1994	1996
633	Le Paudex	Ballens, Yens	1994	
645	Grèves du lac	Chabrey, Champmartin, Cudrefin[70]	1994	2001
647	Grèves du lac	Chevroux[71]	1998	2001
649	Grèves du lac	Chevroux[72]	1994	
655	Les Grèves	Cudrefin	1998	
1101	Pré Bernard	Chavornay	1994	
1110	Grèves du lac	Cheseaux-Noréaz, Yverdon-les-Bains	1994	
1111	Grèves du lac	Yvonand	1994	
1112	Grèves du lac	Yvonand[73]	1994	1996
1291	Champ-Buet	Bettens, Bournens	1994	
1330	Les Preises	Ormont-Dessous	1994	
1345	Les Nicolets	Ormont-Dessus	1994	
1348	Marais d'Ensex	Ollon	1994	1996
1356	Les Verneys	Gryon	1998	
1378	La Muraz	Noville	1994	1996
1379	Les Saviez	Noville	1994	1996/ 2004
1380	L'Aulagniez	Noville	1994	1996
1381	Clos Montet	Noville	1998	
1382	Gros Brasset	Noville	1994	1996
1400	Les Mosses de la Rogivue	La Rogivue[74]	1994	1996
1421	Les Tenasses	Blonay, Saint-Légier-La Chiésaz	1994	
1424	Les Chapelles	Rougemont	1994	
1425	Fessu Derrière	Rougemont[75]	1994	
1429	Les Roseys	Rougemont	1994	
1442	La Manche	Rougemont	1994	
1444	Ciernes Picat	Château-d'Oex, Rougemont	1994	
1445	Les Cases	Rougemont	1994	
1446	Vers Champ	Rougemont	1994	
1465	Le Bucley	La Rippe	1994	
1467	Grand Bataillard	Chavannes-de-Bogis	1994	
1483	Les Cruilles	Le Lieu	1994	

70 L'objet est situé dans les communes Chabrey, Champmartin, Cudrefin VD/Delley FR.
71 L'objet est situé dans les communes Chevroux VD/Gletterens, Portalban FR.
72 L'objet est situé dans les communes Chevroux VD/Forel FR.
73 L'objet est situé dans les communes Yvonand VD/Cheyres FR.
74 L'objet est situé dans les communes La Rogivue VD/Saint-Martin FR.
75 L'objet est situé dans les communes Rougemont VD/Charmey FR.

No.	Localité	Communes	Inscription	Révisions
1484	Lac Brenet	Le Lieu	1994	
1486	Sèche de Gimel	Le Chenit	1994	1996
1489	Creux du Croue	Arzier	1994	
1495	Cua Boussan	Burtigny	1994	
1496	Marais de Bercher	Burtigny	1994	1996
1562	Col des Mosses	Ormont-Dessous, Château-d'Oex	1998	2001
1563	Tourbière à l'ouest de la Lécherette	Château-d'Oex	1994	1998
1566	Communes des Mosses, est de la route	Château-d'Oex, Ormont-Dessous	1998	
1567	La Mossette	Château-d'Oex	1998	
1569	Corne du Soere	Château-d'Oex	1994	1998
1570	Grandes Charbonnières	Ormont-Dessous	1994	
1571	Anteinettes d'en Haut	Château-d'Oex	1994	
1573	Sonna	Ormont-Dessous	1998	
1574	Fonds de l'Hongrin	Ormont-Dessous	1994	1998
1576	Tourbière de Pra Cornet	Château-d'Oex	1994	1998
1582	Pâquier Mottier	Château-d'Oex	1994	
1585	Planzalard	Ormont-Dessous	1994	
1587	Les Rouvenes	Ormont-Dessous, Leysin	1994	
1593	Retaud	Ormont-Dessus	1994	
1606	Monts Chevreuils	Château-d'Oex	1994	1998
1608	Tourbière sous les Plans – Les Tésailles	Château-d'Oex	1994	1998
1618	Les Moilles	Ormont-Dessus	1994	
2031	Vers le Marais	Bex	1994	
3690	Mouille de la Vraconnaz	Sainte-Croix	1994	
3691	Mouille des Creux	Sainte-Croix	1994	
	Canton du Valais			
1363	Poutafontana	Grône, Sierre	1994	
1364	Marais d'Ardon et de Chamoson	Ardon, Chamoson	1994	
1453	Ar du Tsan	Nax	1998	
1783	Triest	Oberwald	1994	
1786	Zwisched Bäch	Obergesteln	1998	
1787	Blasestafel	Oberwald, Ulrichen	1994	
1796	Oxefeld	Binn	1994	
1801	Ninda	Savièse	1994	
1807	Mutt	Raron	1994	
1808	Boniger See	Törbel	1996	
1809	Bieltini	Törbel	1994	
1813	Lac de Champex	Orsières	1998	
1815	Vouasson	Evolène	1998	

No	Localité	Communes	Inscription	Révisions
1820	Villette	Bagnes	1994	
1821	Chevillard	Bagnes	1998	
2020	Les Rigoles	Vionnaz	1994	
2022	Lac de Morgins	Troistorrents	1994	
2025	Les Moilles	Troistorrents	1998	
2027	Champoussin	Val-d'Illiez	1998	
2030	Bochasse	Val d'Illiez	1998	
3702	Bärfel	Oberwald	1998	
3703	Les Esserts	Bagnes	1998	
3734	L'Echereuse	Champéry	1998	
	Canton de Neuchâtel			
233	Les Goudebas	Les Brenets	1994	
235	Les Eplatures-Temple	La Chaux-de-Fonds	1994	
511	Vers le Maix Rochat	La Brévine	1994	
1471	La Sagnette/Les Tourbières	Les Verrières	1994	
1828	Le Bied des Ponts-de-Martel	Les Ponts-de-Martel	1996	
2294	Le Fanel	Marin-Epagnier[76]	1994	1996
	Canton de Genève			
1470	Prés de Villette	Gy	1994	
	Canton du Jura			
488	Tourbières de Chanteraine	Le Noirmont	1994	
494	Neuf Etang	Bonfol	1994	
1298	La Tourbière des Enfers	Les Enfers	1994	
1300	Plain de Saigne	Montfaucon	1994	
1302	Les Embreux	Les Genevez	1994	
1303	Dos le Cras	Lajoux	1994	
1306	Saignes des Fondrais	Saignelégier	1994	
1307	Les Royes	Le Bémont, Saignelégier	1994	
1309	Gros Bois Derrière	Le Bémont	1994	
1310	Le Droit	Le Bémont, Montfaucon	1994	

[76] L'objet est situé dans les communes Marin-Epagnier NE/Gampelen, Ins BE.

Annexe 2[77]
(art. 2)

Description des bas-marais d'importance nationale

77 Non publiées au RO, cette annexe et ses modifications ne figurent pas dans le présent recueil. Conformément à l'art. 2 al. 2, elle peut être consultée en tout temps à la Chancellerie fédérale, à l'Office fédéral de l'environnement, des forêts et du paysage et auprès des cantons (voir RO **1997** 311, **1998** 922, **2001** 1891, **2004** 1799).

Annexe 3[78]

[78] Abrogée par le ch. II al. 3 de l'O du 25 fév. 2004, avec effet au 1er mai 2004 (RO **2004** 1799).

Ordonnance sur la protection des sites de reproduction de batraciens d'importance nationale

(Ordonnance sur les batraciens, OBat)

du 15 juin 2001 (Etat le 2 décembre 2003)

Le Conseil fédéral suisse,

vu l'art. 18*a*, al. 1 et 3, de la loi fédérale du 1er juillet 1966 sur la protection de la nature et du paysage (LPN)[1],

arrête:

Art. 1 Inventaire fédéral

[1] L'inventaire fédéral des sites de reproduction de batraciens d'importance nationale (inventaire des sites de reproduction de batraciens) comprend les objets énumérés dans les annexes 1 et 2.

[2] L'annexe 1 comprend les objets fixes, l'annexe 2 les objets itinérants.

Art. 2 Objets fixes

Les objets fixes comprennent le plan d'eau de reproduction et des surfaces naturelles et quasi naturelles attenantes (secteur A) ainsi que d'autres habitats terrestres et corridors de migration des batraciens (secteur B). Les secteurs A et B sont précisés si nécessaire dans la description des objets (annexe 3).

Art. 3 Objets itinérants

[1] Les objets itinérants comprennent des zones d'exploitation de matières premières, en particulier des gravières et des carrières d'argile et de pierres, incluant des plans d'eau de reproduction dont l'emplacement peut se modifier au cours du temps.

[2] Si les plans d'eau de reproduction ne peuvent plus être déplacés, le Département fédéral de l'environnement, des transports, de l'énergie et de la communication (DETEC) propose au Conseil fédéral que l'objet itinérant soit:

a. remplacé par un nouvel objet itinérant équivalent;

b. désigné comme objet fixe, ou

c. supprimé de l'inventaire.

[3] Lors de l'établissement de sa proposition selon l'al. 2, le DETEC tient compte des conditions locales et collabore étroitement avec les cantons concernés, qui pour leur part consultent les intéressés selon l'art. 5, al. 2.

RO **2001** 2273

[1] RS **451**

Art. 4 Description des objets

[1] Les objets sont décrits dans une publication spéciale. Cette publication fait partie intégrante, sous la forme de l'annexe 3, de la présente ordonnance.

[2] La publication peut être consultée en tout temps à l'Office fédéral de l'environnement, des forêts et du paysage (OFEFP) et auprès des cantons.[2] Ces derniers désignent les services concernés.

Art. 5 Délimitation des objets

[1] Les cantons fixent les limites précises des objets fixes. Ce faisant, ils consultent les propriétaires fonciers et les exploitants.

[2] Pour les objets itinérants, les cantons conviennent avec les propriétaires fonciers, les exploitants ou les branches concernées, d'un périmètre au sein duquel les plans d'eau de reproduction de batraciens peuvent être déplacés dans des lieux appropriés. Le cas échéant, les cantons prennent les décisions nécessaires.

[3] Lorsque les objets n'ont pas encore été délimités au sens des al. 1 et 2, l'autorité cantonale prend, sur demande, une décision de constatation de l'appartenance d'un bien-fonds à un objet. Le requérant doit fonder sa demande sur l'existence d'un intérêt digne de protection.

Art. 6 Buts de la protection

[1] Etant donné qu'ils constituent des sites de reproduction appropriés et de qualité pour les batraciens et qu'ils servent de points d'appui garantissant aux espèces de batraciens menacées une survie à long terme et une possibilité d'expansion future, les objets fixes doivent être conservés intacts et la fonctionnalité des objets itinérants doit être préservée.

[2] La protection vise en particulier à conserver et à valoriser:

a. l'objet en tant que site de reproduction de batraciens;

b. les populations de batraciens qui donnent à l'objet sa valeur;

c. l'objet en tant qu'élément du réseau de biotopes.

[3] Si la conservation ou la valorisation des populations de diverses espèces de batraciens s'excluent, les priorités définies dans les descriptions des sites de l'annexe 3 sont applicables.

Art. 7 Dérogations aux buts de la protection

[1] On n'admet des dérogations aux buts de la protection des objets fixes que pour des projets dont l'emplacement s'impose par leur destination et qui servent un intérêt public prépondérant d'importance nationale également. Celui qui déroge aux buts de

2 Nouvelle teneur selon le ch. I 4 de l'O du 15 janv. 2003 concernant la modification de la réglementation sur la consultation dans les ordonnances en matière de biotopes selon l'art. 18a LPN (RO **2003** 249).

la protection doit être tenu de prendre toutes mesures possibles pour assurer la protection, la reconstitution ou, à défaut, le remplacement adéquat.

[2] On admet en outre des dérogations aux buts de la protection des objets fixes lorsque:

a. des travaux d'entretien nécessaires doivent être entrepris pour assurer la protection contre les crues, en particulier dans le périmètre des pièges à gravier et des bassins de rétention;
b. l'exploitation d'installations de pisciculture existantes l'exige;
c. des mesures doivent être prises en vertu de la loi du 24 janvier 1991 sur la protection des eaux[3];
d. des mesures doivent être prises en vertu de l'ordonnance du 26 août 1998 sur les sites contaminés[4];
e. le maintien de surfaces d'assolement l'exige.

[3] On admet des dérogations aux buts de la protection des objets itinérants lorsque l'accord convenu ou une décision prise selon l'art. 5, al. 2, l'autorise expressément.

Art. 8 Mesures de protection et d'entretien

[1] Après avoir entendu les propriétaires fonciers et les exploitants, les cantons prennent les mesures de protection et d'entretien adéquates pour assurer la protection. Pour les objets itinérants, ces mesures font l'objet de l'accord convenu selon l'art. 5, al. 2.

[2] Les cantons veillent en particulier à ce que les plans et les prescriptions réglant le mode d'utilisation du sol au sens de la loi du 22 juin 1979 sur l'aménagement du territoire[5] soient conformes à la présente ordonnance.

Art. 9 Délais

Les mesures prévues à l'art. 5, al. 1 et 2, et à l'art. 8, doivent être prises dans un délai de sept ans à compter de l'inscription des objets dans l'annexe 1 ou 2.

Art. 10 Protection transitoire

Tant que les cantons n'ont pas pris de mesures de protection et d'entretien, ils veillent, par des mesures immédiates appropriées, à ce que l'état des objets fixes ne se détériore pas et à ce que la fonctionnalité des objets itinérants soit conservée.

Art. 11 Réparation des atteintes

Les cantons veillent, chaque fois que l'occasion se présente, à ce que les atteintes déjà portées à l'objet soient réparées dans la mesure du possible. Dans le cas des

3 RS **814.20**
4 RS **814.680**
5 RS **700**

objets itinérants, les accords convenus en vertu de l'art. 5, al. 2, seront pris en considération.

Art. 12 Devoirs de la Confédération

[1] Dans l'exercice de leur activité, les autorités, services, instituts et établissements fédéraux sont tenus de conserver intacts les objets fixes et de préserver la fonctionnalité des objets itinérants.

[2] Ils prennent les mesures prévues aux art. 8, 10 et 11 dans les domaines relevant de leur compétence en vertu de la législation spéciale.

Art. 13 Compte rendu

Tant qu'ils n'ont pas pris les mesures nécessaires selon l'art. 5, al. 1 et 2, et l'art. 8, les cantons rendent compte à l'office fédéral, tous les deux ans, à la fin de l'année, de l'état de la protection des sites de reproduction de batraciens.

Art. 14 Prestations de la Confédération

[1] L'OFEFP conseille et soutient les cantons dans l'accomplissement des tâches prévues par la présente ordonnance.

[2] Les indemnités de la Confédération pour les mesures prévues aux art. 5, 8, 11 et 16 de la présente ordonnance sont régies par les art. 17 et 19 de l'ordonnance du 16 janvier 1991 sur la protection de la nature et du paysage (OPN)[6].

Art. 15 Recommandations de l'OFEFP

Après avoir consulté les milieux concernés, l'OFEFP édicte des recommandations sur la protection et l'entretien des sites de reproduction de batraciens.

Art. 16 Disposition transitoire

[1] La protection des objets mentionnés dans l'annexe 4 est régie, jusqu'à la décision d'inscription dans l'annexe 1 ou 2, par l'art. 29, al. 1, let. a, OPN[7] ainsi que par l'art. 10 de la présente ordonnance.

[2] Ces objets sont décrits dans les documents de la consultation du 21 juin 1994[8]. Ils peuvent être consultés auprès des services désignés à l'art. 4, al. 2.

Art. 17 Entrée en vigueur

La présente ordonnance entre en vigueur le 1er août 2001.

6 RS **451.1**
7 RS **451.1**
8 Non publiés au RO, ces documents ne figurent pas dans le présent recueil.

Annexe 1[9]
(art. 1, al. 2)

Liste des sites de reproduction de batraciens d'importance nationale – objets fixes

N°		Localité	Commune(s)[10]	Inscription	Revision
		Canton de Zurich			
ZH	1	Eselacherried	Adlikon, Andelfingen	2001	
ZH	2	Ried beim Scheibenstand	Adlikon	2001	
ZH	11	Mülliweiher, Weiher am Rossweg	Adliswil	2001	
ZH	16	Türlersee NW-Ufer	Aeugst a.A.	2001	
ZH	34	Hätteliweiher Oberholz	Andelfingen	2001	
ZH	38	Erlenhofweiher	Andelfingen	2001	
ZH	53	Mülichrammweiher	Bäretswil	2001	
ZH	71	Feuerweiher am Homberg	Bassersdorf	2001	
ZH	72	Kiesgrube SW Runsberg	Dietlikon	2001	
ZH	76	Gruben Hard und Gubel	Bassersdorf	2001	
ZH	101	Kiesgrube Egghau	Birmensdorf	2001	
ZH	110	Weiher und Grube bei Ribacher	Bonstetten	2001	
ZH	144	Waldweiher im Oberholz/ Iffertsmoos	Dägerlen	2001	
ZH	148	Gurisee	Dägerlen, Dinhard	2001	
ZH	162	Längerenweiher	Dinhard	2001	
ZH	201	Kiesgrube Garwid	Dürnten	2001	
ZH	264	Hungerseeli	Fehraltorf	2001	
ZH	284	Altwässer Thurspitz	Flaach	2001	
ZH	294	Prüuselen	Flaach	2001	
ZH	295	Kiesgruben Ebnet	Flaach	2001	
ZH	310	Seewadel	Gossau	2001	
ZH	322	Isert Weiher	Gossau	2001	
ZH	352	Kiesgrube Ebertswil	Hausen a.A.	2001	
ZH	358	Weiher Fromoos (Gerhauweiher)	Hedingen	2001	

9 Nouvelle teneur selon le ch. I 1 de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4147).
10 Inscription 2001: Liste officielle des communes de la Suisse, mutation n° 50, juin 2001. Inscription 2003: Liste officielle des communes de la Suisse, mutation n° 58, février 2002.

N°		Localité	Commune(s)	Inscription	Révision
ZH	403	Kiesgrube Hasel	Hittnau	2001	
ZH	444	Örmis	Illnau-Effretikon	2001	
ZH	450	Ried Schlimberg/Vogelholz	Illnau-Effretikon, Lindau	2001	
ZH	458	Laichgebiet Bogen-Mesikon-Brand	Fehraltorf, Illnau-Effretikon	2001	
ZH	468	Ried südl. Uerzlikon	Kappel a.A.	2001	
ZH	469	Alter Torfstich im Hagenholz	Kappel a.A.	2001	
ZH	485	Mördersee und Pfaffensee	Kleinandelfingen, Ossingen	2001	
ZH	487	Enteler-Weiher	Kleinandelfingen, Marthalen	2001	
ZH	496	Waldried Homberg	Kloten	2001	
ZH	506	Lehmgrube beim Gwerfihölzli	Kloten	2001	
ZH	548	Elliker Auen	Flaach, Marthalen	2001	
ZH	555	Kiesgrube Grischei	Maschwanden	2001	
ZH	558	Kiesgrube Hinterfeld	Maschwanden	2001	
ZH	560	Biotop Süessplätz	Maur	2001	
ZH	577	Schützenweiher	Mettmenstetten	2001	
ZH	603	Biotop bei NOK Breite	Nürensdorf	2001	
ZH	616	Glattaltlaufgebiet Schlosswinkel-Peterli-Solachten	Oberglatt, Rümlang	2001	
ZH	628	Kiesgrube Härdli	Oberstammheim	2001	
ZH	629	Raffoltersee	Oberstammheim	2001	
ZH	638	Laichgebiet Lorzespitz	Obfelden	2001	
ZH	694	Weiher bei Hermatswil	Pfäffikon	2001	
ZH	714	Chatzensee, Chrüenriet	Regensdorf, Zürich	2001	
ZH	726	Kiesgrube Rhinauer Feld und Oberboden	Rheinau	2001	
ZH	732	Kiesgrube Ehnet	Rickenbach (ZH)	2001	
ZH	752	Russiker Ried	Russikon	2001	
ZH	833	Weiher Gütighausen	Thalheim a.d.Thur	2001	
ZH	849	Truttiker Ried	Truttikon	2001	
ZH	860	Seewädeli	Unterstammheim	2001	
ZH	868	Torfstiche im Seewadel	Uster	2001	
ZH	870	Werriker-/Glattenried	Uster	2001	
ZH	872	Hoperenried	Uster	2001	

N°		Localité	Commune(s)	Inscription	Revision
ZH	877	Grube Seefeld und Stopperweiher	Uster	2001	
ZH	881	Grabenriet	Uster	2001	
ZH	899	Kiesgrube Kindhausen (Blutzwies)	Illnau-Effretikon, Volketswil	2001	
ZH	944	Wollwisli	Wangen-Brüttisellen	2001	
ZH	946	Weiher Lochrüti	Wangen-Brüttisellen	2001	
ZH	973	Robenhauserried	Pfäffikon, Seegraeben, Wetzikon	2001	
ZH	975	Ambitzgi-/Bönlerried	Gossau, Wetzikon	2001	
ZH	995	Kiesgrube Rosengarten	Wila	2001	
ZH	1004	Totentäli	Winterthur	2001	
ZH	1013	Weiher Häsental	Winterthur	2001	
ZH	1015	Weiertal	Winterthur	2001	
ZH	1017	Lehmgrube Dättnau	Winterthur	2001	
ZH	1037	Hänsiried	Regensdorf, Zürich	2001	
ZH	1205	Weiher Stigenhof	Oberembrach	2001	
ZH	1210	Kiesgrube Goldbach	Rüti	2001	
ZH	1211	Sandlochgrube Chomberg	Winterthur	2001	
ZH	1212	Amphibienbiotope Allmend III	Zürich	2001	
ZH	1213	Tüfi-Weiher	Adliswil, Zürich	2001	
AG	742	Franzosenweiher und Altes Bad	Dietikon[11]	2001	
TG	197	Kiesweiher Weidacker	Altikon[12]	2001	
ZG	46	Steinhauser Weiher	Kappel a.A., Knonau[13]	2001	
		Canton de Berne			
BE	10	Büeltigen-Weiher	Kallnach	2001	
BE	16	Waldgrube Tannholz	Kappelen	2001	
BE	20	Grube Hardern	Lyss	2003	
BE	47	Mumenthaler Weiher	Aarwangen, Roggwil, Wynau	2001	
BE	49	Vogelraupfi	Bannwil, Walliswil bei Niederbipp	2003	

[11] L'objet est situé dans les communes de Dietikon ZH/Spreitenbach AG.
[12] L'objet est situé dans les communes de Altikon ZH/Uesslingen-Buch TG.
[13] L'objet est situé dans les communes de Kappel a.A., Knonau ZH/Baar, Steinhausen ZG.

N°		Localité	Commune(s)	Inscription	Révision
BE	51	Bleienbacher Torfsee und Sängeli	Bleienbach, Thunstetten	2001	
BE	57	Schmittenweiher	Roggwil	2001	
BE	61	Alte Kiesgrube Schwarzhäusern	Schwarzhäusern	2001	
BE	65	Chlyrot Weiher	Untersteckholz	2003	
BE	71	Elfenaureservat	Bern, Muri b. Bern	2001	
BE	116	Schnydere ob Eichholz	Köniz	2001	
BE	120	Wehrliau Muribadparkplatz	Muri b. Bern	2003	
BE	121	Mettlenweiher	Bern, Muri b. Bern	2001	
BE	132	Leubachbucht, Wohlensee-Nordufer	Wohlen b. Bern	2001	
BE	140	Lörmoos	Wohlen b. Bern	2001	
BE	149	Mettmoos	Biel	2001	
BE	151	Kieswerk Schopsberg	Arch	2003	
BE	152	Widi	Arch	2001	
BE	171	Tümpel b. Schulhaus	Dotzigen	2003	
BE	174	Tümpel bei Alter Aare Meienried	Dotzigen, Meienried	2003	
BE	181	Wengimoos	Wengi	2001	
BE	183	Bermoos	Bäriswil, Mattstetten, Urtenen	2001	
BE	223	Sessenais	La Heutte, Sonceboz-Sombeval	2001	
BE	237	Le Bain, Oversat	Romont	2003	
BE	240	Tourbière de la Chaux d'Abel	Saint-Imier, Sonvilier	2001	
BE	254	La Marnière	Tramelan	2001	
BE	262	Etang de Sagne	Plagne, Vauffelin	2001	
BE	269	Lätti Gals	Gals	2001	
BE	274	Nordteil Fanel	Gampelen	2001	
BE	281	Leuschelzmoos	Ins	2001	
BE	283	Inser-Weiher	Ins	2001	
BE	323	Hahnenmoosbergli	Adelboden, Lenk	2003	
BE	337	Stirple	Frutigen	2003	
BE	341	Spittelmatte	Kandersteg	2001	
BE	358	Kanderauen bei Mülenen	Reichenbach im Kandertal	2001	
BE	383	Chratzera	Grindelwald	2003	

N°		Localité	Commune(s)	Inscription	Révision
BE	397	Tümpel östl. Underläger	Grindelwald	2003	
BE	403	Grosse Scheidegg	Grindelwald	2003	
BE	524	Wyssensee	Hofstetten b. Brienz	2001	
BE	534	Wengernalp Weiher	Lauterbrunnen	2003	
BE	556	Weissenau	Unterseen	2001	
BE	558	Neuenzälgau	Kiesen	2001	
BE	569	Märchligenau-Flühli	Allmendingen, Rubigen	2001	2003
BE	574	Kleinhöchstettenau	Rubigen	2001	
BE	584	Feuerweiher Houti	Worb	2001	
BE	588	Rüfenachtmoos	Worb	2001	
BE	612	Oltigenmatt	Golaten, Wileroltigen	2001	
BE	618	Röselisee	Kriechenwil	2001	
BE	643	Mont Girod 1	Champoz	2001	
BE	649	Lac Vert	Court	2001	
BE	650	Mont Girod 2	Court	2001	
BE	672	La Noz, tourbière de La Sagne	Saicourt	2001	
BE	678	Les Chaufours	Sorvilier	2001	
BE	684	Le Châtelet	Tavannes	2003	
BE	696	Grube uf der Hole	Bühl	2001	
BE	705	Römerareal	Orpund	2001	
BE	708	Reservat Gryfeberg	Safnern	2001	
BE	710	Waldgrube Scheuren, Orpundinsel	Safnern, Scheuren	2001	
BE	719	Grien nordwestl. Dotzigen	Dotzigen, Schwadernau	2003	
BE	742	Ägelsee-Moor	Diemtigen	2001	
BE	756	Flachmoor Oberste Gurbs	Diemtigen	2001	
BE	783	Au-Gand Kander	Wimmis	2003	
BE	815	Juchli Käserstatt	Hasliberg	2003	
BE	862	Weiher am Fuss der Gryde	Lenk	2001	
BE	897	Weiher am Rüschbach	Gsteig	2001	
BE	898	Riedgebiet Saligrabe	Gsteig	2001	
BE	913	Lauenensee	Lauenen	2001	
BE	917	Weiher Obere Brüesche	Lauenen	2003	
BE	930	Tümpel Hornberg Läger	Saanen	2003	
BE	939	Weiher ob Ottenleuebad	Guggisberg	2001	
BE	947	Fischbächen Weiher	Rüschegg	2003	
BE	962	Waldgass-Grube	Wahlern	2001	

N°		Localité	Commune(s)	Inscription	Révision
BE	968	Aareaue bei Jägerheim	Belp	2001	
BE	973	Belpau	Belp	2001	
BE	998	Fischzuchtteich Gurnigelbad	Rüti b. Riggisberg	2003	
BE	1023	Schallenberg Tümpel	Röthenbach i.E.	2001	
BE	1027	Seeli-Egg, Lochsiten	Schangnau	2001	
BE	1063	Schintere Lerchenfeld	Thun, Uetendorf	2001	
BE	1064	Gwattmösli	Thun	2001	
BE	1065	Thuner Allmend	Thierachern, Thun	2003	
BE	1081	Buechholz Weiher	Sumiswald	2001	
BE	1095	Colas Grube	Niederbipp	2003	
BE	1101	Erlimoos	Oberbipp	2001	
BE	1120	Heideweg	Erlach, Twann	2003	
BE	1127	Muttli	Müntschemier	2001	
BE	1135	Cornez de la Mairie	Sorvilier	2001	
BE	1136	Vieille Birse	Court, Sorvilier	2001	
BE	1139	Biaufond	La Ferrière[14]	2001	
		Canton de Lucerne			
LU	3	Stadelmoosweiher	Alberswil	2001	
LU	5	Schlossweiher Altishofen	Altishofen	2001	
LU	10	Hasliweiher	Ballwil	2001	
LU	13	Gütschweiher	Ballwil	2001	
LU	33	Uffikonermoos	Buchs, Dagmersellen, Uffikon	2001	
LU	36	Hetzligermoos	Buttisholz	2001	
LU	47	Chalchloch	Doppleschwand, Entlebuch	2003	
LU	55	Risch, Rotseeried	Ebikon	2001	
LU	60	Ottigenbüel	Ebikon	2001	
LU	86	Riffigweiher	Emmen	2001	
LU	105	Fuchseren	Entlebuch	2001	
LU	116	Gürmschmoos	Entlebuch	2001	
LU	119	Moos	Eschenbach	2001	
LU	122	Mettlenmoos	Eschenbach	2001	
LU	133	Naturlehrgebiet Buechwald	Ettiswil, Grosswangen	2001	
LU	155	Unter Chlotisberg	Gelfingen	2001	

[14] Das Objekt liegt in den Gemeinden La Ferrière BE/La Chaux-de-Fonds NE/Les Bois JU.

N°		Localité	Commune(s)	Inscription	Revision
LU	156	Unterbüel	Gelfingen	2003	
LU	210	Schützenfeld – Moospünten	Hochdorf	2003	
LU	213	Turbiweiher/Ronfeld-weiher	Hochdorf, Römerswil	2001	
LU	222	Götsch/Feldhof	Gisikon, Honau	2001	
LU	227	Steinibachried	Horw	2001	
LU	230	Burgschachen	Buchrain, Inwil	2001	
LU	246	Wolermoos	Knutwil	2001	
LU	248	Hagimoos	Kottwil, Mauensee	2003	
LU	331	Tuetenseeli	Menznau	2003	
LU	341	Vogelmoos	Neudorf	2001	
LU	354	Moosschürweiher	Littau, Neuenkirch	2001	
LU	359	Chüsenrainwald	Neuenkirch	2001	
LU	360	Mühleweiher	Nottwil	2001	
LU	408	Staudenschachen Südarm	Root	2001	
LU	410	Unterallmend	Root	2001	
LU	425	Turbemoos (Forenwäldli)	Ruswil	2001	
LU	434	Steinibüelweier	Sempach	2001	
LU	454	Wauwilermoos	Egolzwil, Ettiswil, Kott-wil, Schötz, Wauwil	2001	
LU	469	NE Hirsboden	Schwarzenberg	2001	
LU	476	Hinter Roren	Schwarzenberg	2001	
LU	486	Grueb Grossfeld	Triengen	2001	
LU	491	Wagenmoos	Udligenswil	2001	
LU	512	Ostergau	Grosswangen, Willisau Land	2001	
LU	519	Grube Stoos Hüswil	Zell, Ufhusen	2001	
LU	523	Forenmoos	Adligenswil, Meggen	2001	
LU	524	Moosweiher	Adligenswil, Udligenswil	2001	
LU	532	Chänzeli/Schachen	Buchrain, Emmen	2001	
LU	606	Wannenholz	Inwil	2001	
LU	669	Lättloch	Gettnau	2001	
		Canton d'Uri			
UR	59	Bi den Seelenen	Isenthal	2001	
UR	76	Schlossried	Seedorf	2001	
UR	77	Reussdelta	Altdorf (UR), Flüelen, Seedorf	2001	
UR	104	Alpler See	Sisikon	2001	

N°		Localité	Commune(s)	Inscription	Revision
		Canton de Schwyz			
SZ	2	Breitried/Schützenried	Einsiedeln, Unteriberg	2001	
SZ	3	Oberer Sihlsee Euthal	Einsiedeln	2001	
SZ	4	Sihlsee S Schönbächli	Einsiedeln	2001	
SZ	5	Sihlsee Steinbach (Luka-srank)	Einsiedeln	2001	
SZ	7	Klosterweiher	Einsiedeln	2001	
SZ	10	Trachslauerweiher	Einsiedeln	2001	
SZ	34	Dreiwässern	Feusisberg	2001	
SZ	60	Reumeren	Reichenburg	2001	
SZ	68	Sägel, Schutt, Lauerzersee	Arth, Lauerz, Steinen	2001	
SZ	77	Klosterried Ingenbohl	Ingenbohl	2001	
SZ	138	Aazopf	Steinen	2001	
SZ	152	Bätzimatt	Tuggen	2001	
		Canton d'Obwald			
OW	1	Schlierenrüti, Reservat Sarna	Alpnach	2001	
OW	45	Mörlisee	Giswil	2001	
OW	78	Gerzensee, Blindseeli	Kerns	2001	
OW	123	Hanenriet	Sachseln	2001	
OW	127	Sachsler Seefeld	Sachseln	2001	
OW	167	Sewenseeli	Sarnen	2001	
OW	213	Melbach	Kerns	2001	
		Canton de Nidwald			
NW	59	Gnappiried	Stans	2001	
NW	61	Vierwaldstättersee Hüttenort	Stansstad	2001	
NW	62	Stansstader Ried/Rotzloch	Stansstad	2001	
NW	69	Chrotteseeli Obbürgen	Stansstad	2001	
		Canton de Glaris			
GL	2	Niederriet	Bilten	2001	
GL	17	Walenberg	Filzbach, Mollis	2001	
GL	18	Talsee	Filzbach	2001	
GL	20	Klöntalersee Nordostufer	Glarus	2001	
GL	37	Oberblegisee	Luchsingen	2001	

N°		Localité	Commune(s)	Inscription	Revision
GL	47	Feldbach	Mollis	2001	
GL	96	Klöntalersee Vorauen	Glarus	2001	
		Canton de Zoug			
ZG	12	Rüss-Spitz	Cham, Hünenberg	2001	
ZG	43	Binzmüli	Risch	2001	
ZG	46	Steinhauser Weiher	Baar, Steinhausen[15]	2001	
		Canton de Fribourg			
FR	5	Les Grèves, Gletterens-Portalban	Delley, Gletterens, Portalban	2001	
FR	35	Poutes Paluds	Charmey	2001	
FR	43	Le Liti	Estavannens	2001	
FR	52	Gros Chadoua	Grandvillard	2001	
FR	53	Le Mongeron	Gruyères	2001	
FR	59	Le Lity	Lessoc	2001	
FR	88	Le Taconnet	Essert, Ferpicloz	2001	
FR	89	Le Mouret	Essert	2001	
FR	99	La Tuilerie	Cottens, La Brillaz	2001	
FR	100	Les Nex	La Brillaz	2001	
FR	102	Les Dailles	Corpataux-Magnedens	2001	
FR	115	Sur Plian, Les Cases	Rossens	2001	
FR	132	Auried	Kleinbösingen	2001	
FR	133	Ehemalige Kiesgrube Reben	Liebistorf	2003	
FR	144	Saaneboden	Düdingen	2001	
FR	145	Stöckholz	Düdingen	2001	
FR	147	Düdingermoos	Düdingen	2001	
FR	161	Rohrmoos	Plaffeien	2001	
FR	166	Nümatt	Plasselb	2001	
FR	170	Entenmoos	Rechthalten	2001	
FR	201	Lac des Joncs	Châtel St-Denis	2001	
FR	210	La Grève, La Grande Gouille	Estavayer-le-Lac	2001	
FR	211	La Grève, Autavaux, Forel	Autavaux, Estavayer-Le-Lac, Forel	2001	
FR	214	Les Grèves, Cheyres sud	Cheyres	2001	

[15] L'objet est situé dans les communes de Baar, Steinhausen ZG/Kappel a.A., Knonau ZH.

N°		Localité	Commune(s)	Inscription	Révision
FR	215	Les Grèves, Cheyres-Font	Châbles, Cheyres, Estavayer-le-Lac, Font	2001	
FR	216	Ancienne carrière Les Saus	Châbles	2003	
FR	217	Pra-les-Bous	Léchelles, Montagny (FR)	2001	
FR	218	Overesses	Villarepos	2001	
FR	220	Petite Sarine	Arconciel, Corpataux-Magnedens, Hauterive (FR), Marly, Rossens, Treyvaux	2001	
FR	276	Vuibroye	Ecublens, Rue	2001	
		Canton de Soleure			
SO	11	Chli Aarli	Wolfwil	2001	
SO	44	Tümpel Stierenberg	Welschenrohr	2001	
SO	65	Tümpel untere Erli	Hauenstein-Ifenthal	2001	
SO	69	Obergösger Schachen	Obergösgen	2001	
SO	83	Erlenmoos, Haag	Bettlach	2001	
SO	84	Biedermannsgrube	Feldbrunnen-St. Niklaus	2001	
		Canton de Bâle-Ville			
BS	4	Eisweiher und Wiesenmatten	Riehen	2001	
BS	10	Autal	Riehen	2001	
		Canton de Bâle-Campagne			
BL	45	Ziegelei Oberwil	Oberwil	2001	
BL	62	Buechloch	Therwil	2001	
BL	64	Mooswasen	Therwil	2001	
BL	111	Talweiher	Anwil, Rothenfluh, Oltingen	2001	
BL	171	Bammertsgraben	Bottmingen	2001	
BL	173	Herzogenmatt	Binningen, Oberwil	2001	
BL	593	Uf Sal Tonwarenfabrik	Laufen	2001	
BL	598	Steinbruch Andil	Liesberg	2001	
BL	599	Steingrube Bohlberg	Liesberg	2001	

N°		Localité	Commune(s)	Inscription	Revision
		Canton de Schaffhouse			
SH	21	Morgetshofsee	Thayngen	2001	
SH	31	Bohnerzgruben Färber-wiesli	Beringen	2001	
SH	43	Eschheimer Weiher	Schaffhausen	2001	
SH	69	Lehmlöcher Rüti	Lohn	2001	
SH	70	Lehmlöcher Dicki	Büttenhardt, Lohn	2001	
SH	0401	Feuchtgebiet Widen	Neunkirch	2001	
SH	1501	Bachtelli/Seeli	Dörflingen	2001	
SH	1901	Rohrenbüeli-Stritholz	Schaffhausen, Stetten	2001	
SH	3201	Bohnerzgruben Chäfer hölzli	Beringen	2001	
SH	3902	Moos-Buck Herblingen	Schaffhausen, Stetten	2001	
SH	6203	Alte Biberschleife	Hemishofen	2001	
SH	6301	Ried/Lehmgrueb Hofenacker	Ramsen	2001	
SH	6401	Egelsee Degerfeld Wagen-hausen	Stein am Rhein	2001	
SH	7101	Weiher Lochgraben	Hallau	2001	
		Canton d'Appenzell Rh.-Extérieures			
AR	118	Wissenbachschlucht	Herisau[16]	2001	
		Canton d'Appenzell Rh.-Intérieures			
		Sans objet			
		Canton de Saint-Gall			
SG	9	Bildweiher	St. Gallen	2001	
SG	20	Wenigerweiher	St. Gallen	2001	
SG	21	Ochsenweid	Gaiserwald, St. Gallen	2001	
SG	27	Ziegelei Bruggwald	Wittenbach	2001	
SG	30	Huebermoos	Berg (SG), Wittenbach	2001	
SG	33	Kiesgrube Schuppis	Goldach	2001	
SG	59	Schlossweiher	Untereggen	2001	
SG	94	Moosanger	Diepoldsau	2001	
SG	103	Bisen	Rheineck, Thal	2001	
SG	110	Eselschwanz	St. Margrethen	2001	

[16] L'objet est situé dans les communes de Herisau AR/Flawil SG.

N°		Localité	Commune(s)	Inscription	Revision
SG	113	Bodenseeriet, Altenrhein	Thal	2001	
SG	118	Fuchsloch-Buriet	Thal	2001	
SG	140	Banriet/Burst	Altstätten	2001	
SG	170	Alte Lehmgrube Hilpert	Oberriet	2001	
SG	177	Wichenstein	Oberriet	2001	
SG	179	Spitzmäder	Altstätten, Oberriet	2001	
SG	201	Wiesenfurt	Buchs, Sennwald	2001	
SG	205	Retentionsbecken Ceres Rhein-Au	Buchs	2001	
SG	236	Burstried, Galgenmad	Sennwald	2001	
SG	248	Egelsee bei Bad Forstegg	Sennwald	2001	
SG	342	Kiessammler Vilters	Vilters-Wangs	2001	
SG	344	Kiesgrube Feerbach	Vilters-Wangs	2001	
SG	365	Baggerseen im Staffelriet	Benken	2001	
SG	367	Mösli	Benken	2001	
SG	374	Kaltbrunnerriet	Benken, Kaltbrunn, Uznach	2001	
SG	384	St. Sebastian	Schänis	2001	
SG	396	Siessenweiher	Eschenbach	2001	
SG	398	Briggisweiher N Auenhof	Goldingen	2001	
SG	399	Joner Allmeind	Jona	2001	
SG	405	Allmeind	Schmerikon	2001	
SG	496	Zuckenmattweiher	Bütschwil	2001	
SG	506	Turpenriet	Kirchberg	2001	
SG	515	Magdenau	Degersheim	2001	
SG	525	Glattal	Flawil, Gossau	2001	
SG	552	Bettenauerweier	Jonschwil, Oberuzwil	2001	
SG	554	Gill-Henau Reservat	Uzwil	2001	
SG	561	Hasenlooweiher	Bronschhofen	2001	
SG	563	Huserfelsen, Himmelbleichi	Niederbüren	2001	
SG	574	Ehemalige Kiesgrube Au	Oberbüren	2001	
SG	587	Riet Zuzwil	Zuzwil	2001	
SG	598	Arniger Witi	Gossau	2001	
SG	600	Espel	Gossau	2001	
SG	603	Waffenplatz Breitfeld	Gossau, St. Gallen	2001	
SG	614	Weiher NE Hohfirst	Waldkirch	2001	

N°		Localité	Commune(s)	Inscription	Revision
AR	118	Wissenbachschlucht	Flawil[17]	2001	
TG	40	Hudelmoos	Muolen[18]	2001	
		Canton des Grisons			
GR	43	Palüds – Agnas	Bever	2001	
GR	82	Cavloc	Stampa	2001	
GR	102	Lais da Pesch	Ftan	2001	
GR	106	Lai da Tarasp	Tarasp	2001	
GR	111	Duigls	Sent	2001	
GR	118	Plan da Chomps	Ramosch	2001	
GR	120	Craistas	Ramosch	2001	
GR	121	Ischlas da Strada	Tschlin	2003	
GR	129	Lai da Juata	Tschierv, Valchava	2001	
GR	140	Lai da Valpaschun	Sta. Maria Val Müstair, Valchava	2001	
GR	141	Plaun Schumpeder	Sta. Maria Val Müstair	2001	
GR	143	Schler dal Podestà	Müstair	2001	
GR	151	Rutisc Tonghi	Poschiavo	2001	
GR	159	Crest'Ota	Mon	2001	
GR	251	Pian di Alne	Cauco, Rossa	2001	
GR	310	Ils Lags Alp Ramosa	Vrin	2001	
GR	319	Ogna da Pardiala	Waltensburg/Vuorz	2001	
GR	325	Plaun da Foppas	Ilanz	2001	
GR	338	Lag digl Oberst	Laax	2001	
GR	339	Liger Alp Falätscha	Safien	2001	
GR	361	Malixer Alp	Malix	2001	
GR	386	Siechenstuden	Maienfeld	2001	
GR	391	Isla	Mastrils	2003	
GR	392	Ellwald	Fläsch	2001	
GR	395	Zizerser Gumpen	Trimmis, Zizers	2001	
GR	396	Girsch	Tamins	2003	
GR	397	Bregl	Bonaduz, Domat/Ems, Rhäzüns	2001	
GR	412	Länder	Maienfeld	2003	
GR	442	Alp da Razen	Rhäzüns	2001	
GR	457	Pro Niev	Feldis/Veulden	2001	

17 L'objet est situé dans les communes de Flawil SG/Herisau AR.
18 L'objet est situé dans les communes de Muolen SG/Amriswil, Zihlschlacht-Sitterdorf TG.

N°		Localité	Commune(s)	Inscription	Révision
GR	470	Sayser See	Says	2001	
GR	567	Punt Planet	Fuldera	2001	
GR	568	Fiin	S-chanf	2001	
GR	569	Lag Miert	Rhäzüns	2001	
GR	570	Tola	Fläsch	2001	
GR	572	Fröschaboda Val Madris	Soglio	2001	
GR	591	Neugüeter	Maienfeld	2001	
TI	16	Isola Sgraver	San Vittore[19]	2001	
		Canton d'Argovie			
AG	3	Zurlindeninsel	Aarau	2001	
AG	19	Halbmond	Aristau, Rottenschwil	2001	
AG	21	Seematten	Aristau	2001	
AG	96	Moos	Boniswil, Seengen	2001	
AG	102	Feldenmoos	Boswil	2001	
AG	104	Niedermoos	Boswil	2001	
AG	120	Fischergrien	Böttstein	2001	
AG	128	Hegnau	Bremgarten	2001	
AG	129	Schwand	Bremgarten	2001	
AG	139	Haldengutweiher	Brittnau	2001	
AG	149	Auschachen	Brugg, Windisch	2001	
AG	159	Lostorf	Buchs, Suhr	2001	
AG	163	Burger Weiher	Burg	2001	
AG	176	Kiesgrube Egg	Dürrenäsch	2001	
AG	181	Mattenplätz	Eiken	2001	
AG	183	Weiher im Tal	Eiken	2001	
AG	201	Dickhölzli	Bremgarten, Fischbach-Göslikon	2001	
AG	202	Zelgli/Höll	Fischbach-Göslikon, Niederwil (AG)	2001	
AG	203	Fischbacher Moos	Bremgarten, Fischbach-Göslikon	2001	
AG	206	Tote Reuss	Fischbach-Göslikon	2001	
AG	208	Letzi	Fischbach-Göslikon	2001	
AG	233	Mättenfeld	Gontenschwil, Oberkulm, Zetzwil	2001	

[19] Das Objekt befindet sich in den Gemeinden San Vittore GR/Lumino TI.

N°		Localité	Commune(s)	Inscription	Revision
AG	254	Wolfshüsli	Hägglingen, Wohlen (AG)	2001	
AG	260	Binsenweiher	Hausen b. Brugg	2001	
AG	268	Steinrüti	Hermetschwil-Staffeln, Rottenschwil	2001	
AG	276	Kohlschwärzi	Muhen	2001	
AG	279	Schümel	Holderbank	2001	
AG	284	Grasströchni Hard	Holziken	2001	
AG	294	Rüssmatten	Jonen	2001	
AG	303	Birristrott	Kaisten	2001	
AG	304	Ankematt	Eiken, Kaisten	2001	
AG	305	Heuberg	Kaisten, Laufenburg, Sulz (AG)	2001	
AG	307	Tägerhau	Kaisten	2001	
AG	340	Giriz	Koblenz	2001	
AG	344	Hof	Kölliken	2001	
AG	348	Grossmoos	Kölliken	2001	
AG	349	Walisgraben	Kölliken	2001	
AG	350	Zopfmatt	Kölliken	2001	
AG	367	Alte Reuss	Eggenwil, Künten	2001	
AG	368	Ägerten	Künten	2001	
AG	369	Buechhübel	Künten, Stetten	2001	
AG	404	Gippinger Grien	Leuggern	2001	
AG	407	Sagenmülitäli	Linn	2001	
AG	416	Talweiher	Magden	2001	
AG	436	Äbereich	Mellingen, Stetten	2001	
AG	439	Burgergrube	Burg, Menziken	2001	
AG	440	Schmulzenchopf	Menziken	2001	
AG	449	Oberschachen	Merenschwand	2001	
AG	453	Birri-Weiher	Aristau, Merenschwand	2001	
AG	454	Schorengrindel	Merenschwand	2001	
AG	459	Unterrütiweiher	Merenschwand	2001	
AG	461	Sibeneichen	Merenschwand	2001	
AG	468	Breitsee	Möhlin	2001	
AG	471	Haumättli	Möhlin	2001	
AG	493	Schoren Schachen	Mühlau	2001	
AG	522	Torfmoos	Niederrohrdorf	2001	
AG	523	Egelmoos	Niederrohrdorf	2001	

N°		Localité	Commune(s)	Inscription	Revision
AG	525	Rütermoos	Niederwil (AG), Wohlen (AG)	2001	
AG	526	Löliweiher	Niederwil (AG), Tägerig	2001	
AG	527	Chlosteräcker	Niederwil (AG), Tägerig	2001	
AG	530	Hard	Niederwil (AG)	2001	
AG	533	Krähhübel	Niederwil (AG)	2001	
AG	534	Breiti	Niederwil (AG)	2001	
AG	569	Schachen	Oberrüti	2001	
AG	582	Looweiher/Heidenloch	Oftringen	2001	
AG	586	Ruebank	Oftringen	2001	
AG	619	Steppberg	Möhlin, Rheinfelden	2001	
AG	620	Tannenchopf	Rheinfelden	2001	
AG	640	Chli Rhy	Rietheim	2001	
AG	649	Eiholz	Rohr	2001	
AG	655	Stockmösli	Rothrist	2001	
AG	667	Giriz	Rottenschwil	2001	
AG	668	Schnäggenmatten	Rottenschwil, Unterlunkhofen	2001	
AG	669	Heftihof	Jonen, Rottenschwil	2001	
AG	671	Stille Reuss	Rottenschwil	2001	
AG	681	Langenmoos	Sarmenstorf	2001	
AG	734	Töniweiher	Sins	2001	
AG	742	Franzosenweiher und Altes Bad	Spreitenbach[20]	2001	
AG	749	Kaltacker	Staffelbach	2001	
AG	759	Wildenau	Stetten	2001	
AG	765	Ramoos	Strengelbach	2001	
AG	766	Ziegelmatt	Strengelbach	2001	
AG	780	Schwarzrain	Sulz (AG)	2001	
AG	799	Schwarzmatt	Unterbözberg	2001	
AG	815	Rottenschwiler Moos	Hermetschwil-Staffeln, Rottenschwil	2001	
AG	820	Breitmoos	Untersiggenthal	2001	
AG	843	Umiker Schachen	Brugg, Villnachern	2001	
AG	881	Windischer Schachen	Windisch	2001	
AG	882	Fröschegräbe	Windisch	2001	
AG	910	Ägelmoos	Mellingen, Wohlenschwil	2001	

[20] L'objet est situé dans les communes de Spreitenbach AG/Dietikon ZH.

N°		Localité	Commune(s)	Inscription	Revision
AG	925	Lochmatt	Zeihen	2001	
AG	931	Ägelsee	Zeiningen	2001	
AG	941	Bärenmoosweiher	Zofingen	2001	
AG	960	Im See	Zurzach	2001	
AG	2002	Butzenmoos	Aristau	2001	
AG	2003	Bremengrien	Aristau	2001	
AG	2005	Folenweid	Bremgarten	2001	
AG	2008	Lindimatt	Möriken-Wildegg	2001	
AG	2011	Eggimoos	Niederwil (AG)	2001	
AG	2012	Friedgraben	Oberlunkhofen, Rottenschwil	2001	
AG	2015	Bösimoos	Niederrohrdorf, Stetten	2001	
AG	2016	Unterzelg	Villmergen	2001	
AG	2150	Zollester	Reinach	2001	
AG	2409	Dorfrüti	Merenschwand	2001	
AG	2419	Forenmoos	Bünzen, Hermetschwil-Staffeln	2001	
AG	2725	Maiholz	Muri	2001	
AG	2933	Weihermatthau	Tägerig	2001	
AG	3035	Ebni	Dintikon	2001	
AG	3054	Chalofe	Villmergen	2001	
		Canton de Thurgovie			
TG	7	Kiesgrube Atzenholz	Egnach	2003	
TG	34	Biessenhofer Weiher	Amriswil, Erlen	2001	
TG	40	Hudelmoos	Amriswil, Zihlschlacht-Sitterdorf[21]	2001	
TG	49	Hauptwiler Weiher	Hauptwil-Gottshaus	2003	
TG	62	Kiesgrube Freudenberg	Hohentannen	2001	
TG	72	Wiimoos	Erlen, Sulgen	2003	
TG	82	Sürch	Basadingen-Schlattingen	2003	
TG	93	Bächli - Gishalde	Schlatt	2003	
TG	94	Riet	Schlatt	2003	
TG	104	Luggeseeli	Aadorf	2003	
TG	116	Baggersee Chasperäcker	Frauenfeld	2001	
TG	117	Ägelsee	Gachnang	2001	

[21] Das Objekt befindet sich in den Gemeinden Amriswil, Zihlschlacht-Sitterdorf TG/ Muolen SG.

N°		Localité	Commune(s)	Inscription	Révision
TG	127	Allmend	Felben-Wellhausen, Frauenfeld	2001	
TG	165	Mösliweiher	Neunforn	2003	
TG	166	Müliweier	Neunforn	2003	
TG	170	Barchetsee	Neunforn	2001	
TG	177	Kiesgrube Bärg	Stettfurt	2003	
TG	179	Grüt – Bietenhart – Wolfsbüel	Hüttlingen, Thundorf	2001	
TG	197	Kiesweiher Weidacker	Uesslingen-Buch[22]	2001	
TG	200	Googlete	Uesslingen-Buch	2003	
TG	213	Bommer Weiher	Kemmental	2003	
TG	242	Lengwiler Weiher	Kreuzlingen, Lengwil	2001	
TG	244	Seeburg	Kreuzlingen	2001	
TG	264	Kiesgrube Wolfsbüel	Wäldi	2003	
TG	294	Lommiser Riet	Lommis	2003	
TG	367	Kiesgruben Neuhus-Bälisteig	Eschenz, Wagenhausen	2001	
TG	386	Bächler	Homburg	2003	
TG	387	Grube Trubeschloo	Homburg	2001	
TG	388	Hüttwiler Seen	Hüttwilen, Uesslingen-Buch	2001	
TG	413	Schoren Riet	Uesslingen-Buch, Warth-Weiningen	2003	
TG	424	Ägelsee	Salenstein	2003	
TG	432	Waldriet Grosswis	Homburg	2001	
TG	438	Heeristobel	Berlingen, Steckborn	2003	
TG	440	Etzwilerriet	Wagenhausen	2001	
TG	443	Reservat Schule Kaltenbach	Wagenhausen	2003	
TG	462	Grube Moos N Weerswilen	Weinfelden	2003	
TG	466	Sangen – Mülifang	Bürglen, Weinfelden	2001	2003
TG	472	Lehmgrube Opfershofen	Bürglen	2001	
TG	488	Kiesgrube Schürliwiesen	Kemmental	2001	
TG	494	Pflanzgarten Tätsch	Weinfelden	2003	
TG	498	Güttingersrüti	Weinfelden	2001	
TG	507	Aue N Aachmündung	Romanshorn	2001	
TG	508	Stockrüti	Warth-Weiningen	2003	

[22] Das Objekt befindet sich in den Gemeinden Uesslingen-Buch TG/Altikon ZH.

N°		Localité	Commune(s)	Inscription	Revision
		Canton du Tessin			
TI	2	Laghetto d'Orbello	Arbedo-Castione	2001	
TI	5	Ciossa Antognini	Cadenazzo, Cugnasco, Gudo, Locarno	2001	
TI	8	Vigna lunga – Trebbione	Gudo	2001	
TI	10	Stagno di Progero	Gudo	2001	
TI	12	Malcantone	Gudo	2001	
TI	16	Isola Sgraver	Lumino[23]	2001	
TI	19	Stagno Motto della Costa	Medeglia	2001	
TI	21	Canale Demanio	Gudo, Sant'Antonino	2001	
TI	34	Bolla di Loderio	Biasca, Malvaglia	2001	
TI	114	Cassina di Lago	Quinto	2001	
TI	139	Pescicoltura Golino	Intragna	2001	
TI	152	Bolle di Magadino	Gordola, Locarno, Magadino, Tenero-Contra	2001	
TI	153	Barbescio – Bolletina Lunga	Losone	2001	
TI	158	Piano di Arbigo	Losone	2001	
TI	161	Bolle di Mondrigo	Losone	2001	
TI	171	Stagno Paron	Piazzogna	2001	
TI	190	Stagno Figino-Cásoro	Barbengo	2001	
TI	193	Cava Rivaccia	Bedigliora	2001	
TI	195	Stagno Agra	Cademario	2001	
TI	199	Gola di Lago	Camignolo, Tesserete, Vaglio	2001	
TI	200	Laghetto	Camignolo	2001	
TI	201	Lago di Lugano a Cantonetto	Caslano	2001	
TI	202	Cava Gere Croglio	Croglio	2001	
TI	209	Ressiga	Monteggio	2001	
TI	211	Bosco Agnuzzo	Gentilino, Muzzano	2001	
TI	223	Pozza a est di Motto	Sessa	2001	
TI	228	Bolle di S. Martino	Vezia	2001	
TI	232	Stagno Avra	Castel San Pietro	2001	
TI	233	Pozza Bosco Penz	Chiasso	2001	
TI	234	Stagni Campagna Seseglio	Chiasso	2001	

[23] L'objet est situé dans les communes de Lumino TI/San Vittore GR.

N°		Localité	Commune(s)	Inscription	Revision
TI	236	Pozza Moreggi Pedrinate	Chiasso	2001	
TI	238	Stagno Pra Vicc	Genestrerio	2001	
TI	239	Prato Grande	Genestrerio	2001	
TI	241	Stagno Roggio	Meride	2001	
TI	243	Pra Coltello	Novazzano	2001	
TI	250	Meandri del Laveggio e Colombera	Genestrerio, Ligornetto, Stabio	2001	
TI	252	Cava Boschi	Stabio	2001	
TI	258	Lanche di Iragna	Iragna	2001	
TI	263	Stagno Campi Grandi	Lodrino	2001	
TI	284	Laghetto Pianca	Maggia	2001	
TI	285	Lago di Masnee	Maggia	2001	
TI	308	Pian Gallina	Porza	2001	
TI	323	Lanca Saligin	Coglio, Lodano, Maggia, Moghegno	2001	
TI	334	Pozza Monzell	Iragna	2001	
TI	335	Cava Motto Grande	Camorino	2001	
TI	336	Valle della Motta	Coldrerio, Novazzano	2001	
TI	337	Basciocca (ovest)	Giubiasco	2001	
TI	343	Stagno Guana	Meride	2001	
TI	347	Pre Murin	Besazio, Ligornetto	2001	
TI	352	Valle della Motta/Ai Prati	Novazzano	2001	
TI	362	Rompiga	Barbengo, Grancia	2001	
TI	375	Delta della Maggia	Ascona, Locarno	2001	
TI	376	Vigna	Besazio, Ligornetto	2001	
TI	378	Torrazza – Pra Signora	Novazzano	2001	
TI	379	Dosso dell'Ora – Dosso Bello	Castel S.Pietro	2001	
		Canton de Vaud			
VD	6	Grand Marais	Bex	2001	
VD	67	Les Mossières	Bière, Saint-Livres	2001	
VD	69	Borire, Corjon	Saubraz	2001	
VD	93	Lac Coffy, Bois Ramel	Bettens, Bioley-Orjulaz, Boussens	2003	
VD	100	Etang de Vigny	Cossonay, La Chaux	2001	
VD	101	Etang du Sépey	Cossonay	2001	
VD	133	Etang du Buron, Les Bioles	Penthéréaz	2001	

N°		Localité	Commune(s)	Inscription	Révision
VD	140	Etang de la Scie	Fiez, Fontaines-sur-Grandson	2001	
VD	145	La Combaz, L'Abbaye	Romairon	2001	
VD	177	Arborex	Lavigny, Villars-sous-Yens	2001	
VD	213	Les Bidonnes	Bogis-Bossey, Chavannes-de-Bogis, Crassier	2001	
VD	224	Bois de Porte, Les Dailles	Commugny, Chavannes-des-Bois, Mies, Tannay	2001	
VD	225	Grand Bataillard, Marais de la Versoix	Chavannes-de-Bogis, Commugny	2001	
VD	232	Ballastière	Gland	2001	
VD	251	Bioute, Etang d'Arnex	Arnex-sur-Orbe	2001	
VD	253	Entremur	Baulmes	2001	
VD	265	Pré Bernard, Creux-de-Terre	Chavornay	2001	
VD	275	Planches de Sergey, Chassagne	Les Clées, Sergey, Valeyres-sous-Rances	2001	
VD	286	Tourbière des Mosses	La Rogivue, Maracon	2001	
VD	292	Prés de Rosex	Corcelles-près-Payerne, Payerne	2001	
VD	299	Vernez-de-Chaux, La Coula	Payerne	2001	
VD	300	Ancienne Broye	Payerne	2001	
VD	357	Bendes	Saint-Légier – La Chiésaz	2001	
VD	362	Les Echelettes, La Léchère	Chamblon	2001	
		Canton du Valais			
VS	26	Pfyn West	Salgesch	2001	
VS	28	Pfyn Ost, Rosensee	Leuk, Salgesch	2001	
VS	50	Canal de Ceinture	Ardon, Chamoson	2001	
VS	66	Poutafontana	Grône, Sierre	2001	
VS	75	Le Rosel	Dorénaz	2001	2003
VS	136	Lac de Tanay	Vouvry	2001	
VS	142	Montagne de l'Au	Vouvry	2001	
VS	269	Lac de Mont d'Orge	Sion	2001	
VS	349	Bonigersee	Törbel	2001	
VS	417	Bettmeralp	Betten	2001	

N°		Localité	Commune(s)	Inscription	Révision
VS	427	Chiebodenstafel	Fiesch	2001	
VS	432	Lüsga	Naters	2001	
VS	476	Le Malévoz	Collombey-Muraz, Monthey	2001	
		Canton de Neuchâtel			
NE	1	Marnière du Plan du Bois	Bôle	2001	
NE	5	La Gare	Boudry	2003	
NE	13	Les Eplatures	La Chaux-de-Fonds	2003	
NE	18	La Galandrure	Les Brenets	2001	
NE	56	La Marnière d'Hauterive	Saint-Blaise	2001	
NE	58	Le Loclat	Saint-Blaise	2001	
NE	68	La Paulière	Coffrane	2001	
NE	99	Le Foulet	La Chaux-de-Fonds	2001	
NE	106	Les Goudebas	Les Brenets	2003	
NE	107	La Fabrique	Cortaillod		
NE	108	Pointe du Grain	Cortaillod, Bevaix	2001	
BE	1139	Biaufond	La Chaux-de-Fonds[24]	2001	
		Canton de Genève			
GE	10	Bois des Mouilles	Bernex	2001	
GE	11	La Petite Grave	Cartigny	2001	
GE	14	Moulin de Vert	Cartigny	2001	
GE	15	Raclerets	Chancy	2001	
GE	19	Pointe à la Bise	Collonge-Bellerive	2001	
GE	22	L'Allondon	Dardagny, Russin, Satigny	2001	
GE	25	Prés de Villette	Gy	2001	
GE	27	Prés Bordon	Gy, Jussy	2001	
GE	28	Réserve de Laconnex	Laconnex	2001	
GE	30	Marais des Crêts	Meyrin	2001	
GE	31	Marais des Fontaines	Meyrin	2001	
GE	33	Teppes de Verbois	Dardagny, Russin	2001	
GE	42	Bois des Douves	Versoix	2001	
GE	43	Vieux Bois	Jussy	2001	
GE	44	Marais du Château	Choulex	2001	

24 L'objet est situé dans les communes de La Chaux-de-Fonds NE/La Ferrière BE/ Les Bois JU

N°		Localité	Commune(s)	Inscription	Révision
		Canton du Jura			
JU	200	Les Esserts	Boécourt	2001	
JU	701	Sous Bâme	Courfaivre	2001	
JU	703	En Cortio	Courfaivre	2001	
JU	902	Le Colliard	Courroux	2001	
JU	1002	Bois de Chaux	Courtetelle	2001	
JU	1400	Combe Tabeillon	Glovelier	2001	
JU	1405	Combe du Bez	Glovelier	2001	
JU	1406	Foradrai	Glovelier	2001	
JU	1600	Les Charbonnières	Mettembert	2001	
JU	1902	Moulin de Bavelier	Pleigne	2001	
JU	2400	La Réselle	Soyhières	2001	
JU	4200	Le Refrain – La Bouège	Le Noirmont, Les Bois	2001	
JU	4300	Les Saignes	Le Noirmont, Les Breuleux	2001	
JU	4806	La Sagne à Droz	Les Genevez	2001	
JU	4900	La Vauchotte – Bois Banal	Goumois	2001	
JU	5001	Dos le Cras	Lajoux (JU)	2001	
JU	5101	Plain de Saigne	Montfaucon	2001	
JU	5412	La Goule – Le Theusseret	Goumois, Le Noirmont	2001	
JU	5413	La Bouège – La Goule	Le Noirmont	2001	
JU	5600	Bois Banal – Moulin Jeannotat	Les Pommerats	2001	
JU	5606	Les Pommerats	Les Pommerats	2001	
JU	5701	La Gruère	Le Bémont (JU), Saignelégier	2001	
JU	5702	Les Royes	Le Bémont (JU), Saignelégier	2001	
JU	5800	Côte d'Oye	Lajoux (JU), Saint-Brais	2001	
JU	6400	Etangs de Vendlincourt	Vendlincourt	2001	
JU	6600	Lorette	Saint-Ursanne	2001	
JU	6604	Bellefontaine	Saint-Ursanne	2001	
JU	7000	Etang Corbat	Porrentruy	2003	
JU	7500	Etangs Rougeat	Bonfol, Vendlincourt	2001	
JU	7501	Etangs de Bonfol	Bonfol	2001	
JU	7508	Les Queues de Chats	Bonfol	2001	

N°		Localité	Commune(s)	Inscription	Révision
JU	8400	Le Martinet	Courgenay	2001	
JU	8700	Les Coeudres	Damphreux	2003	
BE	1139	Biaufond	Les Bois[25]	2001	

[25] L'objet est situé dans les communes de Les Bois JU/La Ferrière BE/ La Chaux-de-Fonds NE.

Annexe 2[26]
(art. 1, al. 2)

Liste des sites de reproduction de batraciens d'importance nationale – objets itinérants

N°		Localité	Commune(s)[27]	Inscription	Revision
		Canton de Zurich			
ZH	61	Kiesgrube Schürli	Bäretswil, Wetzikon	2001	
ZH	140	Kiesgrube Zelgli und Flachweiher im Hardwald	Bülach, Glattfelden	2001	
ZH	306	Kiesgruben Mittlerboden	Glattfelden	2001	
ZH	318	Kiesgrube Langfuhr	Gossau	2001	
ZH	343	Kiesgrube Hochfurenzelg (Tobelacker)	Hagenbuch	2001	
ZH	542	Lehmgrube Häuli	Lufingen	2001	
ZH	591	Kiesgrube Riedt	Neftenbach	2001	
ZH	636	Laichgebiet Tambrig-Oberholz	Obfelden	2001	
ZH	704	Lehmgrube Tonwarenfabrik	Pfungen	2001	
ZH	712	Ziegelei Rafz	Rafz	2001	
ZH	883	Kiesgrubenbiotope Zimiker Eichli-Breiti	Uster	2001	
ZH	887	Kiesgrube Im Türli	Uster	2001	
ZH	906	Kiesgrube Härdacher	Volketswil	2001	
		Canton de Berne			
BE	19	Kies- und Betonwerk Bangerter	Lyss	2001	
BE	58	Ziegelei Roggwil	Roggwil	2003	
BE	206	Ziegeleigrube Oberburg	Oberburg	2001	
BE	381	Steinbruch Oberacher	Därligen	2001	
BE	837	Kiesgrube Balmgüeter	Meiringen	2003	
BE	1122	Oberfeld - Oberholz	Finsterhennen, Treiten	2003	
BE	1126	Grube Gugleracher	Ins, Müntschemier	2003	
BE	1204	Kiesgrube Mattehölzli	Walperswil	2003	

[26] Nouvelle teneur selon le ch. I 2 de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4147).
[27] Inscription 2001: Liste officielle des communes de la Suisse, mutation n° 50, juin 2001. Inscription 2003: Liste officielle des communes de la Suisse, mutation n° 58, février 2002.

N°		Localité	Commune(s)	Inscription	Revision
		Canton de Lucerne			
LU	12	Gruben Pfannenstil/ Morgenhalden/Höchi	Ballwil	2001	
LU	118	Kiesgrube Eschenbach (Rüchlig)	Eschenbach	2001	
LU	233	Grube Hohrüti	Inwil	2001	
LU	234	Lehmgrube Pfaffwil	Inwil	2001	
LU	240	Grube Utigen	Inwil	2001	
LU	268	Kiesgrube Hombrig	Kulmerau	2001	
LU	271	Hochrüti/Vogelmoos	Littau	2001	
LU	333	Kiesgrube Sticherlöchli	Menznau	2003	
LU	384	Booler	Rickenbach (LU)	2001	
LU	392	Lehmgrube Ober Huwil	Römerswil	2001	
LU	521	Grube Briseck	Zell	2001	
LU	587	Kiesgrube Hübeli	Zell	2001	
		Canton de Schwyz			
SZ	153	Unterschönenbuch	Ingenbohl	2001	
		Canton d'Obwald			
OW	8	Steinbruch Guber	Alpnach	2001	
		Canton de Nidwald			
NW	48	Ennerberg	Oberdorf	2001	
		Canton de Zoug			
ZG	10	Chrüzegg	Baar	2001	
ZG	38	Kiesgrube Sarbach/Hintertann	Neuheim	2001	
ZG	59	Chrüzstross	Cham	2001	
		Canton de Fribourg			
FR	64	Le Villaret	La Roche	2001	
FR	69	La Delèse	Villars-sous-Mont	2001	
FR	80	Côte à Bourgeois	Corpataux-Magnedens	2001	
FR	81	Vurzy	Corpataux-Magnedens	2001	
FR	142	Les Baumes	Villarepos, Wallenried	2001	
FR	152	Unter Balliswil	Düdingen	2001	
FR	221	Le Chaney	Corpataux-Magnedens	2001	
FR	222	Monteynan	Arconciel	2001	

N°		Localité	Commune(s)	Inscription	Revision
		Canton de Soleure			
SO	6	Ägertengrube	Neuendorf	2001	
SO	9	Äbisholzgrube	Oensingen	2001	
SO	101	Allmend-Forenban	Boningen, Gunzgen	2001	
		Canton de Schaffhouse			
SH	1301	Lättgrueb	Bibern	2001	
SH	3907	Kiesgrube Solenberg	Schaffhausen	2003	
SH	7402	Kiesgrube Bannen	Wilchingen	2001	
		Canton d'Appenzell Rh.-Extérieures			
AR	2	Kiesgrube List	Stein (AR)	2001	
		Canton de Saint-Gall			
SG	96	Kieswerk Sieber Agersten	Diepoldsau	2001	
SG	504	Kiesgrube Wisgraben	Kirchberg	2001	
SG	517	Kiesgrube NW Büel	Degersheim	2001	
SG	527	Kiesgruben Burgauerfeld	Flawil	2001	
		Canton d'Argovie			
AG	31	Steinbruch Jakobsberg	Auenstein	2001	
AG	99	Kiesgrube Bürlihübel	Boswil	2001	
AG	117	Tongrube Böttstein	Böttstein	2001	
AG	243	Kiesgrube Moortel	Gränichen	2001	
AG	378	Galmet	Küttigen	2001	
AG	432	Steinbruch Mellikon	Mellikon	2001	
AG	498	Kiesgrube Eichrüteli	Mülligen	2001	
AG	695	Tongrube Eriwis	Schinznach Dorf	2001	
AG	710	Am Schöftler	Holziken, Schöftland	2001	
AG	750	Stolten	Staffelbach	2001	
AG	755	Kiesgrube Ägerten/ Steinächer	Stetten	2001	
AG	758	Kiesgrube Honert	Stetten	2001	
AG	830	Steinbruch Gabenchopf	Villigen	2001	
AG	2013	Lugibach	Wettingen	2001	

N°		Localité	Commune(s)	Inscription	Revision
		Canton de Thurgovie			
TG	78	Kiesgrube HEVA Dietenboden	Diessenhofen	2001	
TG	90	Tongrube Paradies	Schlatt (TG)	2001	
TG	98	Kiesgruben Steig	Aadorf	2001	
TG	211	Kiesgrube Lätten	Warth-Weiningen	2001	
TG	455	Lehmgrube Bergerwilen	Berg (TG)	2001	
TG	468	Kiesgrube Mayer Grossfeld	Bürglen	2001	
TG	470	Zil	Bürglen	2001	
TG	511	Tongrube Ziegelei	Basadingen-Schlattingen	2001	
		Canton de Genève			
GE	5	Champs Grillet	Avusy	2001	
GE	36	Peney	Satigny	2001	
		Canton du Jura			
JU	800	Le Tayment	Courrendlin	2001	

Annexe 3
(art. 4, al. 1)

Description des sites de reproduction de batraciens d'importance nationale[28]

[28] Non publié au RO, le texte de cette annexe et de ses modifications ne figure pas dans le présent recueil.
Conformément à l'art. 4, al. 2, il peut être consulté en tout temps à la Chancellerie fédérale, à l'Office fédéral de l'environnement, des forêts et du paysage et auprès des cantons. (voir RO **2003** 4147).

Annexe 4[29]
(art. 16, al. 1)

Liste des sites de reproduction de batraciens d'importance nationale dont la mise au net n'est pas terminée

N°	Localité	Commune(s)
	Canton de Berne	
BE 72	Ziegelei Rehhag	Bern
BE 184	Ziegelei Fischermätteli	Burgdorf, Heimiswil
BE 199	Grube Fa. Hofstetter	Hindelbank
BE 332	Sumpf unterh. Station Heustrich	Aeschi b. Spiez
BE 567	Kiesgrube Oppligen	Oppligen
BE 770	Weiher Hinter Richisalp	Oberwil i. S.
BE 835	Junzlensee	Meiringen
BE 991	Kiesgrube Oechtlen	Riggisberg
BE 1137	Gravière sous Graitery	Court
BE 1138	Gravière + STEP	Loveresse
	Canton d'Uri	
UR 79	Weidbach	Seedorf
	Canton de Schwyz	
SZ 30	Schindellegi	Feusisberg
SZ 58	Seeboden	Innerthal
SZ 131	Hinter Ibach	Schwyz
SZ 150	Bachtellen/Golfpark Nuolen	Tuggen, Wangen
SZ 154	Stausee Rempen	Vorderthal
	Canton d'Obwald	
OW 9	Kiesgrube Zelgenwald	Alpnach
OW 35	Glaubenbielen Ribihütte	Giswil
OW 47	Jänzimatt	Giswil
OW 63	Usser Allmend	Giswil
OW 109	Lungerer See Nordende	Lungern
OW 201	Ritzenmattseeli	Sarnen
OW 204	Obermatteggweiher	Sarnen

[29] Nouvelle teneur selon le ch. I 4 de l'O du 29 oct. 2003, en vigueur depuis le 1er déc. 2003 (RO **2003** 4147).

N°		Localité	Commune(s)
		Canton de Nidwald	
NW	37	Challenbiel, Cholwald	Ennetmoos
		Canton de Zoug	
ZG	27	Chälenmoor	Menzingen
		Canton de Fribourg	
FR	10	La Russille, Vers les Gours	Montagny
FR	63	Frangueires	La Roche
FR	68	Verchaux	Villarbeney
FR	95	Le Chaney	Farvagny
FR	96	Contramont	Farvagny
FR	159	Stein Bruch	Plaffeien
FR	181	Galmisgrube Filistorf	Schmitten
FR	200	Rathevi	Châtel-Saint-Denis
		Canton de Bâle-Ville	
BL	3	Ziegelei Allschwil	Allschwil
BL	98	Zurlindengrube	Pratteln
		Canton d'Appenzell Rh.-Extérieures	
AR	44	Dorfweiher	Grub
		Canton d'Appenzell Rh.-Intérieures	
AI	36	Feuerweiher Kellenberg	Oberegg
AI	38	Alter Feuerweiher Fegg	Oberegg
		Canton de Saint-Gall	
SG	190	Au Büchel	Rüthi
SG	341	Malerva	Sargans
		Canton des Grisons	
GR	37	Flaz Golfweiher	Samedan
GR	90	Val Piogn	Zernez
		Canton d'Argovie	
AG	134	Eichholz	Bremgarten, Fischbach-Göslikon

N°		Localité	Commune(s)
		Canton de Thurgovie	
TG	69	Kiesgruben Befang/Auholz	Sulgen
TG	89	Schaarenwies/Schaarenwald	Schlatt
TG	231	Riet Espen Ermatingen-Gottlieben	Ermatingen, Gottlieben, Tägerwilen
TG	261	Seerhein Chuehorn – Paradies	Tägerwilen
TG	338	Kiesgrube Heerenwis	Braunau
TG	349	Grütriet	Wängi
TG	425	Grube Gündelhart	Gündelhart - Hörhausen
TG	506	Weierwies	Warth-Weiningen
TG	509	Kiesgrube Buech	Amlikon-Bissegg
TG	510	Kiesgrube Sunnenhof	Eschenz
		Canton du Tessin	
TI	26	Lanca Sant'Antonio	Sementina
TI	147	Lanche Al Pizzante	Cugnasco, Locarno
TI	246	Pozza a sud di Lischee	Rancate
TI	251	Palazzetta – Sta. Margherita – Colorina	Stabio
TI	344	Pozza Pavú Ronco	Besazio, Rancate
TI	346	Basciocca 2 (est)	Giubiasco
TI	373	Santa Maria	Gudo
		Canton de Vaud	
VD	21	Les Grangettes	Noville
VD	49	Col d'Isenau	Ormont-Dessus
VD	78	Les Monod	Mollens
VD	89	La Grève	Chabrey
VD	90	Les Grèves	Cudrefin
VD	105	Côtes de Vaux, Les Esserts	Eclepens
VD	124	Bois de Vaux	Penthalaz
VD	128	A la Mottaz	Bioley-Orjulaz
VD	142	Corcelettes	Grandson
VD	158	Le Taulard, Bois Genoud	Crissier, Lausanne
VD	171	La Grève	Buchillon
VD	221	Vettancs	Coinsins
VD	223	La Tourbière	Coinsins
VD	229	Bois de Chênes	Genolier

N°		Localité	Commune(s)
VD	244	Molard Parelliet	Trelex
VD	260	La Bernoise	Bavois
VD	274	Vy des Buissons, Creux du Lavoir	Rances
VD	290	Les Grèves	Chevroux
VD	366	Champ Pittet, Châble Perron	Cheseaux-Noreaz, Yverdon-les-Bains
VD	374	Les Vernes	Grandson, Yverdon-les-Bains
VD	375	Les Grèves	Yvonand
VD	377	Le Moulin	Yvonand
VD	379	Le Gotteau	Yvonand
VD	381	Le Vursis	Yvonand
		Canton du Valais	
VS	120	Châtelet	Port-Valais
VS	121	Grand-Blettay	Fully
VS	130	Lac de Morgins	Troistorrents
VS	132	Mont Culet	Troistorrents
VS	175	Ripaille	Champéry
VS	185	L'Arpille	Martigny-Combe
VS	273	Lac Noir	Nendaz
VS	308	Les Briesses	Chermignon
VS	477	Fontaine de la Combe	Collombey-Muraz
		Canton du Jura	
JU	7801	Place d'armes, le Nalé	Bure
JU	8101	La Cocuvatte	Coeuve

451.35

Ordonnance sur la protection des sites marécageux d'une beauté particulière et d'importance nationale

(Ordonnance sur les sites marécageux)

du 1er mai 1996 (Etat le 13 avril 2004)

Le Conseil fédéral suisse,

vu les art. 23*b*, al. 3, et 23*c*, al. 1, de la loi fédérale du 1er juillet 1966[1] sur la protection de la nature et du paysage (LPN),

arrête:

Art. 1 Inventaire fédéral

[1] L'Inventaire fédéral des sites marécageux d'une beauté particulière et d'importance nationale (Inventaire des sites marécageux) comprend les objets énumérés dans l'annexe 1.

[2] L'inventaire n'est pas exhaustif; il sera régulièrement contrôlé et mis à jour.

Art. 2 Description des objets

[1] La description des objets est publiée séparément. En tant qu'annexe 2, cette publication fait partie intégrante de la présente ordonnance.

[2] La publication peut être consultée en tout temps à l'Office fédéral de l'environnement, des forêts et du paysage (office fédéral) et auprès des cantons.[2] Ceux-ci désignent les services concernés.

Art. 3 Délimitation des objets

[1] Les cantons fixent les limites précises des objets. Ils prennent l'avis:

a. des propriétaires fonciers;

b. des exploitants, en particulier dans les domaines agricole et sylvicole;

c. des bénéficiaires de concessions et d'autorisations pour des installations et constructions;

d. des communes;

e. des organisations habilitées à recourir en vertu de l'art. 12, al. 2 LPN.

RO **1996** 1839

1 RS **451**

2 Nouvelle teneur selon le ch. I 5 de l'O du 15 janv. 2003 concernant la modification de la réglementation sur la consultation dans les ordonnances en matière de biotopes selon l'art. 18*a* LPN (RO **2003** 249).

[2] Dans le secteur des conceptions et des plans sectoriels de la Confédération qui se réfèrent à des installations et constructions, les cantons prennent également l'avis des services fédéraux compétents.

[3] Lorsque les limites précises n'ont pas encore été fixées, l'autorité cantonale compétente prend, sur demande, une décision de constatation de l'appartenance d'un bien-fonds à un objet. Quiconque présente une demande doit pouvoir la fonder sur l'existence d'un intérêt digne de protection.

Art. 4 Buts visés par la protection

[1] Dans tous les objets:

a. le paysage sera protégé contre les modifications qui portent atteinte à la beauté du site marécageux ou à son importance nationale;

b. les éléments et les structures caractéristiques des sites marécageux seront sauvegardés, notamment les éléments géomorphologiques, les biotopes, les éléments culturels ainsi que les constructions et les structures traditionnelles de l'habitat;

c. les espèces végétales et animales protégées en vertu de l'art. 20 de l'ordonnance du 16 janvier 1991[3] sur la protection de la nature et du paysage (OPN), ainsi que les espèces végétales et animales menacées et rares figurant dans les Listes rouges publiées ou approuvées par l'office fédéral seront particulièrement ménagées;

d. l'exploitation durable et typique des marais et des sites marécageux sera encouragée afin qu'elle puisse être maintenue dans la mesure du possible.

[2] La description des objets à l'annexe 2 sert aux cantons de base contraignante pour concrétiser les buts visés par la protection.

Art. 5 Mesures de protection et d'entretien

[1] Les cantons, après avoir pris l'avis des intéressés (art. 3, al. 1 et 2), prennent les mesures de protection et d'entretien nécessaires pour atteindre les buts visés par la protection.

[2] Ils veillent en particulier à ce que:

a. les plans et les prescriptions qui règlent le mode d'utilisation du sol au sens de la législation en matière d'aménagement du territoire soient conformes à la présente ordonnance;

b. les biotopes au sens de l'art. 18, al. 1bis LPN, qui se trouvent à l'intérieur d'un site marécageux soient désignés;

c. l'aménagement et l'exploitation admissibles selon l'art. 23*d*, al. 2, LPN, ne portent pas atteinte aux éléments caractéristiques des sites marécageux;

[3] RS **451.1**

d. des installations et constructions, autres que celles relatives à l'aménagement et l'exploitation réglés sous lettre c, qui ne servent ni à l'entretien des biotopes, ni au maintien des habitats typiques, ne soient érigées ou agrandies que si elles ont une importance nationale, ne puissent être réalisées qu'à l'endroit prévu et n'entrent pas en contradiction avec les buts visés par la protection;

e. l'exploitation à des fins touristiques et récréatives soient en accord avec les buts visés par la protection;

f.[4] lorsqu'une remise en état selon l'art. 25*b* LPN n'est pas possible ou qu'elle est disproportionnée par rapport aux buts visés par la protection, il y ait remplacement ou compensation adéquats, notamment par la création, l'agrandissement ou la revitalisation de biotopes, la revalorisation d'élé-ments et de structures caractéristiques des sites marécageux, l'amélioration de l'exploitation durable et typique des marais et des sites marécageux ou par des mesures de compensation écologique selon l'art. 15 OPN[5].

Art. 6 Délais

[1] Les mesures prévues à l'art. 3, al. 1, et à l'art. 5 doivent être prises dans un délai de trois ans.

[2] Pour les cantons à faible et à moyenne capacité financière, pour lesquels la protection des sites marécageux représente une charge considérable, ce délai est de six ans lorsqu'il s'agit d'objets dont la conservation n'est pas menacée. Le Département fédéral de l'environnement, des transports, de l'énergie et de la communication[6] désigne les cantons concernés.

Art. 7 Protection transitoire

Les constructions, installations et modifications de terrain ainsi que les changements notables du mode d'utilisation du sol sont interdits dans les objets tant que les cantons n'ont pas pris de mesures de protection et d'entretien. Les cantons peuvent autoriser des dérogations si elles sont compatibles avec l'art. 5.

Art. 8 Réparation des dommages

Les cantons veillent à ce que les atteintes déjà portées à des objets soient réparées le mieux possible, chaque fois que l'occasion s'en présente.

Art. 9 Devoirs de la Confédération

[1] Dans leur activité, les autorités, services, instituts et établissements fédéraux sont tenus de respecter les buts visés par la protection.

4 Nouvelle teneur selon le ch. III de l'O du 19 juin 2000, en vigueur depuis le 1er août 2000 (RO **2000** 1869).
5 RS **451.1**
6 La désignation de l'unité administrative a été adaptée selon l'art. 4*a* de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

[2] Ils prennent les mesures prévues aux art. 5, 7 et 8 dans les domaines relevant de leur compétence en vertu de la législation fédérale spéciale.

Art. 10 Compte rendu

Tant qu'ils n'ont pas pris les mesures nécessaires selon l'art. 3, al. 1, et l'art. 5, les cantons rendent compte à l'office fédéral, à la fin de chaque année, de l'état de la protection des sites marécageux sur leur territoire.

Art. 11 Prestations de la Confédération

[1] La Confédération conseille et soutient les cantons dans l'accomplissement des tâches prévues par la présente ordonnance.

[2] Les indemnités de la Confédération pour les mesures prévues aux art. 3, 5 et 8 de la présente ordonnance sont réglés par l'art. 22 OPN[7].

Art. 12 Modification du droit en vigueur

L'ordonnance du 24 janvier 1996[8] sur les contributions écologiques est modifiée comme suit:

Art. 7, al. 3

...

Art. 13[9]

Art. 14 Entrée en vigueur

La présente ordonnance entre en vigueur le 1er juillet 1996.

7 RS **451.1**
8 [RO **1996** 1007 1842, **1997** 2458, **1999** 295 art. 6 let. b]
9 Abrogé par le ch. I de l'O du 25 fév. 2004, avec effet au 1er mai 2004 (RO **2004** 1833).

Annexe 1[10]
(art. 1)

Liste des sites marécageux d'une beauté particulière et d'importance nationale

No	Localité	Canton(s)	Commune(s)	Inscription	Révisions
1	Rothenthurm	ZG, SZ	Einsiedeln, Feusisberg, Oberägeri, Rothenthurm	1996	2004
2	Les Ponts-de-Martel	NE	Brot-Plamboz, Les Ponts-de-Martel, Noiraigue, Travers	1996	
3	Schwantenau	SZ	Einsiedeln	1996	
5	Pfäffikersee	ZH	Fehraltorf, Pfäffikon, Seegräben, Wetzikon	1996	
6	Zugerberg	ZG	Walchwil, Zug	1996	2004
7	Etang de la Gruère	JU, BE	Le Bémont, Montfaucon, Saignelégier, Tramelan	1996	
8	Hinter Höhi	SG	Amden, Nesslau	1996	
9	La Vraconnaz	VD	Sainte-Croix	1996	
10	Breitried/Unteriberg	SZ	Einsiedeln, Unteriberg	1996	
11	Chaltenbrunnen	BE	Meiringen, Schattenhalb	1996	
12	La Chaux-des-Breuleux	JU, BE	La Chaux-des-Breuleux, Mont-Tramelan, Saignelégier, Tramelan	1966	
13	Habkern/Sörenberg	LU, BE	Beatenberg, Eriz, Flühli, Habkern, Horrenbach-Buchen, Niederried bei Interlaken, Oberried am Brienzersee, Schangnau	1996	
15	Glaubenberg	OW, LU	Alpnach, Entlebuch, Flühli, Giswil, Hasle, Sarnen, Schüpfheim, Schwarzenberg	1996	
16	Bellelay	BE	Châtelat, Saicourt	1996	
19	Lauenensee	BE	Gsteig, Lauenen	1996	
21	Vallée de Joux	VD	L'Abbaye, Le Chenit	1996	2001
22	Gamperfin	SG	Grabs	1996	
25	Ibergeregg	SZ	Alpthal, Einsiedeln, Oberi-berg, Schwyz, Unteriberg	1996	
27	Les Pontins	BE	Saint-Imier, Sonvilier	1996	

[10] Nouvelle teneur selon le ch. II al. 1 de l'O du 25 fév. 2004, en vigueur depuis le 1er mai 2004 (RO **2004** 1833).

No	Localité	Canton(s)	Commune(s)	Inscription	Révisions
33	Les Gurles	FR	Grangettes, Marsens, Maules, Riaz, Romanens	1996	
35	La Chaux-d'Abel	BE, JU	Le Noirmont, Les Bois, Muriaux, Saint-Imier, Sonvilier	1996	
37	Hirzel	ZH	Hirzel, Horgen, Schönenberg, Wädenswil	1996	
38	Rotmoos/Eriz	BE	Eriz, Horrenbach-Buchen, Schangnau, Sigriswil	1996	
39	Lac de Lussy	FR	Châtel-Saint-Denis, Remaufens	1996	2004
45	God da Staz/Stazerwald	GR	Celerina/Schlarigna, St. Moritz	1996	
53	San Bernardino	GR	Hinterrhein, Mesocco	1996	
55	Schwänditai	GL	Näfels, Oberurnen	1996	
56	Alp Nadéls	GR	Trun	1996	
59	Wolzenalp	SG	Ebnat-Kappel, Nesslau	1996	
62	Schwägalp	SG, AR, AI	Alt St. Johann, Gonten, Hundwil, Krummenau, Nesslau, Schwende, Stein, Urnäsch	1996	2004
66	Chellen	SG	Ebnat-Kappel, Hemberg, Krummenau, Wattwil	1996	
88	Creux du Croue	VD	Arzier	1996	
93	Le Niremont	FR	Châtel-Saint-Denis, Semsales	1996	
94	La Brévine	NE	La Brévine, La Chaux-du-Milieu, Le Cerneux-Péquignot	1996	
98	Klein Entlen	LU	Entlebuch, Flühli, Hasle, Schüpfheim	1996	
99	Col des Mosses/ La Lécherette	VD	Château-d'Oex, Ormont-Dessous	1996	2001
105	Unterägeri	ZG	Unterägeri, Zug	1996	2004
106	Wetzikon/Hinwil	ZH	Dürnten, Gossau, Hinwil, Wetzikon	1996	
109	Furner Berg	GR	Furna, Jenaz, Schiers	1996	
110	Fulensee	UR	Erstfeld	1996	
118	Sparenmoos/Neuenberg	BE	Boltigen, Zweisimmen	1996	
119	Haslerberg/Betelberg	BE	Lauenen, Lenk	1996	
132	Unter Hüttenbüel	SG	Ebnat-Kappel, Gommiswald, Rieden, Wattwil	1996	
163	Gurnigel/Gantrisch	BE	Blumenstein, Guggisberg, Rüeggisberg, Rüschegg, Rüti bei Riggisberg	1996	
189	Lucomagno/Dötra	TI	Olivone	1996	

No	Localité	Canton(s)	Commune(s)	Inscription	Révisions
204	Göscheneralp	UR	Göschenen	1996	
217	Alp Flix	GR	Sur	1996	
226	Val Fenga	GR	Ramosch, Sent	1996	
227	Faninpass	GR	Fideris, Jenaz, Peist	1996	
232	Oberhauen/Scheidegg	NW, UR	Emmetten, Seelisberg	1996	
235	Sägel/Lauerzersee	SZ	Arth, Lauerz, Steinen	1996	
251	Maschwander Allmend	ZG, ZH	Cham, Hünenberg, Maschwanden, Obfelden	1996	2004
260	Piano di Magadino	TI	Cadenazzo, Cugnasco, Giubiasco, Gordola, Gudo, Locarno, Magadino, S. Antonino, Sementina	1996	
263	Val da Sett	GR	Bivio	1996	
265	Tamangur	GR	Scuol, Valchava	1996	
268	Grimsel	BE	Guttannen	2004	
275	Petersinsel	BE	Erlach, Twann	1996	
280	Aare/Giessen	BE	Allmendingen, Belp, Muri bei Bern, Rubigen	1996	
289	Les Grangettes	VD	Noville	1996	2004
296	Le Marais des Monod	VD	Apples, Ballens, Mollens, Montricher, Pampigny	1996	
302	Val de Réchy	VS	Nax	1996	
315	Maighels	GR	Tujetsch	1996	
319	Riet/Tamons	SG	Mels	1996	
320	Tratza-Pany	GR	Luzein	1996	
322	Albrun	VS	Binn	1996	
324	Vorder Höhi	SG	Alt St. Johann, Amden	1996	
325	Alpe di Chièra	TI	Osco, Quinto	1996	
326	Monti di Medeglia	TI	Isone, Medeglia, Robasacco	1996	
336	Amsoldingen	BE	Amsoldingen, Höfen, Thierachern, Uebeschi	1996	2004
339	Albrist	BE	St. Stephan	1996	
347	Alpe Zaria	TI	Fusio	1996	
351	Frauenwinkel	SZ	Freienbach	1996	
357	Urnerboden	UR, GL	Linthal, Spiringen	1996	
359	Plaun Segnas Sut	GR	Flims	1996	
364	Alp da Stierva	GR	Mon, Salouf, Stierva	1996	
365	Alp Anarosa	GR	Casti-Wergenstein	1996	
368	Buffalora	GR	Tschierv	1996	
369	Plan da San Franzesch	GR	Poschiavo	1996	
370	Hilferenpass	LU	Escholzmatt, Flühli, Marbach	1996	

No	Localité	Canton(s)	Commune(s)	Inscription	Révisions
378	Neeracher Ried	ZH	Dielsdorf, Hochfelden, Höri, Neerach, Niederglatt, Niederhasli, Stadel, Steinmaur	1996	
385	Lützelsee	ZH	Bubikon, Gossau, Grüningen, Hombrechtikon, Stäfa	1996	
387	Gräppelen	SG	Alt St. Johann	1996	
390	Bachsee	BE	Grindelwald	1996	
391	Grosse Scheidegg	BE	Grindelwald	1996	
414	Durannapass	GR	Conters im Prättigau, Langwies	1996	
416	Grande Cariçaie	VD, FR, BE, NE	Autavaux, Chabrey, Champmartin, Cheseaux-Noréaz, Chevroux, Cheyres, Châbles, Cudrefin, Delley, Estavayer-le-Lac, Font, Forel, Gampelen, Gletterens, Haut-Vully, Ins, Marin-Epagnier, Portalban, Yverdon-les-Bains, Yvonand	1996	2001
419	Steingletscher	BE	Gadmen	1996	
420	Fänerenspitz	AI, SG	Altstätten, Oberriet, Rüte	1996	2004
421	Val da Campasc/ Passo del Bernina	GR	Poschiavo	1996	

Annexe 2[11]
(art. 2 et 4)

Description des sites marécageux d'une beauté particulière et d'importance nationale

[11] Non publiées au RO, cette annexe et ses modifications ne figurent pas dans le présent recueil. Conformément à l'art. 2 al. 2, elle peut être consultée en tout temps à la Chancellerie fédérale, à l'Office fédéral de l'environnement, des forêts et du paysage et auprès des cantons (voir RO **2001** 1894, **2004** 1833).

Annexe 3[12]

[12] Abrogée par le ch. II al. 3 de l'O du 25 fév. 2004, avec effet au 1er mai 2004 (RO **2004** 1833)

Loi fédérale sur la chasse et la protection des mammifères et oiseaux sauvages
(Loi sur la chasse, LChP)

du 20 juin 1986 (Etat le 22 décembre 2003)

L'Assemblée fédérale de la Confédération suisse,

vu les art. 24sexies, al. 4, 24septies, 25 et 25bis de la constitution[1,2]
vu le message du Conseil fédéral du 27 avril 1983[3],

arrête:

Chapitre 1 But et champ d'application

Art. 1 But

[1] La loi vise à:

a. La conservation de la diversité des espèces et celle des biotopes des mammifères et oiseaux indigènes et migrateurs vivant à l'état sauvage;

b. La préservation des espèces animales menacées;

c. La réduction à une proportion supportable des dégâts causés par la faune sauvage aux forêts et aux cultures;

d. L'exploitation équilibrée par la chasse des populations de gibier.

[2] Elle fixe les principes selon lesquels les cantons doivent réglementer la chasse.

Art. 2 Champ d'application

La loi concerne les animaux suivants vivant en Suisse à l'état sauvage:

a. Les oiseaux;

b. Les carnivores;

c. Les artiodactyles;

d. Les lagomorphes;

e. Le castor, la marmotte et l'écureuil.

RO **1988** 506

1 [RS **1** 3; RO **1962** 783, **1971** 905, **1974** 721]. Aux dispositions mentionnées correspondent actuellement les art. 74, 78, al. 4, 79 et 80 de la Constitution du 18 avril 1999 (RS **101**).

2 Nouvelle teneur selon le ch. VIII 1 de la LF du 24 mars 2000 sur la création et l'adaptation de bases légales concernant le traitement de données personnelles, en vigueur depuis le 1er sept. 2000 (RO **2000** 1891 1914; FF **1999** 8381).

3 FF **1983** II 1229

Chapitre 2 Chasse

Art. 3 Principes

[1] Les cantons réglementent et organisent la chasse. Ce faisant, ils tiennent compte des conditions locales ainsi que des exigences de l'agriculture et de la protection de la nature. Le traitement soutenu des forêts et la régénération naturelle par des essences en station doivent être assurés.

[2] Ils fixent les conditions de l'autorisation de chasser, déterminent le régime et le territoire de chasse, et pourvoient à une surveillance efficace.

[3] Ils établissent, conformément aux prescriptions du Conseil fédéral, une statistique du nombre des animaux tirés et de la population des espèces les plus importantes.

[4] Le Conseil fédéral détermine les moyens et engins de chasse dont l'usage est prohibé. Il fait établir une statistique fédérale de la chasse.

Art. 4 Autorisation de chasser

[1] Celui qui désire chasser a besoin d'une autorisation du canton.

[2] L'autorisation est accordée à celui qui prouve, lors d'un examen dont les modalités sont fixées par le canton, qu'il possède les connaissances nécessaires.

[3] Les cantons peuvent octroyer à des personnes qui se préparent à passer l'examen de chasseur ainsi qu'à des hôtes une autorisation de chasser limitée à quelques jours.

Art. 5 Espèces pouvant être chassées et périodes de protection

[1] Les espèces suivantes peuvent être chassées, sauf pendant les périodes de protection qui sont fixées comme il suit:

a. Le cerf élaphe
   du 1er février au 31 juillet
b. Le sanglier
   du 1er février au 30 juin
c. Le daim, le cerf Sika et le mouflon
   du 1er février au 31 juillet
d. Le chevreuil
   du 1er février au 30 avril
e. Le chamois
   du 1er janvier au 31 juillet
f. Le lièvre commun, le lièvre variable et le lapin de garenne
   du 1er janvier au 30 septembre

g. La marmotte

du 16 octobre au 31 août

h. Le renard

du 1er mars au 15 juin

i. Le blaireau

du 16 janvier au 15 juin

k. La martre et la fouine

du 16 février au 31 août

l. Le coq du tétras lyre, le lagopède et la perdrix

du 1er décembre au 15 octobre

m. Le pigeon ramier, la tourterelle turque, le grand corbeau et la corneille mantelée

du 16 février au 31 juillet

n. Le faisan

du 1er février au 31 août

o. Le grèbe huppé, la foulque macroule, le cormoran et les canards sauvages

du 1er février au 31 août

p. La bécasse des bois

du 15 décembre au 15 septembre.

2 Parmi les canards sauvages, les espèces suivantes sont protégées: les oies sauvages, la Tadorne de Belon, la Tadorne casarca, les harles et les cygnes, ainsi que la sarcelle marbrée, l'eider de Steller, le garrot arlequin, l'érismature à tête blanche, le garrot d'Islande et la nette rousse.

3 Les espèces suivantes peuvent être chassées toute l'année:

a. Le chien viverrin, le raton laveur et le chat haret;

b. La corneille noire, la pie, le geai des chênes et le pigeon domestique retourné à l'état sauvage.

4 Les cantons peuvent prolonger les périodes de protection ou réduire la liste des espèces pouvant être chassées. Ils sont tenus de le faire lorsque la protection d'espèces localement menacées l'exige.

5 Ils peuvent, avec l'assentiment préalable du Département fédéral de l'environnement, des transports, de l'énergie et de la communication (Département)[4], écourter temporairement les périodes de protection, dans le but de réduire des populations trop importantes ou de conserver la diversité des espèces.

4 La désignation de l'unité administrative a été adaptée selon l'art. 4*a* de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

[6] Le Conseil fédéral peut, après avoir entendu les cantons, réduire la liste des animaux dont la chasse est autorisée dans l'ensemble de la Suisse lorsque cela s'impose pour protéger des espèces menacées, ou la compléter en indiquant les périodes de protection, dès lors que les populations des espèces protégées permettent qu'on les chasse à nouveau.

Art. 6 Lâcher d'animaux pouvant être chassés

[1] Les cantons peuvent lâcher des animaux pouvant être chassés à condition qu'existent des biotopes appropriés et la garantie d'une protection suffisante.

[2] Le lâcher d'animaux qui peuvent causer d'importants dégâts ou menacer la diversité des espèces indigènes est interdit. Le Conseil fédéral désigne ces animaux.

Chapitre 3 Protection

Art. 7 Protection des espèces

[1] Tous les animaux visés à l'art. 2 qui n'appartiennent pas à une espèce pouvant être chassée, sont protégés (espèces protégées).

[2] Les cantons peuvent, avec l'assentiment préalable de l'Office fédéral de l'environnement, des forêts et du paysage (Office fédéral)[5], prévoir le tir d'animaux protégés si la sauvegarde des biotopes ou le maintien de la diversité des espèces l'exige. Le Conseil fédéral désigne les animaux visés par cette disposition.

[3] La chasse des bouquetins peut être autorisée du 1er septembre au 30 novembre, lorsqu'elle vise à une régulation des populations. A cette fin, les cantons soumettent chaque année à l'approbation du Département une planification des tirs. Le Conseil fédéral arrête les prescriptions nécessaires.

[4] Les cantons assurent une protection suffisante des mammifères et des oiseaux sauvages contre les dérangements.

[5] Ils règlent en particulier la protection des jeunes animaux et de leurs mères en période de chasse, ainsi que celle des oiseaux adultes pendant la couvaison.

[6] Lors de l'élaboration et de la réalisation de projets qui peuvent compromettre la protection des mammifères et des oiseaux sauvages, la Confédération prend l'avis des cantons. Lorsque les projets affectent des zones protégées d'importance internationale et nationale, il y a lieu de demander le préavis de l'Office fédéral.

Art. 8 Tir d'animaux blessés et malades

Les gardes-chasse, les surveillants et les locataires d'une chasse sont autorisés à abattre des animaux blessés et malades également en dehors des périodes d'ouverture de la chasse. De tels tirs doivent être immédiatement annoncés à l'autorité cantonale de la chasse.

5 La désignation de l'unité administrative a été adaptée selon l'art. 4*a* de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

Art. 9 Autorisations de la Confédération

[1] Une autorisation de la Confédération est nécessaire pour:

a. Importer, faire transiter ou exporter des animaux d'espèces protégées, de même que des parties ou produits tirés de ceux-ci;

b. Lâcher des animaux d'espèces protégées;

c. Importer, dans le but de les lâcher, des animaux pouvant être chassés;

d. Utiliser, à titre exceptionnel, des moyens et engins de chasse dont l'usage est prohibé.

[2] Le Conseil fédéral règle les compétences et la procédure.

Art. 10 Détention d'animaux protégés

[1] Une autorisation cantonale est nécessaire pour détenir des animaux protégés.

[2] Le Conseil fédéral fixe les conditions auxquelles les animaux protégés peuvent être détenus.

Art. 11 Zones protégées

[1] Le Conseil fédéral, après avoir consulté les cantons, délimite des réserves de sauvagine et d'oiseaux migrateurs, d'importance internationale.

[2] D'entente avec les cantons, il délimite des districts francs fédéraux ainsi que des réserves de sauvagine et d'oiseaux migrateurs, d'importance nationale.

[3] Les districts francs fédéraux ne peuvent être supprimés ou remplacés par un district franc équivalent qu'avec l'accord du Conseil fédéral.

[4] Les cantons peuvent délimiter d'autres districts francs et réserves d'oiseaux.

[5] La chasse est interdite dans les districts francs et les réserves d'oiseaux. Les organes cantonaux d'exécution peuvent cependant y autoriser le tir d'animaux non protégés lorsque l'exigent la sauvegarde des biotopes, la conservation de la diversité des espèces, des raisons cynégétiques ou la prévention de dommages excessifs causés par le gibier.

[6] Le Conseil fédéral édicte les dispositions concernant la protection dans les réserves de sauvagine et d'oiseaux migrateurs, d'importance internationale et nationale, ainsi que dans les districts francs fédéraux. La Confédération prend à sa charge 30 à 50 pour cent des frais de surveillance.

Chapitre 4 Dommages causés par la faune sauvage

Art. 12 Prévention des dommages causés par la faune sauvage

[1] Les cantons prennent des mesures pour prévenir les dommages dus à la faune sauvage.

[2] Les cantons peuvent ordonner ou autoriser en tout temps des mesures contre certains animaux protégés ou pouvant être chassés, lorsqu'ils causent des dégâts importants. Seuls des personnes titulaires d'une autorisation de chasser ou des organes de surveillance peuvent être chargés de l'exécution de ces mesures.[6]

[2bis] Le Conseil fédéral peut désigner des espèces protégées pour lesquelles la compétence d'ordonner les mesures prévues à l'al. 2 appartient à l'Office fédéral.[7]

[3] Les cantons déterminent les mesures qui peuvent légalement être prises à titre individuel en vue de protéger du gibier les animaux domestiques, les biens-fonds et les cultures.[8] Le Conseil fédéral désigne les espèces protégées contre lesquelles il est permis de prendre de telles mesures.

[4] Lorsque la population d'animaux d'une espèce protégée est trop nombreuse et qu'il en résulte d'importants dommages ou un grave danger, les cantons peuvent prendre des mesures pour la réduire, avec l'assentiment préalable du Département.

Art. 13 Indemnisation des dégâts causés par la faune sauvage

[1] Les dommages causés par le gibier à la forêt, aux cultures et aux animaux de rente seront indemnisés de façon appropriée. Sont exceptés les dégâts causés par des animaux contre lesquels il est possible de prendre des mesures individuelles selon l'art. 12, al. 3.

[2] Les cantons règlent l'indemnisation. Les indemnités ne seront versées que pour autant qu'il ne s'agisse pas de dommages insignifiants et que des mesures de prévention raisonnables aient été prises. Les dépenses pour des mesures de prévention peuvent être prises en compte lors de l'indemnisation des dégâts causés par le gibier.

[3] La Confédération prend à sa charge 30 à 50 pour cent des indemnités pour les dommages causés par le gibier dans les districts francs fédéraux.

[4] La Confédération et les cantons participent à l'indemnisation des dommages causés par certains animaux protégés. Le Conseil fédéral, après avoir consulté les cantons, détermine ces espèces protégées et fixe les conditions d'indemnisation.

6 Nouvelle teneur selon le ch. II 11 de l'annexe à la LF du 22 mars 2002 sur l'adaptation de dispositions du droit fédéral en matière d'organisation, en vigueur depuis le 1er fév. 2003 (RO **2003** 187 188; FF **2001** 3657).

7 Introduit par le ch. II 11 de l'annexe à la LF du 22 mars 2002 sur l'adaptation de dispositions du droit fédéral en matière d'organisation, en vigueur depuis le 1er fév. 2003 (RO **2003** 187 188; FF **2001** 3657).

8 Nouvelle teneur selon le ch. II 11 de l'annexe à la LF du 22 mars 2002 sur l'adaptation de dispositions du droit fédéral en matière d'organisation, en vigueur depuis le 1er fév. 2003 (RO **2003** 187 188; FF **2001** 3657).

Chapitre 5 Information, formation et recherche

Art. 14

[1] Les cantons veillent à ce que la population soit suffisamment informée sur le mode de vie, les besoins et la protection de la faune sauvage.

[2] Ils règlent la formation et le perfectionnement des surveillants de la faune sauvage et des chasseurs. La Confédération organise des cours pour la formation complémentaire du personnel affecté à la surveillance des zones protégées de la Confédération.

[3] La Confédération encourage l'étude des animaux sauvages, de leurs maladies et de leurs biotopes. A cet effet, l'Office fédéral peut déroger aux dispositions de la présente loi concernant les animaux protégés. Les dérogations qui ont trait aux animaux pouvant être chassés sont du ressort des cantons.

[4] La Confédération gère le Centre suisse de documentation sur la recherche concernant la faune sauvage. Elle encourage l'information du public et peut allouer des subventions à des centres de recherche et à d'autres institutions de formation et de recherche d'importance nationale.

[5] Le Conseil fédéral édicte des prescriptions sur le marquage des mammifères et des oiseaux sauvages.

Chapitre 6 Responsabilité et assurance

Art. 15 Responsabilité

[1] Celui qui pratique la chasse est responsable des dommages qu'il cause.

[2] Pour le reste, les dispositions du code des obligations[9] sur les actes illicites sont applicables.

Art. 16 Assurances

[1] Tous les titulaires d'une autorisation de chasser sont tenus de conclure une assurance-responsabilité civile. Le Conseil fédéral fixe le montant minimum de la couverture.

[2] Dans les limites du montant de la couverture prévu par le contrat d'assurance, le lésé peut intenter une action directe contre l'assureur.

[3] Les exceptions découlant du contrat d'assurance ou de la loi fédérale du 2 avril 1908 sur le contrat d'assurance[10] ne sont pas opposables au lésé.

9 RS 220
10 RS 221.229.1

[4] L'assureur dispose d'un droit de recours contre le preneur d'assurance ou l'assuré pour autant qu'il soit habilité, en vertu du contrat d'assurance ou de la loi fédérale du 2 avril 1908 sur le contrat d'assurance, à refuser le versement de prestations ou à en réduire le montant.

Chapitre 7 Dispositions pénales

Art. 17 Délits

[1] Sera puni de l'emprisonnement jusqu'à un an ou de l'amende celui qui intentionnellement et sans autorisation:

a. Aura chassé ou tué du gibier et des animaux d'espèces protégées, ou capturé, ou gardé en captivité des animaux protégés, ou se les sera appropriés;

b. Aura déniché des œufs ou de jeunes oiseaux d'espèces protégées ou dérangé les oiseaux pendant la couvaison;

c. Aura importé, fait transiter, exporté, mis en vente ou aliéné des animaux protégés vivants ou morts, des parties ou produits de ces animaux, ainsi que des œufs;

d. Aura acquis, reçu en don ou en gage, pris sous sa garde, dissimulé, écoulé ou aidé à écouler des animaux vivants ou morts ou des produits de ceux-ci, qu'il savait ou devait présumer avoir été obtenus par un acte délictueux;

e. Aura pénétré sans motif suffisant dans une zone protégée, muni d'une arme de tir;

f. Aura rabattu ou attiré des animaux hors de zones protégées;

g. Aura lâché des animaux;

h. Aura enfumé, gazé, noyé ou empalé des renards, des blaireaux et des marmottes;

i. Aura fabriqué, importé, fait transiter, exporté, utilisé, acheté ou mis en vente des moyens et engins de chasse prohibés.

[2] Si le délinquant a agi par négligence, il sera puni de l'amende.

Art. 18 Contraventions

[1] Sera puni des arrêts ou de l'amende jusqu'à 20 000 francs celui qui, intentionnellement et sans raison valable:

a. Aura capturé, tenu en captivité ou se sera approprié des espèces pouvant être chassées, ou les aura importées dans le but de les lâcher;

b. Aura pénétré sans motif suffisant sur le territoire de chasse, muni d'une arme de tir;

c. Aura conservé, en dehors de la période de chasse, des armes ou des pièges sur les mayens et les alpages;

d. Aura laissé chasser des chiens;

e. N'aura pas observé les mesures visant à protéger les animaux contre les dérangements;

f. Aura déniché des œufs ou de jeunes oiseaux d'espèces pouvant être chassées;

g. Aura brûlé sur de grandes surfaces des talus, des lisières de champs ou des pâturages ou éliminé des haies;

h. Aura entravé l'exercice de la chasse.

2 La tentative et la complicité sont punissables.

3 Si le délinquant a agi par négligence dans les cas visés à l'al. 1, let. a à g, il sera puni de l'amende.

4 Celui qui se sera livré à la chasse sans avoir sur lui les pièces de légitimation prescrites ou aura refusé de les montrer aux organes de surveillance compétents sera puni de l'amende.

5 Les cantons peuvent réprimer en tant que contravention d'autres infractions au droit cantonal.

Art. 19 Application aux personnes morales et aux sociétés commerciales

L'art. 6 de la loi fédérale du 22 mars 1974 sur le droit pénal administratif[11] est applicable.

Art. 20 Retrait et refus de l'autorisation de chasser

1 Le retrait de l'autorisation de chasser est prononcé par le juge, pour une année au minimum et dix ans au maximum, lorsque le titulaire:

a. Intentionnellement ou par négligence, a tué ou blessé grièvement une personne au cours de la chasse;

b. A, intentionnellement, commis ou tenté de commettre un délit visé à l'art. 17, qu'il en soit l'auteur, l'instigateur ou le complice.

2 Le retrait de l'autorisation vaut pour toute la Suisse.

3 Les cantons peuvent prévoir d'autres motifs de retrait de l'autorisation ainsi que du refus de celle-ci. Les dispositions administratives édictées à ce sujet ne sont valables que pour le canton concerné.

11 RS **313.0**

Chapitre 8 Procédure pénale

Art. 21 Poursuite pénale

[1] La poursuite pénale et le jugement des infractions sont du ressort des cantons.

[2] L'Office vétérinaire fédéral poursuit et juge les infractions en rapport avec l'importation, le transit ou l'exportation. S'il y a simultanément infraction à la loi fédérale du 1er octobre 1925 sur les douanes[12] l'enquête est menée par l'Administration fédérale des douanes, qui décerne aussi le mandat de répression.

[3] Si un acte constitue à la fois une infraction selon l'al. 2 et une infraction à la loi fédérale du 9 mars 1978[13] sur la protection des animaux, à la loi fédérale du 1er octobre 1925 sur les douanes, à la loi fédérale du 8 décembre 1905[14] sur le commerce des denrées alimentaires et de divers objets usuels ou à la loi fédérale du 1er juillet 1966[15] sur les épizooties, qui doivent être poursuivies par les mêmes autorités administratives, la peine encourue est celle qui est prévue pour l'infraction la plus grave; cette peine peut être augmentée de façon appropriée.

Art. 22[16] Communication obligatoire

[1] Tout retrait de l'autorisation de chasser prononcé par le juge doit être communiqué à l'Office fédéral.

[2] L'Office fédéral communique aux cantons la liste des personnes auxquelles l'autorisation a été retirée pour qu'ils puissent assurer le retrait de l'autorisation sur leur territoire.

[3] Il peut conserver ces données dans un fichier électronique. A l'échéance du retrait de l'autorisation, il efface les inscriptions électroniques et détruit les décisions cantonales correspondantes. Il peut conserver celles-ci sous une forme anonyme à des fins scientifiques ou statistiques.

Art. 23 Dommages-intérêts

Le locataire de la chasse, dans les régions où la chasse est affermée, le canton ou la commune, dans les autres régions, ont le droit d'exiger la réparation du dommage causé par un délit de chasse ou par une contravention. Pour le reste, les dispositions du code des obligations[17] sur les actes illicites sont applicables.

12 RS **631.0**
13 RS **455**
14 [RS 4 475; RO **1979** 1758, **1985** 1992 ch. I 1, **1991** 362 ch. II 404. RO **1995** 1469 art. 58 let. a]. Voir actuellement la loi du 9 oct. 1992 sur les denrées alimentaires (RS **817.0**).
15 RS **916.40**
16 Nouvelle teneur selon le ch. VIII 1 de la LF du 24 mars 2000 sur la création et l'adaptation de bases légales concernant le traitement de données personnelles, en vigueur depuis le 1er sept. 2000 (RO **2000** 1891 1914; FF **1999** 8381)
17 RS **220**

Chapitre 9 Exécution et procédure[18]

Art. 24 Exécution par la Confédération[19]

Le Conseil fédéral édicte les dispositions d'exécution.

Art. 25 Exécution par les cantons[20]

1 Les cantons exécutent la présente loi, sous la surveillance de la Confédération. Ils délivrent toutes autorisations qui ne ressortissent pas à une autorité fédérale en vertu de la loi.

2 Les dispositions cantonales d'exécution concernant la prolongation de la période de protection, la réduction de la liste des espèces pouvant être chassées (art. 5, al. 4), la protection des animaux contre les dérangements (art. 7, al. 4), la protection des jeunes animaux, de leurs mères et des oiseaux adultes (art. 7, al. 5), ainsi que les mesures individuelles de protection (art. 12, al. 3) ne produisent effet qu'après avoir été approuvées par la Confédération[21].

3 Toutes les prescriptions légales des cantons relatives à la chasse seront communiquées à l'Office fédéral avant leur entrée en vigueur.

Art. 25*a*[22] Voies de droit

1 La procédure de recours est régie par la loi fédérale du 20 décembre 1968 sur la procédure administrative[23] et l'organisation judiciaire du 16 décembre 1943[24].

2 Un recours peut être formé devant la commission de recours DETEC contre les décisions prises par l'Office fédéral en application de la présente loi.

3 Les autorités de recours de première instance consultent l'Office fédéral avant de rendre leur décision.

Art. 26 Droit de perquisition et confiscation

Les cantons règlent le droit de perquisitionner dans les locaux et installations et de confisquer les véhicules et objets, afin d'assurer l'exécution de la présente loi. Ils confèrent aux personnes chargées de l'exécution la qualité de fonctionnaires de la police judiciaire.

18 Nouvelle teneur selon le ch. 10 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).
19 Nouvelle teneur selon le ch. 10 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).
20 Nouvelle teneur selon le ch. 10 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).
21 Modifié par le ch. III de la LF du 15 déc. 1989 relative à l'approbation d'actes législatifs des cantons par la Confédération, en vigueur depuis le 1er fév. 1991 (RO **1991** 362 369; FF **1988** II 1293).
22 Introduit par le ch. 10 de l'annexe à la loi du 21 mars 2003 sur le génie génétique, en vigueur depuis le 1er janv. 2004 (RS **814.91**).
23 RS **172.021**
24 RS **173.110**

Chapitre 10 Dispositions finales

Art. 27 Abrogation et modification de lois fédérales

1. La loi fédérale du 10 juin 1925[25] sur la chasse et la protection des oiseaux est abrogée.

2. La loi fédérale du 1er juillet 1966[26] sur la protection de la nature et du paysage est modifiée comme il suit:

Art. 23

...

3. Le code des obligations[27] est modifié comme il suit:

Art. 56, 3e al.

Abrogé

Art. 28 Dispositions transitoires

1 Les cantons règlent la validité des autorisations de chasser accordées avant l'introduction des examens de chasse.

2 Sous réserve de l'art. 5, al. 4 à 6, la perdrix ne pourra être chassée qu'après un délai de dix ans à dater de l'entrée en vigueur de la présente loi.

Art. 29 Référendum et entrée en vigueur

1 La présente loi est sujette au référendum facultatif.

2 Le Conseil fédéral fixe la date de l'entrée en vigueur.

Date de l'entrée en vigueur: 1er avril 1988[28]

25 [RS 9 535; RO **1954** 573 ch. I 7, **1959** 961 art. 11 let. c, **1962** 832, **1971** 854, **1977** 1907 art. 1er, 2, **1981** 497 art. 1er]

26 RS **451**. La modification mentionnée ci-dessous est insérée dans ladite loi.

27 RS **220**

28 ACF du 29 fév. 1988 (RO **1988** 516)

Ordonnance sur la régulation des populations de bouquetins (ORB)

du 30 avril 1990 (Etat le 1er octobre 1996)

Le Département fédéral de l'intérieur,

vu l'article 7, 3e alinéa, de la loi du 20 juin 1986[1] sur la chasse (LChP);
vu l'article 4, 4e alinéa, de l'ordonnance du 29 février 1988[2] sur la chasse (OChP),

arrête:

Section 1: Recensement des populations

Art. 1 Désignation des différentes colonies de bouquetins

[1] Les cantons désignent tous les cinq ans sur des cartes à l'échelle 1:25 000 ou 1:50000 l'habitat (demeures d'été et d'hiver) de chaque population de bouquetins (unité de reproduction).

[2] Les populations ainsi délimitées sont appelées colonies.

Art. 2 Indications relatives aux différentes colonies (formulaire I)

[1] Les cantons relèvent chaque année la grandeur de la population, la structure des sexes et des âges, l'accroissement, les pertes et l'évolution de la population.

[2] Les données à communiquer concernent la population d'été, faons compris. Celle-ci est déterminée par recensement direct en été ou calculée sur la base de la population d'hiver (formulaire I).

[3] La proportion de mâles et de femelles est déterminée sur la base des animaux qui ont plus de trois ans.

[4] Une distinction est faite entre les classes d'âge et de sexe suivantes:

a. Faons;
b. Jeunes animaux des deux sexes (de un et deux ans);
c. Chèvres de trois ans et plus;
d. Boucs de trois à cinq ans;
e. Boucs de six à dix ans;
f. Boucs de onze ans et plus.

RO **1990** 1678

[1] RS **922.0**
[2] RS **922.01**

Art. 3 Colonies vivant sur le territoire de deux ou de plus de deux cantons

[1] Les données relatives aux colonies vivant sur le territoire de deux cantons ou plus sont relevées de manière coordonnée par les cantons concernés.

[2] Elles sont communiquées par l'un des cantons d'entente avec les autres cantons concernés.

Art. 4 Communication des données relatives aux différentes colonies

[1] Les données relatives aux colonies doivent être communiquées avant la fin de l'année à l'Office fédéral de l'environnement, des forêts et du paysage (Direction fédérale des forêts).

[2] La Direction fédérale des forêts élabore les formulaires nécessaires à cet effet et les met à la disposition des cantons.

Section 2: Mesures de régulation

Art. 5 Justification des mesures de régulation

[1] Les cantons doivent fournir au Département fédéral de l'environnement, des transports, de l'énergie et de la communication (département)[3], pour chaque colonie, des données concernant les effets de la population de bouquetins sur la forêt, les zones agricoles et d'autres espèces animales (concurrence) ainsi que des indications sur l'état général et l'état de santé de la population de bouquetins.

[2] Le bien-fondé des mesures de régulation prévues (tirs et captures) ainsi que les buts de ces mesures (stabilisation ou réduction de la population) doivent être démontrés.

Art. 6 Planification des tirs

[1] Une planification des tirs n'est généralement requise que pour les colonies dont l'effectif est supérieur à 50 animaux.

[2] Les tirs doivent être planifiés de manière que les structures naturelles des classes d'âge et de sexe soient garanties à long terme (formulaire II).

[3] Les chèvres suitées en lactation sont à protéger.

[4] Les articles 8 et 12, 2e alinéa, de la LChP sont réservés.

Art. 7 Planification des tirs pour les colonies vivant sur le territoire de deux ou plus de deux cantons

[1] Pour les colonies vivant sur le territoire de deux cantons et plus, les cantons concernés doivent planifier les tirs ensemble et selon les principes énoncés à l'article 6.

[2] Ils fixent ensemble et conformément à la planification les quotas de tirs respectifs.

3 La désignation de l'unité administrative a été adaptée selon l'art. 4a de l'O du 15 juin 1998 sur les publications officielles (RS **170.512.1**).

[3] S'ils ne parviennent pas à une entente, c'est la Direction fédérale des forêts qui fixe les quotas correspondants.

[4] Il est souhaitable d'appliquer cette procédure par analogie aux colonies dont l'habitat est situé en partie hors des frontières du pays.

Art. 8 Approbation des plans de tirs

[1] Les cantons présentent à la Direction fédérale des forêts, avant la fin de l'année, les planifications complètes des tirs pour chaque colonie.

[2] L'Office fédéral de l'environnement, des forêts et du paysage approuve les plans de tirs. Il peut émettre des conditions lorsque:[4]

a. La planification des tirs n'a pas été effectuée conformément à l'article 6;

b. Le contrôle de la planification des tirs fait apparaître des lacunes dans l'exécution du plan de tirs de l'année précédente;

c. Les dégâts causés par les bouquetins contrarient des projets forestiers subventionnés par la Confédération et qui ont pour but de protéger les routes et les agglomérations contre les glissements de terrain, les crues ou les avalanches.

[3] Les plans de tirs approuvés sont valables pour l'année suivante.

[4] Dans des cas particuliers, tels que maladies ou pertes importantes au cours de l'hiver, les cantons peuvent s'écarter des plans de tirs.

Art. 9 Contrôle des tirs

[1] Tous les animaux abattus conformément aux plans de tirs doivent être contrôlés par des organes cantonaux de surveillance de la faune.

[2] Pour chaque animal, il y a lieu de relever des indications sur le sexe, l'âge, le poids, le lieu et la date du tir.

[3] Les cantons peuvent relever d'autres données.

[4] Les indications visées aux 1er et 2e alinéas, regroupées par colonie, doivent être transmises jusqu'à la fin de l'année à la Direction fédérale des forêts (formulaire III).

Art. 10 Annonces et approbations

L'article 3 s'applique par analogie aux annonces et aux approbations visées aux articles 8 et 9.

Art. 11 Autorisation de procéder à des tirs

[1] Les cantons règlent et organisent cette chasse. Ils instruisent les chasseurs.

4 Nouvelle teneur selon le ch. I 29 de l'O du 26 juin 1996 sur l'attribution de nouvelles compétences de décision dans l'administration fédérale, en vigueur depuis le 1er août 1996 (RO **1996** 2243).

[2] Ils sont habilités à percevoir des droits.

[3] Les cantons peuvent aussi prévoir des captures en lieu et place de tirs.

[4] En vertu de l'article 18, 5e alinéa, de la LChP, les cantons ont le droit de réprimer les erreurs de tirs relatives aux classes d'âge et de sexe (art. 2, 4e al.).

Art. 12 Tirs dans des districts francs fédéraux

[1] Des tirs ou des captures peuvent aussi être entrepris dans les districts francs fédéraux.

[2] Le garde-chasse chargé de la surveillance doit superviser cette chasse.

Section 3: Entrée en vigueur

Art. 13

La présente ordonnance entre en vigueur le 1er janvier 1991.

Ordonnance concernant les districts francs fédéraux (ODF)

du 30 septembre 1991 (Etat le 9 mars 2004)

Le Conseil fédéral suisse,

vu l'art. 11 de la loi fédérale du 20 juin 1986[1] sur la chasse et la protection des mammifères et oiseaux sauvages (loi sur la chasse);
vu l'art. 26 de la loi fédérale du 1er juillet 1966[2] sur la protection de la nature et du paysage (LPN),

arrête:

Section 1 Districts francs fédéraux

Art. 1 But

Les districts francs fédéraux (districts francs) ont pour but la protection et la conservation des mammifères et oiseaux sauvages rares et menacés ainsi que la protection et la conservation de leurs biotopes. Ils ont en outre pour but la conservation de populations saines d'espèces pouvant être chassées, adaptées aux conditions locales.

Art. 2 Définition

1 Sont considérés comme districts francs les objets énumérés dans l'annexe 1.

2 L'inventaire fédéral des districts francs fédéraux (Inventaire) comprend pour chaque district franc:

a. une représentation cartographique du périmètre et une description de la zone;

b. le but visé par la protection;

c. des mesures particulières pour la protection des espèces et des biotopes et la régulation des populations d'animaux pouvant être chassés ainsi que la dure de validité de ces mesures;

d. éventuellement un périmètre à l'extérieur du district franc, dans lequel les dégâts causés par la faune sauvage sont indemnisés.

3 L'Inventaire, qui fait partie intégrante de la présente ordonnance n'est pas publié (art. 4 de la loi du 21 mars 1986[3] sur les publications officielles) dans le Recueil officiel des lois fédérales (RO), mais paraît sous forme de tiré à part (annexe 2).

RO 1991 2304

1 RS **922.0**
2 RS **451**
3 RS **170.512**

Art. 3[4] Modifications minimes

Le Département fédéral de l'environnement, des transports, de l'énergie et de la communication est autorisé à modifier légèrement la définition des objets, d'entente avec les cantons, dès lors que la diversité des espèces est préservée. Constituent une modification légère:

a. une modification du périmètre correspondant au maximum à cinq pour cent de la surface de l'objet;

b. une réduction du périmètre correspondant au maximum à dix pour cent de la surface de l'objet si le périmètre est élargi à un nouveau secteur d'étendue au moins égale;

c. les mesures de régulation des populations d'animaux pouvant être chassés.

Art. 4 Mesures particulières en cas de suppression ou de modification de districts francs

Dans les zones nouvellement ouvertes à la chasse, les cantons veillent à ce que la chasse soit d'abord pratiquée avec modération, le plein déroulement de l'activité cynégétique ne devant intervenir qu'après une période de transition appropriée.

Section 2 Protection de la diversité des espèces et des biotopes

Art. 5 Protection des espèces

[1] Les dispositions ci-après s'appliquent d'une manière générale aux districts francs:

a. la chasse est interdite, sous réserve de l'art. 2, al. 2, et de l'art. 9;

b. les animaux ne doivent pas être dérangés, traqués, ni attirés hors du district franc;

c. les chiens doivent être tenus en laisse; les dispositions particulières prises en vertu de l'art. 2, al. 2, et de l'art. 9 sont réservées;

d. il est interdit de porter, de conserver ou d'utiliser des armes et des pièges. Les cantons peuvent accorder des dérogations aux personnes habitant à l'intérieur du district franc et pour les zones partiellement protégées. Les personnes autorisées à chasser et celles qui sont astreintes au service militaire ont le droit de traverser le district franc munies d'armes non chargées en empruntant des chemins et des routes, pendant la chasse ou pour remplir leurs obligations militaires (service, tir et inspection obligatoire). L'utilisation d'armes et de pièges est autorisée pour le personnel de surveillance de la faune;

e. il est interdit de camper librement. L'utilisation de places de camping officielles est réservée. Les cantons peuvent accorder des dérogations;

4 Nouvelle teneur selon le ch. I de l'O du 18 fév. 2004 (RO **2004** 1265).

f. l'autorité cantonale compétente peut, d'entente avec le propriétaire foncier, promulguer une interdiction de pénétrer dans le district franc avec des ailes delta et des parapentes;

g. le ski pratiqué en dehors de pistes et d'itinéraires balisés est interdit;

h. il est interdit de circuler sur des routes d'alpage et des routes forestières et d'utiliser des véhicules en dehors des routes, des chemins forestiers et de ceux de campagne, excepté à des fins agricoles et sylvicoles ainsi que pour la surveillance de la faune. Les cantons peuvent prévoir des exceptions;

i. les exercices militaires avec de la munition pour tir réel ou à blanc sont interdits. L'utilisation de places de tir et d'installations militaires particulières, selon des dispositions contractuelles, est réservée. Le service de garde de la troupe avec arme chargée ainsi que le port d'armes lors des tâches de contrôle du corps de gardes-fortifications et du corps de gardes-frontière sont autorisés.

2 L'organisation de réunions sportives et d'autres manifestations collectives n'est admise que si celle-ci ne peut compromettre le but visé par la protection. Les organisateurs ont besoin d'une autorisation cantonale.

3 D'autres mesures, d'une plus grande portée ou d'une autre teneur, visant la protection des espèces selon l'art. 2, al. 2, de la présente ordonnance sont réservées.

Art. 6 Protection des biotopes

1 Dans l'accomplissement de leurs tâches, la Confédération et les cantons veillent à ce que les buts visés par la protection des districts francs ne soient pas compromis par d'autres exploitations. S'il y a d'autres intérêts en présence, une pondération des intérêts permettra de trancher.

1bis Lorsque des autorités fédérales autres que l'Office fédéral de l'environnement, des forêts et du paysage (office fédéral) sont compétentes pour l'exécution, la collaboration de ce dernier est régie par les art. 62*a* et 62*b* de la loi fédérale du 21 mars 1997 sur l'organisation du gouvernement et de l'administration[5].[6]

2 Les districts francs doivent être pris en considération lors de l'élaboration de plans directeurs et de plans d'affectation.

3 Dans les districts francs, une attention particulière sera accordée à la conservation des biotopes au sens de l'art. 18, al. 1bis, LPN, notamment comme milieux vitaux des mammifères et des oiseaux sauvages indigènes et migrateurs. Les cantons veillent notamment à ce que de tels biotopes:

a. bénéficient d'une exploitation agricole et sylvicole adaptée;

b. ne soient pas fragmentés;

c. bénéficient d'une offre suffisante en matière de pâture.

5 RS **172.010**

6 Introduit par le ch. II 20 de l'O du 2 fév. 2000 relative à la loi fédérale sur la coordination et la simplification des procédures de décision (RO **2000** 703).

[4] D'autres mesures, d'une plus grande portée ou d'une autre teneur, visant la protection des biotopes selon l'art. 2, al. 2, de la présente ordonnance ou prises conformément aux art. 18 et suivants LPN sont réservées.

[5] L'encouragement des mesures de protection des biotopes est régi par les art. 18 et suivants LPN.

Art. 7 Signalisation et information

[1] Les cantons veillent à ce que les titulaires d'une autorisation de chasser et le public soient informés sur les districts francs.

[2] Ils s'occupent de la signalisation des districts francs sur le terrain.

[3] Aux entrées principales des districts francs ainsi que, dans le cas de biotopes dont la protection est particulièrement importante, à l'intérieur de ces zones, il y a lieu de placer des panneaux comportant des indications sur la zone protégée, sur le but visé par la protection et sur les principales mesures de protection.

Section 3 Prévention des dommages causés par la faune sauvage

Art. 8

[1] Les cantons veillent à ce que la faune sauvage n'occasionne pas des dégâts intolérables dans les districts francs. Le rajeunissement naturel des forêts doit être assuré.

[2] Les gardes-chasse des districts francs peuvent, à la requête du service cantonal compétent, prendre en tout temps des mesures contre certains animaux pouvant être chassés, lorsqu'ils causent des dégâts importants.

[3] Dans les districts francs, l'affouragement constant de la faune et les saunières permanentes sont interdits. Le nourrissage dissuasif des sangliers est réservé.

[4] Pour le reste, les dispositions cantonales concernant la prévention des dommages causés par la faune sauvage sont applicables.

Section 4 Mesures cynégétiques

Art. 9 Régulation des populations

[1] Les cantons veillent à ce que, dans les districts francs, les populations d'ongulés pouvant être chassés soient en tout temps adaptées aux conditions locales et aient une pyramide naturelle des classes d'âge et de sexe. Ce faisant, ils tiennent compte des intérêts liés à l'agriculture, à la protection de la nature et du paysage et à la conservation des forêts.

[2] A cette fin, on délimite:

a. des zones dans lesquelles des mesures de régulation ne peuvent être prises qu'exceptionnellement (zones intégralement protégées);

b. des zones dans lesquelles les populations de chevreuils, de chamois, de cerfs élaphes et de sangliers peuvent être soumises à une régulation ou réduites régulièrement (zones partiellement protégées).

[3] Avant de prévoir des mesures de régulation dans des zones à protection intégrale, il y a lieu de prendre l'avis de l'office fédéral.

[4] Pour les zones soumises à une protection partielle, les cantons établissent des plans de tir pour les diverses espèces de gibier et les communiquent à l'office fédéral. Si des districts francs de différents cantons ont des frontières communes, ces plans doivent être coordonnés.

[5] L'utilisation de chiens pour la régulation des populations est interdite, excepté celle de chiens de rouge exercés, pour la recherche d'animaux blessés. Les cantons peuvent autoriser des dérogations.

[6] Pour l'exécution des plans de tir, les cantons peuvent, en plus du personnel affecté à la surveillance des districts francs, faire appel à des titulaires d'une autorisation de chasser.

Art. 10 Tirs sélectifs

[1] Le personnel affecté à la surveillance des districts francs est tenu d'abattre les animaux malades, affaiblis ou blessés.

[2] Il annonce immédiatement ces tirs au service cantonal compétent.

Section 5 Gardes-chasse

Art. 11 Statut et nomination

[1] Les cantons désignent un ou plusieurs gardes-chasse pour chaque district franc. Ils leur confèrent les droits de la police judiciaire selon l'art. 26 de la loi sur la chasse.

[2] Les gardes-chasse des districts francs sont des fonctionnaires cantonaux.

[3] Ils sont subordonnés au service cantonal compétent.

[4] Ils sont nommés par le canton. Les dossiers de nomination doivent être soumis à l'office fédéral.

[5] Lorsque les districts francs sont proches de frontières nationales, les gardes frontières remplissent également des tâches relevant de la police de la chasse.

Art. 12 Tâches

[1] Le service cantonal compétent charge les gardes-chasse de l'accomplissement des tâches suivantes:

a. police de la chasse, en vertu de la loi sur la chasse;

b. recensement et surveillance des populations d'animaux sauvages dans les districts francs;

c. participation à la planification de biotopes particuliers, aux soins à leur donner ainsi qu'à leur entretien;

d. marquage et signalisation des districts francs sur le terrain;

e. information et surveillance des visiteurs des districts francs;

f. participation à la planification de mesures de prévention des dommages causés par la faune sauvage et à la régulation des populations d'ongulés ainsi, qu'à l'exécution de ces mesures;

g. organisation de la recherche et recherche effective d'animaux blessés dans les districts francs;

h. entretien de contacts, échange d'informations et collaboration avec les représentants des communes ainsi que des milieux de l'agriculture et de la sylviculture, de la protection de la nature et du paysage et de la chasse;

i. représentation des intérêts liés à la protection des espèces lors de l'élaboration, à l'échelon communal et régional, de plans directeurs et de plans d'affectation qui concernent un district franc;

k. prise de contact avec les services régionaux de coordination et les commandements de places de tir pour l'occupation des places d'armes et de tir, dans la mesure où des districts francs sont concernés, et conseils aux commandants d'unités sur le terrain;

l. soutien et collaboration lors de recherches scientifiques effectuées de concert avec le service cantonal compétent.

2 Le service cantonal compétent peut, de son propre chef ou à la demande de l'office fédéral, confier d'autres tâches aux gardes-chasse.

3 Les gardes-chasse tiennent un journal des travaux exécutés.

4 Un rapport sur l'accomplissement de ces tâches est établi chaque année à l'intention de l'office fédéral.

Art. 13 Formation

1 Les cantons assurent la formation de base des gardes-chasse.

2 L'office fédéral organise des cours de perfectionnement sur les problèmes relatifs aux districts francs.

Section 6 Indemnités

Art. 14 Surveillance et formation

1 La Confédération verse aux cantons, selon leur capacité financière, des indemnités globales représentant 30 à 50 pour cent des frais de surveillance dans les districts francs.

² L'indemnité est calculée en fonction de la superficie des districts francs et d'une durée de surveillance de neuf mois par an. Peuvent être indemnisés en général:

a. pour tous les districts francs d'une superficie allant jusqu'à 20 km²: des charges salariales annuelles d'un montant de 45 000 francs;

b. pour les districts francs de 20 à 100 km²: des charges salariales annuelles supplémentaires pouvant aller jusqu'à 45 000 francs, proportionnellement à la superficie dépassant 20 km²;

c. des frais administratifs représentant 10 pour cent des frais indemnisables selon les lettres a et b.

³ Dans les limites des crédits alloués, la Confédération peut en outre soutenir les mesures suivantes par des subventions représentant 30 à 50 pour cent des frais, selon la capacité financière des cantons:

a. formation de base et équipement du personnel chargé de la garde, ainsi que renforcement temporaire de celui-ci ou engagement de personnel auxiliaire;

b. infrastructure pour la surveillance;

c. signalisation des districts francs sur le terrain.

Art. 15 Dégâts causés par la faune sauvage

¹ La Confédération verse aux cantons, selon leur capacité financière, des indemnités représentant 30 à 50 pour cent des frais d'indemnisation des dégâts causés par la faune sauvage dans un district franc ou à l'intérieur d'un périmètre délimité conformément à l'art. 2, al. 2, let. d.

² La Confédération peut prendre à sa charge 30 à 50 pour cent des dépenses occasionnées par les mesures de prévention des dégâts causés par la faune sauvage.

³ Les dépenses occasionnées par les mesures de prévention doivent être prises en compte lors de l'indemnisation.

⁴ Il ne sera pas versé d'indemnités si les mesures prévues aux art. 8 ou 9 n'ont pas été prises.

Art. 16 Disposition commune

La Confédération ne verse plus d'indemnité lorsque le but visé par la protection est trop fortement compromis par d'autres formes d'exploitation.

Art. 17 Compétence

L'office fédéral prend les décisions concernant l'indemnisation.

Section 7 Dispositions finales

Art. 18 Abrogation du droit en vigueur

L'ordonnance du 19 août 1981[7] concernant les districts francs fédéraux est abrogée.

Art. 19 Entrée en vigueur

La présente ordonnance entre en vigueur le 1er janvier 1992.

7 [RO **1981** 1452, **1986** 1440, **1988** 517 art. 20 ch. 3]

Annexe 1[8]
(art. 2, 1er al.)

Districts francs fédéraux

1. Augstmatthorn, canton de Berne
2. Combe-Grède, canton de Berne
3. Kiental, canton de Berne
4. Schwarzhorn, canton de Berne
5. Tannhorn, canton de Lucerne
6. Urirotstock, canton d'Uri
7. Fellital, canton d'Uri
8. Mythen, canton de Schwyz
9. Silbern-Jägern-Bödmerenwald, canton de Schwyz
10. Hahnen, canton d'Unterwald-le-Haut
11. Hutstock, cantons d'Unterwald-le-Haut/Unterwald-le-Bas
12. Kärpf, canton de Glaris
13. Schilt, canton de Glaris
14. Rauti-Tros, canton de Glaris
15. Graue Hörner, canton de Saint-Gall
16. Säntis, cantons Appenzell Rh.-Int./Appenzell Rh.-Ext.
17. Bernina-Albris, canton des Grisons
18. Beverin, canton des Grisons
19. Campasc, canton des Grisons
20. Piz Ela, canton des Grisons
21. Trescolmen, canton des Grisons
22. Pez Vial/Greina, canton des Grisons
23. Campo Tencia, canton du Tessin
24. Greina, canton du Tessin
25. Dent de Lys, canton de Fribourg
26. Hochmatt-Motélon, canton de Fribourg
27. Creux-du-Van, canton de Neuchâtel
28. Grand Muveran, canton de Vaud

[8] Mise à jour selon le ch. I de l'O du 18 fév. 2004 (RO **2004** 1265).

29. Les Bimis-Ciernes Picat, canton de Vaud
30. Le Noirmont, canton de Vaud
31. Pierreuse-Gummfluh, canton de Vaud
32. Forêt d'Aletsch, canton du Valais
33. Alpjahorn, canton du Valais
34. Wilerhorn, canton du Valais
35. Bietschhorn, canton du Valais
36. Mauvoisin, canton du Valais
37. Val Ferret/Combe de l'A, canton du Valais
38. Haut de Cry/Derborence, canton du Valais
39. Loèche-les-Bains, canton du Valais
40. Vallée de Tourtemagne, canton du Valais
41. Dixence, canton du Valais

Annexe 2
(art. 2, 2e et 3e al.)

Districts francs fédéraux

Inventaire fédéral des districts francs fédéraux[9]

[9] N'étant pas publiés au RO, à l'exception de la modification parue au RO **2004** 1265, cet inventaire et ses modifications ne figurent pas dans le présent recueil. Le texte peut être obtenu, sous forme de tiré à part, auprès de l'OFCL, Diffusion publications, 3003 Berne (voir RO **1994** 1902, **2000** 2119, **2002** 4340 4341, **2003** 863).



Management Plan for the proposed

UNESCO-World Heritage Site

Glarus Overthrust

IG UNESCO World Heritage Site Glarus Overthrust

Heiligkreuz/Mels, Switzerland, 31 August 2006

Management Plan for the proposed UNESCO-World Heritage site Glarus overthrust

IG UNESCO World Heritage Site Glarus Overthrust

Heiligkreuz/Mels, Switzerland, 31 August 2006

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Frontpage:
IG UNESCO World Heritage Site Glarus Overthrust, Switzerland
Top: Glarus overthrust on the Ringelspitz
(Photograph: D. Imper, Heiligkreuz/Mels)
Top: Glarus overthrust on the Tschingelhoren
(Photograph: H. Rhyner, Elm)
Top: Glarus overthrust on the Graue Hörner
(Photograph: D. Kalberer, Heiligkreuz/Mels)

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SUMMARY

The present Management Plan shows how the nominated property, with its ecosystems and its unique wealth of structural geological elements, can be protected over the long term. At the same time, the developments and structures that are desirable for the region are presented. The Management Plan is addressed to all stakeholders – the authorities, the public, business, and the tourism and conservation sectors. For the governing body, it represents a binding commitment to achieve the goals that have been elaborated in a broad-based manner and to implement the proposed measures.

The 19 communes of Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt, Elm, Laax, Flims, Trin and Tamins, together with the cantons of St. Gallen, Glarus and Graubünden, have nominated the Glarus overthrust property for inclusion in UNESCO's World Heritage List. In view of the varying legal frameworks, the communes concerned have prepared and approved an *Agreement on the joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust",* including a Development Plan and a table listing acceptable and unacceptable uses. The Agreement – which defines the purpose and nature of cooperation between the parties, and covers organizational, financial and legal aspects – forms the essential basis of the present Management Plan.

The most important geological element of the property is the Glarus overthrust. This is to be included in the UNESCO World Heritage List on the basis of the following characteristics: its unique appearance, readily visible over extensive stretches; its scientifically important exposures, readily accessible for research; and its major importance in terms of scientific history with regard to the formation of mountains. In addition to the Glarus overthrust, the nominated property includes an abundance of valuable geotopes, geotope complexes and geotope landscapes, diverse landscapes – ranging from mixed deciduous forest, through mountain pastures or mire landscapes, to glaciated areas – and species-rich communities of flora and fauna.

Although the nominated property does not contain any permanent settlements, it is used by the mountain farming, forestry and energy sectors, and also for tourist, fishing, hunting and military purposes. One key goal is to preserve the property's diversity, unique character and beauty, and the full diversity of the natural and semi-natural ecosystems and ecosystem complexes for present and future generations, including the area's significance as a recreational and economic resource.

Numerous aims and measures have already been defined in the Development Plan of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"*. One important instrument is the management of visitors: the absence of infrastructure (paths, notice boards, etc.) should deter visitors from entering sensitive areas, and elsewhere a well-maintained infrastructure should facilitate management.

An organizational structure has also already been defined in the above-mentioned agreement for the proposed World Heritage site, consisting of the following bodies: the Delegates' Assembly, Committee with Chair, Auditing Body, Management, Scientific Advisory Committee and Working Groups. It is envisaged that regional subsidiary centres

will provide support for the Management. In the areas of marketing, communication/information/public relations and infrastructure, close cooperation – maximizing synergies – is to be sought with existing organizations and institutions, in particular with the GeoPark Sarganserland Walensee-Glarnerland Association, tourist authorities and regional exhibitions and museums.

Evaluation measures will involve in particular the reviewing of goals and assessment of the extent to which they have been attained. This process will be based on existing national and cantonal monitoring programmes, including the Biodiversity Monitoring project organized by the Federal Office for the Environment (FOEN), the National Forest Inventory, game censuses and the National Soil Monitoring Network (NABO).

The budget is to be limited to expenditures of just under CHF 1,000,000. Funding will consist of contributions from the federal authorities, the cantons of St. Gallen, Glarus and Graubünden, and the communes concerned. After a start-up period, revenues are also expected to be derived from services (e.g. sale of merchandise, guided tours), sponsorship/donations, marketing contributions, etc.

1 INTRODUCTION

For centuries, locals and visitors have been fascinated by the knife-edge "magic line" straddling the cantons of St. Gallen, Glarus and Graubünden – the Glarus overthrust. Many years before its scientific significance was revealed, the Glarus overthrust had already been depicted in drawings and engravings.

The nineteenth century then saw major scientific disputes over the interpretation of the geological phenomena discovered and the acceptability of the theories propounded concerning the mechanisms of mountain formation. In an endeavour to interpret this extraordinary phenomenon, leading geologists from all over the world visited the striking and well-preserved exposures in the border regions of the cantons of St. Gallen, Glarus and Graubünden. In the twentieth century, thanks to the excellent exposure conditions, numerous pioneering hypotheses concerning mountain formation and orogenic processes in the nominated property were developed and demonstrated. Intense research efforts have continued down to the present day.

The outcrops of the Glarus overthrust became a Mecca for scientists. A source of particular pride for the local population was the project undertaken by researchers from the United States, who visited Sool and made a cast of the Lochsite outcrop for reconstruction at the renowned American Museum of Natural History in New York. With growing international recognition of the importance of the property, the desire arose to establish a Glarus overthrust World Heritage Site. Inscription on the UNESCO World Heritage List requires not only a demonstration of the site's global uniqueness but also long-term efforts to protect the nominated property.

In order to assess whether the property is of "Outstanding Universal Value", a "*Comparative Study on Thrust Faults"* (PFIFFNER et al. 2006) was commissioned from the structural geologists Professors A. Pfiffner, S. Schmid and M. Burkhard. This study, which was reviewed by Professor J. Kley (Jena, Germany) and Professor S. Wojtal (Oberlin, Ohio, US) (PFIFFNER et al. 2006), shows that the Glarus overthrust is unique worldwide in terms of the values assessed – scientific value, scenic value, geomorphic expression and educational value. Having acknowledged the authors' expertise – "All three authors are internationally renowned experts in the fields of Alpine tectonics and structural geology in general" (Prof. J. Kley) and "all three authors are among the most highly respected geoscientists conducting research on the character of thrust faults, on their tectonic setting, and on their significance in the formation of maountain belts (Prof. S. Wojtal) – the reviewers conclude their detailed analysis as follows (PFIFFNER et al. 2006): "In summary, the conclusion reached in Pfiffner et al.'s 'Comparative study on thrust faults' is sound: the Glarus thrust is a truly outstanding example of a large-scale thrust-fault matched by very few, if any, other fault in the world. I fully agree with the authors that this property deserves to be inscribed in the UNESCO World Natural Heritage list." (Prof. J. Kley) and "Their *Comparative Study on Thrust Faults* is, in my view, an excellent example of objective scientific analysis of the significance of thrust faults as structural features in mountain belts and of the assessment of the significance of the Glarus overthrust as one of the classic 'type' example of a thrust fault … As the authors have made very clear in their *Comparative Study on Thrust Faults*, the proposed property readily meets the criteria outlined for outstanding universal value required to be inscribed on the World Heritage List." (Prof. S. Wojtal). This assessment is shared by various internationally recognized experts and Swiss institutions that have sent letters of support, confirming the outstanding universal value of the Glarus overthrust (PFIFFNER et al. 2006).

In order to guarantee long-term conservation, the present Management Plan was developed. Based on the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* (Annex MP01), signed by all the 19 communes concerned (Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Filzbach, Obstalden, Mollis, Ennenda, Sool, Engi, Matt, Elm, Flims, Laax, Trin and Tamins), it is designed to specify how these provisions and goals are to be implemented.

The landscape, which is largely shaped by geological factors, is to be preserved over the long term. The bulk of the property, extending over an area of more than 300 km2, lies in alpine and mountainous territory. Most of the Glarus overthrust exposures are not directly threatened. However, as the property is also of great value as a habitat and recreational area, the conservation provisions are largely concerned with the ecosystems.

The key document – *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* (Annex MP01) – was developed over a period of several years in

Fig. 01-01: The central part of the proposed World Heritage site – the Piz Sardona/Piz Segnes group. Photograph: D. Kalberer, Heiligkreuz.

consultation with numerous stakeholders from the sectors concerned: agriculture, forestry, hunting, gamekeeping, tourism, accommodation, mountain railways, commerce, conservation, culture, administration, planning and local development. The agreement was adopted by the communes concerned.

The Management Plan describes the natural, cultural and economic conditions currently existing within the boundary of the proposed World Natural Heritage site "Glarus Overthrust", defines goals for sustainable development and proposes measures for implementation.

Section 1 of the Management Plan provides a general introduction, Section 2 describes the current situation in the various sectors, Section 3 specifies goals, principles and measures, and Sections 4 and 5 present the guidelines and framework necessary for implementation.

1.1 Aims of the Management Plan

The aim of the Management Plan is to establish a framework for protection of the nominated property.

The Management Plan is designed to
- indicate in concrete terms how the proposed World Heritage site is to be conserved and sustainably developed;
- consider the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* including the Development Plan and list of acceptable/unacceptable uses (Annex MP01) and specify how these provisions and goals are to be implemented;
- provide information for interested parties.

Upon the inscription of the property on the World Heritage List, the governing body will be committed to initiating and coordinating the implementation process.

1.2 Methods and legal basis

One of the central concerns of the Management Plan is the conservation of the property as a World Heritage site. Under the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage, the provisions of national law alone are applicable when a site is inscribed on the World Heritage List. Thus, from a legal perspective, inscription would not involve any changes to the property's existing status as a protected area. Instead, it would merely confirm that the property merits protection and recognition at the international level and that, as part of the world's natural heritage, it should be preserved intact for future generations. However, under the UNESCO Convention, Switzerland would be obliged to maintain the existing legal protection and to establish arrangements for the management of the property.

On 26 April 2006, Switzerland's federal government commented as follows on the situation regarding the nominated property: "The cantons concerned are aware of the high landscape value of the Glarus overthrust and of the political significance of a UNESCO World Heritage nomination. In the canton of Glarus, almost the entire territory is included in the cantonal inventory of landscapes of regional importance. For their part, the communes have committed themselves in an agreement to the long-term preservation of geotopes (natural monuments), biotopes and the landscape within the boundary of the property. In the master plan of the canton of St. Gallen, the proposed World Heritage site is designated as a habitat for threatened species, to which stringent conservation goals are applicable by definition. In addition, various biotopes and geotopes of cantonal importance lie within this area. In the canton of Graubünden, the entire territory forms part of a protected landscape area. To a very large extent, this requirement has been given legal force in the communes' land use planning."

Of particular relevance to the protection of the World Heritage property are the provisions of the Nature and Cultural Heritage Protection Act (NHG) and the provisions of the Spatial Planning Act (RPG) concerning building outside construction zones. In line with the federalist system, the communal, cantonal and federal levels of nature and landscape protection in the World Heritage region are closely interconnected. They involve, for example, international agreements and national and cantonal constitutional and legal foundations. Thus, the nationally protected areas within the boundary of the nominated property are complemented by cantonally and communally protected nature and landscape areas, and protection is further strengthened by the provisions of, for example, agricultural, forestry and hunting legislation. In addition, the efforts of private conservation organizations played a crucial role in the designation of many areas and sites subject to national and cantonal protection.

The proposed World Natural Heritage site lies in the territory of 19 communes in three different cantons. Protective instruments are in place at the federal, cantonal and communal levels. Just as the protective instruments are diverse, so is their implementation.

- Federal Inventory of Landscapes and Natural Monuments of National Importance (BLN): The protective functions of the BLN primarily concern federal tasks (those for which the federal government is responsible) and must be implemented primarily at the federal level. These functions are exercised through practices such as the following: a) assessment of projects for compatibility with the requirements of the Nature and Cultural Heritage Protection Act and its implementing regulations, performed by the relevant sections of the Federal Office for the Environment and b) mandatory assessment by the Federal Commission for the Protection of Nature and Cultural Heritage (ENHK).

- Federal hunting reserves: Compliance with regulations is monitored by the cantons. To this end, the canton appoints one or more gamekeepers for each area. These are cantonal officers who supplement the existing cantonal gamekeeping service.

- Other federal inventories (mire landscapes, mires, alluvial zones): Implementation of these inventories is a cantonal responsibility, and the cantons are free to choose appropriate instruments (protective decrees, contracts, etc.).

- Cantonally protected areas: Federal legislation obliges the cantons to protect and conserve inventoried areas of national importance, as well as biotopes of regional and local importance. How to do so is left to them. They can even assign responsibility to private parties, as has been done in some areas.

In general, protection, upkeep and enhancement measures are cantonal tasks. The communes are responsible for implementing communally protected areas; the canton has a supervisory role in this respect. The federal government extends specialist support to the cantons and bears a substantial proportion of the costs.

The nominated property has been integrated into various cantonal, regional and communal plans in the cantons of St. Gallen, Glarus and Graubünden. Protection rests on three main pillars: protection of nature and cultural heritage, implementation of land-use plans, and building codes. In terms of land-use planning, the area is covered at the master plan level. Master plans are approved by the federal government and are binding on all authorities.

Master plans

The master plan lists protected areas that are considered to be of particular value from a cantonal viewpoint. These so-called nature and landscape priority areas are either particularly valuable habitats for animals and plants, or landscapes distinguished by their original character, diversity and beauty or their geohistorical significance. At the same time, many of these areas have also been designated by the federal authorities as sites of national importance.

In fulfilling their tasks, the cantonal and communal authorities take account of the conservation objectives for the nature and landscape priority areas specified in the master plan. Measures that would destroy or degrade these areas may only be approved if it can be demonstrated that the conservation interest is overridden by an important need. In such cases, the substantial need in opposition to the conservation objectives specified in the master plan must also be of cantonal importance.

Forest plans

In forest plans/forest development plans, forest reserves are also designated close to settlements. These represent an important new instrument – binding on all agencies – providing instructions for all activities and decisions relating to forests.

Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust

In view of Switzerland’s federal structure and the differences between the various parties’ legal regulations and powers, the legal basis for the establishment of a World Natural Heritage site was created by the conclusion of an agreement.

Between September 2001 and May 2003, all the Contracting Parties approved the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust”,* including a Development Plan and a table listing acceptable and unacceptable uses

(Annex MP01). The parties have undertaken to respect the interests of the World Natural Heritage site in any decisions concerning projects in this area The agreement will come into force when the site has been inscribed in the World Heritage List.

1.3 The UNESCO World Heritage programme in Switzerland

UNESCO is the specialized UN agency responsible for education, science, culture and communication. The Convention Concerning the Protection of the World Cultural and Natural Heritage adopted by the UNESCO General Conference in 1972 (UNESCO 1972) is designed to help to conserve important cultural and natural properties.

Properties deemed to be of outstanding universal value according to the relevant criteria are included in the World Heritage List. As of 2005, 812 properties have already been inscribed – 628 forming part of the cultural heritage, 160 natural heritage and 24 mixed properties.
States Parties to the UNESCO Convention are obliged to operate a National Commission. The Swiss UNESCO Commission, attached to the Federal Department of Foreign Affairs (EDA), is the federal authorities' consultative body for all of Switzerland's dealings with UNESCO. The Federal Office of Culture (FOC) is primarily responsible for cultural heritage matters, and the Federal Office for the Environment (FOEN) for natural heritage matters.

In Switzerland, four properties are inscribed under the heading of cultural heritage: the Old City of Berne; the Convent of St Gall; the Benedictine Convent of St John at Müstair; and the Three Castles, Defensive Wall and Ramparts of the Market-Town of Bellinzone. To date, Switzerland's natural heritage properties are the Jungfrau-Aletsch-Bietschhorn region and the fossil site Monte San Giorgio.

The idea of establishing the Glarus overthrust property as a UNESCO World Heritage site was first presented at a GeoPark Sarganserland-Walensee-Glarnerland hearing on 27 May 2000. In view of the favourable response, a Working Group was set up, comprising representatives of local conservation and tourist bodies, and the necessary exploratory studies were initiated in the autumn of 2000. Within this Working Group, the difficulties of balancing the interests of conservation and tourist development already emerged. The centrepiece of the Working Group's efforts was an agreement including a Development Plan. In the spring of 2001, the authorities and landowners concerned were duly informed. The individual communes and landowners were then given an opportunity to submit written comments. To become legally valid, the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* including the boundary, Development Plan and funding arrangements (Annex MP01) had to be approved by the communal authorities or citizens' assemblies, depending on the individual cantonal regulations. By May 2003, after the necessary amendments had been made, the agreement had been approved by all of the 19 communes concerned and by the three cantons, thus making it possible for the nomination to be submitted.

2 CURRENT SITUATION

2.1 The property

A map indicating the boundary of the Glarus overthrust property nominated as a UNESCO World Natural Heritage site forms part of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* (Annex MP01). The boundary is primarily marked by topographical features such as waterbodies, valleys, ridges, forest edges or roadways. It often coincides exactly with the boundaries of existing protected areas.

The proposed World Heritage site lies on the borders of the cantons of St. Gallen, Glarus and Graubünden, extending over an area of more than 300 km2, across 19 communes (Annex MP02). The lowest-lying point is at Ennenda (just under 520 m above sea level) and the highest elevation is Ringelspitz (3247 m a.s.l.).

Any subdivision of the territory is best undertaken along political lines since cantonal legislation in many sectors (spatial planning, hunting, fisheries, etc.) varies between the cantons of St. Gallen, Glarus and Graubünden, and responsibility lies with the individual cantonal authorities. The cantonal boundaries generally follow the highest mountain ranges.

The central element of the property is the Glarus overthrust, a geological monument of international importance. Other unique elements include the beautiful glacial landscapes, Alpine plateaus and peripheral valley areas, with characteristic flora and fauna at each of the various altitudes.

Fig. 02-01: The Glarus overthrust raises at the Ringelspitz range to 3100 m a.s.l Photograph: R. Schwitter, Pfäfers.

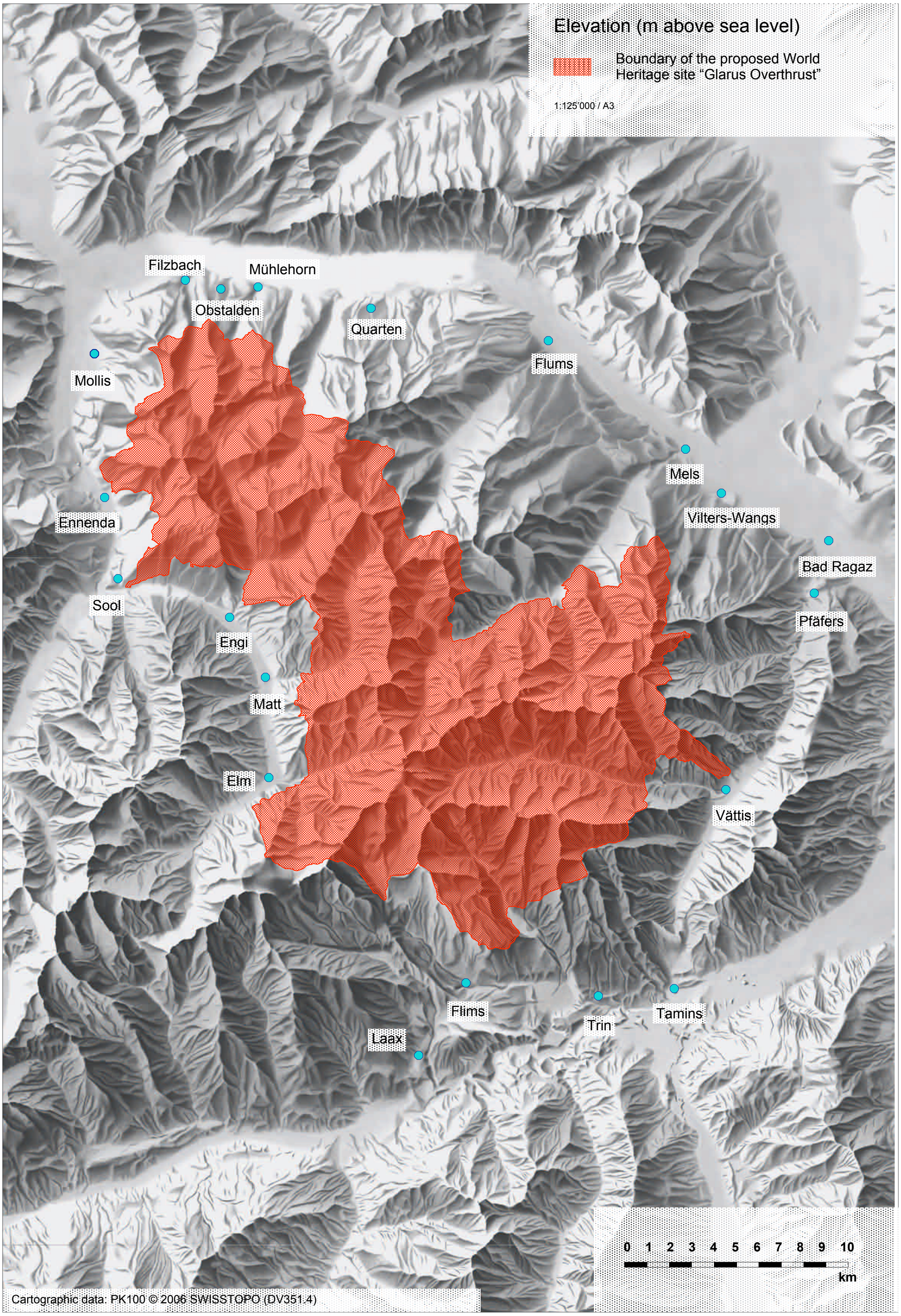

Fig. 02-02: Map of the proposed UNESCO World Heritage site "Glarus overthrust”.

Until the seventeenth century, parts of the area were settled by the Walser people. Today the nominated property no longer contains any permanent settlements. However, it is utilized by a variety of sectors: mountain farming, agriculture, forestry, hunting, fisheries, power generation, the armed forces and tourism.

The majority of the population is German-speaking. The native language of some of the population in the canton of Graubünden is Romansh.

2.2 Sustainable regional development

The Management Plan is designed to conserve and sustainably develop the property demarcated by the proposed boundary. For the region, development is sustainable if it meets all the needs of the present without compromising the ability of future generations to meet their own needs. At the same time, it should ensure that the diversity of habitats (including flora and fauna) will be preserved, together with the cultural heritage.

On the other hand, for the communes and regions concerned – some of which are affected by rural exodus – development is a matter of survival, and hopes are pinned on the tourist sector. The most important task will therefore be to reconcile the needs of humans and nature, and to balance the various types of use, i.e. to guarantee sustainable development within the boundary of the World Heritage site.

With the establishment of a UNESCO World Natural Heritage site, the areas now largely enjoying binding protection will be interlinked with an intercantonal Development Plan and should therefore be even more effectively protected and preserved. This should be facilitated by the pristine nature of the property and the general lack of infrastructure. At the same time, sustainable tourism is to be promoted in areas that are currently developed or are to be developed under the Development Plan, and awareness of the region's natural wonders is to be raised. In the proposed site, the UNESCO label will foster the principle of sustainability. Of particular importance is an awareness among the public and the authorities of the special character of the property. The educational process associated with the nomination will help to promote the concerns of nature and landscape.

Local products and services are to be marketed under an eco-label.

In accordance with the country's democratic traditions, the local population was involved at a very early stage in the processes of policy development and decision making.

2.3 Natural resources

2.3.1 Climate

Precipitation: Precipitation levels are primarily altitude-dependent. The mountain ranges are subject to adverse weather influences from North to West. Locally, precipitation is significantly influenced by topography and exposure. Central Alpine valleys such as the Taminatal near Vättis have below-average levels of precipitation.

At around 1000 m a.s.l., mean annual precipitation is as follows:

Elm GL	960 m a.s.l.	1587 mm
Weisstannen SG	1000 m a.s.l.	1397 mm
Vättis SG	950 m a.s.l.	1061 mm
Flims GR	1080 m a.s.l.	1221 mm

At an altitude of 2000 m, mean precipitation ranges from 2000 to 2300 mm, while in areas such as Vorab-Segnas-Sardona-Foostock and Schilt-Mürtschen-Spitzmeilen levels in excess of 2800 mm are to be expected.

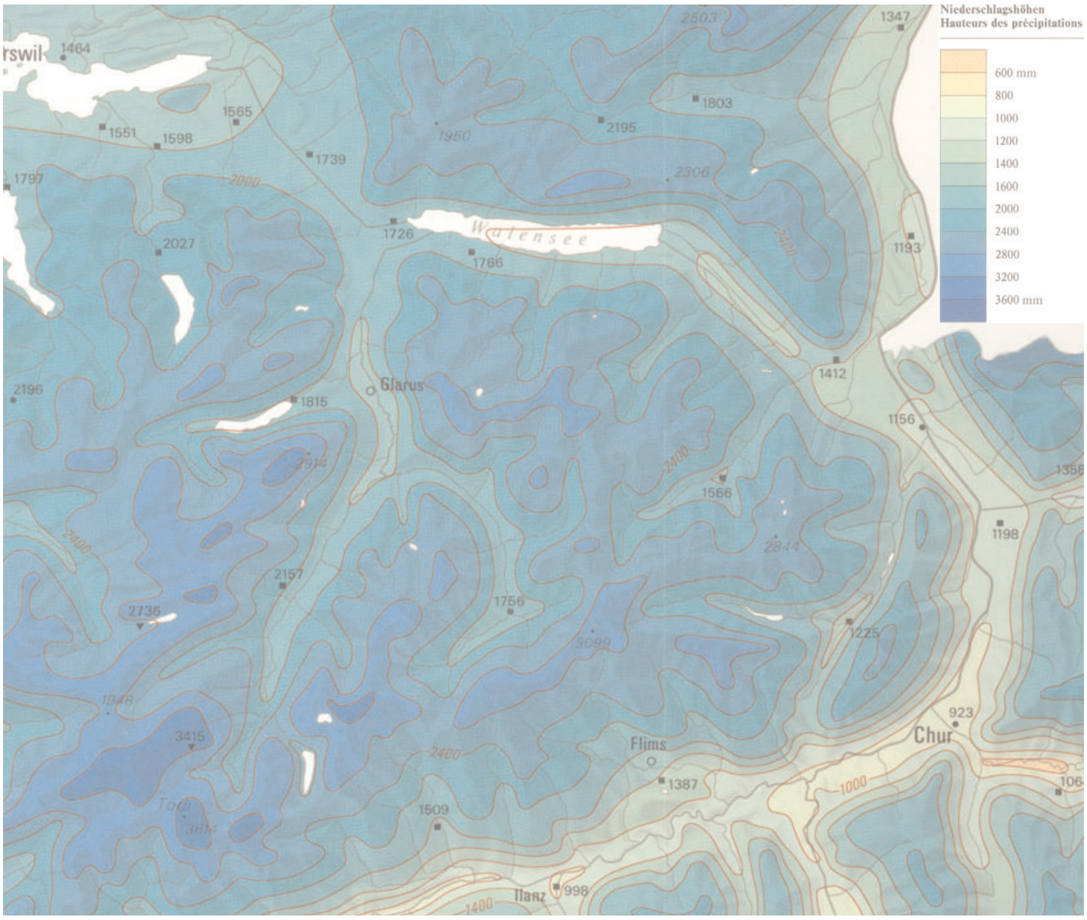

Fig. 02-03: Annual totals of precipitation (From: SPREAFICO, M., WEINGARTNER, R. & LEIBUNDGUT, CH. 1992).

Temperature: Nearby, but outside the proposed World Natural Heritage site, the following annual mean temperatures (in degrees Celsius, 1864 - 1959) have been recorded.

	Altitude (m a.s.l.)	Temperature in January °C	Temperature in July °C	Annual mean °C
Vättis (1899–1959)	950	-2.1	14.6	6.2
Bad Ragaz (1871–1959)	520	-0.4	17.3	8.8
Sargans (1864–1959)	510	-0.2	17.3	8.8
Glarus (1864–1959)	480	-1.7	16.7	7.7
Elm (1881–1959)	960	-3.0	14.5	5.8
Reichenau (1864–1935)	600	-0.9	16.8	8.1
Chur (1864–1959)	600	-0.7	17.2	8.5

Tab. 02-01: Annual mean temperatures from 1864 to 1959 (Source: SCHÜEPP, 1960).

From 1961 till 1990 the annual mean temperatures (in degrees Celsius) have been recorded at comparable stations.

Station	Altitude (m a.s.l.)	Temperature in January °C	Temperature in July °C	Annual mean °C
Bad Ragaz (1961-1990)	496	-0.3	17.9	9.0
Glarus (1961-1990)	515	-1.2	16.9	8.0
Elm (1961-1990)	965	-2.7	14.5	5.9
Chur (1961-1990)	555	-0.5	17.7	8.7

Tab. 02-02: Annual mean temperatures from 1961 to 1990 (Source: www.meteoswiss.ch).

In relation to the period 1864-1959 the mean temperatures from 1960 to 1990 have risen considerably.

Station	Altitude (m a.s.l.)	Temperature in January °C	Temperature in July °C	Annual mean °C
Bad Ragaz	496	0.1	0.6	0.2
Glarus	515	0.5	0.2	0.3
Elm	965	0.3	0.0	0.1
Chur	555	0.2	0.5	0.2

Tab. 02-03: Increase of the average mean temperatures from 1961 to 1990 and from 1864 to 1959.

A phenomenon characteristic of the Rheintal, Seeztal and Linthal is the dry, southerly katabatic wind known as the föhn.

As part of the "Ostluft" project, concentrations of air pollutants are regularly measured. Compared with the rest of Switzerland, air quality can be described as good with regard to nitrogen dioxide (NO_2) and particulates (PM10) and as average with regard to ozone (O_3). No major traffic routes or industrial plants are to be found within the boundary of the proposed World Natural Heritage site. Pollutants found in very low concentrations can only be attributable to the scattered cabins and local traffic, and to livestock. Therefore, no measures can be taken within the boundary to improve air quality.

During the Ice Age, cold periods alternated with warmer periods. Evidence of a warm era with a relatively mild climate is provided by the Drachenloch cave (2427 m a.s.l.) above Vättis, with human traces and finds of cave bear bones dating back over 50,000 years. The last cold period came to an end more than 10,000 years ago.

In recent decades, average temperatures in the Alps have risen (Tab. 02-03). At present, the impacts of climate warming can only be estimated. In summary, the following changes are to be expected:

- a receding snowline will lead to glacial retreat, the expansion of areas with unconsolidated material, and an increase in suspended load in streams;
- in areas affected by the lack of snowfall at lower altitudes, there will be an adverse economic impact on winter sports resorts;
- increased rainfall (thunderstorms due to high temperatures) will lead to a higher incidence of flooding, unstable slopes and greater debris transport in streams, possibly exposing valley-dwelling communities to an increased debris flow hazard;
- permafrost thawing and melting will destabilize formerly frozen slopes, leading to an increase in rockfalls, landslides and debris flows.

2.3.2 Geology and soils

Within the boundary of the proposed World Natural Heritage site, the mountains consist of Helvetic nappes, an allochthonous (substantially displaced) pile of thrust sheets, and the underlying Infrahelvetic complex. This complex comprises a crystalline basement (exposed at the Vättis window) and its sedimentary cover, also shaped into folds and small-scale nappes. The Glarus overthrust separates the Infrahelvetic complex from the Helvetic nappes.

At Chrüzbachtobel near Vättis, the crystalline basement and the unconformity with the overlying autochthonous sedimentary series are exposed in the so-called Vättis window. The gneisses, syenites and dykes of the basement belong to the Aar Massif. To the east of Vättis, the Aar Massif is no longer exposed - the nearest exposures to the west are at the Limmernboden window, more than 30 km away. The autochthonous sedimentary series is well exposed, from the underlying sandstones/breccia with overlying Röti dolomites (Triassic) to the Globigerina marls (Tertiary).
In the southern part of the property, from the Flimserstein to the Ringelspitz group, the rock units form part of the Infrahelvetic complex. In the northeastern flanks of Flimserstein and

Ringelspitz range, the imbricate structure of Mesozoic-Tertiary sediments can be readily observed. In the north face of the Panärahörner, up to four imbricates (schuppen) are stacke on top of each other.

The landscape is also shaped by flysch deposits, which often produce relatively soft landscape forms on account of the thick slate and marl beds. Flysch units predominate in the Calfeisental west of St. Martin, in the eastern and southern Weisstannental, and in the Sernftal east of Matt and Elm. The flysch can be divided into three parts: the North Helvetic unit (deposited 50–35 Ma ago), the South Helvetic Blattengrat unit (deposited 85–45 Ma ago) and the more southerly Ultrahelvetic Sardona unit (deposited 90–50 Ma ago). These flysch units were already transported many kilometres northwards at an early stage of the Alpine orogeny, so that the sediments of the Sardona unit originally deposited further south came to rest on the Blattengrat unit, which itself was thrust onto the North Helvetic flysch.

At certain points, e.g. on the Tschingelhoren or the Foostock, limestone masses several decametres thick lie between the flysch and the Glarus overthrust. The uppermost 1–2 m of this material was sheared by the action of the Glarus overthrust and now constitutes what is known as Lochseiten limestone or calcmylonite. The surface of the Glarus overthrust rises from 600 m a.s.l. in the Vorderrheintal to the culmination in the Vorab–Piz Segnes–Ringelspitz area, reaching an altitude of over 3000 m a.s.l., before falling away northwards

Fig. 02-04: *The Glarus overthrust is readily discernible from afar: Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano (top) and flysch. Photograph: H. Rhyner, Elm.*

further north and disappearing below the surface near Lochsite (Sool) at just under 570 m a.s.l.

Overlying the Glarus thrust are the Helvetic nappes. Within the boundary of the nominated property, these essentially consist of Verrucano formations, parts of which are more than 1500 m thick. The peaks of the Vorab, Piz Sardona and Ringelspitz groups, and of the Pizol and Foostock, the northern Pizol area, the western Weisstannental, the Schilstal, the Murgtal, the Gufelstock area, the Mühlebachtal and the northern Chrauchtal are composed of Permian Verrucano rocks. The lower and peripheral parts of these rocks consist of dark green and purple-red coarse-grained detrital Sernifit, while the central and upper parts tend to comprise purple-grey to blood-red fine-grained detrital siltstone and slate series.

In the Flumserberg area, in the Mürtschental and in the Gufelstock region, the light-coloured overlying Triassic rocks, generally less than 100 m thick, are exposed over an extensive area. While imbricate structures are difficult to detect in the Verrucano formations, the nappes in the Murgtal–Mürtschenalp–Schwarzstöckli area can be divided thanks to the clearly evident Triassic horizon into the underlying Glarus nappe and the overlying Mürtschen nappe. This division can no longer be made to the east of the Flumserberg area. In the Mürtschen area, particularly within the Mürtschen group and on the Nüenchamm, the Mürtschen nappe is exposed. It consists of a sedimentary series ranging from the uppermost Verrucano to the lower Tertiary.

Between the Widersteinerfurggel and the Murgseefurggel, and also in the Murgtal, large strike-slip faults can be detected along which the rock masses slid past each other over a distance of more than a kilometre.

Essentially, the soils that developed on the crystalline units at Vättis, on the Verrucano units, on the Mels formation, on the sandy limestone of the Upper Lias in certain areas, on the Cretaceous siliceous limestone and Garschella (greensand) formations, and on Sardona quartzite tend to be acidic, while the soils that developed on the remaining, largely carbonate series are predominantly alkaline. On beds containing a high proportion of clay (Verrucano basin facies, Quarten series, Lower Lias, Lower Dogger, flysch), waterlogged soils developed, giving rise to mires.

2.3.3 Landscape

The proposed World Natural Heritage site includes a wide variety of types of landscape. The appearance of the present-day landscape was largely shaped by the last Ice Age and by weathering and erosion. During the Ice Ages, the area between Flims, Chur, Sargans, Ziegelbrücke, Schwanden and Elm was largely glaciated. The highest-lying Ice Age relicts indicate a minimum glacier elevation of 2300 m a.s.l. at Chur and 2100 m a.s.l. at Sargans. During the period of maximum glaciation, a connected network of main and side valley glaciers existed. In the Ringelspitz range, the Piz Sardona–Piz Segnas–Vorab group and the Pizol region, a number of glacial landscapes are to be found, with small glaciers, cirque lakes and moraine ridges, and alluvial plains and outwash areas. The alpine alluvial plain of

Plaun Segnas Sut (unterer Segnesboden) and the foreland of the Glatschiu dil Segnas (Segnesgletscher) are designated as sites of national importance. Many relicts of the last Ice Age, such as the glacial landscapes in the Pizol region, in the Murgtal or on Fessis, are geotope landscapes of national importance. In glacial landscapes of this type, a variety of raised bogs and mire landscapes of national importance have developed, e.g. in the Plaun Segnas Sut, at Heubützli, by the Murg lakes and on the Mürtschenalp.

At the foot of the cliffs, large scree slopes developed above the vegetation line. This is followed by the unforested zone, which is used for mountain farming. Here the landscape is shaped not only by glacial relicts (small lakes, moraine ridges, erratic blocks) but also by karst phenomena (fans, Helloch doline, Schilt region, Flimserstein) and alluvial fans with untouched meandering mountain streams (Calfeisental, Weisstannental, Mühlebachtal, Chrauchtal, La Rusna, Schneca, Plaun Segnas Sura). The scrub vegetation zone is followed by coniferous and finally mixed deciduous forests.

The scenery has also been and continues to be shaped by landslides and rockfalls, with scars, debris fields and fallen rock masses - the headwalls of the largest-ever Central Alpine, late to post-glacial landslide (Flims) and the disastrous Elm landslide of 11 September 1881 are situated on the periphery of the nominated property.

The landscape has been moulded and is constantly remodelled by weathering and erosion. It is thanks to the forces of erosion that the line of the Glarus overthrust is perceptible to the naked eye over such a long distance. The character of the following landscapes is unique: the Calfeisental, the Pizol region, the Murgsee–Mürtschen region, the Talsee, Fessis, the Tschingelhoren (including Martin's Gap), the Segnes Plains (Plaun Segnas Sut and Plaun Segnas Sura) and the southern slopes of the Ringelspitz range. Within the boundary of the proposed World Heritage site, seven peaks rise to an elevation of more than 3000 m a.s.l.

The Weisstannental and the Calfeisental were decisively shaped by clear-felling associated with Walser settlements in the thirteenth century (Section 2.4.1). The pastures that originated at that time have been preserved in the same form as a result of continuous use by mountain farmers. In most cases, forest clearance was carried out by the Walser people on valley slopes exposed to the sun. Accordingly, the original natural treeline can still be observed on the southern (shaded) slopes of the Calfeisental.

2.3.4 Flora and fauna

Owing to the wide variety of geological substrates, altitudes and topographical features, the proposed World Natural Heritage site harbours extremely diverse plant communities. For a northern Alpine region, the estimated 800 different plant species represent a high degree of species diversity. The property is home to a number of rare Tertiary relicts, such as the buttercup *Callianthemum coriandrifolium or the crowfoot Ranunculus parnassifolius.*

Lower-lying areas are largely covered by forest communities, with beech-silver fir and spruce forests being the most common. Of particular interest are various forests on unusual sites, e.g. mountain pine on limestone or wetland soils. A notable feature is the occurrence of arolla pine (Pinus cembra) at higher altitudes in the Calfeisen, Murg and Mürtschen valleys; these are the northernmost examples of extensive stands in the whole of Central Europe. The subalpine alluvial forests in the Chrauchtal (of national importance) and in the Calfeisental are also of particular landscape value. Above the treeline, mountain pastures with mat-grass swards and dwarf shrub heath predominate up to an altitude of approximately 2200 m a.s.l. Higher up, areas free of rocks and debris are covered by alpine swards. Blue moorgrass predominates on sunny slopes, and rusty sedge on damper shady slopes. Also of special interest are the raised bogs in the Murgtal and Mürtschental, and the subalpine and alpine fens. Even rarer than the fens are the alluvial riparian zones, which have only been formed over wide areas in the alpine alluvial plain at Plaun Segnas Sut (Canton Graubünden). Large parts of the property are covered by alpine rock and scree habitats, with the nature of the flora depending essentially on whether the substrate consists of base-poor or base-rich rocks. In some areas, they are colonized by rare alpine plant species, e.g. Triglav hawksbeard *(Crepis terglouensis)* in the Segnas region.

In some places, very old forest stands have been preserved. In the Calfeisental, for example, a tree believed to be "the world's largest Norway spruce" was discovered, with a diameter of 1.84 metres. Although this title may be claimed by spruces elsewhere, the specimens growing in the Calfeisental are of an impressive size.

The property is home to several colonies of the alpine ibex, which after being eradicated from Switzerland was first reintroduced in the Weisstannental. The red deer and roe deer are to be found mainly in forested areas. Intact populations of chamois, mountain hare and alpine marmot survive above the treeline.

Within the boundary of the proposed World Natural Heritage site, 80 to 90 species of breeding birds can be found, including in particular the capercaillie, black grouse, ptarmigan, snow finch, wallcreeper and golden eagle. Various amphibians and reptiles are found even in the highest-lying areas of the property. Around 90 butterfly species have been recorded. On account of its diverse habitats, the property is of major significance for subalpine and alpine insect species.

2.3.5 Glaciology

Within this only lightly glaciated property, the following glacier complexes are to be found:

- Pizol–Graue Hörner–Schwarzchopf alpine glacier complex, comprising Zanai, Valplona, Pizolgletscher and Schwarzsee;
- Ringelspitz–Tristelhorn alpine glacier complex, comprising the Glasergletscher, Ringelspitz SE, Taminser Gletscher, Morchopf, Camutschera, Lavadignas I and II;
- Segnas–Sardona alpine glacier complex, comprising the Chligletscher, Sardonagletscher I and II, Glatschiu dil Segnas and Las Palas.

The Pizolgletscher and Chligletscher are included in the Swiss glacier monitoring network. The rate of glacial retreat within the boundary of the proposed World Natural Heritage site is striking. Between 1850 and 1973, the glaciers' total length decreased from 17 to 9.25 km (54 % reduction), with the total area declining from 7.02 to 3.29 km^2 (53 % reduction) and the total volume from 0.116 to 0.067 km^3 (59 % reduction).

Between 1850 and 1973, the equilibrium line altitude rose by an average of 120 m, from 2580 to 2700 m a.s.l. The rise in altitude varies widely according to exposure: the increase was less pronounced for north-facing glaciers, such as the Sardonagletscher (55 m), Chligletscher (25 m) or Glasergletscher (15 m), than for south- or east-facing glaciers, such as the Glatschiu dil Segnas (100 m), Ringelspitz SE (220 m) or Taminser Gletscher (145 m). Exceptions to this rule are the north-facing Pizolgletscher (110 m) and the south-facing Lavadignas I and II (35 and 60 m).

Fig. 02-05: *The Pizolgletscher serves as an example of glacial retreat: a postcard from around 1920 compared with the current state of the glacier. In 1850, the Pizolgletscher still extended as far as the Wildsee. Photograph: D. Imper, Heiligkreuz.*

2.3.6 Water

The following major surface waterbodies are situated within the property:

- the watercourses Tamina, Gafarrabach, Gufelbach, Seez, Schils, Murgbach, Gsponbach, Mülibach, Chrauchbach, Raminer Bach, Tschinglenbach, Ual Segnas and Aua da Mulin with side streams;
- numerous idyllic mountain lakes, such as the Plattenseeli, Heubützliseeli, Wildsee, Schottensee, Schwarzsee, Baschalvasee, Chammseeli (Obersiez), Madseeli, Sächserseelein, Chammseeli (Murgtal), Murgseen, Glotelseen, Spanneggsee, Talsee, Heustockseelein, Fessisseelein, Ober-Seeloch or Laghet;
- the Gigerwald reservoir in the Calfeisental.

The spring water from the property, which is generally of excellent quality for drinking, is abstracted at numerous private and public wells. Spring water used for public water supplies is subject to legal protection in designated groundwater zones (Mugg, Precht, Fursch, Meerenalp, Fessis, Übelis).

Outside the boundary, in the Rhine, Seez and Linth plains, extensive groundwater reservoirs are formed by gravel beds in the valley floor. However, the proposed World Heritage site lies within the hydrological catchment area of these important aquifers.

2.3.7 Protected areas and protected sites

A large number of federally and cantonally protected areas and sites are to be found within the boundary of the proposed World Natural Heritage site: landscapes and natural monuments, mire landscapes, raised bogs, transitional mires and fenlands, alluvial zones, amphibian spawning areas, dry grasslands, game reserves and ibex colonies (Annex MP03).

2.3.8 Geotopes, geotope complexes and geotope landscapes

Within its boundary, the proposed World Heritage site includes not only the Glarus overthrust geotope, but many other structural, sedimentological, palaeontological, geohistorical, petrographical, geomorphological and hydrogeological geotopes of international, national or cantonal importance (Annex MP04). Most of these geotopes are not threatened.

Although a geotope protection plan was developed at the federal level in recent years, it does not have any independent legal force and has yet to be implemented. The Inventory of Geotopes of National Importance, prepared by the Working Group for the Protection of Geotopes and published in 1999, has been adopted by the federal authorities as an indicative inventory.

An inventory of geotopes in the canton of St. Gallen was drawn up in 2002, and in Glarus a cantonal geotope inventory is still being prepared. An inventory of sites within the boundary of the proposed World Natural Heritage property has been compiled by the canton of Graubünden. These inventories are binding on the authorities or serve to provide guidance. At the communal level, geotope protection provisions are included in inventories and ordinances or in land use plans that are binding on land owners.

*Fig. 02-06:
Plaun Segnas Sut: a mire landscape and alluvial zone of national importance.
Photograph: David Imper, Heiligkreuz.*

2.4 Human settlements

2.4.1 Population trends in the communes concerned

Finds of national/international importance were made in the Drachenloch cave at an altitude of 2427 m a.s.l., providing evidence of human activities in the Middle Palaeolithic period (130,000 to 30,000 years ago) and the presence of numerous cave bears. The Drachenloch site became well known particularly on account of the controversy concerning a possible cave bear cult. It has, however, yet to be demonstrated that the site was concurrently occupied by humans – who were not yet settled – and bears.

The Weisstannental and the Calfeisental were settled by the Walser people in the thirteenth century. Evidence of these bygone times survives in the form of characteristic dispersed settlements, old Walser houses and typical place names, which are also found within the boundary of the proposed World Natural Heritage site (e.g. St. Martin, Gigerwald, Gafarra, Valtnov). The Walsers settled in close proximity to the property, near Elm and on the Wissenberg near Matt. Many of today's mountain pastures can be traced back to the clear-felling carried out at that time. From the mid-fifteenth century onwards, the Walsers abandoned this area as a result of the deteriorating climate and more frequent avalanches triggered by forest clearance. Around 1400, the Walser population in the Calfeisental numbered about 100, with a dozen homesteads; by 1652, the last Walsers had left the valley and moved to Vättis.

Fig. 02-07: Until 1652 the Walser settlement of St. Martin (1350 m a.s.l.) was occupied all year round. Recently, it has been preserved and restored. Photograph: P. Donatsch, Bad Ragaz.

No farms or settlements occupied the whole year round are currently to be found within the boundary of the proposed World Natural Heritage site. Among the 40,000 inhabitants of the 19 communes concerned, 63 % live in the 6 St. Gallen communes, 22.5 % in the 9 Glarus communes and 14.5 % in the 4 Graubünden communes (Annex MP02). In the Sarganserland communes, the population has increased since 1950 primarily in centres with well-developed transport infrastructure - Bad Ragaz (+90 %) and Sargans/Mels (+45 %)/Vilters-Wangs (+75 %), while declining slightly in Pfäfers (-8 %) and remaining stable in Quarten and Flums (Annex MP05). Among the communes in the canton of Glarus, the population has increased since 1950 only in Filzbach (+40 %) and Mollis (+35 %), while decreasing - sometimes markedly – in most of the other communes: Ennenda (-5 %), Elm (-12 %), Obstalden -13 %), Mühlehorn and Sool (-30 %), and Matt and Engi (-40 %). Over the same period, the population in the Graubünden communes has doubled overall, but with substantial local differences (Laax +250 %, Flims +120 %, Trin +60 %, Tamins +50 %).

The villages lie on the margins of the property, along the axes of the Walensee-Seez, Linth, Sernf and Vorderrhein valleys. A variety of establishments are to be found in the higher-lying areas.

2.4.2 Actors

The following actors were involved in the development of the Management Plan:

- Sarganserland-Walensee-Glarnerland GeoPark Association;
- UNESCO World Natural Heritage Working Group;
- the communes concerned: Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool/Schwanden, Engi, Matt, Elm, Laax, Flims, Trin and Tamins;
- the regions and communal associations concerned: Sarganserland-Walensee, Glarner Hinterland-Sernftal and Surselva;
- the cantonal agencies responsible for nature and landscape protection in St. Gallen, Glarus and Graubünden;
- Federal Office for the Environment (FOEN);
- regional tourist bodies: Sarganserland-Walensee Tourist Association/Ferienregion Heidiland, Elm Sernftal Tourism and Flims Laax Falera Tourismus AG;
- various sites of geological interest forming part of the Sarganserland-Walensee-Glarnerland GeoPark;
- the local population.

2.4.3 Natural hazards

Natural disasters are an integral part of the ecosystem. Extreme precipitation and storm events, avalanches, debris flows, landslides, rockfalls and forest fires are ever-present possibilities. As long as they do not directly threaten human life and property, they are accepted as "natural” phenomena.

The risk of damage within the boundary is relatively low. Assets exposed to hazards are the infrastructure of power plants and small funicular railways, mountain roads and buildings, and cabins. Possible natural hazards originating in the proposed World Heritage site present only a low risk for the valley-dwelling population. Population centres lying on alluvial fans, such as Vättis, Bad Ragaz, Mels, Flums, Murg, Mollis, Ennenda, Engi or Matt, could be at risk from debris flows or flooding. Equally, individual sites of interest could be damaged by avalanches, storms, landslides or rockfalls.

The local community has become accustomed to natural hazards. In the choice of sites and designs for buildings, these hazards have generally been taken into account or plans are adapted to the natural conditions. The authorities have been instructed to designate hazard zones (cantonal hazard maps are in preparation) and to take appropriate measures.

Fig. 02-08: Forest management is required to ensure sufficient protection against natural hazards in many places, such as here in the Mülibachtal. Photograph: D. Imper, Heiligkreuz.

2.4.4 Knowledge management (education, research, etc.)

The mountains lying between the Rhine, Seez-Walensee and Linth are known collectively as the Glarus Alps. Since the nineteenth century, the Glarus Alps and in particular the Glarus overthrust have been the subject of intensive geological research. These mountains have been a source of fundamental observations and insights of a general character in the fields of Sedimentology, Tectonics and Quaternary geology. No research or teaching institute is exclusively concerned with the Glarus Alps; instead, specific topics are investigated by researchers from a variety of institutes and universities.

The Glarus overthrust has given rise to a large volume of scientific and cantonal literature. A detailed list has been appended to the Nomination Dossier. No documentation centre devoted to the Glarus Alps currently exists. The most important geology library is to be found at the Swiss Federal Institute of Technology (ETH) in Zurich. A collection of the works of Jakob Oberholzer – one of the most important researchers in the field, who produced detailed descriptions and maps of the Glarus Alps – was made accessible to the public at Engi in the summer of 2004. Natural history exhibitions are to be found at the Museum of Nature in Chur, the St. Gallen Nature Museum or the Sarganserland Museum (Sargans Castle).

As part of the "GeoPark Sarganserland-Walensee-Glarnerland" project, a great deal of important preliminary work has already been done, including the production of educational publications in the geological field.

The Educational Forestry Centre Maienfeld – in cooperation with the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) and the Swiss Federal Institute for Snow and Avalanche Research (SLF) – carries out forestry and forest ecological studies in the forests of the nominated property (silvicultural pilot projects on the management of forests providing protection against natural hazards in cooperation with federal and cantonal agencies; long-term studies of storm-damaged forests (Vivian) in cooperation with the WSL and SLF; studies on the growth of young spruce trees in the Calfeisental, conducted by the WSL; education and training of forestry personnel in cooperation with the WSL and SLF; numerous national and international excursions; IMIS monitoring stations operated by the SLF).

With regard to flora and fauna, observations, maps and descriptions have also been made over the centuries. Under the Swiss Biodiversity Monitoring (BDM) programme, data on animal and plant species is collected using a sampling procedure, collated by a documentation centre and periodically published.

2.5 Economic resources

2.5.1 Agriculture

Agricultural use is based on mountain pastures and farms located in the valleys. Owing to natural constraints, it is confined to a small number of areas. As Switzerland's agricultural sector is under pressure and undergoing radical changes, farms are increasingly dependent on opportunities for direct marketing of produce.

The pastures are situated on the slopes beyond the valleys, up to an altitude of 2500 m a.s.l. They are mainly grazed by dairy/beef cattle and sheep, and are only used for this purpose during the summer months (June to September). This traditional form of extensive management can be described as sustainable and environmentally sound. The rearing of dairy cattle and hence the summer pasturing of beef cattle is declining, and new forms of grassland management are becoming increasingly significant (single-suckling systems on pasture). As a landscape management measure, mountain farming helps to prevent the development of scrub (hedgerow management, path maintenance, etc.). As a result of the growing industrialization of agriculture and economic pressures, steep slopes and less favoured areas are no longer being grazed and are increasingly turning to scrub. Consequently, there is a risk that these important management measures may be abandoned.

A total of 68 mountain farming enterprises are to be found within the boundary of the proposed World Natural Heritage site, including 12 lying largely outside the property (Annex MP06). In the summer of 2005 (2002), these 68 farms were populated with around 2804 (2742) head of cattle, 5708 (5393) head of youngstock, 6404 (6908) sheep, 624 (453) goats, and 74 (37) horses and donkeys. In the canton of Glarus, a number of higher-lying areas (In

Fig. 02-09: Dry grasslands, Alpeli (Ennenda). Photograph: D. Imper, Heiligkreuz.

den Zügen Obstalden, Äugsten Ennenda, Glattmatt Engi, Bruch Matt, Lauben Elm) are used as hay meadows.

In the peripheral valley regions, year-round farming is practised up to an altitude of 1000 m a.s.l. or more. The boundary of the proposed World Heritage site extends at only a few points (Weisstannen, Mullerenberg, Ennenda, Sool, Elm) into these lower-lying, year-round farming areas. Given the nature of the terrain, only extensive management is possible. These areas are mainly used by small farms as grass- and pastureland.

2.5.2 Forestry

The forests in this region serve a number of different functions. As well as offering protection against natural hazards such as avalanches and rockfalls, they are a source of raw materials and are valuable both as a habitat and an area for recreation. The legal foundations are provided by the forest development plan, which has binding force for the authorities.

Demand for timber as a source of energy and a construction material and also for pastureland led to the overexploitation of forests until well into the nineteenth century. After devastating storms in the mid-nineteenth century and considerable damage to the lower reaches of streams, the first forestry law was enacted at the federal level. Mountain forests were placed under legal protection and major efforts were undertaken to increase the forested area and promote replanting, mainly with Norway spruce. As can be seen from habitat maps, this policy did not necessarily reflect the natural conditions. The maps indicate that up to an altitude of about 1300 m a.s.l. most stands would consist of silver fir-beech forests and then up to about 1600 m a.s.l. silver fir-spruce forests, only giving way to subalpine, almost exclusively spruce forests in the highest altitude band below the treeline.

Wherever livestock could be pastured, the natural treeline, which would otherwise lie at an altitude of 1700 to almost 2000 m a.s.l., has been lowered by 100–200 m as a result of forest clearance. At certain points, however, natural forest development was preserved due to inaccessibility or adverse topographical conditions. A notable example is the arolla pine forest below the treeline in the Murgtal (a reserve since 1935). Other arolla stands are to be found in the Sardonaalp region, on the Flumserberg area and in the Mürtschental. In the Weisstannental, primeval silver fir-spruce forest still grows on undeveloped areas towards the Marchstein. The forestry service is responsible for ensuring that these assets are preserved.

The forests are subject to a process of constant ageing, which is accelerated by environmental factors (inputs of airborne pollutants and nitrogen). Mountain forest ageing is manifested by decreased resistance of the spruce stands – largely well adapted to the environment at the altitudes in question – to the ravages of the bark beetle and of increasingly frequent and violent storms. The aim of current forest management efforts is to prevent the decline of stands by means of near-natural regeneration measures and to promote stabilization. The forest may be adversely affected by avalanche damage, föhn storms, game browsing and the use of land for mountain farming.

Since the 1980s, net profits per cubic metre of timber have declined sharply. Within the boundary of the property, given the lack of infrastructure and the economic constraints, commercial exploitation of the forest is confined to a few well-developed areas such as the Mülibachtal (Glarus canton).

In each canton, responsibility lies with a cantonal forest agency, headed by the Cantonal Forester. Each canton has its own regional forest agencies, with a further subdivision into forest districts (Annex MP07).

2.5.3 Hunting

On this property, hunting has a long tradition and is well accepted and adequately regulated. It is practised in such a way as to promote sustainable use of game populations in the long term, based on planning principles derived from wildlife biology.

Two federal game reserves – Graue Hörner (St. Gallen canton) and Schilt (Glarus canton), where hunting is completely prohibited – lie within the boundary of the proposed World Natural Heritage site. The reserves were originally established in order to boost game populations; they now serve a particularly important function from the point of view of species and habitat protection.

The Graue Hörner game reserve, established in 1901, lies on the border between the communes of Mels and Pfäfers. Its particular importance dates back to 1911, when the ibex, which at that time had become extinct, was reintroduced in Switzerland for the first time, near Weisstannen. With regard to flora, this reserve offers one of the most species-rich alpine landscapes anywhere in Switzerland. According to the FOEN Red List, a considerable number of plant and animal species are to be classified as rare and/or threatened. The Schilt reserve lies on the western slopes of Schilt and Schwarzstöckli, to the west of Ennenda and Mitlödi. The landscape on the steep valley slope is richly structured (forest, hayfields and meadows, scree slopes, rocks). The Graubünden region contains four general reserves where all hunting is prohibited (Muladera, Laax; Tschenghel, Trin; Lawoi, Tamins; and Schreus, Tamins), as well as reserves for hares and for small game *(Niederwild).*

*Fig. 02-10:
The capercaillie (Tetrao urogallus) is a threatened and protected species characteristic of untouched mountain forests (Walabütz, Weisstannental).
Photograph: O. Good, Mels.*

Outside the game reserves, hunting is regulated on a cantonal basis. The boundary of the proposed World Natural Heritage site passes through six gamekeeping management districts (Annex MP08). In the canton of St. Gallen a preserves system *(Revierjagd)* is in operation, while in the cantons of Glarus and Graubünden a certification system *(Patentjagd)* is used. In St. Gallen, the 15 preserves lying at least partly within the boundary of the proposed World Heritage site are leased to 136 hunters (Annex MP09). Hunters are required to hold a cantonal certificate, which is only awarded to those who successfully complete a hunting examination.

2.5.4 Fisheries

Most of the streams within the boundary of the nominated property are fishing waters and valuable aquatic habitats. Angling is subject to cantonal laws and ordinances, with federal legislation taking precedence. Fishing is regulated on a cantonal basis and structures vary accordingly.

In the Glarus region of the proposed World Natural Heritage site, all watercourses are essentially considered to be fishing waters. By contrast, none of the watercourses in the territory of Graubünden are fishing waters. In the area belonging to St. Gallen, the following are designated as fishing waters: the Tamina from its source to St. Martin, the Fooalpbach and the upper reaches of the Seez to a point above Weisstannen, the upper reaches of the Schilsbach and Furschbach, and the upper reaches of the Murgbach.

The official angling lakes within the boundary are the Gigerwald reservoir, Wildsee, Schottensee, Schwarzsee, Baschalvasee, Upper, Middle and Lower Murgsee, Talsee, Fessisseelein and Ober-Seeloch.

In many fishing waters, young fish are regularly released by the cantonal authorities. Licences are sold which are valid throughout a given canton for periods of a day, a week, 2 weeks, a month or a year. In Graubünden, but not in Glarus or St. Gallen, people purchasing a fishing licence are required to provide evidence of their competence.

2.5.5 Tourism

Tourism is of major economic significance for all the regions concerned. In the Flims area and on Flumserberg almost the entire population is directly or indirectly dependent on tourism for its livelihood, and in the communes that are parties to the agreement the same applies to a large proportion of the population. Weisse Arena AG alone employs 200 people in the summer and 600 in the winter, and the Flumserberg mountain railways provide jobs for 75 people in the summer and up to 200 in the winter.

At most resorts, tourism had its origins in the establishment of Kurhäuser towards the end of the nineteenth century. The development of winter sports resorts began with the construction of the first ski lifts in the middle of the twentieth century. During the winter season, the average number of visitors per day is now 8000 (with a maximum of 20,000) in the resorts of Flims-Laax-Falera, 5000 (13,000) on Flumserberg, and 1500 (3500) in the Pizol region. Transport facilities are also to be found on Kerenzerberg, with a few ski tows near Weisstannen and Engi. Infrastructure for the Weisse Arena (Flims-Laax), Pizol, Flumserberg and Kerenzerberg ski resorts lies outside the boundary. Near Flims and Weisstannen, there may be overlaps between a small number of ski runs and the boundary of the proposed World Natural Heritage site.

The nominated property is exceptionally suitable for hikers, mountain walkers and experienced summer and winter climbers. Well-developed paths lead from the cable railway stations onto the territory of the proposed World Heritage site. Within the property, a variety of mountain cabins are available: St. Martin, Schräahütte SAC, Sardonahütte SAC, Spitzmeilenhütte SAC, Murgseehütte, Skihütte Gams, Martinsmadhütte SAC and Niederen. In addition, a number of mountain pasture establishments offer simple accommodation.

Modern sports such as hang-/paragliding and mountain-biking are of secondary importance within the boundary of the property. In the Schilt game reserve, routes for descents have been elaborated with the hang-/paragliding associations. Adverse technical conditions make the alpine and high-alpine zones unsuitable for mass tourism facilities.

2.5.6 Energy

Since 1977, water from the Seez and Tamina rivers has been used for power generation by Kraftwerke Sarganserland AG. The Gigerwald reservoir (upper level), with a capacity of 33.4 million m^3, is situated in the Calfeisental, within the boundary of the nominated property. The equalizing basin and the Mapragg plant (lower level), as well as the Sarelli plant, are located outside the boundary. The combined storage and pump-storage plant generates an average of 500 million kWh per year and is of major economic importance for the canton and for the concession-holding communes of Pfäfers, Bad Ragaz and Mels.

At the upper level (Gigerwald-Mapragg), Kraftwerke Sarganserland AG uses outflows from a catchment area of 45 km^2 in the southern Weisstannental and of 52 km^2 in the Calfeisental. All of the extraction points in the Weisstannental lie within the boundary: Siezbach, Mattbach, Seez (Walabütz), Scheubsbach, Gufelbach (Lavtina) and Gafarrabach. Although no residual flow levels are stipulated for these points, a minimum flow rate of 600 liters per second is required to be maintained in the Seez river near Mels. The concession was granted in 1960 for a period of 80 years.

In the Murgtal, the Murgbach is used at four points between Bachlaui and the Merlen barrage. In this area, the Murgbach forms the boundary of the nominated property. The power generated meets a proportion of Murg's energy requirements. On the Alp Ramin, drinking and process water is used in a small plant to generate power supplies to meet local needs. Given the water flows available in the watercourses within the nominated property, the construction of further large-scale hydropower plants would scarcely be possible or economically viable.

High-voltage power lines are only to be found in peripheral areas of the nominated property, e.g. east of Ennenda, east of Sool and from Elm via Martinsmad to Vorab.

2.5.7 Transport/accessibility

In general, the gateway locations are readily accessible by means of public transport (rail and coach) or by private car. Particularly important are the good links to the railway nodes of Ziegelbrücke, Sargans, Landquart and Chur.

From Zurich Airport the Glarnerland (Mollis and Weesen exit) and Sarganserland (Murg, Walenstadt, Flums and Bad Ragaz exit) are an hour's drive away along the A3. Surselva (Graubünden) is about 2 hours away by car. From St. Gallen (Germany, Austria and the Principality of Liechtenstein) the gateways to the proposed World Natural Heritage site are a 1–2 hours' drive away along the A13.

On the Vorab a helipad is situated next to the boundary of the nominated property, and small airports for sports aircraft are located near Bad Ragaz and Mollis.

The Sarganserland is accessible via the Pizol and Flumserberg mountain railways. In addition, public coach services provide access to the gateway locations of Vättis (as far as the Gigerwald dam in the summer) and Weisstannen. Journeys into the Murgtal can be made using an on-demand bus or via a toll road.

The Kerenzerberg is accessible via the Kerenzerberg mountain railways and the toll road to the Talsee, and the Mullerenberge are served by an on-demand bus and a toll road.

From Graubünden, the nominated property is most readily accessible via Flims or Laax, where numerous mountain railways serving the Flimserstein and Vorab lead onto the margins of the property. A public coach service is available from Flims to Bargis.

Funicular railways used for transporting goods are also available for tourist purposes, running from Vättis to the Vättnerberg, from Ennenda to Äugsten, from Matt to Wissenberg, and from Elm to Niederen. The last of these routes is the only one within the boundary of the nominated property.

The following areas are not served by public transport: the road from the Gigerwald dam to St. Martin in the Calfeisental, the Weisstannental/Vorsiez south of Weisstannen, the Mülibachtal and the Chrauchtal.

2.5.8 Industry

No industrial plants are to be found within the boundary of the proposed World Heritage site.

2.5.9 Trades/commerce/services

Within the boundary of the nominated property, the service-sector businesses consist of mountain hotels and cabins offering meals and accommodation.

No commercial or trade enterprises are to be found within the boundary of the proposed World Natural Heritage site. However, in the communes that are parties to the agreement, a large – sometimes highly traditional – craft sector still survives, although its significance is declining. Many more modern trade and commercial businesses are indirectly dependent on (winter sports) tourism, especially in the ski resorts of Weisse Arena (Flims-Laax), Pizol, Flumserberg, Kerenzerberg and Elm.

2.5.10 Armed forces

Until a few years ago, certain areas within the nominated property had been used for military purposes for some decades. These included target areas for artillery and mortar fire. However, as this type of use was non-intensive, the property's assets – especially those of a geological nature – were not impaired. There is no evidence of any other military activities that could have an adverse impact on the property.

The following firing ranges are still situated within the proposed World Natural Heritage site:

- Obersiez/Walabütz ranges for infantry weapons, with emplacement and target areas (Walenstadt federal weapons training grounds, Sectoral Plan for Weapons Training Grounds 17.13)
- Fronalp-Schilt artillery target area (Linthebene range, Sectoral Plan for Weapons Training Grounds 17.22)
- Mülibachtal range for infantry weapons (Wichlen range, Sectoral Plan for Weapons Training Grounds 08.23)
- Chrauchtal and Haris range for infantry weapons (Wichlen range, Sectoral Plan for Weapons Training Grounds 08.23)

Under the Swiss Army's latest stationing plans, the firing ranges and training grounds of Walabütz, Fronalp-Schilt, Mülibachtal, and Chrauchtal and Haris are no longer required, and the multi-year leases are to be terminated as soon as possible.

Fig. 02-11: *The Gigerwald reservoir produce renewable energy. Photograph: D. Imper, Heiligkreuz.*

3 GOALS AND IMPLEMENTATION

3.1 Strategic goals

In Article 1 ("Purpose”) of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust”,* signed by the 19 communes concerned (Annex MP01), the following goals are specified:

- Joint action is to be taken to conserve and manage the natural monument "Glarus overthrust” as a UNESCO World Heritage site, together with the surrounding landscape and habitats.
- Sites of geological importance ("geotopes”), biotopes and the landscape within this natural monument are to be conserved over the long term.
- As far as is consistent with the conservation of the geotopes, biotopes and landscape, the region and its natural aesthetic features are to be accessible to visitors and available for sustainable, appropriate use.

On this basis, the following goals have been defined:

- The property’s diversity, unique character and beauty and the full diversity of the natural and semi-natural ecosystems and ecosystem complexes are to be preserved for present and future generations, including the area’s significance as a recreational and economic resource.
- All of the wild plant and animal species indigenous to the property, together with their biological communities, are to be conserved, and if necessary nurtured, in populations that are viable over the long term.
- The cultural and traditional elements of the various man-made landscapes are to be preserved.
- Commercial use is to be aligned with the carrying capacity of the natural ecosystem.
- Bearing in mind the natural hazards and taking account of the sensitivity and need for conservation of the natural resources, people are welcome to visit the property. Appropriate infrastructure is to be maintained and if necessary expanded in line with the capacity of the natural ecosystem to tolerate use.
- Awareness of the property’s value, unique character and aesthetic features is to be promoted among visitors and the local community.

3.2 Operational goals, measures and implementation

In preparing the Development Plan for the UNESCO World Heritage site "Glarus Overthrust”, goals were specified for the various types of use. A list of permissible uses is included as Appendix 2 to the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust”* (Annex MP01). The uses specified in this list form the basis of the proposals given in the following sections. It should, however, be noted that these are presented without prejudice to higher-level legislation, and that additional regulations concerning protection, especially those specified in cantonal master plans, will take precedence.

Development and the impact of the various types of use is to be monitored with the aid of appropriate indicators (Section 6.1).

To determine the key points and priorities to be considered when measures are specified and implemented, a relevance matrix was prepared (Fig. 03-01). This indicates to what extent the natural values of the property (Glarus overthrust, geotopes, landscape, climate, air, glaciers, groundwater, streams and lakes, soil, flora and fauna) may be exposed to impacts from agriculture, forestry, hunting, fishing, tourism/visitors, cabins/accommodation, hiking paths, railways, transport/roads (including those for agriculture and forestry), energy production and military activities.

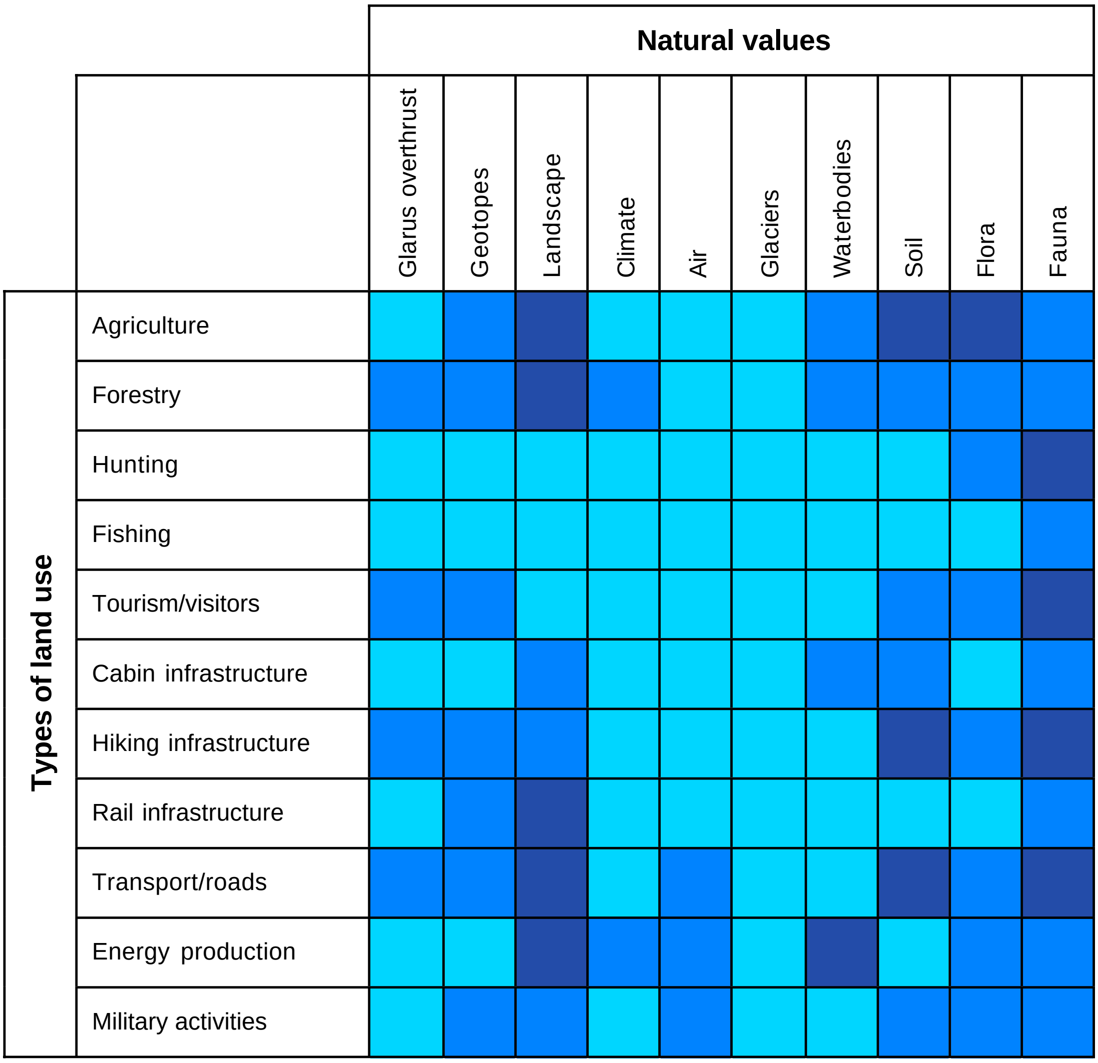

Fig. 03-01: The relevance matrix indicates the potential for existing types of land use to affect the various elements of the environment. To permit rapid identification of priority issues in the specification of goals, measures and proposals for implementation, the potential for impacts is rated on a three-point scale: light blue = none or very limited, blue = limited to moderate, dark blue = substantial. Note that the dark-blue colour does not mean that conflicts arising from land use already exist in these fields, but that they are most likely to occur here.

With this type of presentation, there is a risk that a dark-blue field may be interpreted as a "land use problem”. However, this would not be a valid conclusion: firstly, the classification into three levels of exposure to impacts is based on a relative scale, and secondly it involves potentialities. This matrix provides a valuable basis for the specification of goals, measures and proposals for implementation. Based on current conditions, an additional aid to the implementation of measures was developed, involving relative urgency:

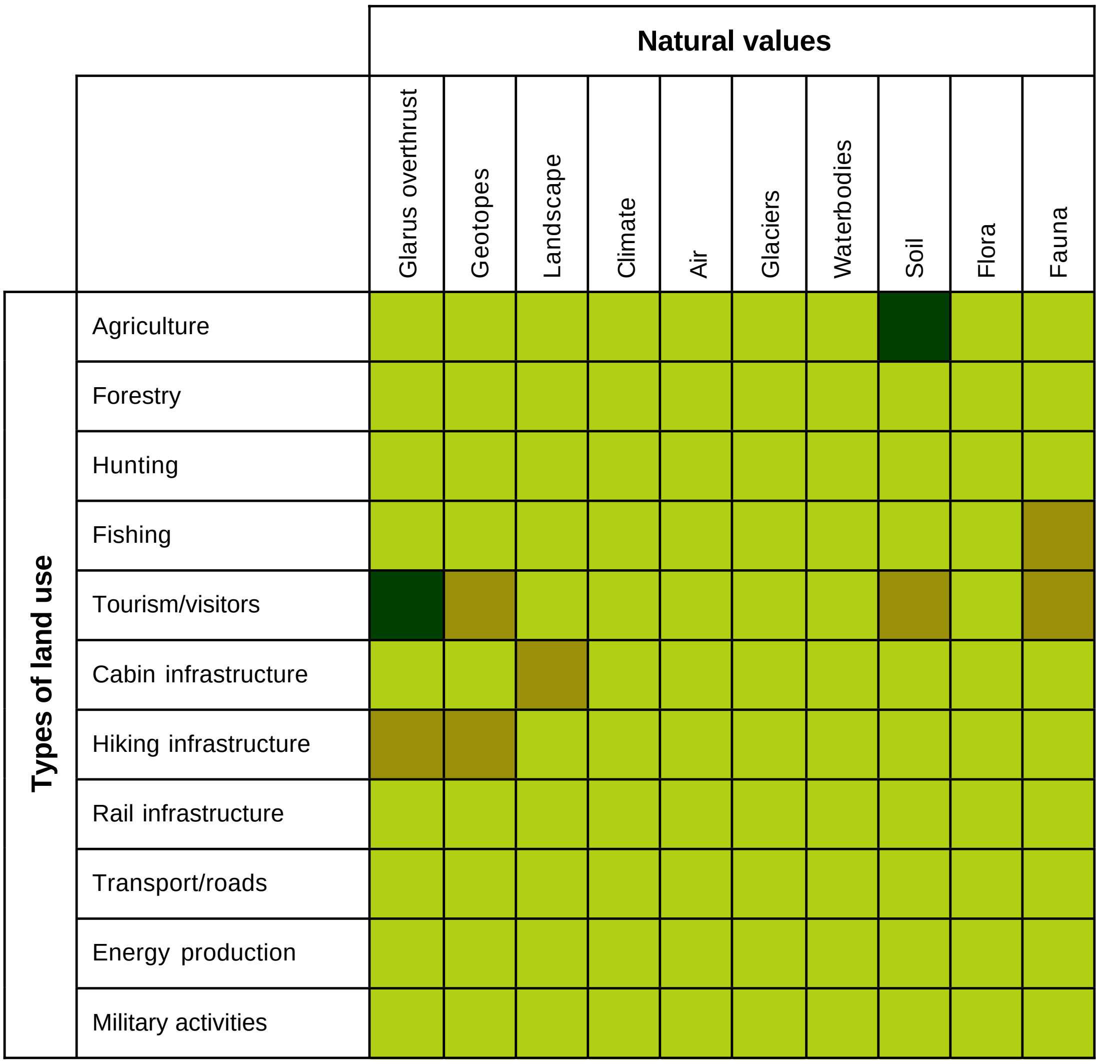

Fig. 03-02: *The urgency with which measures should be implemented is also indicated on a three-point (relative) scale: light green = not urgent, olive-green = moderately urgent and dark green = priority measures. This presentation is mainly designed to permit rapid identification of relative urgency. Thus, the dark-green colour does not mean that an acute need for action exists in these fields, but merely that priority should be accorded to these topics.*

In the following sections, the effects of the various types of land use are summarized. The specific goals, measures and proposals for implementation were developed on the basis of this current situation.

3.2.1 Agriculture

Effects

Agricultural use, which has a centuries-old tradition, mainly affects the (cultural) landscape, soils and flora. This type of land use helps to preserve the existing cultural landscape, which would otherwise largely be reclaimed by forests. The mountain farming buildings blend in with and add character to the landscape. As a result of agricultural use, there have been changes in the diversity of flora, with new plant communities becoming established. Mountain farming creates opportunities for near-natural production of high-quality organic food products. At frequently used sites (watering places, stores), there is a risk of soil destruction or erosion, especially with prolonged wet weather conditions.
Agricultural use may have minor to moderate impacts on waterbodies (local pollution), fauna (game behaviour) and certain geotopes (especially geomorphology: blasting of erratic blocks, preparation of paths, filling-in/removal of terrain irregularities).

Within the boundary of the nominated property, agriculture has scarcely any impact on the Glarus overthrust phenomenon, climate, air or glaciers.

According to the urgency table (Fig. 03-02), overuse of soils at sensitive sites (watering places, stores) is among the topics for which measures are most urgently required.

Goals

- Agricultural produce from the nominated World Natural Heritage site is to be of a high quality and characteristic of the region.
- The marketing of this produce is to be supported.
- Agricultural use is to be in line with natural yield potentials.
- The construction and renewal of agricultural buildings and infrastructure is to be optimized with regard to nature and landscape.
- The existing cultural landscape is to be preserved.

Measures

- *Labelling of agricultural produce from the UNESCO World Heritage site is to be considered.*
- *Potential for cooperation with other sectors, especially tourism, is to be assessed in detail.*
- *Operators are to be informed about soil formation and erosion.*
- *Planning authorities are to be given advice with regard to construction projects.*

Implementation

- Appointment of a Working Group of balanced composition to deal with agricultural issues (labelling, marketing support, land use conflicts, etc.).
- Preparation and distribution of guidance on best management practices.
- Periodic reviews of optimal size of mountain pasture livestock populations.
- Periodic meetings with agricultural organizations and farm owners (implementation of labelling, raising awareness of geotopes and highlighting possible threats, land use conflicts, etc.).

- Periodic meetings with planning authorities (raising awareness of geotopes and highlighting possible threats, emphasizing the importance of scenery in connection with renovation projects).
- Continuation of biodiversity monitoring programme.

3.2.2 Forestry

Effects

Forestry use may have moderate to major impacts on the (cultural) landscape (Fig. 03-01). Scenery may be substantially altered by changes in species composition, and possibly also by a forest road.

Forestry use may also have minor to moderate impacts on the Glarus overthrust phenomenon (poorer exposures, e.g. at Lochsite), geotopes (poorer view of geotopes in forests, destruction/formation of geomorphological geotopes such as earth pillars), the local climate, waterbodies (retention effects), soils, flora and fauna (forest habitat).

Within the boundary of the nominated property, forestry has scarcely any impact on the air or glaciers.

No measures are urgently required in the forestry sector (Fig. 03-02).

Fig. 03-03: There is a centuries-old tradition of mountain farming. Within the proposed World Heritage site, the rare and now threatened breed of mountain goat known as the booted goat (Stiefelgeiss) is still farmed. Photograph: B. Walder, Steffisburg.

Goals

- The forests are to fulfil the functions arising from the biogeographical conditions.
- The forests are to serve as valuable habitats and important factors in relation to the landscape and recreation.
- Stable, near-natural or natural forests are to be promoted.
- New infrastructure permitting access for appropriate forestry use and structures providing protection against natural hazards are to be optimized with regard to nature and landscape.

Measures

- *The principles of near-natural silviculture are to be implemented.*
- *The functional capacity of protective forest is to be preserved.*
- *Existing labels (e.g. FSC) are to be promoted.*
- *Labelling of forestry products from the UNESCO World Heritage site is to be considered.*
- *The forest development plans/forest plans are to be finalized, periodically reviewed and if necessary adapted.*
- *Wherever reasonable and permissible, forest reserves are to be designated or forests are simply to be allowed to develop naturally.*

Implementation

- Completion of forest development plans/forest plans.
- Regular updating of register of losses (event register).
- Incorporation of these measures in forest development plans/forest plans.
- Communication of measures and goals to the district foresters and forestry workers in the communes concerned.
- Assessment of demand for a label for World Heritage forestry products.

3.2.3 Hunting

Effects

Hunting, a traditional activity dating back centuries, may affect fauna in particular (Fig. 03-01).

It may have minor to moderate impacts on flora (due to changes in fauna).

Within the boundary of the nominated property, hunting has scarcely any impact on the Glarus overthrust phenomenon, geotopes, landscape, climate, air, glaciers, waterbodies or soils.

No measures are urgently required in the hunting sector (Fig. 03-02).

Goals

- Hunting practice is to be based on planning principles derived from wildlife biology.
- Existing game reserves and conservation areas are to be preserved as core habitats for game species.
- Species that are threatened either locally or throughout the Alpine region are not to be hunted.

Measure

- *Planning principles derived from wildlife biology should continue to be incorporated into hunting regulations.*

Implementation

- Monitoring of game populations is to be pursued.

3.2.4 Fishing

Effects

Fishing may affect fauna in particular (Fig. 03-01).

Within the boundary of the nominated property, fishing has scarcely any impact on the Glarus overthrust phenomenon, geotopes, landscape, climate, air, glaciers, waterbodies, soils or flora.

According to the urgency table (Fig. 03-02), measures to preserve native species diversity are required with moderate urgency.

Goals

- Fishing waters – like all other waterbodies – are to be preserved as valuable aquatic habitats.
- Fishing and restocking are to be in line with the waters' natural yield potentials.
- Only indigenous species are to be used for restocking.

Measure

- *Waterbodies and the development of fisheries should be included in environmental monitoring.*

Implementation

- Collection and evaluation of statistical data on fisheries.

3.2.5 Tourism

Effects

The tourism sector was divided into four sub-sectors – tourism/visitors, cabins, hiking paths and railways.

Tourism/visitors

Visitor flows are likely to affect fauna most markedly (e.g. through noise) (Fig. 03-01).

However, visitors may also have minor to moderate impacts on the Glarus overthrust phenomenon (increased attention, destruction of structures), geotopes (increased attention, destruction of structures), soils (trampling) and flora.

Within the boundary of the nominated property, walkers have scarcely any impact on the landscape, climate, air, glaciers or waterbodies.

According to the urgency table (Fig. 03-02), the greatest urgency attaches to communication measures – preparation and provision of information on the Glarus overthrust phenomenon. Measures relating to the other geotopes and fauna are less urgently required.

Cabins

The property contains only a very small number of cabins that offer overnight accommodation. The cabins may have minor to moderate impacts on the landscape (architecture), waterbodies (wastewater), soils and fauna (noise) (Fig. 03-01).

Within the boundary of the nominated property, cabins have scarcely any impact on the Glarus overthrust phenomenon, geotopes, climate, air or glaciers.

Fig. 03-04: The SAC shelter "Sardonahütte" is one of the few facilities offering accommodation within the proposed World Heritage site. Photograph: D. Imper, Heiligkreuz.

According to the urgency table (Fig. 03-02), moderate urgency attaches to measures relating to landscape aspects of cabins.

Hiking paths

Visitor management is to be facilitated by well-maintained and well-kept hiking paths. Such paths may affect soils (erosion risk) and fauna (noise) most markedly (Fig. 03-01).

However, hiking paths may also have less serious impacts on the Glarus overthrust phenomenon (increased attention, destruction of structures), geotopes (increased attention, destruction of structures), landscape and flora.

Within the boundary of the nominated property, the network of paths has scarcely any impact on the climate, air, glaciers or waterbodies.

According to the urgency table (Fig. 03-02), moderate urgency attaches to the modification of hiking paths in the vicinity of the Glarus overthrust and geotopes.

Mountain Railways

Only one small public mountain railway is to be found within the boundary of the nominated property.

Mountain railways may affect the scenery most markedly (Fig. 03-01).

Fig. 03-05: The Niederenbahn is the only mountain railway within the boundary of the proposed World Heritage site. Photograph: H. Brühwiler, Elm.

Mountain railways may also have minor to moderate impacts on geotopes (destruction/exposure during construction) and fauna (noise, wires).

Within the boundary of the nominated property, the railways have scarcely any impact on the Glarus overthrust phenomenon, climate, air, glaciers, waterbodies, soils or flora.

In the mountain railway sector, no measures are urgently required (Fig. 03-02).

Goals

- The emphasis is to be placed on high-quality, close-to-nature tourism that is appropriate to the region and in line with conservation objectives. Attention should be paid to visitors' need for peace and quiet and also to their need to engage in activities. Visitors are to be encouraged to take an active interest in and develop a deeper understanding of nature, landscape and culture.
- Consideration is to be given both to the desire for rights of access and to the requirements of natural biological communities. Sensitive habitats are to be treated with care. However, management measures should only be taken where they are required. The options chosen will depend on the goal to be achieved. Wherever possible, "soft" measures are to be adopted, i.e. measures designed to divert, attract or educate visitors.
- A well-maintained infrastructure should facilitate visitor management, and the absence of infrastructure (paths, notice boards, etc.) should deter visitors from entering sensitive areas. A key planning instrument for visitor management is the development plan.

- Infrastructure for tourists is to be developed in accordance with Appendix 2 to the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"* (Annex MP01). Within the boundary of the nominated property:
  - educational measures and notice boards providing information are desirable;
  - hiking, mountaineering, climbing and walking dogs (provided they are under the owner's control) are permissible;
  - new parking facilities, parking outside designated areas, and off-piste skiing or snowboarding are undesirable;
  - the following are to be prohibited: camping, new tourist transport facilities and buildings, structures or equipment (unless it is essential that they be sited within the property), construction zones, new roads providing access for tourists, littering, heli-skiing, aircraft landing sites and motorized water sports.
- The following are subject to the provisions of the approved development plan for the property: the establishment of resting and picnic areas, campsites, new hiking paths, simple accommodation and catering facilities, winter hiking paths, snowshoeing and cross-country skiing routes, tobogganing runs, ski pistes, ski touring routes, hang-gliding launching and landing areas and mountain bike routes, and the organization of sporting events.

Measures

- *Existing regional marketing efforts are to be consolidated as far as possible.*
- *The development plan is to be regularly reviewed and if necessary adapted. At present, no further regulations concerning recreational activities are required.*
- *Tourism, the facilities provided and visitor management within the property will need to be monitored; if necessary, additional measures should be adopted, e.g. requiring visitors not to stray from footpaths, erecting barriers or introducing protection decrees.*

Implementation

- Implementation of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* in the cantonal master plans.
- Implementation of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust"* in the communal land use plans.
- Appointment of a Working Group of balanced composition to deal with current issues in the tourism sector.
- Periodic meetings with representatives of tourism destinations and operators (joint interregional marketing, raising awareness of geotopes and highlighting possible threats, land use conflicts, etc.).
- Establishment of an agriculture and tourism Round Table for the World Natural Heritage property.
- Good marking and presentation of information for visitor management along routes.

3.2.6 Transport/accessibility

Effects

Transport routes (isolated roads, mountain and forestry roads) may affect fauna most markedly (Fig. 03-01).

Transport routes and access roads may have minor to moderate impacts on flora.
The small number of transport routes within the boundary of the nominated property have

scarcely any impact on the Glarus overthrust phenomenon, geotopes, landscape, climate, air, glaciers, waterbodies or soils.
According to the urgency table (Fig. 03-02), no measures relating to transport/access roads are urgently required.

Goals
- Access to the property for visitors is to be optimized.
- The emphasis is to be placed on access via public transport.
- Within the boundary, developments are to be kept to the essential minimum and are to be in accordance with the objectives specified for the nominated World Natural Heritage site.

Measures
- *Public transport services are to be extended into the Calfeisen, Weisstannen and Murg valleys, onto the Mullerenberge, and into the Mühlebach and Chrauch valleys by introducing minitaxis, so that visitors can gain direct access to the nominated property.*
- *For private cars, only a limited number of parking spaces are to be made available at the entrances to the property.*

Implementation
- Efforts are to be made to coordinate railway, mountain railway and coach timetables, to provide minitaxi services and to introduce a travel pass valid throughout the region.

3.2.7 Energy

Effects

Energy production may have moderate to major impacts on the landscape (Gigerwald reservoir, power transmission lines) and waterbodies (Fig. 03-01).

Energy production may also have minor to moderate impacts on the climate (renewable energy without CO2 emissions), air (replacement of a generator with a turbine at a cabin), flora and fauna (altered streamflows, reservoirs).

Within the boundary of the nominated property, power generation has scarcely any impact on the Glarus overthrust phenomenon, geotopes, glaciers or soils.

In the energy production sector, no measures are urgently required (Fig. 03-02).

Goals
- Optimal use is to be made of local renewable resources.
- Use of local renewable resources is not to impair other assets (landscape, water quality, etc.).
- Appropriate compensation should be provided for the use or non-use of hydropower.
- No new installations are to be established beyond that which is required to meet the energy needs of cabins.
- No new above-ground high-voltage power lines are to be erected.

Measures
- *Power generation potential is to be reviewed.*
- *The potential for energy savings by technical means is to be explored.*

Implementation
- The nominated property is to be included in the federal sectoral plan for power transmission lines (SÜL).
- An inventory of visually intrusive structures is to be prepared.

3.2.8 Military activities

Effects

Military activities within the boundary of the nominated property, which mainly involved the use of mountain firing ranges, have been sharply reduced since the initiation of efforts to have the property inscribed on the World Natural Heritage List (3 of the 4 firing ranges have been closed).

Military use no longer has any major impacts (Fig. 03-01).

However, military use may have minor to moderate impacts on geotopes and the landscape (risk of erosion in target areas), air (transport, firing), soils and flora (risk of erosion in target areas) and fauna (firing noise).

Within the boundary of the nominated property, military use has scarcely any impact on the Glarus overthrust phenomenon, climate, glaciers or waterbodies.

According to the urgency table (Fig. 03-02), no measures are urgently required in the military sector.

Goals

- Erosion damage is to be avoided.
- Adverse impacts on landscape and habitats are to be kept to a minimum.
- New military facilities are not desirable.

Measures

- *Close contacts are to be maintained with the military authorities so that any conflicts that may arise can be resolved at an early stage.*

Implementation

- Periodic meetings with the military authorities to assess erosion risks and impacts on landscape and habitats.

3.2.9 Other types of use

Within the boundary of the nominated property, the gathering of mushrooms is permissible in accordance with the relevant legal provisions, while the gathering of berries is unproblematic and generally permissible. The collection of rock crystals is subject to communal regulations; for example, it is prohibited in the Calfeisen valley.

According to the development plan of the *Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus overthrust"* (Annex MP01), the extraction or depositing of materials, terrain modifications, and the construction of above-ground pipelines are not permissible.

Measures

- *Information is to be provided about the regulations/prohibitions concerning the collection of crystals.*
- *Information is to be provided about the regulations concerning mushroom gathering.*

Implementation

- Regular renewal by the communal authorities of notices providing information on the regulations/prohibitions concerning mushroom gathering.
- Regular renewal by the communal authorities of notices providing information on the regulations/prohibitions concerning the collection of rock crystals.

4 PUBLIC RELATIONS AND KNOWLEDGE MANAGEMENT

4.1 Marketing

The unspoilt landscape and the property's natural and near-natural habitats provide a sound basis for nature-friendly tourism, but also for products and services that originate or are finished in the region.

The goal is to increase the value creation associated with tourism in the region. Ongoing monitoring should ensure that marketing activities are consistent with the long-term protection objectives. Adverse impacts on nature and landscape are to be avoided at all costs. A consolidated, coordinated strategy should be adopted to ensure that the region's assets, products and services are marketed in a consistent fashion.

To ensure that synergies are exploited, marketing efforts should be conducted in close cooperation with the GeoPark Sarganserland-Walensee-Glarnerland project. Responsibility for the coordination of marketing lies with the Management (Secretariat). For the purposes of national and international marketing, synergies should be sought with the infrastructure and networks of existing marketing organizations (Elm Sernftal Tourism, Sarganserland-Walensee Tourist Association/Heidiland holiday region, Flims Laax Falera Tourismus AG). Certain tasks may be delegated to subsidiary centres by the Manager (cf. Section 5.1 "Organizational structures").

4.2 Communication/information/public relations

Internal and external communication are to be conducted in accordance with the following scheme:

Topic	Responsibility	Target group	Medium	Frequency
Information issues	Committee, Management	Communes	Delegates' Assembly	As required
List of responsibilities	Committee	Management		Start of project
Scientific advice	Scientific Advisory Committee	Management, Committee	Report	As required
Status of evaluation	Management	Committee, environment agencies	Report	Yearly
Delegation of certain tasks	Management	Subsidiary centres	Meetings, correspondence, etc	As required
Current news	Management, subsidiary centres	Population, visitors	Media, presentations	As required
Elaboration of specific topics	Management	Population, visitors	Magazine	At least once a year
World Heritage site exhibitions/events	Management, subsidiary centres	Population, visitors	Website, leaflets	Updated yearly

Tab. 04-01: Internal and external communication

4.3 Presentation of information

Extensive documentation exists on all aspects of the Glarus overthrust property. The property itself provides an incomparable record of natural history. Unfortunately, the various information resources are widely dispersed. One key aim is to consolidate this knowledge and make it accessible.

Efforts are to be made to create a central repository of scientific literature concerning the property. A database (project) should make it possible to conduct specific searches for additional information and to establish where additional resources can be found (books, journals; localities of natural phenomena, etc.).

Knowledge is to be disseminated at visitor centres, and at regional museums and exhibitions, with lay-friendly media (exhibits, videos, books, etc.) being used to create striking presentations on natural, cultural and economic topics. A website is to be used to communicate a basic knowledge of the Glarus overthrust and the geology of the Glarus Alps to the interested public. (www.glarnerhauptueberschiebung.ch; www.glarusoverthrust.org.)

It is important that the local community, as well as visitors, should have a knowledge and understanding of the property. This is the only way to ensure that the assets will be appreciated and the necessary protection will be provided over the long term. Promoting an in-depth experience of natural, cultural and landscape features represents an important attraction for tourists, which also contributes to value creation for the inhabitants. To facilitate communication of the unique character and beauty of the landscape to visitors at a number of different levels, local tourism professionals, mountain guides and hiking group leaders, scientists and interested laypeople are to be trained as so-called GeoPark Guides.

Communication between the research community and the public is to be promoted by means of public lectures on ongoing or completed research activities. Events, project weeks, etc. on various topics will be organized for visitors in conjunction with educational institutions at all levels.

Fig. 04-01: Visitors are to be managed with the aid of well-maintained hiking trails and information resources. Photograph: B. Walder, Steffisburg.

4.4 Knowledge management/research

Responsibility for knowledge management lies with the Scientific Advisory Committee (Section 5.1.5), which includes representatives from many of the most important Swiss research centres. The nominated property is, to a greater or lesser extent, the subject of research in a wide variety of disciplines – ranging from the earth sciences through biology to tourism studies.

The Management (Section 5.1.4), with the support of the Scientific Advisory Committee, is required to promote and coordinate scientific and socioeconomic research at universities of applied sciences and other universities.

4.5 Quality assurance

In view of the UNESCO label, quality assurance is a requirement at World Natural Heritage sites. The goal is certification to the ISO 8000, 9001 and 14001 standards.

Compliance with quality assurance guidelines is to be ensured by continuous quality controls. Product testing is to be carried out periodically by experts.

5 ORGANIZATION

5.1 Organizational structures

The property is embedded in a complex system of regulations, enforcement and administration. However, the management system that is to be established for the World Heritage site requires overarching structures that are broadly based at the local and higher political levels.

The management structure envisaged for the organization that is to be responsible for the site is simple, transparent and based on conventional principles of business/project organization. It will enable the organization to operate in a professional, efficient and coordinated manner. Representatives are drawn primarily from administrative bodies within the region, with a basis of political support at the cantonal and national levels. Wherever possible, existing structures and instruments are to be used.

The relevant tasks and responsibilities are defined in the *Agreement on joint protection of the UNESCO World Natural Heritage site* "*Glarus Overthrust",* signed on 31 October 2001 (Annex MP01). The following bodies are to be established:

- Delegates' Assembly;
- Committee, with Chair;
- Auditing Body;
- Management, with subsidiary centres;
- Scientific Advisory Committee
- Working Groups.

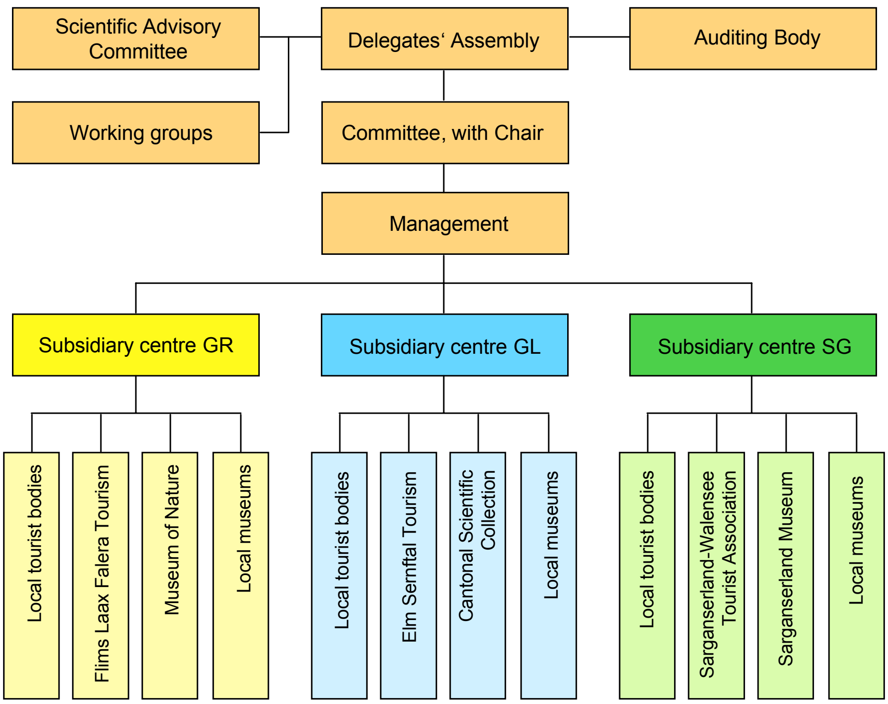

Fig. 05-01: Organisational structures of the IG UNESCO World Natural Heritage Site "Glarus Overthrust".

The responsibilities and powers of the various bodies are defined in the Agreement. The Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust" will only enter into force when the property has been inscribed in the World Heritage List. Nonetheless, the Delegates met on 26 November 2003 in order to make ad interim appointments and to grant funds for the preparatory phase. These provisional arrangements have proved effective during this busy period.

5.1.1 Delegates' Assembly

The Delegates' Assembly, consisting of one representative from each of the 19 communes concerned, will serve as the central pillar of the project. The following will also be invited to attend meetings of the Delegates' Assembly as permanent guests: the affected regions Glarner Hinterland-Sernftal and Sarganserland-Walensee, the communal associations Bündner Rheintal and Surselva, the cantons of St. Gallen, Glarus and Graubünden, and the Federal Office for the Environment (FOEN).

Only the Contracting Parties are entitled to vote, with each commune holding at least one vote. For each complete 20 km^2 unit of territory forming part of the natural monument and for every 4000 inhabitants, each commune receives an additional vote, up to a maximum of four votes. The resultant distribution of votes, based on the 2000 census, is as follows (Annex 2): Mels 4 votes; Pfäfers 3 votes; Flims, Trin, Bad Ragaz, Flums, Engi, Matt and Elm 2 votes each; Laax, Tamins, Vilters-Wangs, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda and Sool 1 vote each.

The Delegates' Assembly is responsible for the following:

- fundamental and major decisions, within the framework of the Financial Plan, concerning ways and means of achieving the purpose of the agreement;
- decisions on the budget, accounts and balance sheet;
- approval of the Financial Plan and of amendments to the Development Plan;
- approval of projects arising from the assigned responsibilities and for which funding has been secured;
- election of the Chair, and of members of the Committee and the Scientific Advisory Committee;
- supervision of the Committee's activities;
- establishment of regulations concerning the obligations and powers of the Chair, the Management, the Committee and the Scientific Advisory Committee;
- appointment of the Auditing Body;
- granting of funds for the conclusion of transactions with third parties;
- decisions on the admission of new Contracting Parties;
- decisions on the exclusion of Contracting Parties;
- other tasks not expressly assigned to some other body in the agreement.

5.1.2 Committee, with Chair

Responsibility for operational management lies with the Committee. The Committee consists of three or four voting and two advisory members:

- the Chair;
- a representative of the Contracting Parties from the canton of Glarus;
- a representative of the Contracting Parties from the canton of Graubünden;
- a representative of the Contracting Parties from the canton of St. Gallen;
- a FOEN representative, with an advisory vote;
- a representative of the three cantons concerned, with an advisory vote;
- if possible an additional person, who may also be elected as Chair.

The representatives of FOEN and the cantons are appointed by these agencies, and the remaining members are elected by the Delegates' Assembly. Office holders are elected for a period of four years, and may be re-elected twice.

The Committee is responsible for the following:

- preparation of business and submission of motions to the Delegates' Assembly;
- fulfilment of tasks assigned to it by the Delegates' Assembly under the regulations or on an ad hoc basis;
- appointment of the Management;
- supervision of the Management;
- establishment of Working Groups.

The Chair is responsible for the following:

- Presiding over meetings of the Delegates' Assembly and of the Committee;
- Representing the Community of Contracting Parties vis-à-vis third parties.

5.1.3 Auditing Body

The auditing body, which has a controlling function, examines the accounts and bookkeeping of the Management and submits a report to the Delegates' Assembly. It may comment on the budget and on future Financial Plans.

The functions of the Auditing Body are exercised by one or more Contracting Parties or external third parties.

5.1.4 Management

The Management reports to the Chair and is responsible for the preparation of the Committee's business. It supports the Chair in the fulfilment of the latter's responsibilities and performs the tasks assigned to it by the Committee or the Chair. The Management is appointed by the assignment of this function to a Contracting Party or a third party.

The Management, which consists of an executive manager, is responsible for the regional subsidiary centres (Graubünden, Glarus, St. Gallen). In particular, the responsibilities of the Management are as follows:

• preparing Committee business and providing support for the Chair;
• making preparations for the Delegates' Assembly;
• managing cash/bookkeeping;
• liaising between the public/subsidiary centres and the Committee;
• liaising with the Scientific Advisory Committee;
• liaising with the federal, cantonal and communal authorities;
• coordination and cooperation with GeoPark;
• coordinating communication and public relations activities;
• coordinating marketing functions (including acceptability checks);
• raising public awareness;
• collecting evaluation data;
• supporting research efforts;
• supervising Working Groups;
• etc.

Subsidiary centres are to be established in all of the cantons concerned. In setting up these centres, synergies with GeoPark Sarganserland-Walensee-Glarnerland are to be exploited as far as possible. The subsidiary centres will support the Management in the areas of public relations and communication. The individuals responsible within the various subsidiary centres will function as interfaces with the Management. At least in the initial phase, no provision is made for compensation of these individuals from the budget of the World Natural Heritage site.

The subsidiary centres are to support the Management in the following ways:

• Assisting with communication and public relations at the local level;
• Assisting with marketing efforts;
• Liaising between the public and the Management.

Ideally, independent visitor centres would be established in each region, exploiting synergies with GeoPark Sarganserland-Walensee-Glarnerland as far as possible. However, this is likely to be difficult, at least initially, mainly for financial reasons. Accordingly, it should also be possible for the subsidiary centres to be affiliated with promotional organizations, such as Elm Sernftal Tourism, Sarganserland-Walensee Tourist Association/Heidiland holiday region or Flims Laax Falera Tourismus AG, or with existing visitor centres, such as the Graubünden Museum of Nature in Chur, Sarganserland Museum in Sargans or the Glarus Cantonal Scientific Collection in Engi.

Within the subsidiary centres, a key role will be played by the regional tourist destinations and visitor centres of supraregional significance (Graubünden Museum of Nature, Chur; Sarganserland Museum, Sargans; Glarus Cantonal Scientific Collection, Engi). However, cooperation should also be possible for local organizations (Elm Tourism, Mels Tourism, etc.) and museums (Drachenloch museum, Vättis; Linth-Escher auditorium, Mollis; etc.).

Private environmental organizations frequently play an important role in advocating conservation interests, so that arguments relating to the protection of nature and landscape are duly considered in decision-making processes relevant to land use. The Management will seek to cooperate with these organizations.

An important element in the work of the Management is its integration into a network of existing structures and institutions:

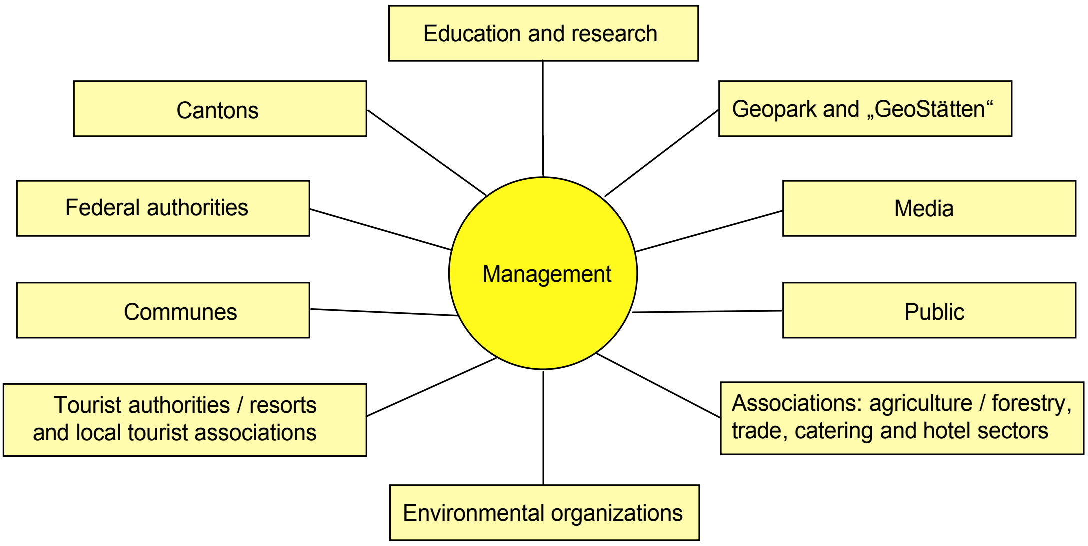

Fig. 05-02: Network, in which the Management is embedded.

5.1.5 Scientific Advisory Committee

The Scientific Advisory Committee provides the Delegates' Assembly and the Committee with advice on scientific matters relating to the conservation and use of the natural monument. The Scientific Advisory Committee offers scientific support in the event of conflicts and promotes constructive relations with the leading Swiss research centres. In the summer of 2003, the following individuals agreed to serve on the Scientific Advisory Committee:

- Professor Adrian Pfiffner (Chair), Institute of Geological Sciences, University of Berne;
- Professor Thomas Bieger, Institute for Public Services and Tourism, University of St. Gallen;
- PD Dr Mario Broggi, Federal Institute of Technology (ETH) Zurich Board;
- Professor Dominik Siegrist, Department of Landscape Architecture, University of Applied Sciences, Rapperswil; President of CIPRA International (International Commission for the Protection of the Alps)
- Professor Martin Burkhard, Geological Institute, University of Neuchâtel;

- PD Dr Max Maisch, Physical Geography Division, Department of Geography, University of Zurich;
- Dr Jürg Paul Müller (wildlife biologist), Museum of Nature, Chur;
- PD Dr Josef Mullis, Geological & Paleontological Institute, University of Basel;
- Professor Stefan Schmid, Geological & Paleontological Institute, University of Basel;
- Professor Helmut Weissert, Geological Institute, Federal Institute of Technology (ETH), Zurich.

5.1.6 Working Groups

In accordance with operational and technical requirements, the Committee may appoint expert Working Groups. These Working Groups are to be supervised and coordinated by the Management.

5.2 Participatory processes

A major concern of sustainable development is to ensure that stakeholders are actively involved. Processes should be participatory, i.e. the parties concerned should be given the opportunity to play an active role in shaping developments themselves. Even during the preparations for the nomination procedure, this approach was repeatedly emphasized.

If the community concerned is to be directly involved at an early stage, a great deal of sensitivity is required on the part of the project managers. However, this approach ensures that the population is well informed and subsequently supports the project. A favourable public attitude and a project firmly rooted in the region are indispensable for the management of a World Natural Heritage site.

In the Delegates' Assembly, only the communes concerned are entitled to vote. The regions and communal associations of Sarganserland-Walensee, Glarner Hinterland-Sernftal, Bündner Rheintal and Surselva, and representatives from the cantons of St. Gallen, Glarus and Graubünden and FOEN have to be invited as permanent observers. Other guests may also be invited to attend, such as environmental organizations or members of the Scientific Advisory Committee or Working Groups. Although the federal and cantonal authorities are not entitled to vote in the Delegates' Assembly, they may exert an influence through their advisory vote on the Committee and as a result of their contribution to funding.

The concerns of the public or of organizations can be addressed to the Management either directly or via the subsidiary centres. The Management then prepares motions for submission to the Committee, which can either present complex issues to the Scientific Advisory Committee or request that they be assessed by a Working Group, balanced in composition. Any amendments to the Agreement or the Development Plan require the approval of the Delegates' Assembly.

5.3 Logistics/infrastructure

The key element in the World Natural Heritage site infrastructure is the Management. During the initial period, this will be located at the offices of the Contracting Party or third party appointed by the Committee to exercise this function. Dedicated websites in German and English have already been established (www.glarusoverthrust.org / www.glarnerhauptueberschiebung.ch). With regard to national and international contacts and public relations, close cooperation with GeoPark Sarganserland-Walensee-Glarnerland is essential.

In the development of infrastructure for the World Natural Heritage site, the greatest possible use should be made of existing organizations – the GeoPark Association and marketing bodies such as Flims Laax Falera AG, Sarganserland-Walensee Tourist Association / Heidiland holiday region, Elm Sernftal Tourism, Weisse Arena AG, Bad Ragaz Tourism, Flumserberg Tourist Association, Kerenzerberg Tourism or Elm Tourism. Information materials should be made available at local tourist centres, communal authorities and other service outlets (restaurants, hotels, banks, retailers, etc.). Expert guidance making the World Natural Heritage site accessible to visitors should be available from any location.

It is important that regionally based subsidiary centres should be developed to serve as a first port of call for visitors. These centres should offer striking presentations of natural, cultural and economic aspects of the Glarus overthrust property, as well as information on guided tours of the site, maps, etc. Rather than establishing new centres, the emphasis should be placed on expanding existing regional museums and exhibitions, such as the Graubünden Museum of Nature (Chur), the Drachenloch Museum (Vättis), the Sarganserland Museum (Sargans), the Hagerbach Test Gallery (Flums), the Glarus Cantonal Scientific Collection (Engi), the "Pavillon Landesplattenberg" (Engi slate workings) or the slate factory (Elm).

The only activities entailing costs for the World Natural Heritage site are the coordination functions fulfilled by the Management.

5.4 Financing

The financing model is based on the principle of public-private partnership: public and private-sector (sponsorship, labelling, business circles) entities are to be responsible for financing the activities associated with the nominated property. Private funding in particular is to be tied to the UNESCO World Heritage label.

A large proportion of the property is either extensively managed or unused land. The federal, cantonal and communal authorities are directly involved in the protection process, e.g. through gamekeeping, provision of grants to compensate for grassland management efforts, or monitoring the conservation of mires and alluvial zones of national importance. The associated costs, borne at the federal and cantonal level, have thus been integrated.

The communes and cantons have undertaken to provide funding of CHF 50,000–100,000 for management, and federal support for projects designed to protect the property will probably amount to CHF 160,000 per year.

The Sarganserland-Walensee-Glarnerland GeoPark and the tourism organizations will contribute around CHF 150,000 in the form of services for joint marketing efforts and educational support.

The costs of fulfilling the tasks arising are expected to total CHF 1,000,000.

	Areas of activity	Funding required		
		Total budget/ year (CHF)	Public funding (%)	Private funding (%)
Management	- Project implementation and supervision - Cooperative ventures / networks - Protection / legal aspects - Communication / awareness raising - Interregional coordination/ marketing - Research coordination - Property monitoring - Knowledge management - Secretariat	250,000	70%	30%
Upkeep	- Gamekeeping (biodiversity) - Path maintenance (visitor management) - Forest management (near-natural silviculture, protective forest management)	350,000	100%	0%
Nature and habitat projects	- Biodiversity - Near-natural silviculture - Traditional cultural landscape - Integrated traffic systems - Managed outdoor activities	200,000	82.5%	17.5%
Tourism & labelling projects	- Tourist offerings - Educational measures - Tourism marketing - Labelling - Agricultural offerings - Networked culture	200,000	30%	70%
Total		**1,000,000**	**75%**	**25%**

Tab. 05-01: Target funding model for the operational phase: Expenditures

Financing model envisaged:

Public financing		
Federal*		
- Proportion of gamekeeping (Federal Hunting Reserves)	50,000	
- Projects	160,000	
- Other public support instruments	80,000	
	290,000	**29%**
Cantonal**		
- Proportion of gamekeeping	100,000	
- Cantonal activities/advisory services	100,000	
- Contribution to management	30,000	
	230,000	**23%**
Communal***		
- Forest management	100,000	
- Communal activities, path maintenance	100,000	
- Contribution to management	30,000	
	230,000	**23%**
Private financing		
- Sarganserland-Walensee-Glarnerland GeoPark/tourism organizations	150,000	
- Sponsoring and labelling/business circles	100,000	
	250,000	**25%**

Tab. 05-02: Target fundling model of operational phase: Income side

* Grants can be expected from the Federal Office for the Environment (FOEN) under the Nature and Cultural Heritage Protection Act (NHG). During the operational phase, these will be payable for projects and activities within the boundary of the World Heritage site. As listed in Tab. 05-01, part of the overall coordination of the nominated property is entered as a project. Applications for funding for NHG-related projects will be submitted to the FOEN.
Other federal agencies to be involved in the financial planning include the State Secretariat for Economic Affairs (seco), the Federal Office for Spatial Development (ARE), the Federal Office for Agriculture (BLW) and the State Secretariat for Education and Research (SER).
For other projects, requests for regional development aid are to be submitted to the relevant federal authorities.

** The cantons of St. Gallen, Glarus and Graubünden will each contribute CHF 10,000 per year for the World Heritage site, together with personnel expenditures for cantonal activities.

*** The 19 communes will contribute a total of CHF 31,000 per year for the World Heritage site (The communes' expenditure is in proportion to the number of votes held (Annex MP01, Appendix 3)).In addition, they will provide personnel support for forest management, maintenance of path infrastructure, and assistance with projects and approvals, as well as their own communal-level activities.

**** The Sarganserland-Walensee-Glarnerland GeoPark is a private-law association financed by members' subscriptions. The World Heritage nomination features prominently in the information booklet that appears annually. Over the past 2 years, around 400 new members have joined the association.
Tourist destinations are integrating the nominated property into interregional marketing efforts (brochures, exhibits).

Procurement of funding in the areas of sponsorship, labelling and merchandising also represents a major challenge. Although it is likely to become easier as a result of the World Heritage label, financing will remain an important long-term task. Experience has shown, however, that it is feasible, especially for specific projects.

6 PERFORMANCE REVIEWS

6.1 Evaluation

Unless goals and measures are subjected to reviews, they are of little value. Reviews should cover various areas, including in particular the evaluation of goals and outcomes. In certain areas, evaluation processes are already under way. The following types of evaluation are envisaged:

Indicator	Frequency	Data held at
Geological indicators:		
State of the most important and most frequent visited outcrops of the Glarus overthrust	Y	Management
State of the most important and most frequent visited geotopes	S	Management
Biological indicators:		
Size and reproduction rate of lynx population (probable number of individuals at present: 0)	S	Canton
Size and reproduction rate of wolf population (probable number of individuals at present: 0)	S	Canton
Sizes of populations of hoofed animals (Alpine ibex, red deer, chamois)	Y	Canton
Hunting statistics	S	Canton
Catch statistics	S	Canton
Size and reproduction rate of bearded vulture population	S	Canton
Size and reproduction rate of golden eagle population	S	Canton
Density of certain bird populations (e.g. grouse)	S	Canton
Ecosystem indicators:		
Quantity and quality of protected areas	S	Canton/federal
Approach of forests to natural state	S	Canton
Mountain pasture livestock density	Y	Canton
Sociocultural indicators:		
Number of overnight stays	Y	Management
Quality of supplies and disposal	S	Management
Mechanical interventions	Y	Management
Length of hiking trails	Y	Management
Length of via ferrata	Y	Management
Length of forest and alpine roads	Y	Management
Number of high-altitude landing facilities	Y	Management
Expansion of existing shelters	Y	Management
Construction of new shelters	Y	Management
Planning indicators:		
Implementation of area in master plans	S	Canton
Implementation of area in zoning plans	S	Canton
Indicators from national monitoring networks:		
MeteoSwiss network: climatological and meteorological parameters	R	MeteoSwiss
National Air Pollution Monitoring Network	R	Federal
Swiss Glacier Monitoring Network	R	Federal
Red Lists	S	Federal
Swiss Biodiversity Monitoring	S	Federal

Tab. 06-01: Proposed key indicators, possible frequency of determination (Y = annually; S = after several years; R = running record), and place of data retention (Management: Management has data from different sources, goal: all data are available at the Management).

6.2 Rangers

Rangers should be deployed in order to help preserve the natural and cultural landscape and existing infrastructure within the boundary of the site, and also to implement visitor management measures. The rangers should have the necessary expertise to answer visitors' queries and possibly also to assume responsibilities in the areas of monitoring/evaluation/quality assurance.

- reporting irregularities (damage to infrastructure, dead game, etc.) to the appropriate authorities;
- drawing the attention of visitors to any infringements.

The deployment of rangers should largely be developed on the basis of existing organizations, primarily including gamekeeping, forestry and staff employed by the local authorities, who already have broad expertise. They are to receive additional instructions concerning the regulations on activities within the World Natural Heritage site and the procedure for dealing with any infringements by visitors.

Fig. 06-01: Gamekeeper in the federal game reserve Graue Hörner. Photograph: D. Imper, Heiligkreuz.

Path and road maintenance is to be managed, as hitherto, by tourist operators, road owners, and the communal and cantonal authorities.

Since 2006, trained GeoPark Guides have been available in the Sarganserland-Walensee-Glarnerland GeoPark. These GeoPark Guides should also be capable of being deployed as rangers. They are entitled to conduct tours on behalf of the Sarganserland-Walensee-

Glarnerland GeoPark and in the proposed World Natural Heritage site. They receive training in the following areas:

• legal framework;
• geographical, local political and cultural fundamentals;
• communication of information on geology, flora and fauna;
• basic didactic skills and visitor management;
• monitoring/evaluation/quality assurance tasks.

Responsibility for the coordination and training of rangers lies with the Management in cooperation with the Sarganserland-Walensee-Glarnerland GeoPark. An annual training day should be held to provide further instruction and promote contacts with and among the rangers.

Rangers from gamekeeping organizations, forestry services, mountain pasture establishments and path and road maintenance services are to fulfil their responsibilities in the course of their existing activities and are not to receive additional compensation. The GeoPark Guides will be financed by revenues from organized activities for visitors.

6.3 Monitoring

Monitoring is to be based on existing national and cantonal programmes, including the ongoing FOEN Biodiversity Monitoring project, National Forest Inventory, game censuses, National Soil Monitoring Network, etc.

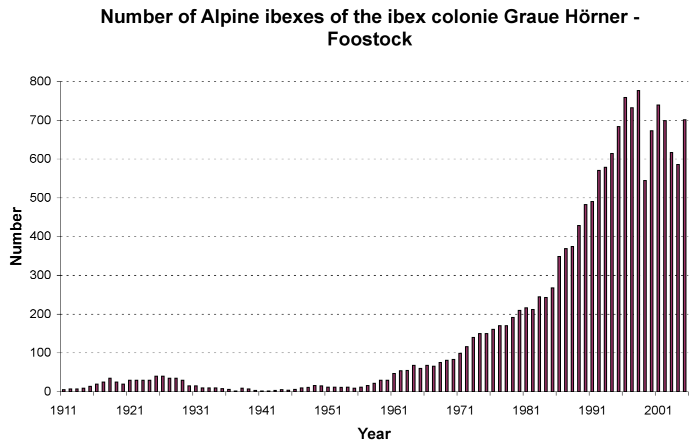

Fig. 06-02: *Development of Switzerland's longest-standing ibex colony, in the Graue Hörner game reserve. Source: Wildhut (gamekeeping authority) St. Gallen.*

The following additional parameters could be included in the monitoring programme:
• glacier fluctuations;
• air pollutant measurements;
• traffic censuses;
• noise measurements;
• hydrological measurements;
• overnight stays at cabins;
• or visitor statistics.

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Fig. 03-01: The relevance matrix indicates the potential for existing types of land use to affect the various elements of the environment. To permit rapid identification of priority issues in the specification of goals, measures and proposals for implementation, the potential for impacts is rated on a three-point scale: light blue = none or very limited, blue = limited to moderate, dark blue = substantial. Note that the dark-blue colour does not mean that conflicts arising from land use already exist in these fields, but that they are most likely to occur here.

Fig. 03-02: The urgency with which measures should be implemented is also indicated on a three-point (relative) scale: light green = not urgent, olive-green = moderately urgent and dark green = priority measures. This presentation is mainly designed to permit rapid identification of relative urgency. Thus, the dark-green colour does not mean that an acute need for action exists in these fields, but merely that priority should be accorded to these topics.

Fig. 03-03: There is a centuries-old tradition of mountain farming. Within the proposed World Heritage site, the rare and now threatened breed of mountain goat known as the booted goat (Stiefelgeiss) is still farmed. Photograph: B. Walder, Steffisburg.

Fig. 03-04: The SAC shelter "Sardonahütte" is one of the few facilities offering accommodation within the proposed World Heritage site. Photograph: D. Imper, Heiligkreuz.

Fig. 03-05: The Niederenbahn is the only mountain railway within the boundary of the proposed World Heritage site. Photograph: H. Brühwiler, Elm.

Fig. 04-01: Visitors are to be managed with the aid of well-maintained hiking trails and information resources. Photograph: B. Walder, Steffisburg.

Fig. 05-01: Organisational structures of the IG UNESCO World Natural Heritage Site "Glarus Overthrust".

Fig. 05-02: Network, in which the Management is embedded.

Fig. 06-01: Gamekeeper in the federal game reserve Graue Hörner. Photograph: D. Imper, Heiligkreuz.

Fig. 06-02: Development of Switzerland's longest-standing ibex colony, in the Graue Hörner game reserve. Source: Wildhut (gamekeeping authority) St. Gallen.

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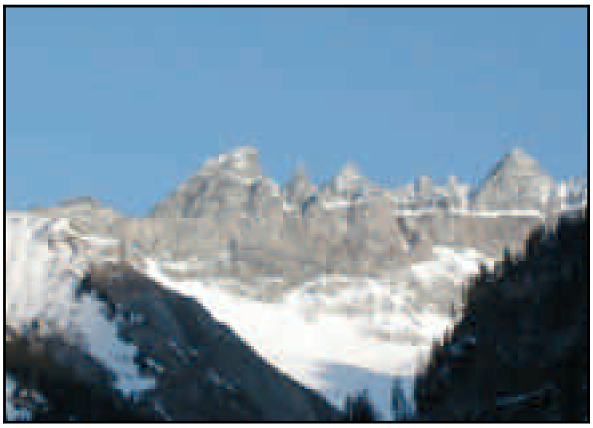
Annex MP01: Agreement on joint protection of the UNESCO World Natural Heritage site "Glarus Overthrust", including a Development Plan and a table listing acceptable and unacceptable uses

Glarus canton

St. Gallen canton

Graubünden canton

Agreement on joint protection of the UNESCO World Heritage site “Glarus Overthrust”



UNESCO-World Heritage site “Glarus Overthrust”

Projekt the communes of Laax, Flims, Trin, Tamins, Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt and Elm

Agreement on joint protection of the UNESCO World Natural Heritage site “Glarus Overthrust”, 26.11.2003

The communes of Laax, Flims, Trin, Tamins, Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt and Elm

hereby agree as follows:

I. General provisions

Art. 1 Purpose

1) The purpose of this agreement is to ensure that joint action is taken to conserve and manage the natural monument “Glarus Overthrust” as a UNESCO World Heritage site, together with the surrounding landscape and habitats.

2) The boundary of this natural monument is defined with the aid of a perimeter in Appendix 1a/b, which forms an integral part of the present agreement.

3) Sites of geological importance (“geotopes”), biotopes and the landscape within this natural monument are to be conserved over the long term.

4) As far as is consistent with the conservation of the geotopes, biotopes and landscape, the region and its natural aesthetic features are to be accessible to visitors and available for sustainable, appropriate use.

5) A declaratory listing of uses that are permissible under current legislation is to be found in Appendix 2. This Appendix will be updated in the event of changes to legislation.

Art. 2 Parties

The communes that are parties to the present agreement are hereinafter referred to as “Contracting Parties”. Whenever rights or obligations are shared by the Contracting Parties under the present agreement, the phrase “Community of Contracting Parties” will be used hereinafter.

Art. 3 Development Plan

1) The Development Plan describes the initial position and the development desired within the natural monument. It forms part of the present agreement (Appendix 1) and is to be revised periodically, taking account of master plans, communal land use plans and the relevant regulations at the cantonal and federal level.

2) The Development Plan is binding on the Contracting Parties’ authorities.

3) Amendments to the Development Plan are to be made in accordance with Art. 7 Para. 4 c below and require the agreement of two thirds of all the Contracting Parties. The Contracting Parties in the canton concerned hold a joint veto; i.e. if the delegates of the canton concerned are unanimously opposed to a decision, it may not be implemented against the wishes of the communes in question.

Art. 4 Financial Plan

1) The Financial Plan quantifies the costs expected to arise in fulfilling the purpose of the agreement over the following four years.

2) The Financial Plan may be revised subject to approval by a two-thirds majority of the votes cast by the Contracting Parties represented.

II. Implementation

Art. 5 Cooperation

In accordance with the purpose of the agreement and within the framework of the Financial Plan, the Community of Contracting Parties may cooperate with third parties who are not Contracting Parties. In the process, it may conclude legal transactions (agreements concerning services, purchase or sale of assets, etc.) arising from the purpose specified in the present agreement.

Art. 6 Organs

The responsibilities and powers defined by the present agreement are to be exercised by the following bodies:

a) Delegates' Assembly;
b) Committee;
c) Chair;
d) Secretariat;
e) Auditing Body;
f) Scientific Advisory Committee.

Art. 7 Delegates' Assembly

1) The Delegates' Assembly consists of one representative nominated by each of the Contracting Parties.

2) The following are invited to attend meetings of the Delegates' Assembly as permanent guests: the affected regions Glarner Hinterland-Sernftal and Sarganserland-Walensee, the communal associations Churer Rheintal and Surselva, the cantons of St. Gallen, Glarus and Graubünden, and the Swiss Agency for the Environment, Forests and Landscape (SAEFL).

3) In the Delegates' Assembly, the Contracting Parties involved have at least one vote. For each complete 20 km^2 unit of territory forming part of the natural monument and for every 4000 inhabitants each Contracting Party is entitled to an additional vote, up to a maximum of four votes. The resultant distribution of votes is specified in Appendix 3.

4) The Delegates' Assembly is responsible for the following:

a) fundamental and major decisions, within the framework of the Financial Plan, concerning ways and means of achieving the purpose of the agreement [Art. 1];

b) decisions on the budget, accounts and balance sheet;

c) approval of the Financial Plan and of amendments to the Development Plan;

d) approval of projects arising from the assigned responsibilities and for which funding has been secured;

e) election of the Chair, and of members of the Committee and the Scientific Advisory Committee;

f) supervision of the Committee's activities;

g) establishment of regulations concerning the obligations and powers of the Chair, the Secretariat, the Committee and the Scientific Advisory Committee;

h) appointment of the Auditing Body;

i) granting of funds for the conclusion of transactions with third parties [Art. 5];

j) decisions on the admission of new Contracting Parties and the appropriate revision of the present agreement;

k) decisions on the exclusion of Contracting Parties and the appropriate revision of the present agreement;

l) other tasks not expressly assigned to some other body by the present agreement.

5) The Delegates' Assembly is to convene at the invitation of the Chair and at the request of the Committee or of at least five communes.

6) Invitations to meetings of the Delegates' Assembly, including the agenda, are to be sent to the Contracting Parties at least three weeks in advance.

7) Decisions are to be taken on the basis of a simple majority of the votes represented, except for amendments to the Development Plan [Art. 3 Para. 3], the Financial Plan [Art. 4 Para. 2], and the present agreement [Art. 21]. In the event of a tied vote, the Chair holds a casting vote. The communes of a canton concerned hold a joint veto.

Art. 8 Committee

1) The Committee consists of the following members:

a) the Chair;

b) a representative of the Contracting Parties from the canton of Glarus;

c) a representative of the Contracting Parties from the canton of Graubünden;

d) a representative of the Contracting Parties from the canton of St. Gallen;

e) a SAEFL representative with an advisory vote;

f) a representative of the cantons with an advisory vote;

g) if possible an additional person, who may also be elected as Chair.

2) The Committee is responsible in particular for the following:

a) preparation of business and submission of motions to the Delegates' Assembly;

b) fulfilment of tasks assigned to it by the Delegates' Assembly under the regulations or on an ad hoc basis;

c) appointment of the Secretariat.

d) supervision of the Secretariat.

3) It is to convene as often as is required for the conduct of business, or at the request of a member or of the Auditing Body.

4) In the event of a tied vote, the Chair holds a casting vote.

5) The representatives of SAEFL and the cantons are appointed by these agencies, and the remaining members are elected by the Delegates' Assembly. Office holders are elected for a period of four years, and may be re-elected twice.

Art. 9 Chair

1) The Chair is a voting member of the Committee.

2) The Chair presides over meetings of the Delegates' Assembly and of the Committee.

3) The Chair is elected by the Delegates' Assembly for a period of four years, and may be re-elected twice.

4) The Chair represents the Community of Contracting Parties vis-à-vis third parties.

Art. 10 Secretariat

1) The Secretariat reports to the Chair and is responsible for the preparation of the Committee's business. It supports the Chair in the fulfilment of the latter's responsibilities.

2) It performs the tasks assigned to it by the Committee or the Chair.

3) The Secretariat is appointed by the assignment of this function to a Contracting Party or a third party [Art. 8 Para. 2 c].

Art. 11 Scientific Advisory Committee

1) The Scientific Advisory Committee provides the Delegates' Assembly and the Committee with advice on scientific matters relating to the conservation and use of the natural monument.

2) The Scientific Advisory Committee is entitled to submit motions to the Committee.

Art. 12 Financial administration

The Secretariat is responsible for the management of assets and cash, and also for bookkeeping and payments.

Art. 13 Auditing Body

1) The auditing body examines the Secretariat's accounts and bookkeeping and submits a report to the Delegates' Assembly. It may comment on the budget and on future Financial Plans.

2) The functions of the Auditing Body are exercised by one or more Contracting Parties or external third parties.

Art. 14 Funding

1) Expenditure primarily consists of payments made for personnel and material resources in pursuit of the goals of the agreement and in accordance with the Financial Plan and the annual budget. Responsibility for the maintenance of paths and roads continues to lie with the existing funding authorities.

2) Measures requiring considerable outlays are to be governed by contractual agreements involving special financial arrangements. These agreements are to be approved by the Delegates' Assembly.

3) Income consists of federal and cantonal contributions and third-party payments.

4) The operating costs remaining after the deduction of income are to be apportioned among the Contracting Parties according to the number of votes held, as specified in Appendix 3. Contributions to costs are to be paid in cash by the Contracting Parties.

5) The Contracting Parties are to be informed of the budget and accounts in good time, to enable them to include their contributions in their own respective budgets and accounts.

6) During the financial year (calendar year), the Contracting Parties may be requested to make advance payments. The Delegates' Assembly sets the level of such payments as a percentage of the budgeted cash flows. The final settlement of accounts with the Contracting Parties takes place after publication of the approved annual accounts.

III. Judicial procedure

Art. 15 Arbitral tribunal

1) Disputes between the Contracting Parties arising from the present agreement are to be settled by an arbitral tribunal, with the legal venue being Glarus. Prior to arbitration, a mutual agreement procedure is to be conducted within the Delegates' Assembly.

2) Within 30 days after referral of a dispute to arbitration, the Contracting Parties' communal authorities are each to appoint an arbitrator. Within 15 days, the arbitrators are jointly to appoint an additional member as Chair of the tribunal, with a casting vote.

3) The arbitration proceedings are to be governed, mutatis mutandis, by the Administrative Law Procedure Act of the Canton of Glarus. The Arbitration Agreement (KSG) of 27 March 1969 (SR 279) is applicable.

4) The decision of the arbitral tribunal is binding on the Contracting Parties and is not subject to appeal, except where this is mandated by overriding legislation.

IV. Transitional and final provisions

Art. 16 Initial capital

When the agreement comes into force, the Contracting Parties undertake to make available to the Community initial capital amounting to CHF 30,000 in cash, according to the distribution of votes within the Delegates' Assembly [Art. 7].

Art. 17 New Financial Plans

At least 12 months before the expiry of the Financial Plan for a given term of office, the Financial Plan for the following term is to be presented. This provision applies likewise for subsequent periods.

Art. 18 Liability

The Contracting Parties are collectively liable vis-à-vis third parties within the framework of the Financial Plan and in accordance with the Contracting Parties' respective voting rights. Joint and several liability is expressly excluded. Provisions of this kind are to be included in all contracts concluded with third parties by the bodies responsible under the present agreement.

Art. 19 Term of agreement

1) This agreement is concluded for a period of ten years. Unless notice of termination is given, it will be renewed for a further five years.

2) A Contracting Party may give notice that the agreement is to be terminated with effect from the end of a year until no later than 24 months before the expiry of the agreement. Even if a Contracting Party withdraws, the agreement will remain in force for the other Contracting Parties.

Art. 20 Dissolution; termination

1) If the present agreement is dissolved, surpluses and material resources remaining after the completion of the liquidation process are to be allocated to the Contracting Parties in accordance with the number of votes held, as specified in Appendix 3. These resources are to be earmarked for use in the protection of nature and landscape.

2) In the event of termination by individual Contracting Parties, any surpluses and material resources are to be transferred to the Community of Contracting Parties. Departing Contracting Parties or the Community of Contracting Parties are only liable to make special payments if this has been stipulated by the Delegates' Assembly in decisions relating to special financial arrangements.

Art. 21 Amendments

Amendments to the present agreement require the consent of the Contracting Parties in the form mandated by applicable law. Amendments may also be subject to approval by cantonal authorities in accordance with the relevant cantonal legislation.

Art. 22 Entry into force

The present agreement will enter into force upon a decision by UNESCO to inscribe the property in the organization's World Heritage List.

Appendices:

Appendix 01a:	Current state of development in the proposed UNESCO World Heritage site "Glarus overthrust"
Appendix 01b:	Development Plan for the proposed UNESCO World Heritage site "Glarus overthrust"
Appendix 02:	Types of land use within the boundary of the UNESCO World Heritage site "Glarus overthrust"
Appendix 03:	Distribution of population, territory and votes in the proposed World Heritage site "Glarus overthrust"

Current state of development in the proposed UNESCO World Heritage site "Glarus overthrust"

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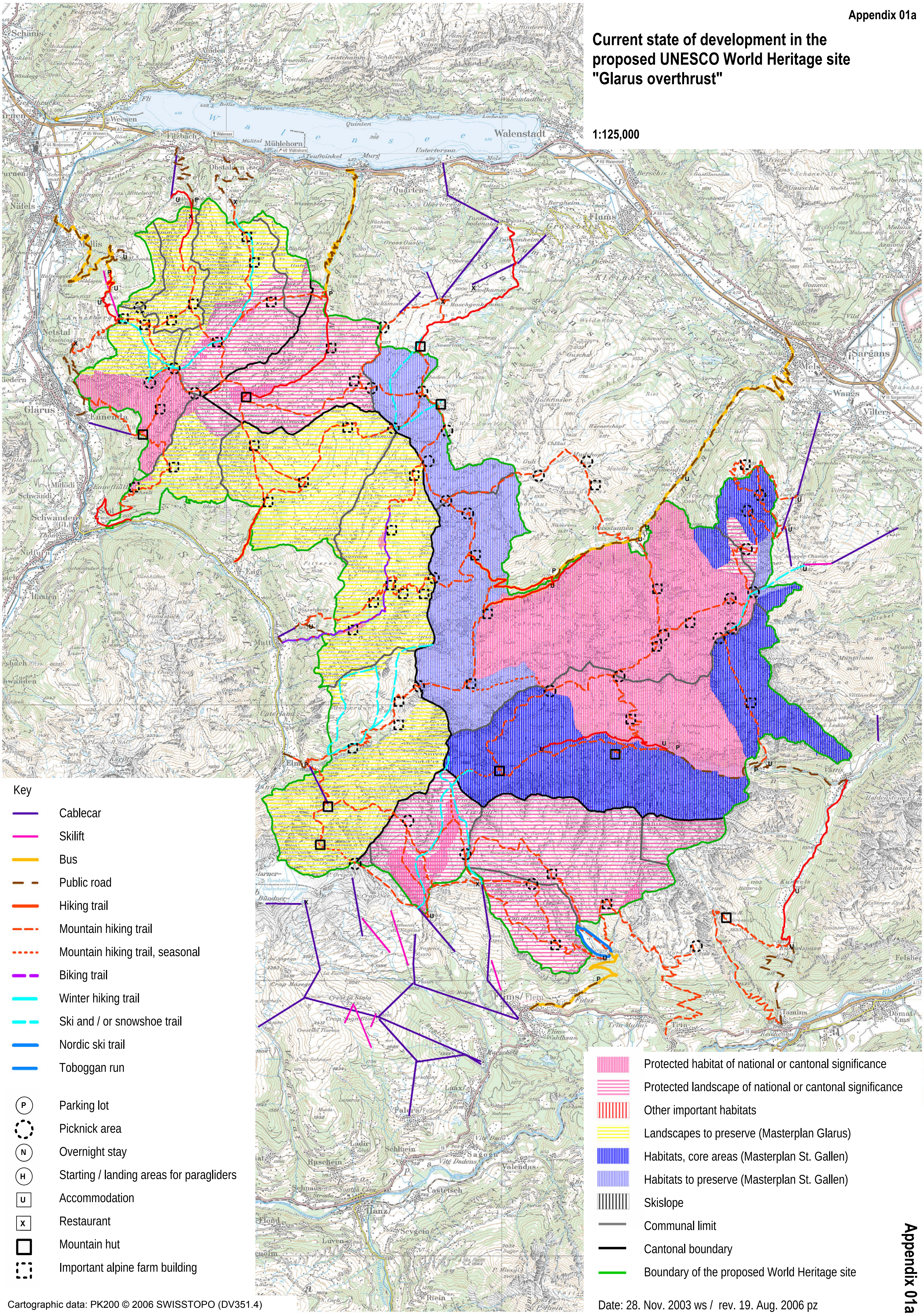

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Appendix 01a

Development plan for the proposed UNESCO World Natural Heritage site "Glarus overthrust"

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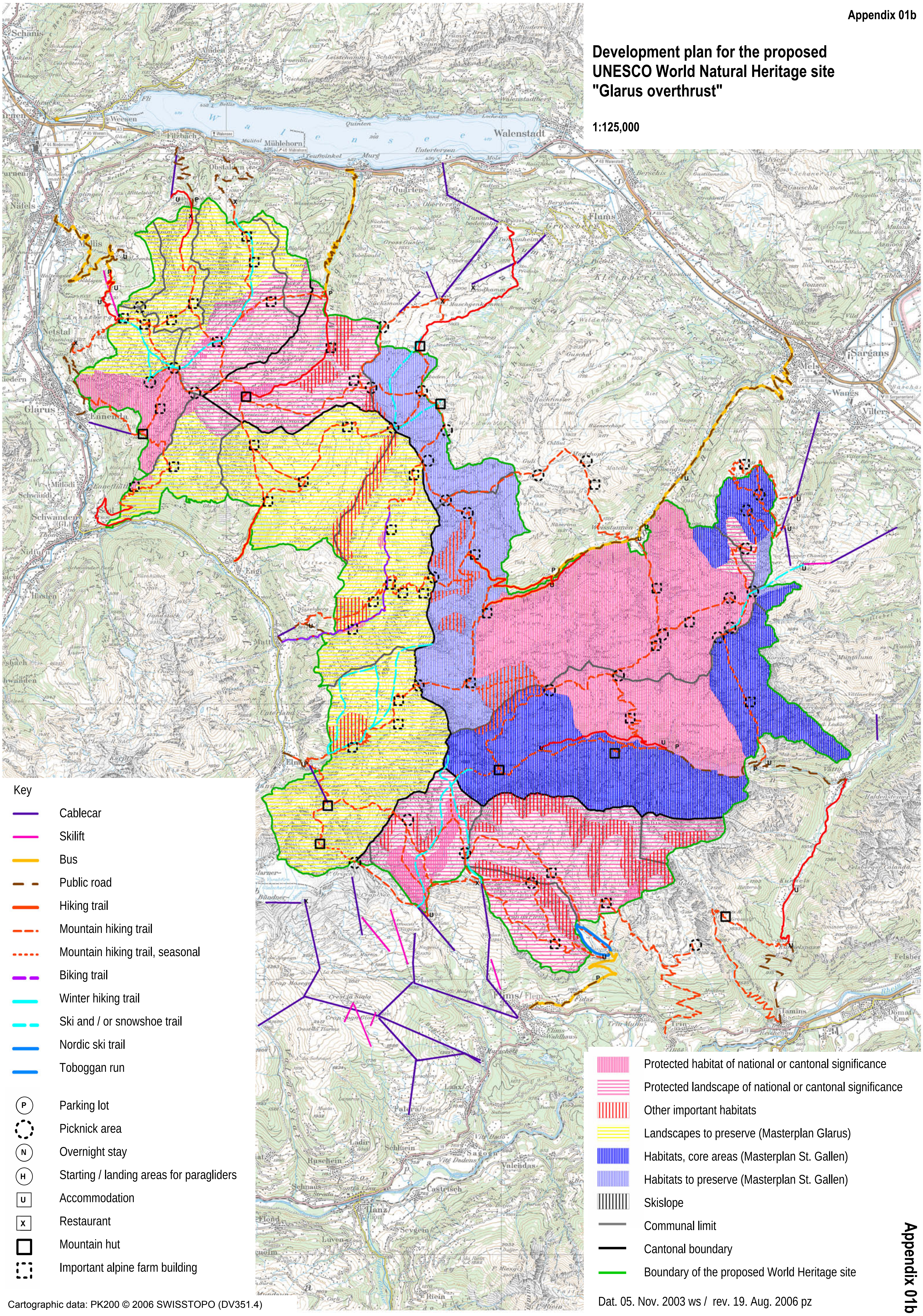

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Appendix 02: Types of land use within the boundary of the UNESCO World Heritage site "Glarus overthrust"

N.B.: This list is issued without prejudice to higher-level legislation. Additional federal, cantonal and communal regulations concerning protection, especially those specified in cantonal master plans, will take precedence.

In the assessment, types of use were rated as follows: desirable – permissible – not desirable – not permissible

Non-tourist-related uses

Forest management	Permissible
Biotope management and upkeep	Desirable
Hazard prevention	Permissible
Appropriate mountain farming use	Permissible
Mountain farming and forestry access roads	Permissible where required for appropriate mountain farming use and forest management
Hunting (except in game reserves)	Permissible
Fishing	Permissible
Gathering berries	Permissible
Gathering mushrooms	Permissible
Military use	Permissible at present levels
New military facilities	Not desirable
Extraction of materials	Not permissible
Terrain modifications	Not desirable
Collection of rock crystals	In accordance with communal regulations
Depositing of materials	Not permissible
Power generation	New plants are not desirable unless they are designed merely to enable cabins to meet their own energy needs
New above-ground high-voltage power lines	Not permissible
Above-ground pipelines	Not permissible

Tourist-related uses

Public information	Desirable
Notice boards	Desirable
Resting/picnic areas	In accordance with the Development Plan
Bivouac areas	In accordance with the Development Plan
Campsites	Not permissible
New hiking paths	In accordance with the Development Plan
Simple accommodation/catering facilities	In accordance with the Development Plan
New tourist transport facilities and buildings	Not permissible
Structures and equipment that do not have to be sited within the property for operational reasons	Not permissible (in accordance with Spatial Planning Law)
Construction zones	Not permissible
New tourist access roads	Not permissible
Vehicular traffic	Use of private cars on existing roads is not desirable
New parking facilities	Not desirable
Parking outside designated areas	Not desirable
Minibus and taxi services	For licensed operators in accordance with the Development Plan
Hiking	Permissible
Mountaineering/climbing	Permissible
Littering	Not permissible
Access for dogs under owners' control	Permissible
Winter hiking paths	In accordance with the Development Plan
Snowshoeing routes	In accordance with the Development Plan
Snowshoeing	In accordance with the Development Plan
Cross-country skiing	In accordance with the Development Plan
Tobogganing	In accordance with the Development Plan
Skiing and snowboarding	In accordance with the Development Plan
Off-piste skiing/off-piste snowboarding	Not desirable
Ski touring	In accordance with the Development Plan
Heli-skiing	Not permissible
Aircraft landing sites	Not permissible
Hang-gliding launching and landing areas	In accordance with the Development Plan
Mountain biking	In accordance with the Development Plan
Motorized water sports	Not permissible
Sporting events	In accordance with the Development Plan

Appendix 03: **Distribution of population, territory and votes in the proposed World Heritage site "Glarus Overthrust"**

Confederation

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
TOTAL	**41316**	**100%**	**328.5**	**100%**	**31**	**100%**	**50.0%**	**SFr. 50,000**

Cantons

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
Glarus	9300	22.5%	127.48	38.8%	12	38.7%	10.0%	SFr. 10,000
St. Gallen	26042	63.0%	155.45	47.3%	13	41.9%	10.0%	SFr. 10,000
Graubünden	5974	14.5%	45.57	13.9%	6	19.4%	5.0%	SFr. 5,000
TOTAL	**41316**	**100%**	**328.5**	**100%**	**31**	**100%**	**25.0%**	**SFr. 25,000**

Communes

	Inhabitants	Proportion of total	Area [km2]	Proportion of total	Votes held	Proportion of total	Financing [50% fed., 25% cant.]	Share of costs [Budget SFr. 100,000]
Mühlehorn	434	1.1%	2.85	0.9%	1	3.2%	0.81%	SFr. 810
Obstalden	542	1.3%	18.75	5.7%	1	3.2%	0.81%	SFr. 810
Filzbach	441	1.1%	6.37	1.9%	1	3.2%	0.81%	SFr. 810
Mollis	2974	7.2%	1.68	0.5%	1	3.2%	0.81%	SFr. 810
Ennenda	2808	6.8%	12.38	3.8%	1	3.2%	0.81%	SFr. 810
Sool	303	0.7%	9.35	2.9%	1	3.2%	0.81%	SFr. 810
Engi	381	0.9%	21.83	6.6%	2	6.5%	1.61%	SFr. 1620
Matt	656	1.6%	24.39	7.4%	2	6.5%	1.61%	SFr. 1620
Elm	761	1.8%	29.88	9.1%	2	6.5%	1.61%	SFr. 1620
Total GL	**9300**	**22.5%**	**127.48**	**38.8%**	**12**	**38.7%**	**9.68%**	**SFr. 9720**
Pfäfers	1754	4.2%	55.58	16.9%	3	9.7%	2.42%	SFr. 2430
Bad Ragaz	4929	11.9%	1.00	0.3%	2	6.5%	1.61%	SFr. 1620
Vilters-Wangs	3891	9.4%	6.25	1.9%	1	3.2%	0.81%	SFr. 810
Mels	7837	19.0%	64.09	19.5%	4	12.9%	3.23%	SFr. 3240
Flums	4882	11.8%	11.28	3.4%	2	6.5%	1.61%	SFr. 1620
Quarten	2749	6.7%	17.25	5.3%	1	3.2%	0.81%	SFr. 810
Total SG	**26042**	**63.0%**	**155.45**	**47.3%**	**13**	**41.9%**	**10.48%**	**SFr. 10,530**
Laax	1150	2.8%	0.23	0.1%	1	3.2%	0.81%	SFr. 810
Flims	2549	6.2%	20.29	6.2%	2	6.5%	1.61%	SFr. 1620
Trin	1108	2.7%	21.48	6.5%	2	6.5%	1.61%	SFr. 1620
Tamins	1167	2.8%	3.57	1.1%	1	3.2%	0.81%	SFr. 810
Total GR	**5974**	**14.5%**	**45.57**	**13.9%**	**6**	**19.4%**	**4.84%**	**SFr. 4860**
TOTAL	**41316**	**100.0%**	**328.50**	**100.0%**	**31**	**100.0%**	**25.00%**	**SFr. 25,110**

Inhabitants: Population figures according to the Swiss census of 5 December 2000.

Annex MP02: **List of protected sites included in national and cantonal inventories lying within the proposed World Heritage site "Glarus Overthrust"**

	Area [km^2]	Proportion	Inhabitants (2000 census)	Proportion
Pfäfers	55.58	16.9%	1'754	4.3%
Bad Ragaz	1.00	0.3%	4'929	11.9%
Vilters-Wangs	6.25	1.9%	3'891	9.4%
Mels	64.09	19.5%	7'837	19.0%
Flums	11.28	3.4%	4'882	11.8%
Quarten	17.25	5.3%	2'749	6.6%
St. Gallen canton	**155.45**	**47.3%**	**26'042**	**63.0%**

	Area [km^2]	Proportion	Inhabitants (2000 census)	Proportion
Mühlehorn	2.85	0.9%	441	1.1%
Obstalden	18.75	5.7%	434	1.1%
Filzbach	6.37	1.9%	542	1.3%
Mollis	1.68	0.5%	2'974	7.2%
Ennenda	12.38	3.8%	2'808	6.8%
Sool	9.35	2.9%	303	0.7%
Engi	21.83	6.6%	656	1.6%
Matt	24.39	7.4%	381	0.9%
Elm	29.88	9.1%	761	1.8%
Glarus canton	**127.48**	**38.8%**	**9'300**	**22.5%**

	Area [km^2]	Proportion	Inhabitants (2000 census)	Proportion
Laax	0.23	0.1%	1'150	2.8%
Flims	20.29	6.2%	2'549	6.2%
Trin	21.48	6.5%	1'108	2.7%
Tamins	3.57	1.1%	1'167	2.8%
Graubünden canton	**45.57**	**13.9%**	**5'974**	**14.5%**

	Area [km^2]	Proportion	Inhabitants (2000 census)	Proportion
Grand total	**328.5**	**100.0%**	**41'316**	**100.0%**

Annex MP03.1: List of protected sites included in national inventories lying within the proposed World Heritage site "Glarus Overthrust”

Landscapes and natural monuments of national importance

Legal basis:	Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0). Ordonnance concernant l’inventaire fédéral des paysages, sites et monuments naturels (RS 451.11)	
Inventory sites:	1602	Murgtal–Mürtschental (only part of the site) (Quarten, Obstalden)
	1611	Lochsite bei Schwanden (Sool)

Federal hunting reserves and ibex colonies

Legal basis:	Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0). Ordonnance concernant les districts francs fédéraux (RS 922.31)	
	Federal Hunting reserves	
	13	Schilt (partly within the boundary) (Ennenda, Sool)
	15	Graue Hörner (almost entirely within the boundary) (Pfäfers, Mels)
	Ibex colonies	
	119	Oberalp–Tödi–Calanda
	129	Foostock
	130	Graue Hörner

Mire landscapes of particular beauty and national importance

Legal basis:	Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0). Ordonnance sur la protection des sites marécageux d’une beauté particulière et d’importance nationale (RS 451.35)	
	359	Plaun Segnas Sut (Flims)

Alluvial zones of national importance and glacier forelands

Legal basis:	Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0). Ordonnance sur la protection des zones alluviales d’importance nationale (RS 451.31)	
Inventory sites:	216	Chrauchbach: Haris (Matt)
	1262	Glatschiu dil Segnas (Flims)
	1316	Plaun Segnas Sut (Flims)

Raised bogs and transitional mires of national importance

Legal basis:	Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0). Ordonnance sur la protection des hauts-marais et des marais de transition d’importance nationale (RS 451.32)	
Inventory sites:	426	Rietlichopf im Murgtal (Quarten)
	428	Unter Murgsee (Quarten)
	441	Mürtschen (Obstalden)

Fenlands of national importance

Legal basis: Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0).
Ordonnance sur la protection des bas-marais d'importance nationale (RS 451.33)

Inventory sites:
1918 Mürtschen (Obstalden)
1919 Ober Mürtschen (Obstalden)
1926 Murgsee (Quarten)
1933 Gnappetriet (Matt)
3698 Plaun Segnas Sut (Flims)

Amphibian spawning areas of national importance

Legal basis: Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0).
Ordonnance sur la protection des sites de reproduction de batraciens d'importance nationale (RS 451.34)

Inventory site: GL 18 Talsee (Filzbach)
Dry grasslands probably of national importance (draft)

Legal basis: Federal Law on the Protection of Nature and Culture Heritage, 1 July 1966 (SR 451.0).

Federal Inventory in preparation

Inventory sites:
GR 8736Tschanenca (mapped but not yet evaluated) (Trin)
GR 8737Schneca (mapped but not yet evaluated) (Flims/Trin)
sites mapped but not yet evaluated)
GR 8858Vadre (mapped but not yet evaluated) (Trin)
GR 8859Vadre (mapped but not yet evaluated) (Trin)

Annex MP03.2: List of protected sites included in cantonal inventories lying within the proposed World Heritage site "Glarus Overthrust"

Cantonally protected landscape and habitat areas

Core habitat areas (SG master plan)

- Weisstannental–Vermii–Graue Hörner–Valtnov
- Calfeisen–Taminatal

Wildlife refuges (SG master plan)

- Calfeisen–Taminatal
- Foo–Obersiez–Spitzmeilen
- Murgtal–Chammen

Protected landscape areas (GL master plan)

- Mülibachtal (inventory no. 11)
- Nüen-Britteren (inventory no. 3)

Exclusion zones for tourist facilities (GL master plan)

- Segnes (inventory no. 13.8)
- Chrauchtal (inventory no. 13.9)
- Schilt (inventory no. 13.10)
- Mürtschenstock (inventory no. 13.11)

Protected landscape areas (GR master plan)

- Ringelspitz (01.LS.07R)
- Segnas–Flimserstein/Crap da Flem–Bargis/Fil de Cassons–Ils Lags (02.LS.34R)

Alluvial zones of cantonal importance

- Weisstannen/Seez (Mels)
- 1227 Bargis (Flims, Trin)

Raised bogs of cantonal importance

- 27002 Im Grüenen (Engi)

Fenlands of cantonal importance

- 595 Gamidaurchamm (Vilters-Wangs)
- 1892 Ober Heubützli (Mels)
- 1893 Unter Heubützli (Mels)
- 1931 Rietboden (Flums)
- 2165 Chli Sächser–Sächserseeli (Flums)
- 2166 Chli Sächser–Sächserseeli (Flums)
- 1927 Murgtal/Seitenhänge: Chammseen (Quarten)
- 1928 Schattenchamm/Wasserboden (Quarten)
- 1002 Rietboden–Rietlibüel (Mühlehorn)
- 1004 Gspon (Mühlehorn)
- 2008 Feldriet (Obstalden)
- 2011 Tschermannen (Obstalden)
- 3916 Rietloch (Filzbach)
- 14001 Auf der Wässeri (Sool)
- 27002 Im Grüenen (Engi)
- 27007 Glattmatt (Engi)
- 27008 Lüsermatt (Engi)
- 28006 Winggel (Matt)
- 28007 Unter Winggel (Matt)
- 28010 Bruch (Matt)
- 29001 Morgedweid (Elm)
- 29002 Chrumm (Elm)
- 29003 Gamperdunwald (Elm)

Amphibian spawning areas of cantonal importance

- 3609 Unterer Murgsee (Quarten)

Dry grasslands likely to be deemed to be of cantonal importance (draft)

- 2006 Hüttenberg (Obstalden)
- 2009 Mürtschen–Grosse Friz (Obstalden)
- 8008 Mulleren (Mollis)
- 12002 Vögeliboden (Ennenda)
- 12003 Ennetrösligen (Ennenda)
- 12004 Ätzgen (Ennenda)
- 12006 Brand–Beglingen (Ennenda)
- 12007 Riegen (Ennenda)
- 14005 Fessis (Sool)
- 27007 Glattmatt (Engi)
- 28010 Bruch (Matt)
- 28011 Geissstafel (Matt)
- 29006 Tschinglenbach (Elm)
- 29007 Nideren (Elm)
- 29008 Böden (Elm)
- 29009 Lauben (Elm)

Annex MP04.1: List of national geotopes in the proposed World Heritage site "Glarus Overthrust"

- Geotope complex Glarus overthrust with
  - Geotope complex Foostock–Tschingelhoren–Ofen/Piz Sardona–Piz Segnas–Piz Atlas/Piz Dolf (SG 17 / GL 26 / GR 1): Glarus overthrust + alpine glacier complex (Mels, Matt, Elm, Flims).
  - Geotope complex: Tschepp–Ringelspitz–Tristelhorn (SG 276 / GR 2): Glarus overthrust + alpine glacier complex (Pfäfers, Trin, Tamins).
  - Geotope complex Pizol–Graue Hörner (SG 19): Glarus overthrust + alpine glacier complex (Pfäfers, Mels, Bad Ragaz, Vilters-Wangs).
  - Individual geotope Lochsite (GL 113): Glarus overthrust (Sool).
  - Individual geotope Crap da Flem - Il Fil (GR 3): Glarus overthrust (Flims)
  - Individual geotope Piz Aulta/Tegia sura (Crap da Flem, GR 4): Glarus overthrust (Flims)

- Geotope complex Mürtschenalp–Hochmättli (SG 183 / GL 40): copper/ silver/uranium ore deposits, copper mine/smelting works (Quarten, Obstalden)

- Geotope landscape Murgsee–Rietlichopf (SG 18 / GL 2): cirque stairway landscape (Quarten, Engi)

- Geotope landscape Segnas Sura (GR 22): outwash plain and glacier foreland (Flims)

- Geotope landscape Segnas Sut (GR 23): outwash plain and mire landscape (Flims)

- Individual geotope Chrüzbachtobel (SG 71): Vättis window (Pfäfers).

- Individual Geotop Martin's Gap (GL 89 / GR 21), (Elm, Flims)

Annex MP04.2: List of cantonal geotopes in the proposed World Heritage site "Glarus Overthrust”

- Geotope complex Tristli–Siwellen–Schilt (GL 114, Ennenda): Tristli and Siwellen klippen and Schilt nappe structure, Schilt type locality, copper ore deposit.
- Geotope complex Siwellen–Mürtschenstock–Fronalpstock (GL 132, Obstalden, Filzbach und Ennenda): karst, tectonic and stratigraphic features.
- Geotope complex Mürtschenstock (GL 85, Obstalden): folded stucture, Mürtschen Gap, iron ore deposit.
- Geotope complex Fursch–Bäll (SG 140, Flums): glacier erosion landscape.
- Geotope complex Batöni (SG 426, Mels): Erosional crater + tectonic window (Mels).
- Geotope complex Platta Grischa (GR 12, Flims): tectonic, stratigraphic and karstic featu-res.

- Geotope landscape Nüenchamm (GL 137, Filzbach) sequence stratigraphy.
- Geotope landscape Heustöckli (GL 148, Ennenda): overthrust zone.
- Geotope landscape Gufelstock (GL 102.1, Ennenda and Sool): Verrucano–Triassic cirque stairway landscape with lakes.
- Geotope landscape Magerrain–Wissmeilen–Spitzmeilen (SG 223 / GL 33, Flums, Engi und Matt): Triassic/Liassic series with gypsum.
- Geotope landscape Hinteres Schilstal (SG 353, Flums): glacier/karst landscape.
- Geotope landscape Ritschli–Heubützli (SG 231, Mels): alpine flysch landscape, mire landscape.
- Geotope landscape Elm landslide (GL 19.1, Elm): landslide.

- Individual geotope Helloch doline (GL 132.2, Filzbach): doline.
- Individual geotope Rottor (GL 84, Engi): stratigraphic hiatus.
- Individual geotope Fuggstock (GL 87, Matt): volcanic rocks.
- Individual geotope Drachenloch (SG 142, Pfäfers): prähistoric used carst cave.
- Individual geotope Raschaglius (GR 11, Flims and Trin): Assilina greensand.

Annex MP05: **Population development from 1850 to 2000 in the proposed World Heritage site "Glarus Overthrust"**

Commune	1850	1900	1950	1980	1990	2000
Pfäfers	1'315	1'510	1'900	1'814	1'792	1'754
Bad Ragaz	1'366	1'866	2'584	3'721	4'325	4'929
Vilters-Wangs	1'659	1'720	2'205	3'243	3'688	3'891
Mels	3'305	4'035	5'387	6'235	6'829	7'837
Flums	2'577	3'567	4'833	4'228	4'541	4'882
Quarten	1'995	2'205	2'727	2'533	2'639	2'749
St. Gallen canton	**12'217**	**14'903**	**19'636**	**21'774**	**23'814**	**26'042**

Commune	1850	1900	1950	1980	1990	2000
Mühlehorn	596	531	631	460	475	441
Obstalden	540	472	497	366	388	434
Filzbach	461	407	393	448	471	542
Mollis	2'041	1'912	2'191	2'621	2'978	2'974
Ennenda	2'313	2'494	2'940	2'512	2'869	2'808
Sool	539	461	429	248	258	303
Engi	1'197	1'160	1'122	672	695	656
Matt	659	690	622	384	406	381
Elm	1'051	913	867	785	791	761
Glarus canton	**9'397**	**3'474**	**3'439**	**3'363**	**6'353**	**6'326**

Commune	1850	1900	1950	1980	1990	2000
Laax	277	280	328	833	948	1'150
Flims	906	789	1'148	2'136	2'258	2'549
Trin	919	755	695	830	922	1'108
Tamins	770	863	781	946	1'112	1'167
Graubünden canton	**2'872**	**2'687**	**1'804**	**2'609**	**1'870**	**5'974**

Annex MP06.1: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Cattle and Youngstock, St. Gallen canton)

St. Gallen canton	**Cattle**		**Youngstock**	
	2002	**2005**	**2002**	**2005**
Panära	24	22	30	38
Schräa	31	39	22	48
Ebni	45	45	0	1
Sardona	12	14	220	222
Gamserälpli	7	3	87	121
Platten	0	43	116	81
Malanseralp	100	91	74	73
Egg	37	28	52	101
Brändlisberg	3	29	164	145
Tersol	14	13	101	112
Zanai*	0	0	0	0
Mugg*	1	5	151	345
Gamidaur	20	23	60	64
Vermii*	58	63	1	1
Gafarra	21	19	6	20
Lavtina	5	8	109	121
Valtüsch	36	48	139	129
Valtnov	54	64	101	133
Scheubs	44	49	159	178
Foo	2	2	182	192
Walabütz	80	80	28	35
Siez	180	180	202	203
Laui*	27	27	149	167
Werdenböll	28	13	282	294
Matossa-Lauiboden-Mad*	81	64	0	19
Fursch-Naserina	68	78	167	153
Tobelwald-Munz-Mütschüel*	23	24	62	57
Murgsee-Nüchen*	25	24	65	59
Murgsee-Merlen-Plätz*	37	39	111	119
Mornen-Erdis	63	44	34	39
Bachlaui-Guflen-Chamm	2	6	78	55
Bütz	0	0	0	0
St. Gallen canton	**1'128**	**1'187**	**2'952**	**3'325**

* : Mountain pasture territory lying largely outside the boundary

Annex MP06.2: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Sheep, Goats and Horses/donkeys, St. Gallen canton)

St. Gallen canton	Sheep		Goats		Horses/donkeys	
	2002	2005	2002	2005	2002	2005
Panära	0	7	0	0	0	3
Schräa	127	0	70	3	1	4
Ebni	0	0	0	0	0	0
Sardona	0	0	0	0	0	0
Gamserälpli	0	0	8	7	0	0
Platten	0	0	0	0	0	0
Malanseralp	0	0	0	0	27	36
Egg	83	80	31	11	0	0
Brändlisberg	16	37	0	0	0	0
Tersol	686	766	0	20	0	0
Zanai*	532	574	0	0	0	0
Mugg*	0	0	0	0	0	0
Gamidaur	178	207	0	29	0	0
Vermii*	0	0	0	0	0	0
Gafarra	1005	981	52	112	3	5
Lavtina	0	0	0	0	0	0
Valtüsch	290	388	131	138	0	0
Valtnov	0	0	0	33	1	1
Scheubs	261	249	0	5	0	1
Foo	265	279	0	85	0	0
Walabütz	0	0	0	0	0	2
Siez	186	223	0	0	0	0
Laui*	0	0	23	17	0	2
Werdenböll	0	0	43	40	0	0
Matossa-Lauiboden-Mad*	0	0	0	0	0	0
Fursch-Naserina	836	694	0	0	0	0
Tobelwald-Munz-Mütschüel*	0	0	8	6	2	1
Murgsee-Nüchen*	0	0	0	0	1	1
Murgsee-Merlen-Plätz*	0	0	10	0	0	0
Mornen-Erdis	0	0	2	0	0	0
Bachlaui-Guflen-Chamm	1	0	2	17	2	2
Bütz	310	231	24	0	0	3
St. Gallen canton	**4'776**	**4'716**	**404**	**523**	**37**	**61**

* : Mountain pasture territory lying largely outside the boundary

Annex MP06.3: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Cattle and Youngstock, Glarus canton)

Glarus canton	Cattle		Youngstock	
	2002	2005	2002	2005
Fierz	7	10	41	45
Gäsi	19	18	103	99
Meren	52	53	86	91
Mürtschen	73	74	124	131
Talalp	65	66	90	83
Tros	0	0	0	0
Fronalp (untere)	34	33	41	41
Heuboden	62	64	72	71
Fessis	33	33	47	54
Gufeli	0	0	0	0
Mühlebach	164	167	207	189
Krauchtal	165	160	154	145
Riseten	54	58	88	79
Vorderegg	38	35	23	33
Hinteregg	32	34	46	37
Trosgi	20	28	30	31
Ramin	65	64	173	167
Gamperdun	81	82	100	110
Falzüber	27	26	21	16
Fronal (mittlere/obere)	67	64	64	75
Hofalpli	21	22	33	17
Kännel	24	25	19	24
Nüen (mittlerer/oberer)	33	33	44	36
Tschinglen	0	0	0	0
Fittern	58	63	61	36
Habergschwänd	26	25	41	47
Holz*	12	12	16	13
Sulzweid*	0	0	12	9
Glarus canton	**1'232**	**1'249**	**1'736**	**1'679**

* : Mountain pasture territory lying largely outside the boundary

Annex MP06.4: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Sheep, Goats and Horses/donkeys, Glarus canton)

Glarus canton	Sheep		Goats		Horses/donkeys	
	2002	2005	2002	2005	2002	2005
Fierz	0	0	0	0	0	0
Gäsi	0	0	0	0	0	1
Meren	0	0	0	0	0	1
Mürtschen	0	0	0	0	0	0
Talalp	0	0	0	0	0	0
Tros	109	117	0	0	0	0
Fronalp (untere)	0	0	0	0	0	0
Heuboden	72	0	0	0	0	0
Fessis	0	0	3	0	0	0
Gufeli	0	0	0	0	0	0
Mühlebach	0	0	12	23	0	1
Krauchtal	291	203	0	0	0	0
Riseten	0	0	0	0	0	0
Vorderegg	0	0	0	0	0	0
Hinteregg	0	0	0	0	0	0
Trosgi	100	94	4	7	0	3
Ramin	0	0	0	29	0	4
Gamperdun	0	0	0	0	0	0
Falzüber	210	51	20	22	0	1
Fronal (mittlere/obere)	0	0	0	0	0	1
Hofalpli	0	0	0	0	0	0
Kännel	0	0	0	0	0	0
Nüen (mittlerer/oberer)	0	0	0	9	0	1
Tschinglen	550	484	0	0	0	0
Fittern	0	0	0	4	0	0
Habergschwänd	0	0	0	0	0	0
Holz*	0	0	0	0	0	0
Sulzweid*	0	0	0	0	0	0
Glarus canton	**1'332**	**949**	**39**	**94**	**0**	**13**

* : Mountain pasture territory lying largely outside the boundary

Annex MP06.5: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Cattle and Youngstock, Graubünden canton and Grand total)

Graubünden canton	Cattle		Youngstock	
	2002	2005	2002	2005
Platta	0	0	120	119
Cassons	85	85	15	21
Flimserstein	172	172	70	50
Bargis	0	0	250	271
Culm da Sterls	0	0	0	0
Lavadinas	0	0	170	154
Mora*	125	111	0	9
Hinteralp-Berg*	0	0	80	80
Graubünden canton	**382**	**368**	**705**	**704**

Grand total	**2'742**	**2804**	**5'393**	**5'708**

* : Mountain pasture territory lying largely outside the boundary

Annex MP06.6: Mountain pasture livestock populations in the proposed World Heritage site "Glarus Overthrust" (Sheep, Goats and Horses/donkeys, Graubünden canton and Grand total)

Graubünden canton	Sheep		Goats		Horses/donkeys	
	2002	2005	2002	2005	2002	2005
Platta	0	0	0	0	0	0
Cassons	0	0	0	0	0	0
Flimserstein	0	0	0	0	0	0
Bargis	0	0	0	0	0	0
Culm da Sterls	800	739	0	0	0	0
Lavadinas	0	0	10	7	0	0
Mora*	0	0	0	0	0	0
Hinteralp-Berg*	0	0	0	0	0	0
Graubünden canton	**800**	**739**	**10**	**7**	**0**	**0**
Grand total	**6'908**	**6'404**	**453**	**624**	**37**	**74**

* : Mountain pasture territory lying largely outside the boundary

Annex MP07: Forest districts in the proposed World Heritage site "Glarus Overthrust"

St. Gallen canton

Vättis

Valens-Vasön

Bad Ragaz

Vilters-Wangs

Mels-Weisstannen

Flums-Dorf

Flums-Berg

Quarten

Glarus canton

Mühlehorn

Obstalden

Filzbach

Mollis

Ennenda

Sool

Engi

Matt

Elm

Graubünden canton

Flims

Trin

Tamins

Annex MP08: Gamekeeping districts in the proposed World Heritage site "Glarus Overthrust"

St. Gallen canton

“Sarganserland Ost” management district

“Graue Hörner game reserve” management district

“Sarganserland West” management district

Glarus canton

“Kerenzen – Linthal Ost” management district

„Sernftal Nord“ management district

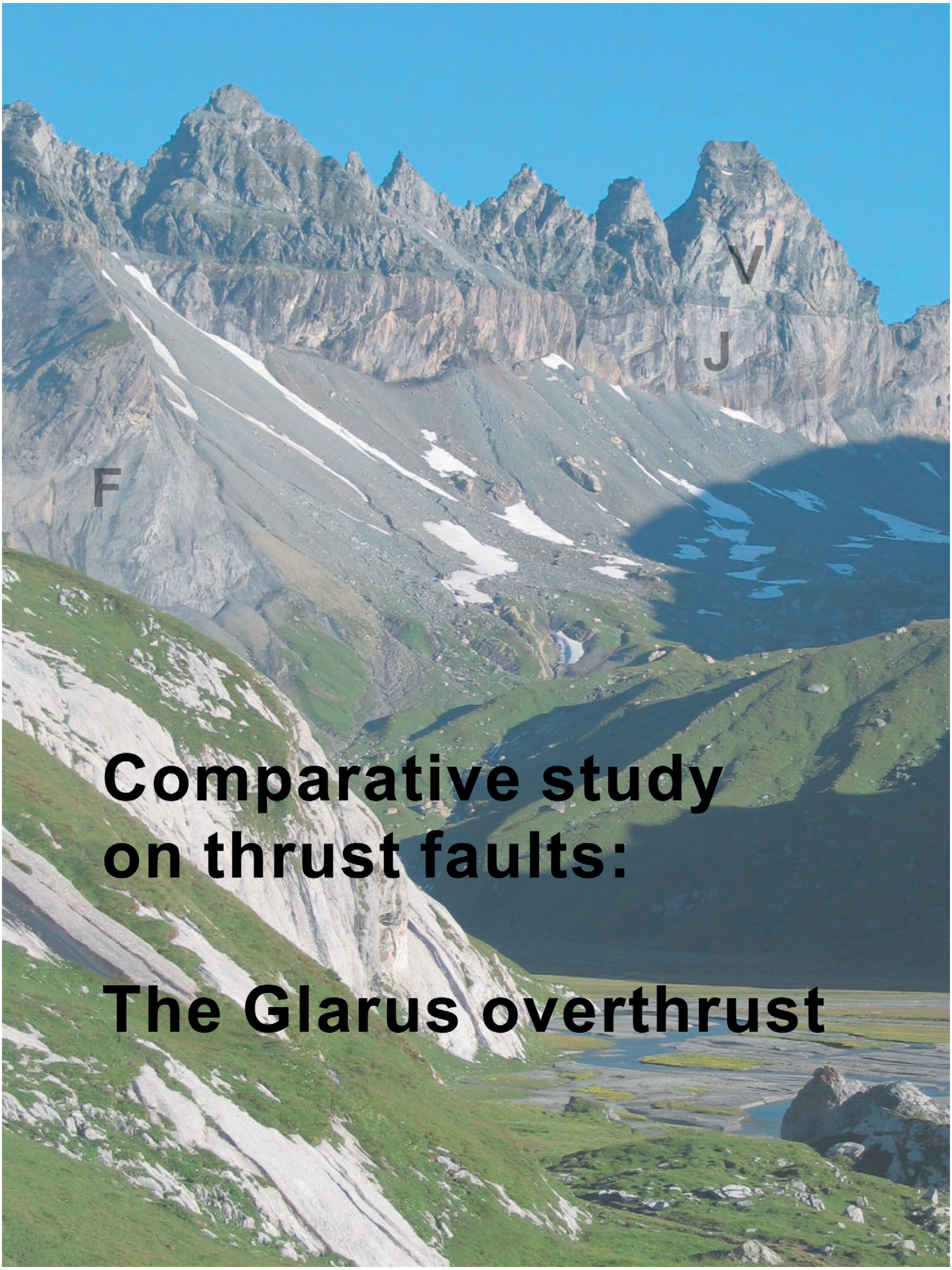
Graubünden canton

Hunting area II (Glenner)

Hunting area XII (Imboden-Plessur-V Dörfer)

Annex MP09: Hunting preserves in the proposed World Heritage site "Glarus Overthrust"

Preserve	**Leaseholders**
Garmil	11
Simel	8
Schräa	7
Sardona	7
Valens	10
Monteluna	5
Ladils	7
Tersol	7
Foo	6
Siez	11
Werdenböhl	9
Fursch	17
Munz	17
Murgsee	8
Schneeliwald	6
total	**136**



Comparative study on thrust faults:

The Glarus overthrust

Comparative Study on Thrust Faults

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The Glarus overtrust as «magic Line» in the Tschingelhoren.
Photo: A. Pfiffner

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SUMMARY

The Glarus overthrust is a major thrust fault in the Earth's crust that is directly linked to the collision between the European and African continents 30 – 15 million years ago. Its trace is exceptionally well visible from great distances in steep rock cliffs over tens of kilometers. The fault plane as such can be inspected in situ at a great range of well accessible outcrops and displays the deformation mechanisms in the rocks at the time of its activity. Owing to its particular structural evolution, parts of the thrust fault once located at depths ranging from 15 to 5 km are observable at outcrop today.

Besides the fault plane itself, there are a number of other structural features like folds, imbricate thrust sheets and highly deformed rocks that outcrop beneath and above the master fault. These structures can be observed in an area of impressive relief, where rivers and glaciers carved out deep valleys running in various directions. As a consequence these structural features are exposed in full three-dimensionality.

We compare the Glarus thrust to other major thrust faults known from around the globe. This comparison is based on four main criteria:

The Scientific Value of the object concerning the process of overthrusting associated with the convergence of tectonic plates, and the process of mountain building in general.

The Scenic Value (natural beauty) of the object, including beauty and outcrop quality of structural features (overthrusts and folds beneath and above the Glarus thrust).

The Geomorphic Expression in the landscape by spectacular and visually striking phenomena.

The Educational Value, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

These criteria are subdivided into a total of 12 subcriteria (see Table 1). Each object analyzed was tested if or not it fulfills these 12 subcriteria.

Our comparison, based on these criteria and subcriteria, suggests that the Glarus thrust merits the ranking "excellent" regarding all four main criteria and thus fulfills the condition of "Outstanding Universal Value". It is the only object evaluated that simultaneously fulfills the conditions of all the 12 subcriteria considered in the comparative analysis. Moreover, it ranks first amongst all the objects in the great majority of the subcriteria. This comparative analysis thus clearly indicates that the nominated property "Glarus overthrust" merits to be inscribed in the World Heritage List.

1 Introduction

The operational guidelines "Geological World Heritage: a global framework" by Dingwall et al. (2005) contain criteria that properties must meet in order to be considered of Outstanding Universal Value (OUV). Paragraph 49 in Chapter II A (Definition of World Heritage) states:

49. Outstanding universal value means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole. The Committee defines the criteria for the inscription of properties on the World Heritage List.

Outstanding Universal Value of Thrust Faults

Thrust faults are faults in the Earth's crust where one rock unit is moved on top of another unit over distances of tens or hundreds of kilometers. Thrust faults are a direct expression of the dynamics of convergent tectonic plates. They are also directly responsible for the formation of mountain belts. Their outstanding universal value is based on the direct relationship to plate tectonics and on the origin of mountain belts.

Plate tectonics shape the interior and the surface of our planet Earth and explain not only the distribution of oceans and land, but also the water depth of the oceans and the elevations of land areas. Mountain ranges, including volcanoes, are the principal features on land that are directly related to plate tectonics. At boundaries between converging plates, the Earth's crust is undergoing horizontal compression. The ensuing contractional deformation leads to narrow belts of high elevations that straddle the plate boundary. Examples include the Andes of South America, the North American Cordillera or the Alpine-Himalayan system.

The uplift of the land surface to a narrow mountain range is mainly caused by horizontal shortening and stacking of the rock units in the contact zone between the two plates. The single most important features responsible for moving blocks of rock units upward toward the surface are thrust faults. These faults originate at depths of more than 10 km beneath the surface and usually reach upward to breach the surface. Downward, major thrust faults merge into the interface between the two converging plates, a contact referred to as Wadati-Benioff zone. It is in this zone that major earthquakes are triggered. Examples include the Alaska earthquake of 1964 or the Sumatra earthquake of 2004 that caused a devastating tsunami.

In a few and rare cases, deformation at the plate interface deforms the plate boundary and associated thrust faults. Through this process, their deeper levels, once located more than 15 kilometers deep in the crust, as well as higher levels become directly accessible to observation at the surface. These thrust faults, including the Glarus thrust, are thus singular witnesses of the processes that are going on at depth at plate interfaces and processes that give rise to the formation of mountain belts.

As outlined in the report by Dingwall et al. (2005), the World Heritage Convention is founded on the will to protect irreplaceable assets of cultural and natural heritage. Parts of that heritage must be of Outstanding Universal Value (OUV) to be inscribed in the World Heritage List. Outstanding Universal Value implies cultural and/or natural exceptional significance. It also means that the property meets one or more of the World Heritage criteria.

In the context of Outstanding Universal Value, the following points apply to the proposed property "Glarus overthrust":

- The Glarus overthrust falls into the topic "Tectonic and structural features" defined by Dingwall et al. (2005)
- The Glarus overthrust meets criterion (vii), a superlative natural phenomenon and area of exceptional natural beauty and aesthetic importance
- The Glarus thrust meets criterion (viii), as outstanding example of significant geomorphic features.

1.1 Aim of this study

This comparative study compares the Glarus thrust and associated structures and geomorphic features with similar thrust faults in mountain ranges around the globe. It presents criteria to make a comparison as objective as possible. The elaboration of these criteria (and subcriteria) was one of the main tasks of this report. Applying these criteria to the objects analyzed subsequently and to deduct a ranking of the various objects was less difficult.
Apart from being alien to the culture of geologists, such a comparison bears the risk of subjectivity. We are aware of this, and we are also aware of the fact that there are other exceptionally beautiful landscapes and other exceptionally interesting thrust faults and associated structures around.

This study is based on the expertise of three geologists, all of them professors at three different Swiss universities and leading in the field of Alpine tectonics, geodynamics and structural geology of mountain belts. To render the conclusions drawn by Swiss geologists more objective, internationally recognized experts in the field of tectonics from Germany and the U.S.A. critically reviewed the report. They were asked to comment on the scientific soundness and completeness of the presentation and the conclusions drawn. In addition, geologists from the international community were contacted and asked to express their opinion on the importance of the Glarus overthurst. These voices from abroad are contained in the appendix of this report.

1.2 Structure of the report

In the first, descriptive part, we present thrust faults or groups of thrust faults from various places around the globe following the criteria later used to compare them. Thus, the tectonic setting of the mountain range is briefly summarized first. This includes a description of the plate tectonic setting of the orogen, the structural style of the internal deformation of the crustal rocks (e.g. folding versus thrusting), and the age of the formation of the mountain range and associated thrust faults.
The discussion of individual thrust faults puts the main emphasis on their scientific importance as indicated by parameters like approximate magnitude of displacement along the thrust faults and the mechanisms that were active during motion along the thrust faults.
The following paragraphs concern the nature of the 3-dimensional exposure and the visibility of the tectonic and structural features in the field.
This is followed by a discussion of the geomorphic expression of the thrust faults, that means their impact on the landscape and the observer. This item is closely linked to the educational value of the thrust fault.
Finally, where appropriate, the relevance of the thrust fault(s) for the history of science is evaluated.
The descriptions are accompanied by cross-sections and photographs. These help in explaining the points made in the text and sustain the conclusions drawn. Owing to the different degrees of information available for each individual thrust fault or thrust system the detail of coverage for each case discussed also varies.
The thrust faults are grouped by continents and by mountain ranges.

1.3 The terminology of faults

Faults dissecting the Earth's crust may be classified into three major types:
(1) Thrust faults (or reverse faults, also called thrusts or overthrusts)
(2) Normal faults
(3) Strike slip faults (or wrench faults), including the subclass of transform faults

Thrust faults are recognized in most orogens, i.e. mountain ranges formed by convergence between tectonic plates. They correspond to crustal blocks moving up along the fault plane in response to horizontal shortening caused by the convergence of two plates. Quality of exposure, and hence visibility, of thrust faults depends much on local climatic conditions and on the altitude within a mountain range. The Glarus overthrust is an example of a thrust fault that exhibits one single spectacularly exposed fault plane. It also illustrates the mechanism how the rocks reacted to the motion of the plates in a particularly instructive and grandiose way.

Normal faults occur where plates move apart whereby the plates are broken and thinned. In the East African rift system, normal faulting created spectaclar depressions (or grabens) that extend over many hundred kilometers. The normal faults lowered the bottom of these basins was lowered by the normal faults by several kilometers. These depressions are now filled by lakes (for example Lake Tanganyka or Lake Malawi).

Strike slip faults accommodate the motion of plates caused mainly by horizontal displacements that may reach hundreds of kilometers. Famous examples include the Rocky Mountain trench in the Canadian Cordillera, the still active San Andreas Fault in California and the Alpine Fault in New Zealand.

The Glarus overthrust. The Glarus overthrust is a major thrust fault in the Earth's crust whose trace is exceptionally well visible from great distances in steep rock cliffs over tens of kilometers. The fault plane as such can be inspected in situ at a great range of well accessible outcrops. Besides the fault plane itself, there are a number of other structural features like folds, imbricate thrust sheets and highly deformed rocks that outcrop beneath and above the master fault. These structures can be observed in an area of impressive relief, where rivers and glaciers carved out deep valleys running in various directions. As a consequence these structural features are exposed in three dimensions

1.4 Comparison scheme

This comparative study provides arguments as to why the Glarus overthrust is considered a feature of Outstanding Universal Value. To compare objects in a most objective way we use a number of objective criteria in a transparent manner. As requested by Dingwall et al. (2005), we include properties already inscribed in the World Heritage List, which have some features in common with the proposed property "Glarus overthrust". This particular type of comparison is rendered difficult by the circumstances given by the perimenter of the properties. For existing properties, the exact definition of the perimeter is not part of the protection regulations, whereas for the nominated property "Glarus overthrust" this is the case.

Our criteria for comparison are:

The Scientific Value of the object concerning the process of overthrusting associated with the convergence of tectonic plates, and the process of mountain building in general.
The Scenic Value (natural beauty) of the object, including beauty and outcrop quality of structural features (overthrusts and folds beneath and above the Glarus thrust).

The Geomorphic Expression in the landscape by spectacular and visually striking phenomena.
The Educational Value, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

The four criteria are subdivided into subcriteria each. These subcriteria are:

Related to the **Scientific Value:**
(1) relation to plate motions
(2) mountain building processes
(3) magnitude of displacement along the thrust fault
(4) deformation of the rocks beneath and above the thrust fault
(5) deformation mechanisms observable along the thrust surface

Related to the **Scenic Value:**
(6) natural beauty of the thrust fault
(7) beauty and quality of the structures beneath and above the thrust fault
(8) three-dimensionality of exposure

Related to the **Geomorphic Expression:**
(9) geomorphic expression of the thrust fault in the landscape
(10) presence of spectacular and visually striking phenomena

Related to the **Educational Value:**
(11) historic geological context of the object
(12) potential of the object to stimulate public awareness

These totally 12 subcriteria allow a qualitative, but also a somewhat quantitative evaluation of the individual objects. Evaluation of the objects making part of this comparative study based on these subcriteria is discussed in detail in chapter 7.

2 Europe

2.1 Alps

The Alps are the result of two orogenies, a mid to Late Cretaceous orogeny with mainly west-directed thrusting, and a Cenozoic orogeny associated with more N-S convergence (Schmid et al. 1996, 2004). Both orogenies involved a subduction stage followed by a collision stage.
Figure 2.1-1 is a simplified tectonic map of the Alps showing the major units and major faults, as well as the traces of three cross sections discussed below. The three cross-sections through the Western, Central and Eastern Alps are given in Figure 2.1-2.

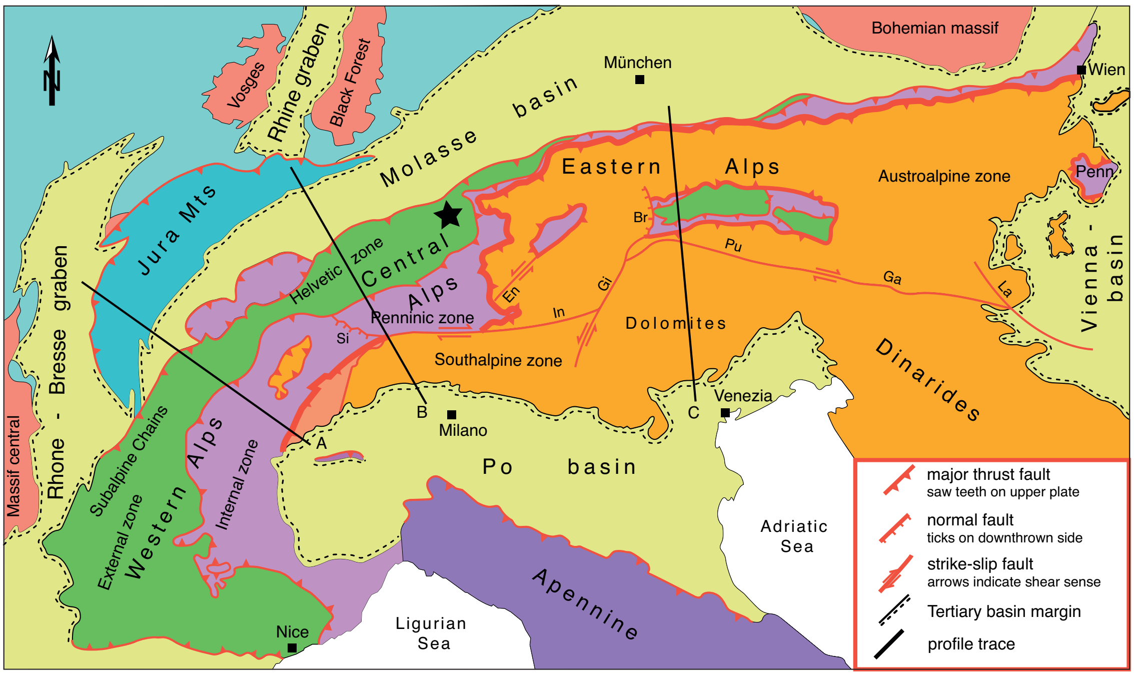


Fig. 2.1-1: Simplifield tectonic map of the Alps. A, B & C: Traces of cross-sections shown in Fig. 2.1-2; Br, Si: Brenner & Simplon normals faults; En, In, Gi, Pu, Ga, La: Engadine, Insubric, Giudicarie, Pustertal, Gailtal & Lavanttal faults;Í Nominated property. From: Pfiffner (2005).

Western Alps

A wealth of geophysical data is available about the deep crustal structure of the Western Alps, including two recent deep seismic campagns (ECORS-CROP and NRP-20). Re-interpretation of the ECORS-CROP high-resolution seismic transect (Schmid and Kissling 2000) reveals a European lower crustal wedge inserted between the autochthonous European lower crust and the Penninic nappe system during the Miocene (see Fig. 2.1-2). In contrast, the deep crustal structure of the Central Alps (see below) is characterized by the Adriatic lower crustal wedge indenting the European lithosphere at mid-crustal level (Schmid et al. 1997b). The transition between Central and Western Alps coincides at depth with the western limit of the Adriatic indenter and the northeastern limit of the European lower crustal wedge, respectively. In addition, the thickness of the seismogenic zone shows a remarkable variation from over 40 km beneath the Penninic realm of the Western Alps to less than 20 km in the Central Alps.

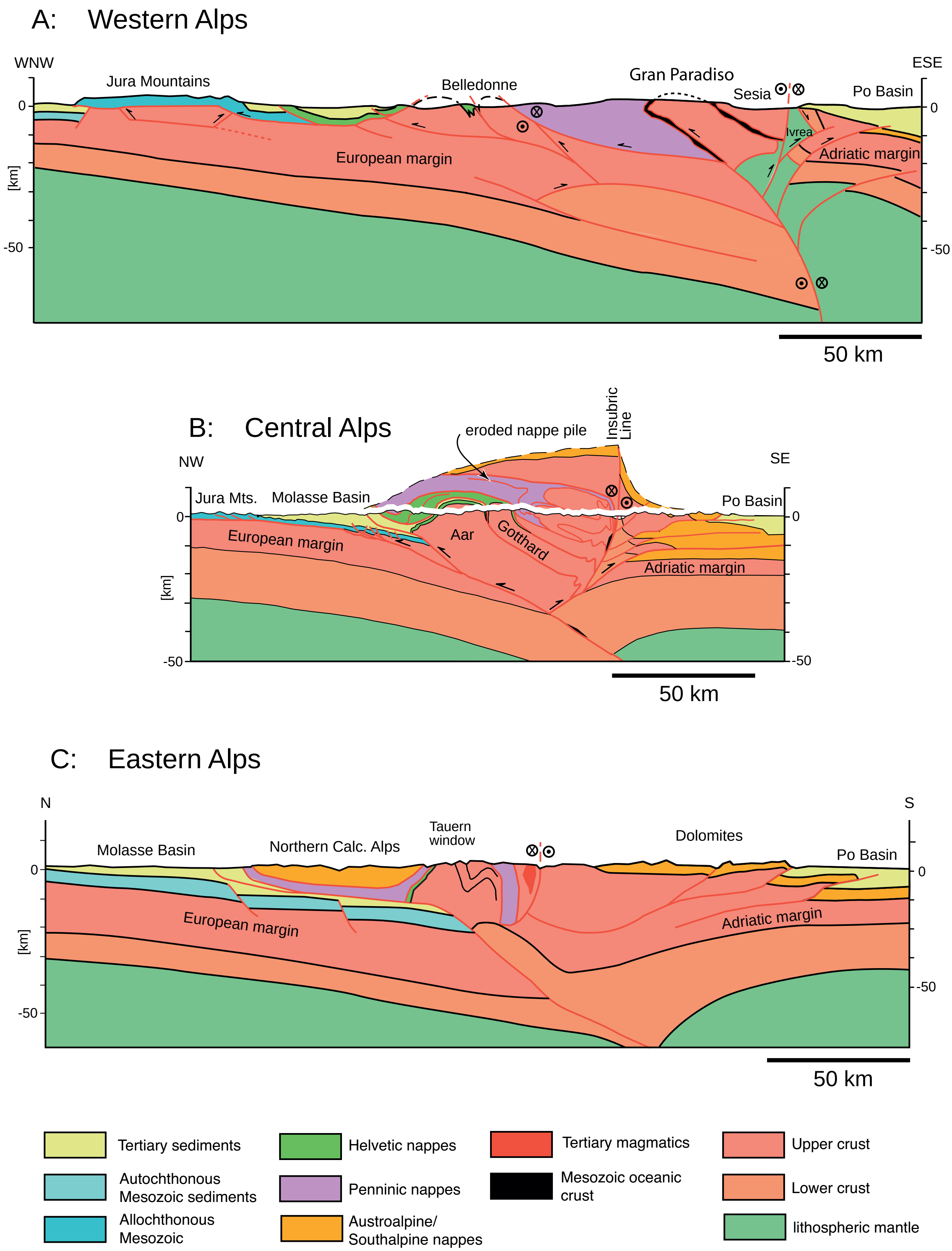


Fig. 2.1-2: Three profiles through the Alps showing the deep structure of the orogen. The traces of the profiles are shown in Fig. 2.1-1. A: Transect through the Western Alps of France and Italy; B: Transect through the Central Alps of Switzerland and Italy; C: Transect through the Eastern Alps of Austria and Italy. From: Pfiffner (2005).

The formation of the arc of the western Alps arc was initiated during convergence and collision before 35 Myr ago, when the Adriatic micro-plate, moving northward with respect to the European foreland, caused sinistral transpression in the western Alps, while the central and eastern Alps underwent head-on convergence and collision. During the post-collisional stage, i.e., after 35 Myr ago, the arcuate shape of the western Alps was accentuated by WNW- directed movement and anticlockwise rotation of the Adriatic microplate, decoupled from the central and eastern Alps along the Tonale-Simplon dextral shear zone. This led to wedging of lower crustal slices both in the western Alps and in the central Alps. The present-day architecture of the Western Alps formed very late, essentially during the past 35 Myr. Thereby the Ivrea mantle plays the role of a backstop in our tectonic model. Three episodes of this post-collisional crustal shortening along the ECORS-CROP transect can be distinguished: From 35 to 30 Ma the Brianconnais basement was back-thrusted over the Gran Paradiso units, leading to 30 km of crustal shortening (first episode). In the early Miocene, movements concentrated mainly along the Penninic frontal thrust and resulted in about 60 km shortening (second episode). Post-12 Ma shortening within the external massifs is associated with folding in the Jura mountains when the crust was shortened by an additional 30 km (third episode).

All the pre-collisional (pre-35 Ma) top-N thrusts were heavily overprinted by later, WNW-directed movements that led to nappe refolding and out-of sequence thrusting. The most spectacular feature on a crustal scale of the Western Alps is the "Penninic Frontal Thrust", also referred to as the "Roselend Thrust". The "Digne Thrust" in the Chaînes Subalpines (most frontal fold-and-thrust belt of the Western Alps) is a thrust of minor importance on a crustal scale but beautifully exposed.

Penninic Frontal Thrust ("Roselend Thrust")

In mid-Oligocene times, earlier Eocene top-N structures were passively transported towards the WNW and on top of the Dauphinois units along a major WNW-directed thrust: the "Penninic Front Thrust", also imaged along the ECORS-CROP profile (Schmid and Kissling 2000). This thrust was also named Roselend thrust after its type locality (Col de Roselend in Savoy) along the ECORS-CROP profile (Ceriani et al. 2001, Ceriani and Schmid 2004, Fügenschuh et al. 1999), since this out-of-sequence thrust only partially coincides with the "Penninic Front". South of Moûtiers, the tip of the Roselend thrust is seen to propagate into the Dauphinois units, carrying the former Eocene "Penninic Front" (including the Priabonian flysch des Aiguilles d'Arves) passively in its hangingwall. WNW-directed transport during this second episode, propagating into the Dauphinois foreland in Mio-Pliocene times, is kinematically related to dextral movements along the Rhone-Simplon and Insubric lines. South of the Pelvoux massif the Roselend thrust finds its continuation along the "Briançonnais front" (Tricart 1986), an out-of-sequence thrust behind the Embrunais-Ubaye nappes.

Although the approximate magnitude of displacement along the Roselend thrust is appreciable (some 60 km) it does not represent a single discrete thrust but rather a several hundreds of meters wide thrust zone, difficult to see in the field without detailed knowledge of the complex geology. Hence, visibility of this thrust in the field, and hence its educational value, is not good although exposure is excellent. In the history of science this thrust only became discovered relatively recently.

Digne Thrust

The Digne thrust is located in the southernmost part of the Western Alps. It formed very late during the Alpine orogeny of the Western Alps, i.e. during the Late Pliocene. Judging from its age, and also the lack of a continuation northwards along the front of the Western Alps, it has more to do with orogeny in the Apennines than with the formation of the arc of the Western Alps. In this sen-

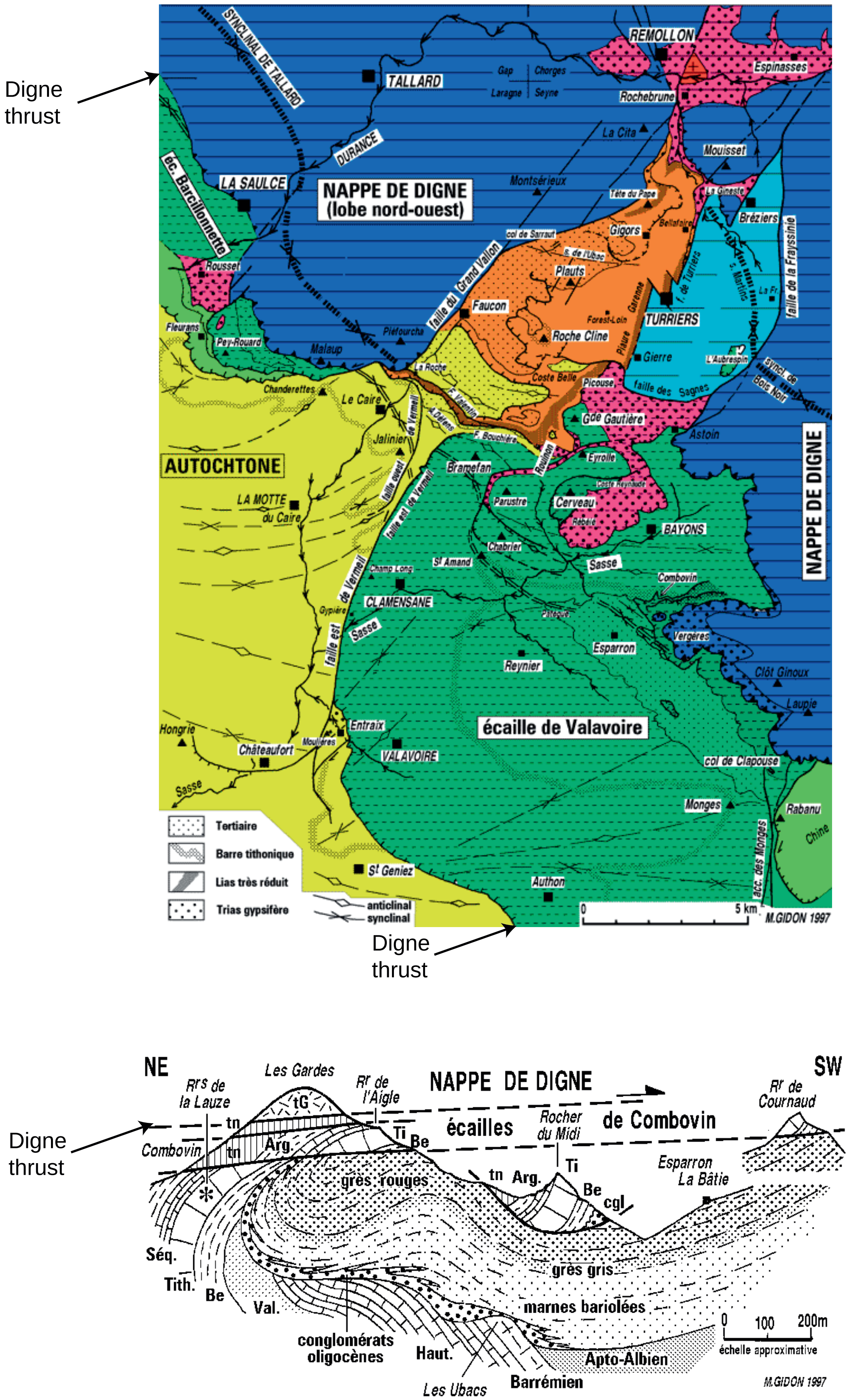


Fig. 2.1-3: Tectonic map and profile of the area around La Motte. The trace of the Digne thrust in map view forms a reentrant. In Profile view the Digne thrust is seen to cut erarlier formed folds in its footwall. Diagrams from Gidon (1997).

se it cannot be considered a typical Alpine thrust. Also, this thrust has little to do with the main stages of mountain building in the Alps.

However, the thrust is beautifully exposed at several locations and easy to reach. Because of the excellent outcrop conditions, but also because of the considerable complexity of the outcrops, the general area around the Digne thrust is regularly visited by students for field mapping courses. However, even for a geologist a map is necessary to recognize the trace of the Digne thrust in the field. The trace of the thrust forms a complex pattern on a map and in the field. The uneducated casual visitor will not be able to appreciate these complexities.

Central Alps

For the Central or Swiss Alps, the Cenozoic orogeny is more relevant. This orogeny encompasses the closure of the Piemont Ocean and the collision between the Adriatic and Eurasian continental margins (see Schmid et al. 1997a and b and references therein).

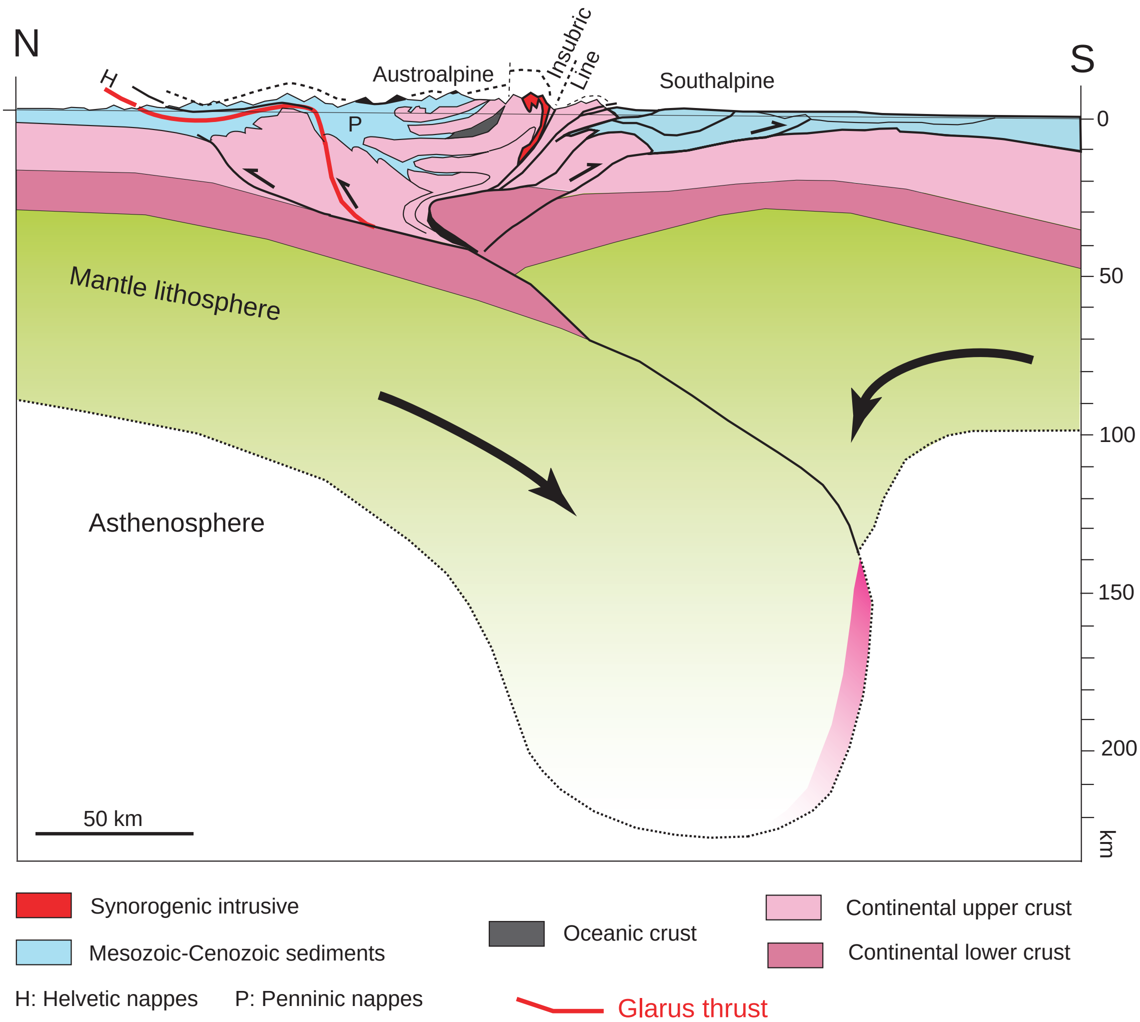


Fig. 2.1-4: Generalized lithosphere scale cross-section across the Swiss Alps. The mantle structure is after Lippitsch (2002) and Lippitsch et al. (2003), the crustal structure after Pfiffner et al. (1997). The Aar massif basement block and the Southalpine zone display thick-skinned tectonic style where thrust faults extend into the lower crust. In the Penninic nappes, a basement-involved thin-skinned style modified by post-nappe folding is recognized. Upper crustal shortening is bivergent, while al lithosphere scale, the lower crust and mantle exhibit an asymmetric subduction geometry. From: Pfiffner (2005).

Figure 2.1-4 is a lithosphere scale cross-section showing the structures formed in the course of the Cenozoic orogeny mainly. The crustal section is based on geophysical and seismic data gathered in the framework of NRP 20 (Pfiffner et al. 1997c), the lithosphere structure on Lippitsch (2002) and Lippitsch et al. (2003). While the mantle lithosphere displays an asymmetric structure, the upper crust is stacked both towards the north and the south. The Penninic nappes (and the overlying Austroalpine nappes) were exhumed in an asymmetric way, such that higher amphibolite grade rocks now outcrop at the surface in the vicinity of the Insubric Line. The degree of metamorphism of the exhumed rocks tapers off towards the north, and a jump in metamorphism to a lower grade is observed as one crosses the Insubric Line southward. The lower crust of the Adriatic plate was shortened and thickened, whereas part of the European lower crust was subducted.
In the following, two nappe systems are discussed: the Helvetic nappes which constitute a classical fold-and-thrust belt, and the Penninic nappes which consist of both, basement and cover nappes intricately overprinted by post-nappe folding.

Helvetic nappes. The Helvetic zone encompasses a Mesozoic-Cenozoic sedimentary sequence deposited in a shelf sea on the European margin of Eurasia (see e.g. Funk et al. 1987 and references therein). Jurassic and Cretaceous carbonates form a framework of mechanically stiff layers, separated by shales and marls of variable thickness. The crystalline basement is composed of polymetamorphic gneisses and granites, overprinted to a large extent by the Variscan orogeny in Late Paleozoic times (von Raumer and Neubauer 1993). The Helvetic nappes were detached from this crystalline substratum along Triassic evaporates or Jurassic shales. In eastern Switzerland Permocarboniferous volcaniclastics are part of the Helvetic nappes as well. The internal style of folding and thrusting of these nappes is largely controlled by the architecture of the Mesozoic basin, which explains the variability of the structural style of individual nappes as one proceeds along strike of the orogen (see Pfiffner 1993 for a discussion).
The basal thrust of the Helvetic nappes is a prominent and important structure. It separates the allochtonous, displaced rock units making up the Helvetic nappes from a highly deformed zone beneath the thrust fault, where crystalline basement and sedimentary rocks are intricately deformed by folding and thrusting. The basal thrust of the Helvetic nappes is particularly well exposed in eastern Switzerland. Here the spectacular Glarus overthrust puts Permian onto Cenozoic sediments (see Figs. 2.1-5a and b).

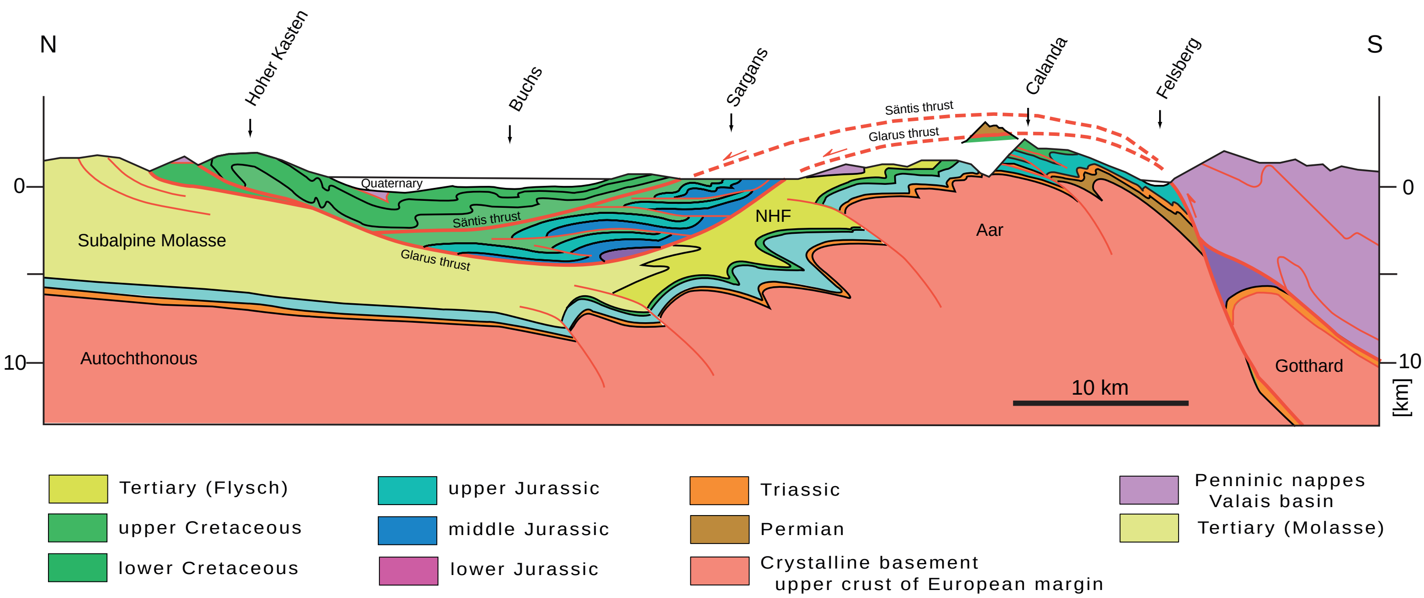


Fig. 2.1-5a: Profile through the Helvetic nappes of the eastern Swiss Alps. The Helvetic nappes were displaced along the Glarus thrust over a distance of around 50 km. But the rocks above and below the Glarus thrust were also intricately deformed as is evident from the fold and thrust structures. The Säntis thrust displaced the uppermost part, the Cretaceous strata, of the Helvetic nappes an additional 10 km to the north. Deeper down, the crystalline basement rocks of the Aar massif were shortened and now form an anticlinal upwarp. From: Pfiffner (2005).

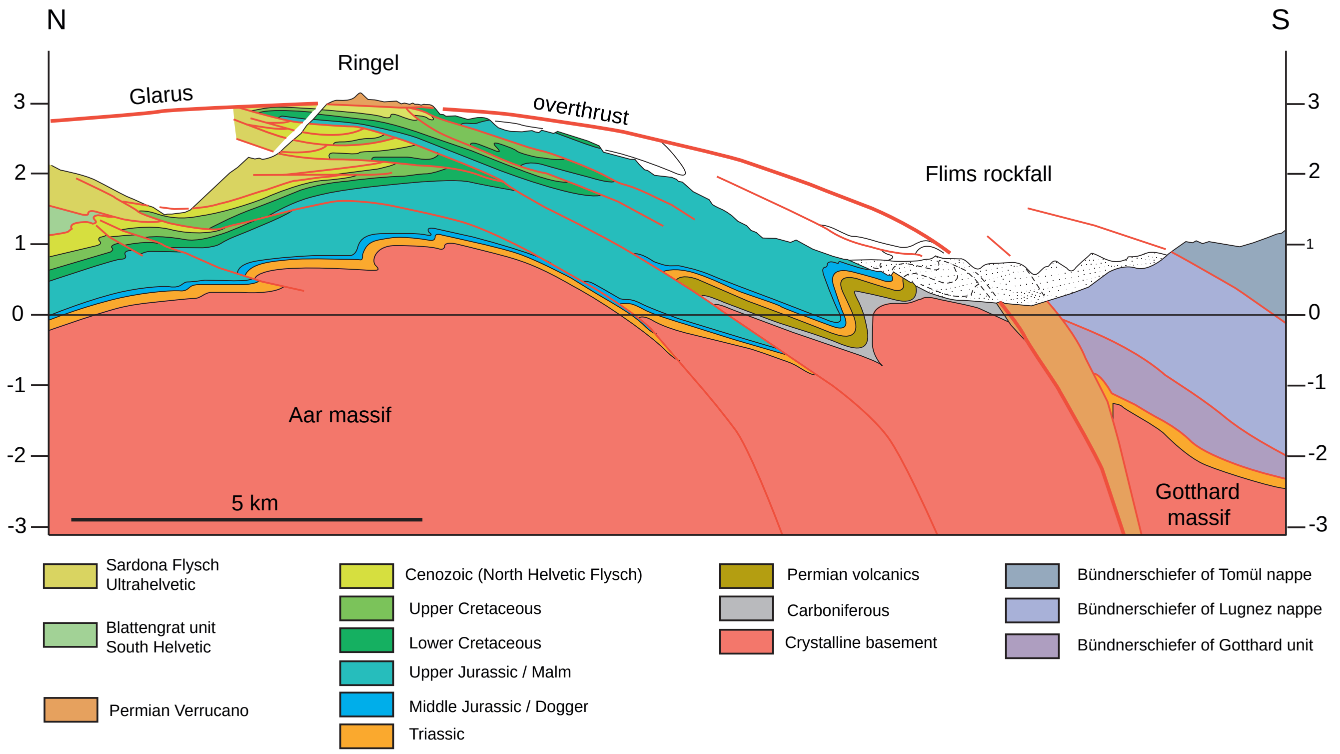


Fig. 2.1-5b: Geological profile across the proposed property showing the Glarus overthrust and the structural style in its footwall and the units in its hanging wall in the south. From: Pfiffner (2005).

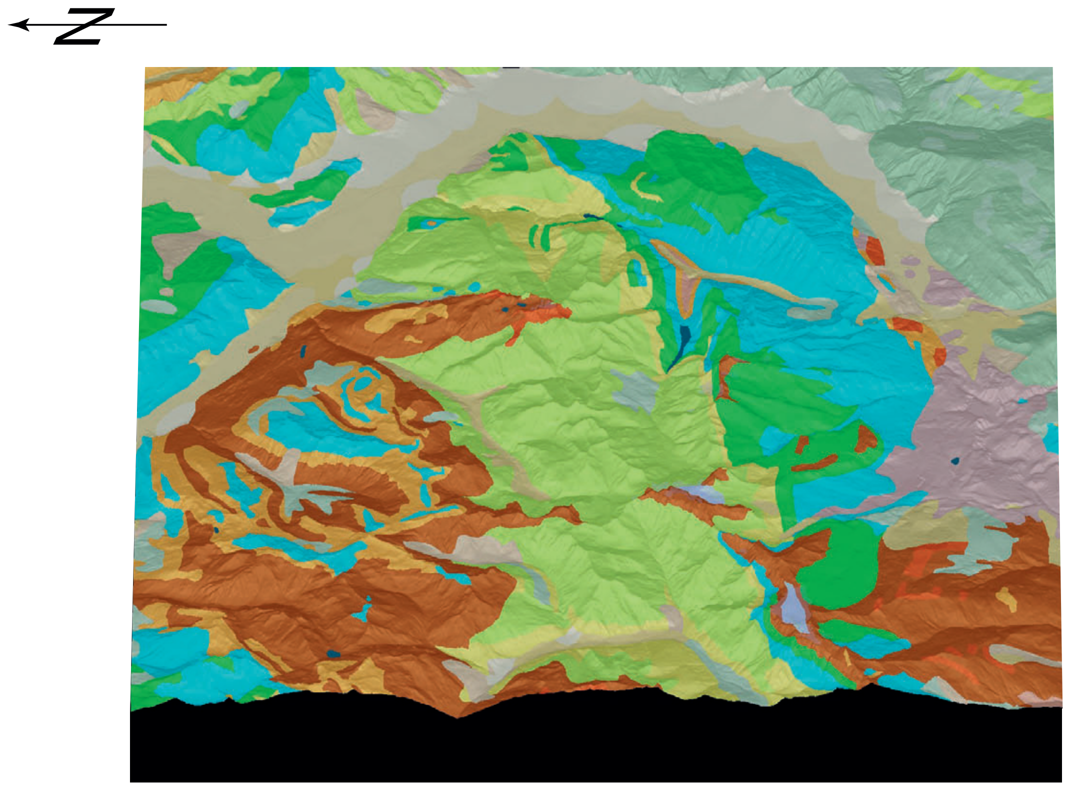
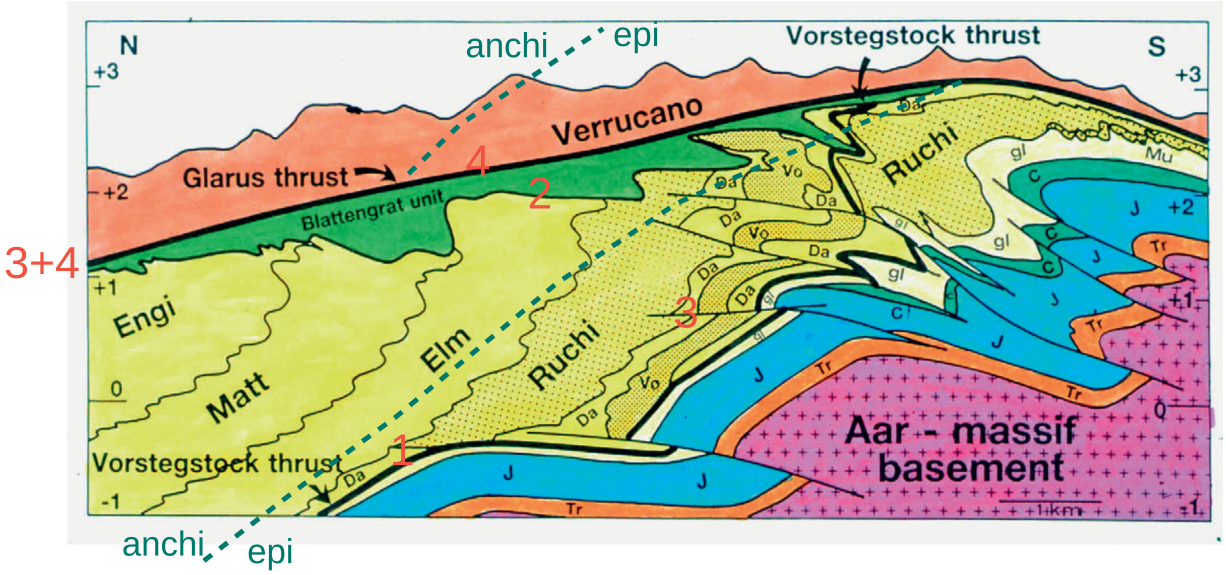


Fig. 2.1-5c: Block diagram of the proposed property, looking towards the east. The arch shape of the Glarus overthrust is outlined by the Permian clastics (Verrucano, shown in brown) that overly the flysch units (in yellow). To the rights of the block diagram, this contact dips to the south (right), to the left toward the north (left). The thrust fault breaks surface NW of the Säntis range. Here, Cretaceous limestones (shown in green) overthrust Cenozoic foreland clastics (Molasse, shown in pale pink). The block diagram was prepared using AdS2.

Deformation phases



4 Ruchi phase:
Final transport along the Glarus thrust produces an inverse metamorphic zonation as shown by the offset of the anchizone/epizone boundary. A prominent crenulation cleavage forms in a band about 500 m thick in the footwall of the Glarus thrust.

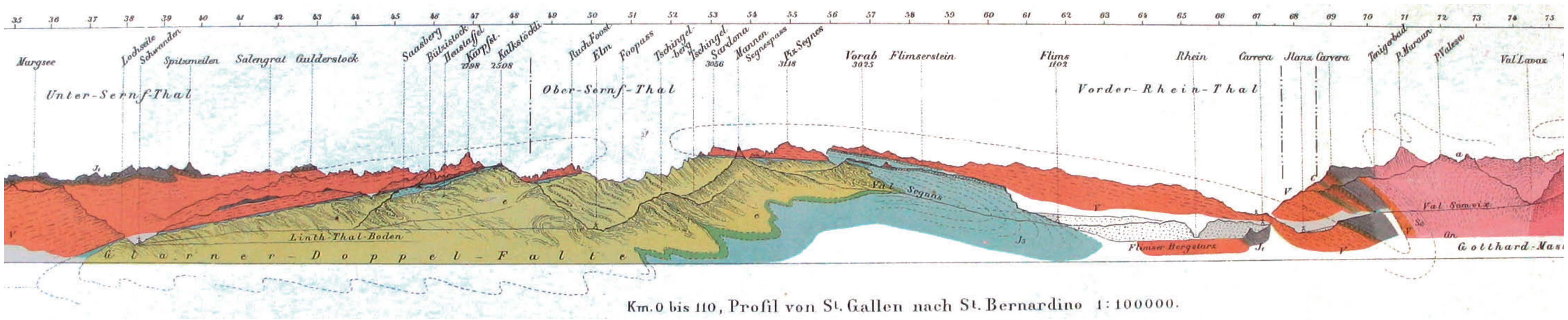
3 Calanda phase:
The Aar massif and its Mesozoic-Cenozoic cover is folded and sliced by thrust faults. A prominent cleavage forms parallel to the axial surfaces of the folds and the thrust faults. Folds and thrusts deform the Vorstegstock and Blattengrat thrusts. The Glarus thrust formed, truncated the Blattengrat thrust and was successively upwarped by folding and thrusting in its footwall.

2 Pizol phase:
The basal thrust of Blattengrat unit is folded by the folds of the Calanda phase, but truncates bedding in the footwall and the Vorstegstock thrust.

1 Vorsteckstock phase:
The Vorstegstock thrust is parallel to bedding, but truncated by Blattengrat thurst and the folds and thrusts of the Calanda phase.

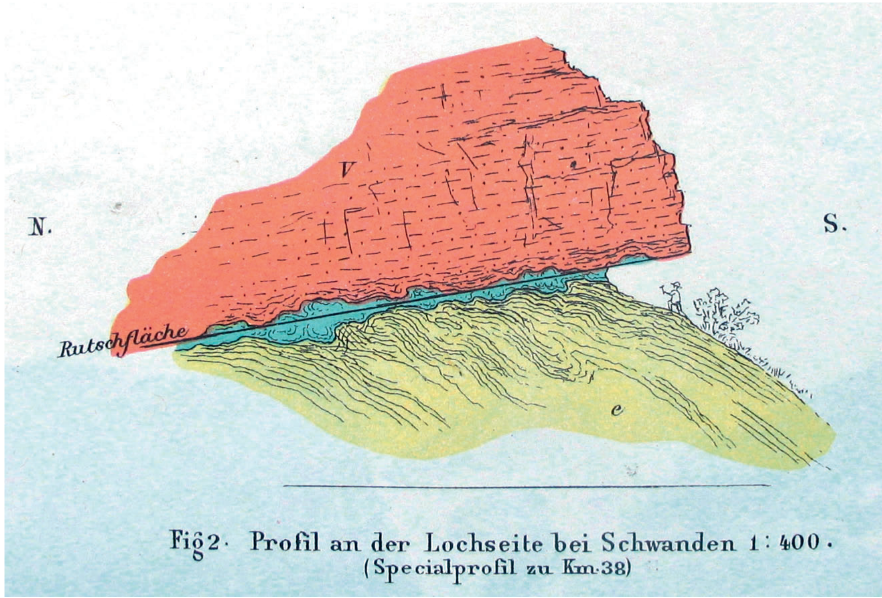
Fig. 2.1-5d: Geologic profile across the proposed property showing the deformation phases within the Helvetic zone of eastern Switzerland. Based on Pfiffner (1986).

The Glarus thrust as "double fold"



Cross section through the proposed property with a "double fold" separating the two Verrucano bodies. From: Alb. Heim (1922-24).

Photograph of the Lochseiten calc mylonite (W flank of Tristelhorn) Clearly visible is the yellow layer at the top of the mylonite. Photo: D. Imper.



Detailed field drawing at the famous Lochseiten locality. From: Alb. Heim (1887).

Fig. 2.1-5e: Heim's of view of the Glarus overthrust as "double fold".

Glarus Overthrust

The Glarus overthrust puts Permian Verrucano onto Mesozoic – Cenozoic sediments in most places. At the contact itself a layer of limestone or calc-mylonite is sandwiched between the two units. This layer is the famous Lochseiten limestone or mylonite that is named after the "Lochsiten" locality. The Lochseiten limestone acted as a lubricant at the base of the Helvetic nappes and accommodated at least 35 km of displacement along the Glarus thrust. The contact between the Lochseiten limestone or mylonite and the rocks in its footwall or hanging wall is sharp. The top boundary is very often a rather planar surface, while the lower boundary forms typical mullion like structures.

Fig. 2.1-5a is an extended profile showing the general structure in the hanging wall of the Glarus thrust. The contact between the Verrucano and overlying Triassic strata is folded and affected by thrust faults. Higher up in the section, a stack of imbricate thrust sheets resulted from shortening of the thick and massif Quinten limestone (Late Jurassic in age). The structure resembles a classic duplex with a roof thrust (the Säntis thrust) and a shear zone exhibiting asymmetric folds in the shaly Liassic and Dogger strata (Early and Middle Jurassic). Southward, imbricate thrusting gives way to folding owing to higher temperatures prevailing during deformation. The Cretaceous strata in the hanging wall of the Säntis were detached along lowermost Cretaceous shales and marls (see below) and were deformed independantly of the Jurassic strata in its footwall. Although these structures are located just outside and north of the proposed property, the spectacular folds and imbrications are clearly visible from within the property. They strike the eye of the non-geologist, as indicated by the name given to a mountain by the local people: "Sichelkamm" ("sickle crest") bears its name from the kilometer-sized fold that resembles the shape of a sickle.

Figure 2.1-5b shows a cross section displaying the overall structure within the proposed property. The Glarus thust has an arcuate shape. In the footwall of the Glarus thrust, the core of the antiform, a stack of imbricate thrust sheets involves mainly Mesozoic sediments. However, crystalline basement rocks of the Aar massif are also affected by this deformation as indicated by the folds and thrust faults. Moreover, far travelled, socalled exotic thrust sheets are also present near the top of the antiform. These exotic thrust sheets are the classical example of out-of-sequence thrusting recognized in this area for the first time and by early workers already (the process is referred to as "Einwicklung", or "wrapping in", in the Alpine literature).

Figure 2.1-5c is a geological block diagram of the proposed property. It shows the arcuate shape of the Glarus thrust and the arrangement of erosional klippen of Verrucano overlying Mesozoic and Cenozoic strata. Deep incision by rivers, aided by the glaciers of the Quaternary expose a 2 kilometer thick structure in differently oriented valleys and give an extensive threedimensional view reaching down into the crystalline basement.

The proposed property covers the area where not only the concept of nappes and thrust faults was conceived, but also where the tectonic evolution of the nappe pile was developed. A number of phases of thrusting and folding could be recognized. Their relative order is established on the basis of crosscutting relationships (e.g. a younger thrust dissecting an older thrust, a fold folding a thrust surface, or folds refolding folds). Figure 2.1-5d is a cross section through the SW part of the proposed property that displays the relative order of deformation phases. Out-of-sequence thrusting is responsible for the occurrence of the far-travelled Blattengrat unit. This unit was originally deposited southward of the strata now forming the Helvetic nappes. It was emplaced onto the future Helvetic nappes and the Mesozoic-Cenozoic strata overlying the (future) Aar massif, and then later overthrust by the Helvetic nappes during incipient motion along the Glarus thrust. For the Glarus thrust, a late phase motion resulted in an inverse metamorphic zonation: higher grade, greenschist facies rocks came to lie on lower grade, anchizonal rocks.

Early workers, like Arnold Escher and Albert Heim, recognized the fact that older rocks (Permian Verrucano) rest on younger rocks (Mesozoic-Cenozoic strata) in the proppsed area, and that the contact formed a single surface easily visible in the mountains. They also recognized that extensive folding affected the various strata at different scales. This ductile deformation and the missing explanation of thrust faulting (discussed below) led these workers to postulate a large scale double fold to explain their observations. Figure 2.1-5e shows the situation as drawn by Albert Heim (1887). Many of the features drawn in the profile containing the double fold separating the two Verrucano bodies are still valid. The detailed field drawings are still valid as a precise description of the observation in the field and outstanding in quality. The yellow layer in the Lochseiten limestone visible in the photograph was interpreted as "Triassic dolomite", making the outcrop an inverted section: Permian Verrucano on top, underlain by Triassic (yellow band), Jurassic (gray part of Lochseiten limestone in lower left corner) and Cenozoic (beneath scree).

<u>Field aspects of the Glarus thrust and structures above and below</u>
The Infrahelvetic complex in the footwall of the Glarus thrust is famous for the ductile deformation features exposed in the steep cliffs. Two examples within the proposed property illustrate this aspect. In Figure 2.1-6a, a ductile deformation zone in the footwall of the Tschep thrust produced an isoclinal fold highlighted by the Middle Cretaceous Garschella formation (colored in red in the diagrams). Ductile shearing modified the angular relationship between bedding and fault: if the simple shear in the footwall of the Tschep thrust is retro-deformed until the tip of the Gault formation makes an angle of around 30-45° (as observed in other outcrops), the angle between bedding and fault in the Lower Cretaceous strata (colored in dark greenish and blueish color) becomes less than 30°. These angles correspond to the cut off angles of thrusts observed elsewhere. Folds modified by shear in the footwall of thrust faults as is the case here are referred to as drag folds in the literature. The ductile deformation style was rendered possible by the elevated temperatures (of around 300°C) prevailing in the Infrahelvetic complex at the time of this deformation. As is clearly visible in the diagrams in Fig. 2.1-6a, additional ductile shear zones crosscut the Cretaceous strata deeper down in the section and led to the formation of similar style folds.

Figure 2.1-6b shows the tip of the Drachenberg thrust sheet. Its basal thrust, the Drachenberg thrust, climbs at low angle from the Jurassic limestones across the Lower Cretaceous, forming a ramp across the Middle Cretaceous (Garschella formation). In its footwall, a bedding-parallel thrust repeats the Cenozoic strata, and the early formed thrust at the base of the Sardona-Flysch is folded by the emplacement of the Drachenberg thrust sheet.

Figure 2.1-6 c shows the Glarus thrust at its most famous locality, the Tschingelhoren. The "magic line" marks the boundary between the Permian Verrucano (building the peaks) and a band of Jurassic limestones. Cenozoic beds (Flysch) are covered by scree and form the cliffs on the left side. Similar photos of the Glarus overthrust can be taken from other mountains. Everywhere the Glarus thrust is visible from the distance to the untrained eye as well as at outcrop as a very sharp and distinct line.

The Lochseiten limestone (also Lochseiten limestone, or Lochseiten calcmylonite) formed at the top of a limestone layer dragged along the thrust fault over many kilometers. The uppermost meter was intensively deformed and transformed into a mylonite. This layer formed the lubricant at the base of the Helvetic nappes. Its uppermost part is often yellowish and contains dolomite and albite. It is this rock that Albert Heim took for Triassic dolomites explaining the inverted limb of the "double fold". Figure 2.1-6d shows some examples of the smeared out limestone and the Lochseiten limestone itself.

The structure of the Helvetic nappes in the hanging wall of the Glarus thrust is characterized by a complex interplay of folding and thrusting cut by strike slip faults. The structure is highlighted in the field by the differing colors and morphologic experession of the various sedimentary strata. An example of folding in Jurassic strata within the proposed property is shown in Figure 2.1-6e (bot-

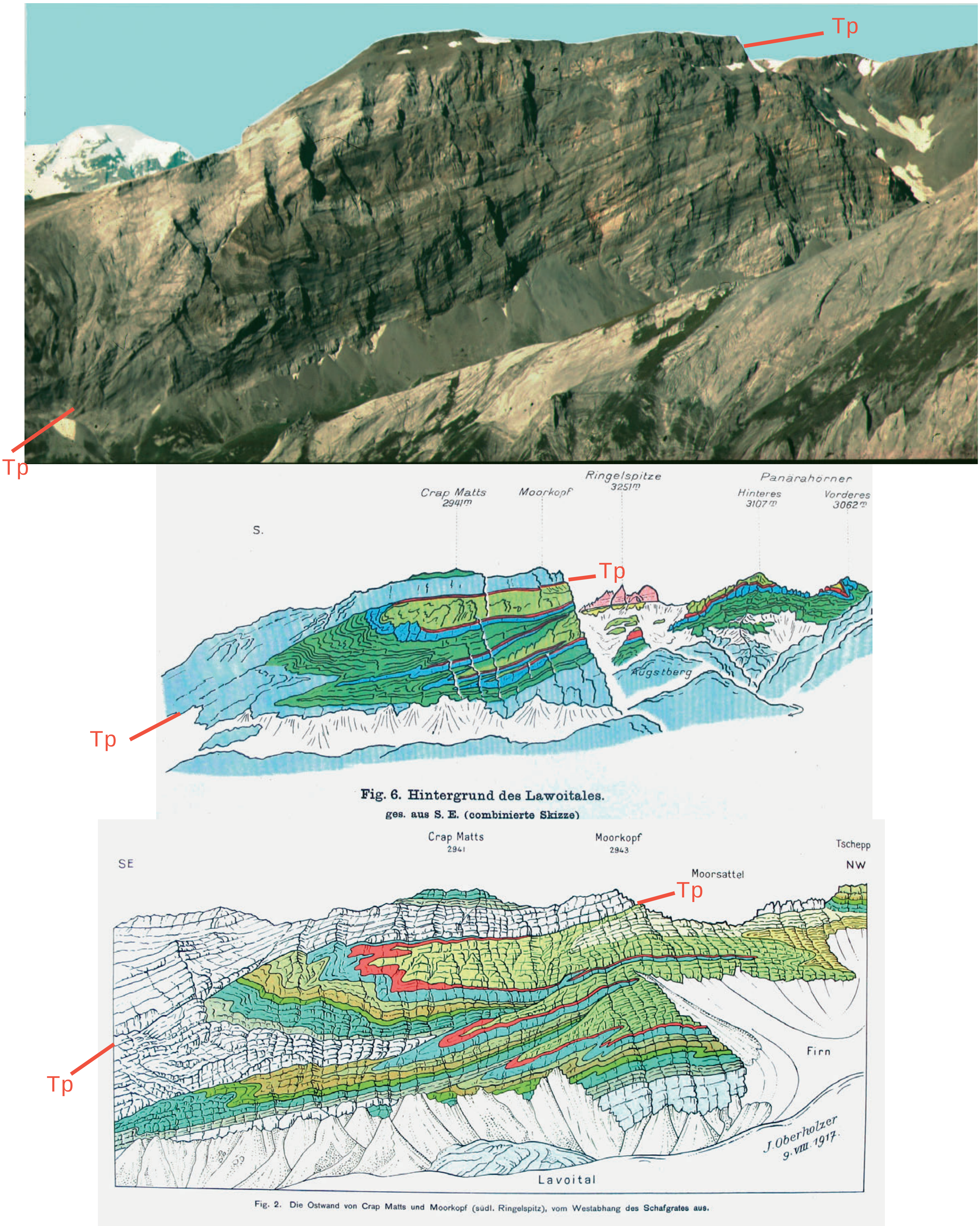


Fig. 2.1-6a: Ductile isoclinal folding in the footwall fo the Tschep thrust (Tp), a major thrust fault in the footwall of the Glarus overthrust. Photo: A. Pfiffner; drawings: Blumenthal (1911, upper diagram) and Oberholzer (1933, lower diagram).

tom). The asymmetric fold is is visible within an oolithic limestone. The underlying marls show classic cleavage-bedding relationships. In the upper part photograph, the transition from imbricate thrusting to folding is beautifully exposed in a view across the valley marking the northern boundary of the property (Figure 2.1-6e middle). The various thrust fault merge upward into the Säntis thrust. The latter follows a shaly horizon in lowermost Cretaceous strata. The Cretaceous strata in its hanging wall were displaced northward relative to the Jurassic of the footwall by more than 10 km. An erosional klippe of the Säntis thrust sheet is present in the NW corner of the proposed property (Guligrind – Hoch Farlen area). The displaced Cretaceous strata are locally folded as "lift-off" or "detachment folds". An example includes the photo given at the top showing the mountain called "Sichelkamm" (meaning "sickle crest" as discussed above). In the northwestern part of the proposed property, fault related folding is visible in the Mürtschenstock (see Fig. 2.1-6f). Here a thrust fault within the Verrucano of the Helvetic nappes climbs stratigraphic section and thereby provokes a large-scale anticline in the Late Jurassic Quinten limestone. Interesting enough, this thrust fault, the Mürtschen thrust, also climbs section across a strike slip fault (see Pfiffner 1981), producing a three-dimensional structural feature not encountered in many places that puzzled earlier workers.

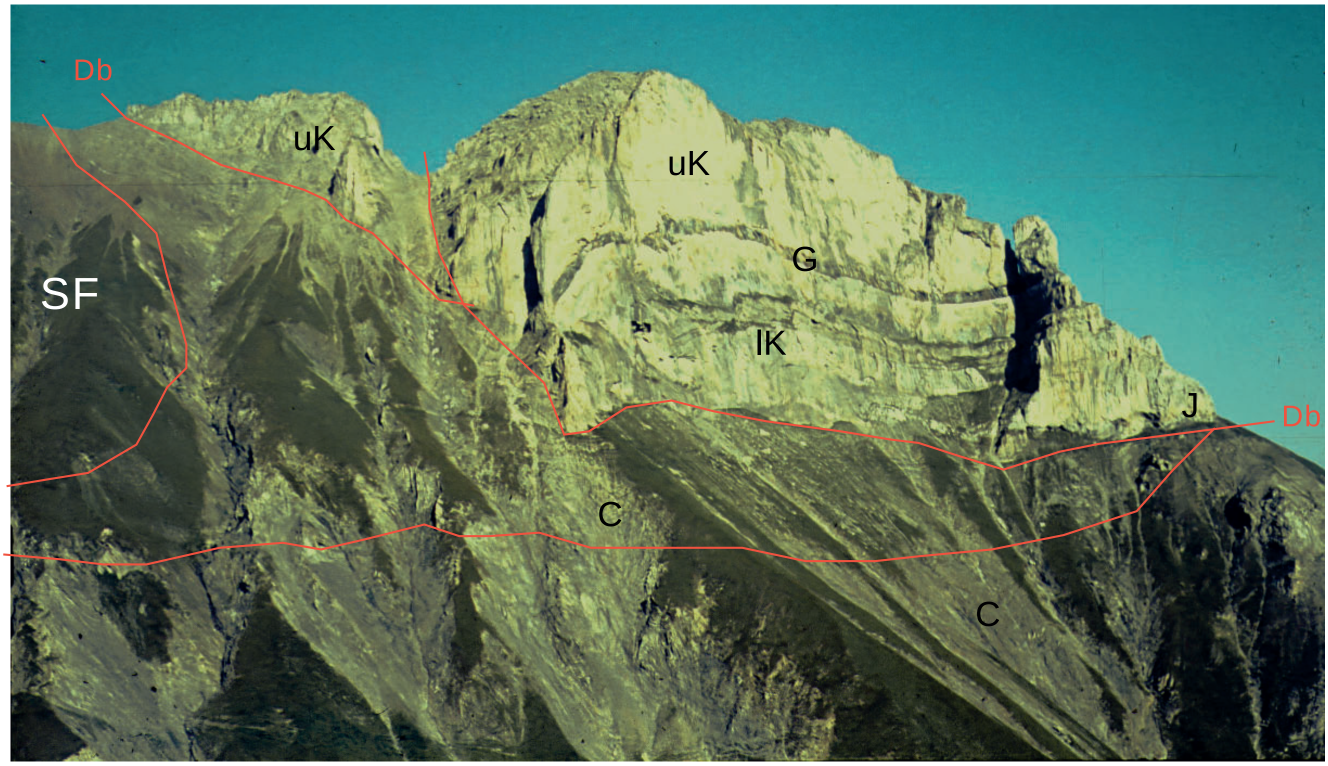
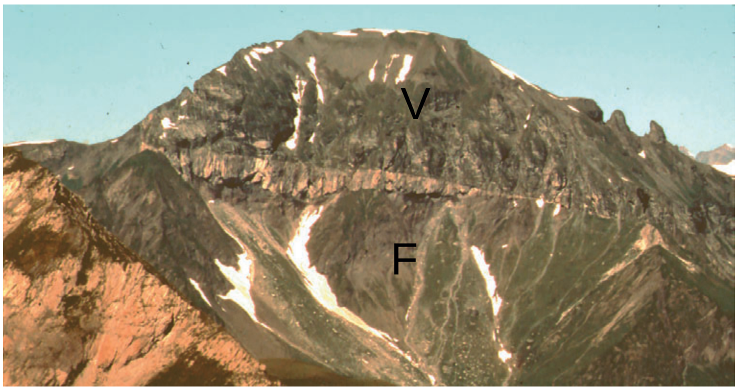


Fig. 2.1-6b: The Drachenberg thrust (Db) is a thrust fault in the footwall of the Glarus overthrust. It puts Jurassic and Cretaceous limestones onto Cenozoic strata. At the front of the Drachenberg thrust sheet, the basal thrust of the Sardona Flysch is folded. The Sardona Flysch also lies in thrust contact on the Mesozoic-Cenozoic strata. The photograph is a cross sectional view. Thrusting is clearly indicated by the repetition of strata (e.g. the dark band of the Middle Cretaceous Garschella Fm ("Gault")). J: (upper) Jurassic, lK: lower Cretaceous, G: middle Cretaceous, uK: upper Cretaceous, C: Cenozoic, SF: Sardona Flysch. Photo: A. Pfiffner.

Fig. 2.1-6c: The Glarus overthrust as "magic line" in the Tschingelhoren. Permian clastics (Verrucano, V) overlies Jurassic limestones (J) and Cenozoic Flysch (F). Photo: A. Pfiffner.

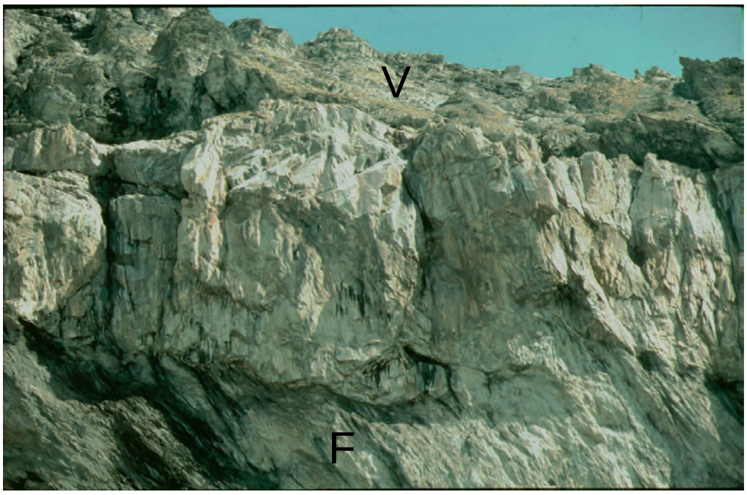
The Lochsiten calc mylonite

Foostock: A limestone layer marks the Glarus overthrust. It gets successively thinner to the right (N) in the direction of nappe transport along the Glarus overthrust. Only the uppermost meter is transformed into Lochseiten calc mylonite.
Photo: D. Imper.



Atlas: A ca. 5 m thick limestone marks the Glarus overthrust. Its uppermost meter is transformed into Lochseiten calc-mylonite.
Photo: A. Pfiffner.

V: Permian Verrucano
F: Cenozoic Flysch



Ofen: In the foreground, Lochseiten calc-mylonite is exposed on a suface polished by the galcier. This surface corresponds to the contact between Lochseiten calc mylonite an the overlying Verrucano. In the background, the same contact is visible as a sharp line beneath the peaks.
Photo: A. Pfiffner.

Fig 2.1-6d: Limestone layer and Lochseiten calcmylonite: lubricant of the Glarus overthrust.

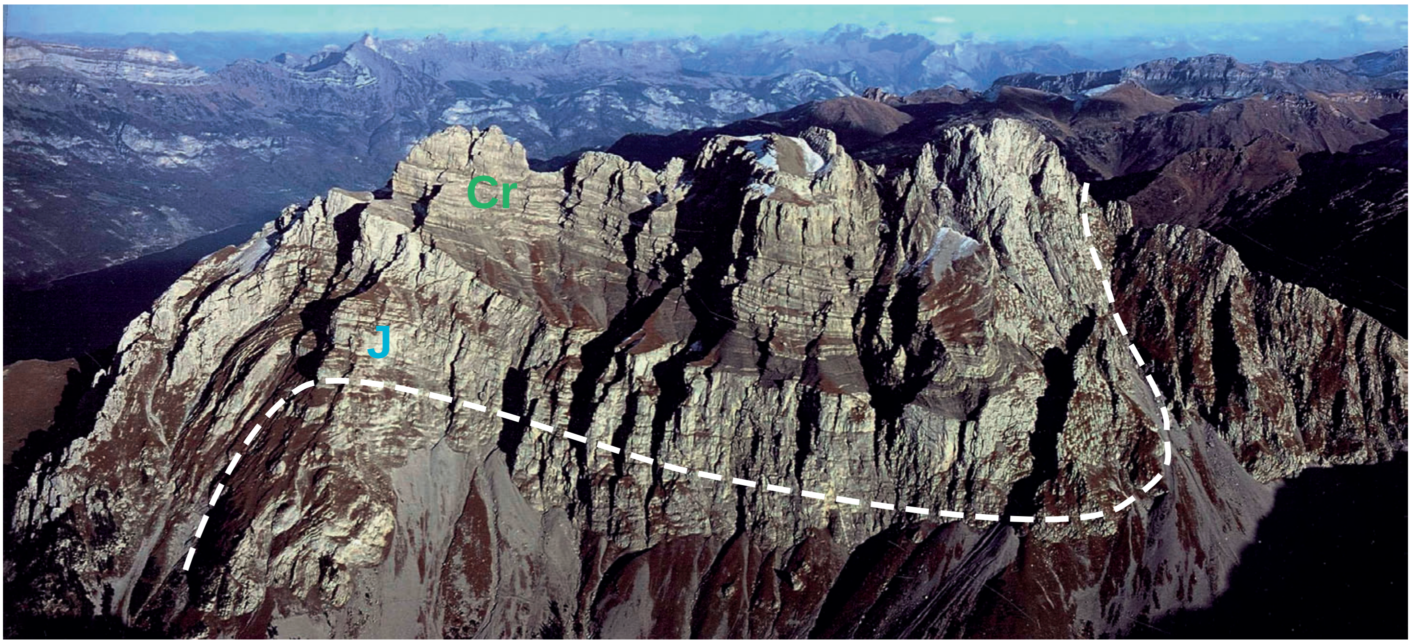


Fig. 2.1-6f: The folds in the Mürtschenstock massif. The with dashed lines shows the outline of the fold pair within the upper Jurassic Quinten limestone. J: upper Jurassic Quinten limestone, Cr: lower Cretaceous limestones.Photo: D. Kalberer.

Morphological expression and scientific importance of the Glarus thrust

A single knife-sharp thrust contact is three-dimensionally exposed over a length of some 30km. Due to its arcuate convex-upwards shape this same thrust can be studied at all altitudes between the valley floor and some 3000m. And by following the thrust from south to north one is able to study thrust-related processes going from a deep level (15 km beneath the Earth's surface) to a shallow level of a few kilometers depth only. World-wide no other single thrust (there are no splays or other forms of a complex thrust system) is so spectacularly exposed and, at first sight, so simple

The scientific importance of the thrust lies in the extreme form a strain-concentration within the narrow (1 meter or less) band of Lochseiten limestone which obviously accommodates the translation of the overlying Helvetic nappes over several tens of kilometers. However, there is a lively debate in the literature, as to what exactly governs the weakness of this layer. The interpretations regarding the Lochseiten limestone range from the view that this tectonite represents an over-pressured cataclasite (e.g. Badertscher & Burkhard 2002) all the way to its interpretation in terms of a viscously flowing limestone mylonite (e.g. Schmid 1975). The truth may lie, as is usually the case in scientific debates, somewhere in between.

It this the combination of a lively ongoing scientific debate and the extreme simplicity of its almost monumental morphological appearance which make the Glarus thrust a unique feature that fascinates geologists and non-geologists alike. The mechanical paradox as to how basal friction within the Lochseiten limestone can be sufficiently reduced in order to accommodate one single large overthrust is one that was and still is of utmost importance in the history of science.

Säntis Thrust

The Säntis thrust is an important thrust fault within the Helvetic nappes of eastern Switzerland. It follows a stratigraphic horizon (lowermost Cretaceous shales and marls of the Palfris formation) and displaced the Cretaceous limestones in its hanging wall northward relative to the Jurassic strata in its footwall. The northern tip of the Cretaceous strata is now roughly 12 km north of the formerly underlying Jurassic strata. As is evident in Fig. 2.1-5b, folding and imbricate thrusting in its footwall and hanging wall telescoped the sequence such that the displacement along the Säntis thrust nearly vanishes towards the southern end of the Säntis thrust sheet. The Säntis thrust is visible from the proposed property looking across its northern limit (Seez valley and Walensee). Here the Säntis thrust dips to the north to form a synform farther north and breaking surface at the (northern) foot of the Säntis-Alpstein range. The Säntis thrust can be observed in the northwestern corner of the proposed property around the klippe of the Guligrind – Hoch Farlen area. The thrust fault marks the morphology at all three localities (see e.g. Fig. 2.1-6e), but the actual fault contact is visible at one locality only (Dunkelberndtli). The Säntis thrust was recognized as thrust fault in the 1930s only.

Axen and Drusberg Thrusts

In the transect across central Switzerland shown in Fig. 2.1-7, the Helvetic nappes consist of two thrust sheets, the Axen nappe and the Drusberg nappe. The lower unit, the Axen nappe, consists of basically Jurassic sediments forming a number of recumbent folds. These recumbent folds are lift-off folds that developed in the strata overlying thick shaly units of Early and Middle Jurassic age. They can be interpreted in terms of inverted basins where rapid lateral thickness variations led to squeezing out of the basin fill. The expulsed sediments first form asymmetric folds cored by weak shales. Continued shearing rotated the inverted limbs and ultimately resulted in recumbent folds (Panien et al. 2005). The basal detachment of the Axen nappe from the crystalline basement followed Triassic evaporates and stepped upward in the transport direction in a staircase fashion into the Early and Middle Jurassic shales.

The Axen thrust is exposed on the northern flank of the Aar massif and can be traced along strike over roughly 100 km. Apart from the easternmost exposures in the Linth valley (just east of the proposed property) it dips to the north and can be traced along the transport direction over only a relatively short distance. Thus it does not expose the continuous outcrop as is typical for the Glarus thrust. Moreover, the Axen thrust itself is exposed at a few localities only. But in some of these localities – for example at the foot of the famous climbing face, the Eiger north face – a calcmylonite comparable to the Lochseiten mylonite can be observed. The internal deformaton of the units in beneath and above the Axen thrust are comparable to the ones encountered in the proposed property.

The overlying Drusberg nappe consists of essentially Cretaceous-Cenozoic sediments. These were detached from the underlying Jurassic along a thick layer of lowermost Cretaceous shales and marls (Palfris formation) and were internally shortened by folding. This detachment is referred to as Drusberg thrust. This thrust fault corresponds to a shear zone several tens or hundreds of meters thick rather than to single fault. As a consequence, the Drusberg fault expresses itself morphologically only and went unnoticed for quite some time after the nappe theory was established. The Drusberg thrust may be interpreted as an equivalent of he Säntis thrust described above.

Owing to the motion on the Drusberg thrust, the Drusberg nappe traveled farther North than the underlying Axen nappe and came to rest on Oligo-Miocene clastic foreland strata of the Molasse Basin. This basin formed as foredeep during nappe stacking in the Alps (Pfiffner 1986, Pfiffner et al. 2002). Its internal part was shortened in Miocene times. The resulting nappe stack is referred to as Subalpine Molasse in Alpine literature. It represents a thin-skinned type style with detached along the oldest Molasse deposits, a thick sequence shales pertaining to the UMM (lower marine Molasse). The southward continuation of the basal thrust fault is nowhere observable at outcrop. The solution shown in Fig. 2.1-7 represents a plausible solution. As can be seen on Fig. 2.1-7, the Drusberg and Axen thrusts rise southward above the Aar massif. This basement uplift formed above a thrust fault cutting down into the crystalline basement, a structure well visible in seismic sec-

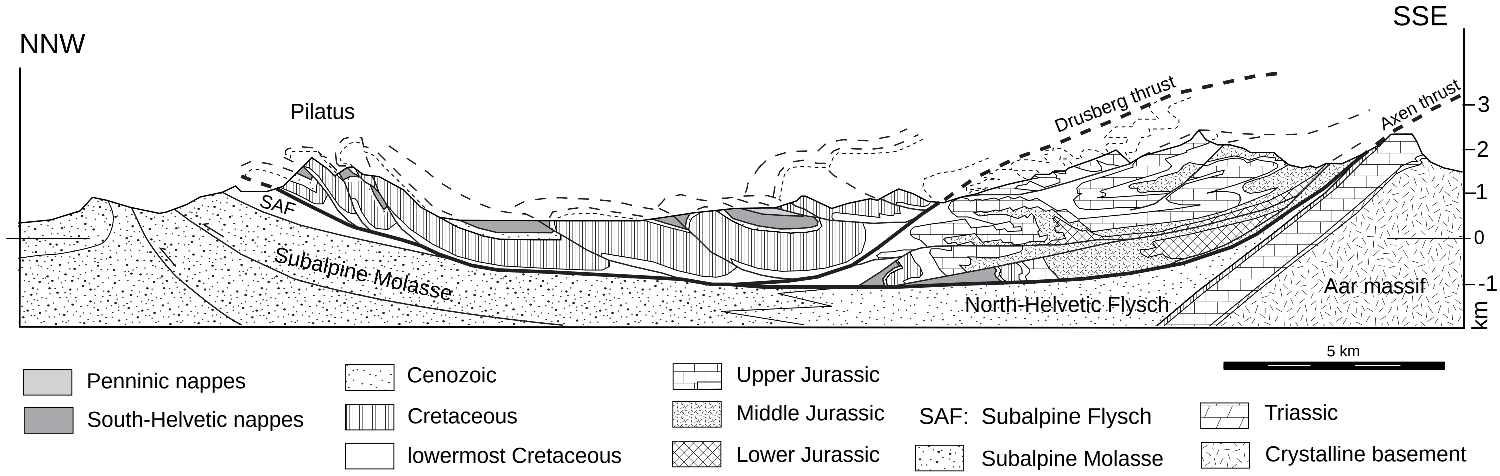


Fig. 2.1-7: Geological profile across the Helvetic nappes of central Switzerland, adapted and extended from Menkveld (1995). The Axen thrust is the basal thrust of the Helvetic nappes and puts allochthonous Mesozoic-Cenozoic sediments onto the Mesozoic-Cenozoic cover of the Aar massif. The Drusberg thrust separates the Helvetic nappes into two stockwerks. The lower unit consists essentially of Jurassic cover rocks that are isoclinally folded into recumbent and even plunging anticlines. The upper unit is made up of Cretaceous-Cenozoic strata that are detached from their Jurassic strata along the Drusberg thrust. This thrust follows a thick lowermost Cretacous marl unit. Internal shortening of this upper unit is by imbricate thrusting, which also affects the basal thrusts of the overlying South-Helvetic and Penninic nappes. In the footwall of the Helvetic nappes, the Subalpine Molasse exhibits imbricate thrusting and a triangle zone at the NNW corner of the section. Modified from Pfiffner (in press).

tions (see Fig. 2.1-4). This thick-skinned style of deformation formed late in the orogenic sequence and is held responsible for the upwarp of the Axen and Drusberg thrusts and the nature of the plunging anticlines of the recumbent folds within the Axen nappe.

Jungfrau-Aletsch-Bietschhorn property

The Aar massif, which is located south of the Drusberg thrust, is an area of high elevation and thus glaciated. The high elevation is the result of the resistance of the mainly granitic rocks to erosion (other areas of high elevation include the Mont Blanc, Dent Blanche, Bregaglia and Bernina areas; see Kühni & Pfiffner 2001). The landscape of the Aar massif was shaped by glaciers. This process is still ongoing and may be observed in a spectacular way in the Jungrau-Aletsch-Bietschhorn (JAB) property. The granites within the JAB property intruded the crust at approximately 4 km beneath the paleo-landsurface around 300 million years ago. 100 million years later, their roof was eroded and the granitic rocks were exposed at the bottom of a shallow sea. Alpine mountain building raised the rocks to 4000 m and more above sea level. The associated structures are folds (visible south of Grindelwald, in the north of the JAB property) and a thrust fault located at depth, several 1000 m below sea level. The thrust fault was imaged by seismic reflection profiling (Pfiffner et al. 1997b). The Mesozoic sediments deposited onto the granitic rocks were folded and faulted during the Alpine orogeny. In the northern exension of the JAB property, the Doldenhorn nappe is an excellent example of this process. Its basal thrust, the Doldenhorn thrust, can be seen in the Gastern valley (but a geological map is needed to locate it). Here, some spectacular folds at the front of the Doldenhorn nappe visible in the steep cliffs surprise the visitor. The Doldenhorn thrust and nappe have been analyzed recently by Herwegh & Pfiffner (2005) to understand its tectono-thermal evolution and the process of basin inversion, which is thought to be responsible for the large-scale recumbent folds. Despite this scientifically interesting feature, the JAB property is not of Outstanding Universal Value regarding tectonics and structural features. Its value regarding glacial processes, however, is unquestionable.

Axen thrust in Central Switzerland

Fig. 2.1-8a: Axen thrust near Engelberg, Central Switzerland. Jurassic limestones overly Cenozoic sandstones of the North Helvetic Flysch. Photo: A. Pfiffner.

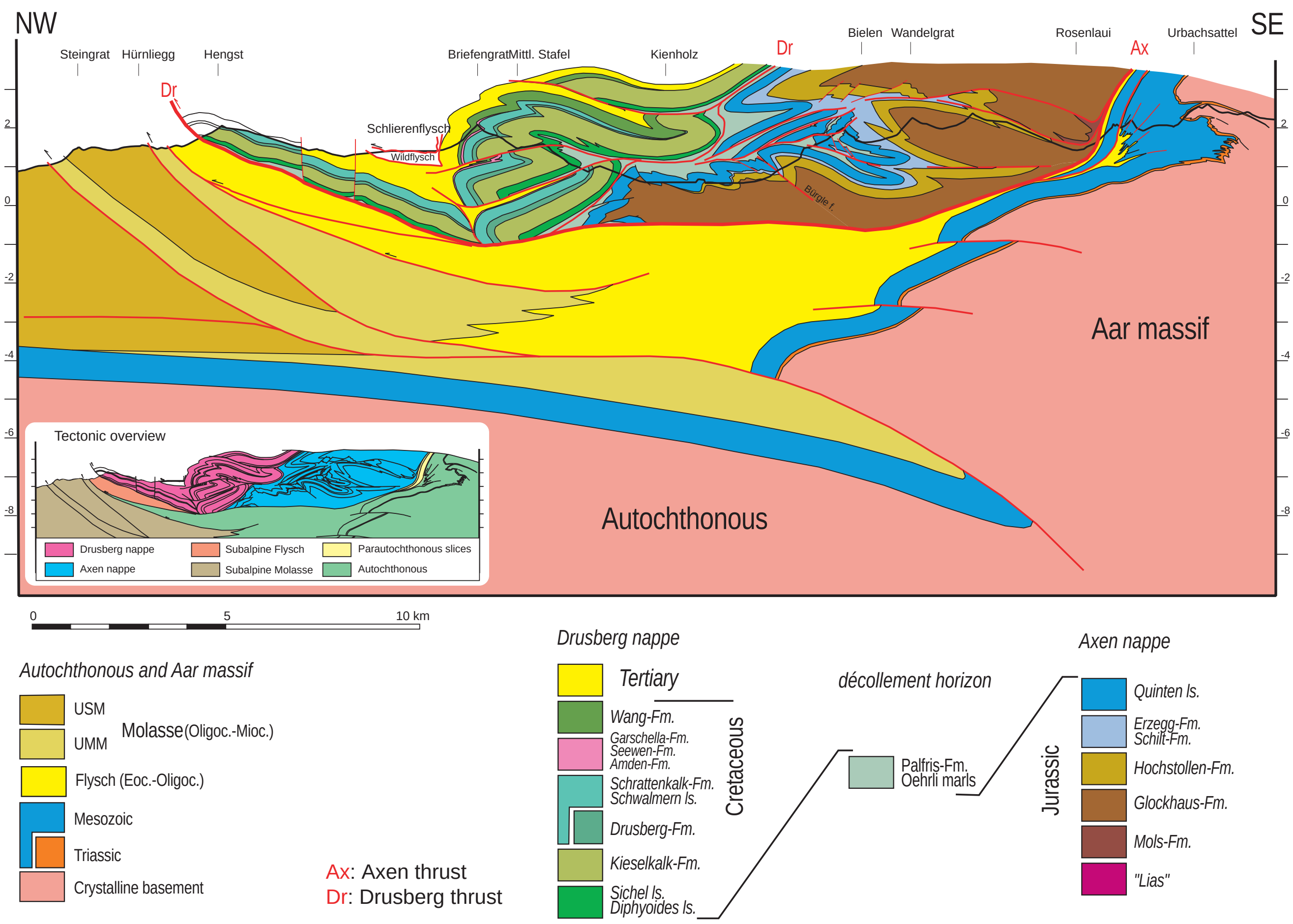
Fig. 2.1-8b: Nappe internal deformation of the Axen nappe near Engelberg, Central Switzerland. Lower Jurassic limestones form a plunging anticline closing towards the right (North). Photo: A. Pfiffner.

Wildhorn Thrust

Going west, the Axen thrust gives way to the Wildhorn thrust as basal thrust fault of the Helvetic nappes. This change occurs across the Kander valley and is most probably controlled by a strike slip fault within the Jurassic stockwerk active during nappe formation. Two minor thrust sheets in the footwall of the Axen and Wildhorn thrusts, the Gellihorn and Diablerets thrusts, take up some of the displacement.

Fig. 2.1-9 is a cross section showing the particular style of internal deformation east of the Kander valley that is governed by recumbent folds cut by numerous normal faults (see Hänni & Pfiffner 2001). Similar to the situation in eastern and central Switzerland, the Cretaceous strata were detached along lowermost Cretaceous marls and traveled farther north. The associated thrust fault (respectively shear zone) is buried by scree and vegetation and therefore cannot be observed at outcrop.

The internal deformation of the Helvetic nappes west of the Kander valley, i.e. essentially the Wildhorn nappe, gets more and more controlled by large-scale folding (see Fig. 2.1-10). This is due to the change in the Mesozoic strata (limestones get replaced by shales and marls). The entire nappe stack was deformed in several phases (Burkhard 1988). Thrust faults are only exposed in rare instances (Diableret, Gellihorn, Doldenhorn and Morcles thrusts). Thus, despite the fact that the Wildhorn nappe forms a broad antiformal structure above the Aar and Aiguilles Rouges massifs, the Wildhorn thrust cannot be followed as a distinct feature across the antiform as is the case for the Glarus thrust.



2.1-9: Geological profile across the Helvetic nappes of the Bernese Oberland, adapted from Hänni & Pfiffner (2001).

The basic structure of the Wildhorn nappe was elaborated by M. Lugeon (see e.g. cross sections given in Heim 1921/1922). Thrust contacts were mapped out in detail. However, the observer needs a geological map to find where the actual fault contacts are located. In some instances, their general outline is highlighted by limestone cliffs and grass covered slopes associated with shales. The prime interest of the early workers was directed at the large scale folds and their lateral correlation.

One particular point of interest concerns the Ultrahelvetic and South-Helvetic thrust slices. They correspond to the far traveled exotic strip sheets that occur within the proposed property discussed above. These thrust sheets were emplaced onto the future Wildhorn, Gellihorn and Doldenhorn nappes and then deformed passively. As consequence, the associated basal thrust faults are now intricately folded and sliced (see Fig. 2.1-10). These faults are actually very hard to detect in the field.

Both, the Gellihorn and Diablerets thrust sheets are of minor importance as far as their volume and displacement of the associated basal thrusts are concerned.

The Doldenhorn and Morcles thrust sheets (see fig. 2.1-10) are better known for their internal structure. This structure encompasses large scale recumbent folds that formed in response to the inversion of an Early to Middle Jurassic basin (Pfiffner 1993 and in press, Herwegh & Pfiffner 2005). The mylonites that formed in the thinned parts of the inverted limbs attracted the attention of many structural geologists (Durney 1972, Ramsay 1981, Dietrich & Casey 1989, Herwegh & Pfiffner 2005, Ebert et al. 2005). The main emphasis was on the deformation mechanisms and the accumulation of strain in these highly sheared rocks. A direct comparison with the comparison with the Lochseiten mylonite is being carried out presently (Ebert, Ph D thesis). The nappe internal deformation was studied in detail by Burkhard (1986, 1988).

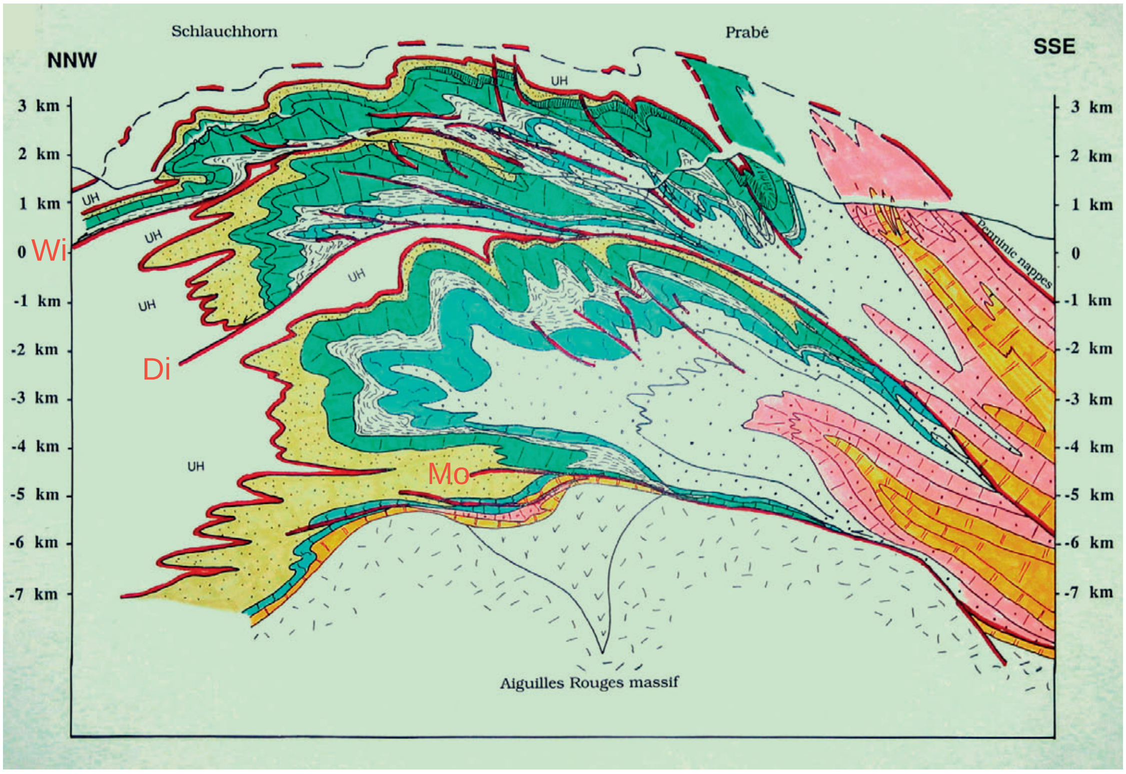


Fig. 2.1-10: Geologic profile across the Helvetic nappes of western Switzerland. Mo, Di, Wi: Morcles, Diablerets, Wildhorn thrust. Adapted from Pfiffner (1993).

Although the Morcles and Doldenhorn thrust may be observed at outcrop in a number of places, the morphologic expression is rather minimal. The educational value lies within the spectacular large-scale folds.

From the historical perspective, these areas gained interest in the second half of the 20th Century only, and in conjunction with the folds rather than with thrusts.

Penninic nappes. Thin-skinned basement nappes, thin-skinned cover nappes and large-scale folds affecting basement and cover rocks as well as the thrust faults separating the nappes characterize the tectonic style of the Penninic nappes. The structural style of individual nappes varies along strike of the orogen. An important change in style occurs across the Maggia transverse zone of south central Switzerland (Pfiffner et al. 2002). This transverse zone separates the earlier formed nappe stack of eastern Switzerland, which is dominated by imbricate thrusting, from the nappe stack of western Switzerland where basement thrust sheets involve large scale folds (see e.g. Escher et al. 1993). The contrasting structural style is most likely controlled by the presence of relatively thick Permo-Carboniferous or Permo-Triassic clastic sequences, which occur in narrow basins beneath the décollement horizon of the detached cover nappes. These clastics remained attached to the crystalline basement, but upon contraction and basin inversion they were squeezed out and folded. The cross section shown in Figure 2.1-11 passes east of the Maggia transverse zone.

The crystalline basement nappes contain essentially polymetamorphic gneisses and schists intruded by Caledonian and Late Variscan granitic intrusions, all of which were deformed in Alpine orogeny. Small remnants of Mesozoic cove sediments (quartzites, dolomite marbles and cargneules/evaporites) overly the crystalline basement rock locally. But most of the Mesozoic-Cenozoic cover rocks were detached from their crystalline substratum, transported northwards to form a nappe stack of their own. Figure 11 shows the Penninic nappe stack in eastern Switzerland (based on Pfiffner and Hitz 1997 and Schmid et al. 1997b). The cross section summarizes the structures in eastern Switzerland. It is based on fieldwork and mapping of generations of geologists (see Schmid et al. 1997 a, b and references therein), as well as seismic data (Pfiffner & Hitz 1997 and references therein). Owing to axial plunges, the nappe stack can be projected eastward into the subsurface and westward to above the present day land surface. Crystalline basement nappes include the Gotthard massif, the Simano nappe, the Adula nappe complex, the Tambo and the Suretta nappes. Cover nappes include the Terri, Aul, Grava, Tomül and Schams nappes.

As can be seen in Figure 2.1-11, most of the nappe contacts are intricately folded. Particularly noteworthy are the backfolds in the Suretta nappe, the folded thrust at the base of the Schams nappes and the Grava nappe. The Adula nappe complex consists of a stack of imbricates. High-pressure assemblages indicate deep burial in an early stage followed by Barrovian type regional metamorphism. Between the Adula nappe complex and the Tambo nappe, an imbricate stack of Mesozoic sediments and an ophiolite sequence can be distinguished (referred to as Aul nappe, Misox zone and Chiavenna ophiolites in the literature). In the southern part of the cross section, just north of the Insubric Line, a large-scale antiform folds all the nappe contacts. In the core of this backfold we find the Bergell intrusion which is dated at 30 – 28 Ma and which crosscuts nappe contacts.

The structural evolution of this nappe pile involves two phases of thrusting followed by pervasive folding. In a first phase, the Mesozoic cover was detached from its crystalline substratum, transported northwards and stacked to an imbricate fan. Triassic evaporites played an important role as décollement horizon in this process. In a second phase thrusting affected the crystalline basement. The thrust sheets, which formed in this process, are typically around 5 km thick and several tens of kilometers long. This geometry resembles the geometry of thin-skinned thrust sheets typical for foreland fold-and-thrust belts. Nevertheless the detachment was within the crystalline basement, but the décollement horizon is not clearly related to a lithologic boundary. It might be controlled to thermal weakening facilitating temperature sensitive creep in quartz. The thrust ramps at the front of the nappes seem to be associated with lithologic discontinuities in many cases. This is suggested by orthogneisses (Caledonian, Variscan or older intrusions), which are found at the very front of nappes, or Permo-Carboniferous volcaniclastic grabens marking the rear of basement blocks. The two phases of thrusting are documented by the observation that only remnants of the autochthonous cover of the crystalline basement nappes remained attached to the substratum, while most of it was removed before the stacking of basement nappes. An interesting example in this context is represented by the Schams nappes shown in Figure 2.1-11. The Schams nappes are made of cover sediments, which originally derive from the Tambo and Suretta nappes. A palinspastic restoration points to the fact that the cover length in the Schams nappes exceeds the length of the basement available in the Tambo and Suretta nappes. Thus, additional crustal pieces must have been lost by subduction (see Schmid et al. 1997a for a detailed discussion). The Schams nappes were detached from their crystalline substratum in an early stage to form a rootless allochthonous thrust sheet. Subsequently the Tambo and Suretta basement blocks were stacked and rammed into the Schams nappes. As a result, the Schams nappes were wrapped around the two basement nappes and a large-scale recumbent fold structure formed within the Schams and adjacent Tomül nappes (its axial surface straddles the topographic surface in Figure 2.1-11).

Although the Penninic nappes display a dominant folding style, the early evolution was by thrusting under prograde metamorphic conditions. Imbricate thrusting is indicated by remnants of cover rocks attached to the top of basement slices and the predominantly normal sequences of the cover nappes. Metamorphism reached greenschist facies in the north of the cross section shown in Figure 2.1-11, and higher amphibolite facies in the south adjacent to the Insubric Line. Metamorphic isograds crosscut the nappe contacts indicating peak conditions post-dating nappe

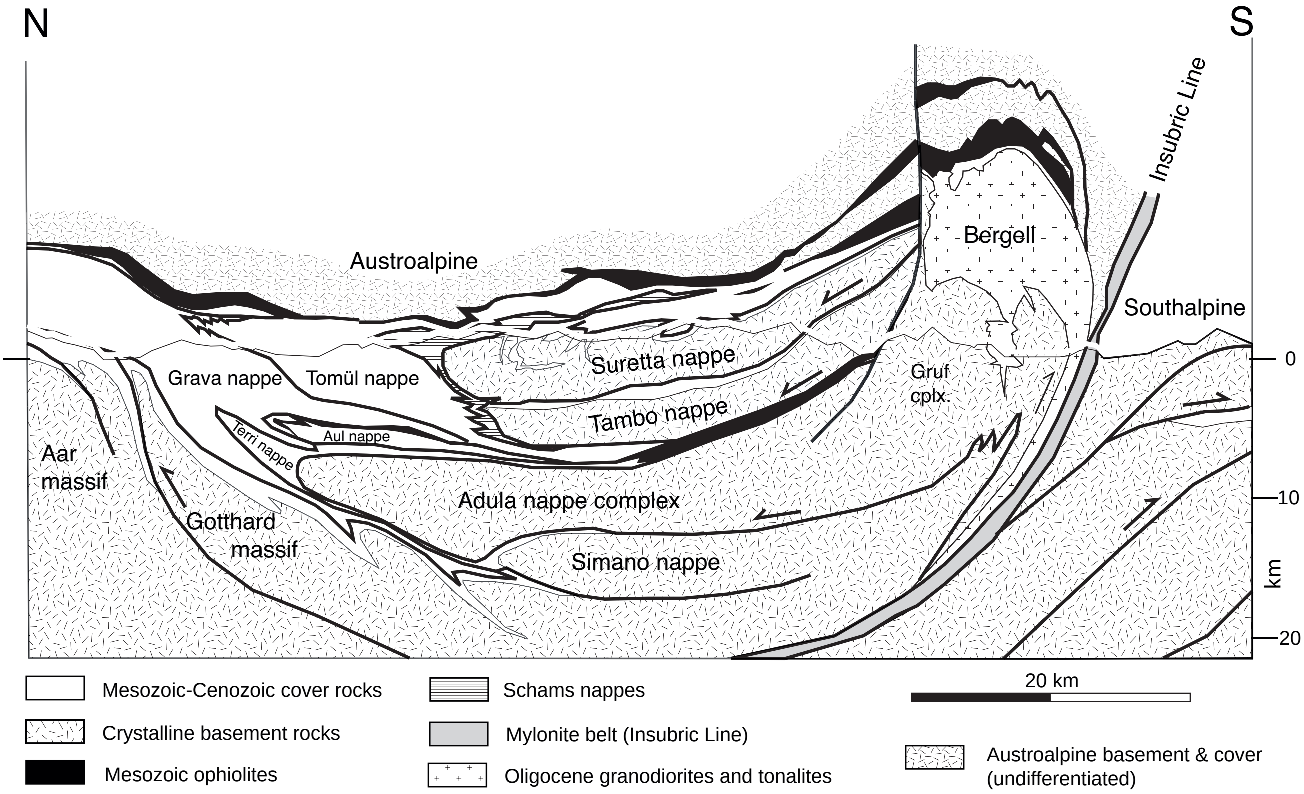


Fig. 2.1-11: Geologic profile across the Penninic nappes of the Swiss Alps, based on Pfiffner & Hitz (1997) and Schmid et al. (1997b). To the south, several thrust sheets up to 5 km thick are separted by thin slivers of Mesozoic cover rocks and are piled up. Most of the Mesozoic-Cenozoic cover of these crystalline thrust sheets was sheared off and now forms a nappe stack of its own in the northern part of the section. The thrust faults were intricately folded subsequent to nappe stacking. A broader antiform occurs in the vicinity of the Insubric Line, a major backthrust that exhumed the deeper, amphibolite-grade thrust sheets.

stacking. Thus the ductile style observed at outcrop is largely the product of ongoing deformation under higher temperatures overprinting the more brittle early thrusting event.
A peculiar structure is represented by the large scale backfold near the Insubric Line, which passively folds nappe contacts. This backfolding is referred to as "post-nappe folding" in Alpine literature (Milnes 1974). Backfolding occurred simultaneously to backthrusting along the Insubric Line and can be envisaged as a vertical escape mechanism at the onset of continent-continent-collision (see Schmid et al. 1997a). Exhumation of high-grade rocks in the hanging wall of the Insubric Line was aided by erosion (see Pfiffner et al. 2000). The Insubric Line has a strike slip component also, which is dextral and amounts to at least 100 km. Westward motion of the Ivrea mantle piece along the Insubric Line combined with reverse thrusting in the Penninic nappes shifted the locus of orogenic contraction (from east of to west of the Maggia transverse zone), rock uplift (by horizontal contraction) and surface uplift. These factors controlled the evolution of the North Alpine foreland basin (Pfiffner et al. 2002), where an equivalent shift of the depot center and the shedding of conglomerates may be observed.

Basal thrust of Klippen nappe (Préalpes Médianes)

The Klippen nappe is a thrust sheet containing thick carbonate sequences of Triassic and Jurassic age. These carbonates were deposited on the Briançonnais swell, a platform that persisted between the Piemont ocean in the SE and the Valais trough in the NW. In the course of the Alpine orogeny, the Klippen nappe was detached from its crystalline basement along a Triassic evaporite horizon, transported northward onto the foreland and incorporated into the accretionary wedge of the closing Piemont ocean. The thin-skinned tectonic style was influenced by the stratigraphy of the Mesozoic strata. As a consequence, large scale fold structures are observed in the frontal, northwestern part, while imbricate thrusting dominates at the trailing, southeastern end of the nappe (see Mosar 1989, 1991, and Fig. 2.1-12, based on Wissing & and Pfiffner 2002). The Klippen nappe was transported over a distance exceeding 100 km (Masson 1976). Today it is preserved as an erosional remnant, bordered by its basal thrust. This thrust fault can be mapped by following the Triassic evaporates. However, the latte are transformed into cargneules near the surface such that the thrust fault itself is not exposed.

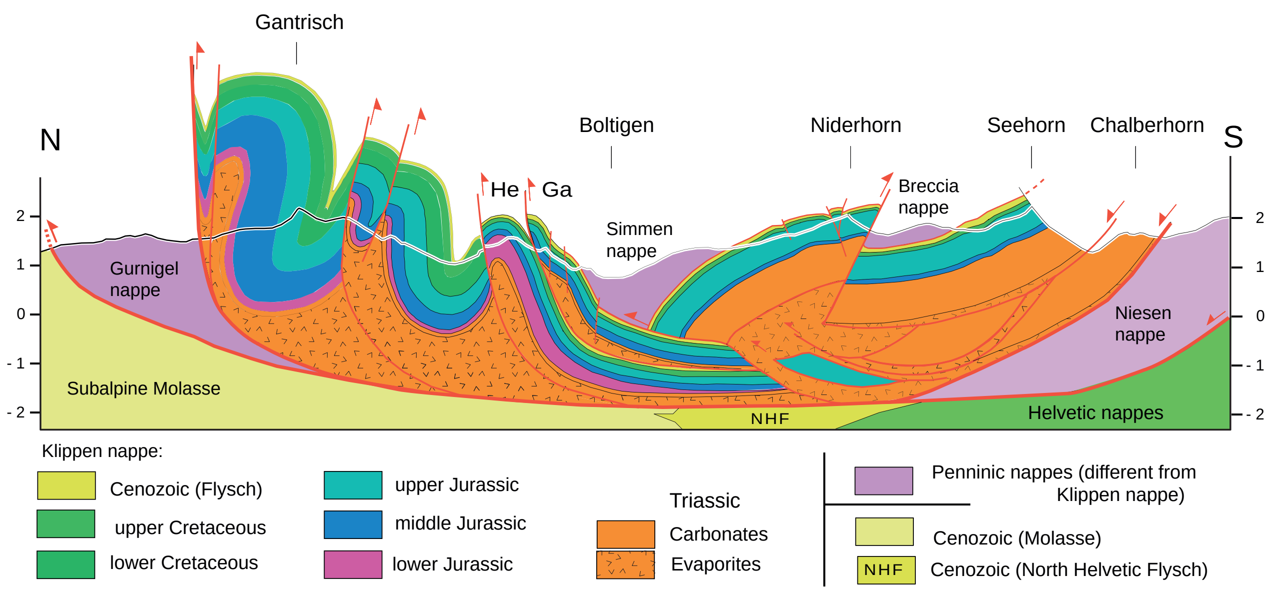


Fig. 2.1-12: Profile across the Penninic Klippen nappe of the western Swiss Alps, adapted from Wissing & Pfiffner (2002). The Klippen nappe consists of sediments of the former Brianconnais swell that have been overthrust onto sediments offscraped from the Valais basin and the Piemont ocean (Niesen and Gurnigel nappes, resp.), the nappe internal structure of the frontal, NW part of the Klippen nappe is dominated by folding, while in the inernal, SE part imbrications stemming from thrust faulting prevail.

The allochthonous nature of the Klippen nappe was discovered by Schardt (1893 and 1898) in the early stages of the discovery of nappes. Lugeon (1902) then convinced the geologists of his time of the existence of far travelled nappes (see Franks & Trümpy 2005, and Masson 1976 for a review of the history of geology). The Prealps played an important role in the understanding of nappe tectonics and mountain building. Interestingly despite the fact that the basal thrust fault is not exposed directly. The klippen nature of the thrust sheet is expressed by the morphology of the thick carbonates (mainly Late Jurassic limestones to the north and Triassic dolomites to the south) that overly shaly sandy flysch units of the Gurnigel and Niesen nappes. A trained geologist's eye is needed to locate the thrust fault and the internal folds and thrusts of the Klippen nappe.

Fig. 2.1-13: The frontal range of the Klippen nappe (Gantrisch chain, south of Bern). Mesozoic carbonates or the Klippen nappe (high peaks in the background) overly Cenozoic Flysch. The forested areas is Cenozoic Moloasse of the foreland basin. Photo: A. Pfiffner.

Fig. 2.1-14: Thrust fault at the base of the Klippen nappe in the Wirihorn area. Triassic dolomites forming the cliffs overly Cenozoic sandstones of the Niesen nappe. The thrust fault follows Triassic evaporites (anhydrite) that is transformed into cargneule near the surface. The cargneule layer is covered by scree. Photo: A. Pfiffner.

Austroalpine nappes. The Austroalpine nappes represent the deformed margin of the southern continental plate involved in the Alpine continent-continent collision. Their basal thrust once formed the Benioff-Wadati zone, a seismogenic plate boundary. The displacment along this fault zone must be on the order of a few hundred kilometers. The internal structure of the Austroalpine nappes includes an imbricate stack of cover nappes (the Northern Calcareous Alps, see below) and a stack of crystalline basement nappes.

Basal thrust of Austroalpine nappes

The basal thrust of the Austroalpine nappes, a "former continental margin" in the words of R. Trümpy (1975) appears on a tectonic map as erosional klippen (outliers), as tectonic windows (inliers), and/or as a contact swaying across the Alps in a N-S direction in eastern Switzerland (see Fig. 2.1-1), forming half-klippen and half-windows.

Famous klippen:
The most spectacular small-scale erosional relics of the Austroalpine nappes in the form of isolated klippen composed of the Austroalpine units are found in the Iberg klippen (Trümpy, in press), which represent an important key area in Central Switzerland. However, since the outcrop conditions are not very good educational value and visibility are poor.

The Matterhorn represents a "piece of Africa" (=Austroalpine nappe system), an erosional klippe of Austroaalpine units (Sesia-Dent Blanche unit) thrusted onto the ophiolites derived from the Piemont-Liguria ocean (Marthaler 2001, 2002). The basal thrust is visible in an extremely touristic area (Zermatt) visited by numerous rock climbers. Although very spectacular from a distance, accessibility is extremely limited for a number of reasons (overcrowded by rock climbers, dangerous terrane).

<u>Famous windows</u>
The two most famous windows of the Alps, the Engadine and Tauern windows expose a very significant area of Penninic units below the Austroalpine nappe system.

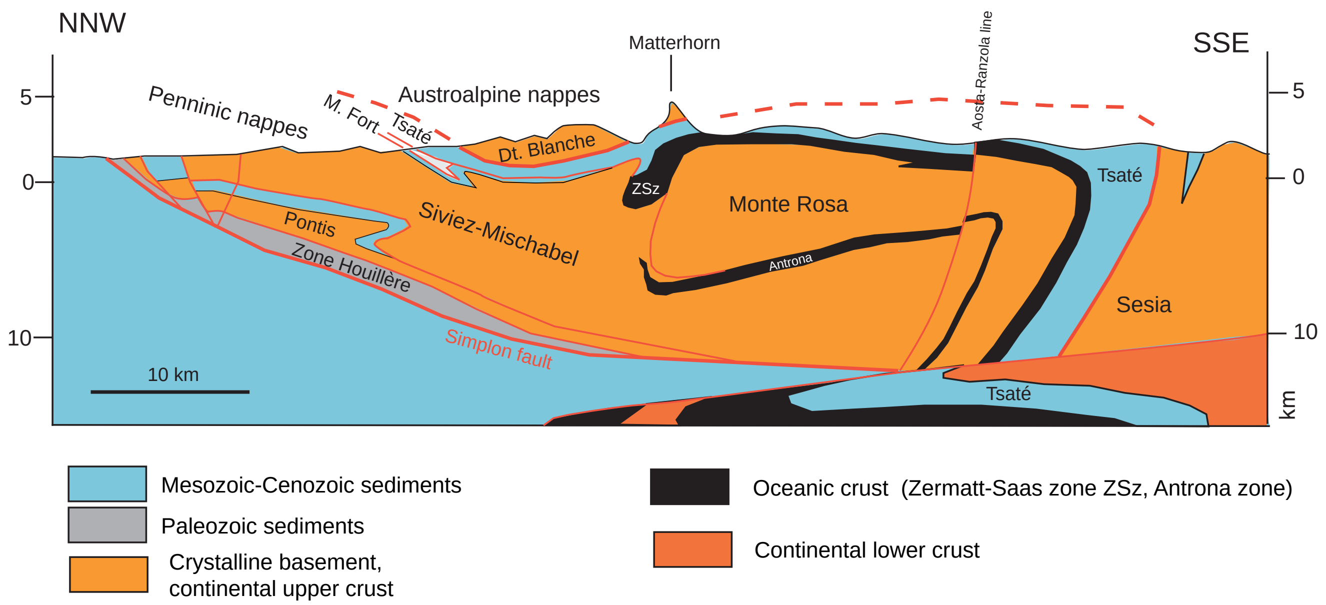


Fig. 2.1-15: Geologic profiel across the Matterhorn area showing the basal thrust of the Austroalpine nappes (Dt. Blanche nappe and Sesia zone) and its relation to the Penninic nappes in its footwall. The Simplon fault corresponds to normal fault that displaced its hanging wall toward the observer. From: Pfiffner (2005).

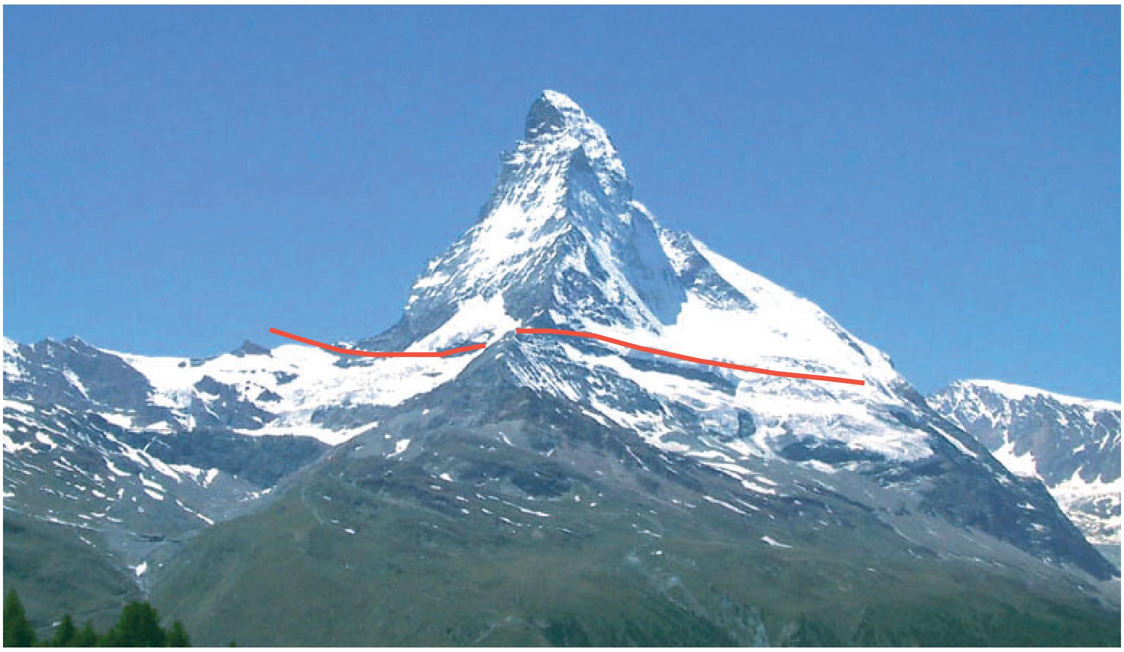


Fig. 2.1-16: Basal thrust of the Austroalpine nappes as seen at the base oth the Matterhorn.

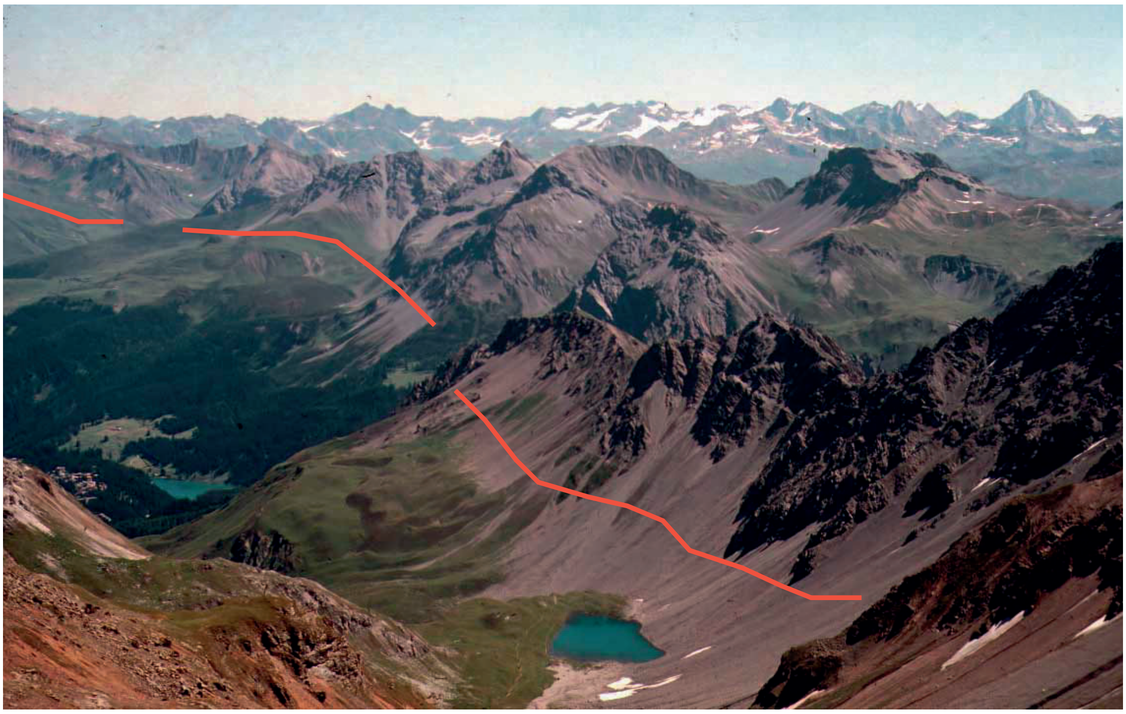


Fig. 2.1-17: Basal thrust of the Austroalpine nappes in Graubünden (Arosa area). Photo: A. Pfiffner.

Both these windows are very spectacular on the scale of a geological map. However, the nature of the 3-dimensional exposure and the visibility in the field are extremely variable in quality, although occasionally very good. However, the impact on the landscape and the observer is limited, and so is the educational value of the thrust faults defining these windows. The windows are far too large in their dimensions and hence their importance is difficult to grasp by concentrating on certain protected key areas that expose this
basal thrust of the Austroalpine nappe system. In spite of this, these windows undoubtedly are of great relevance for the history of science.

In Graubünden (eastern Switzerland) and neighboring Liechtenstein and Austria, the basal thrust of the Austroalpine nappes puts crystalline basement of the Silvretta nappe onto onto sediments and ophiolites of the Penninic nappes in the Rätikon Range. In central Graubünden, slivers of Austroalpine sediments overly the Penninic nappes. The basal thrust of the Austroalpine nappe is not a single fault surface and thus does not have a clear geomorphic expression. Geologists working and mapping this contact zone often had – and still have – difficulties to identify the tectonic provenance of individual rock units. The whole zone is in some places a tectonic mélange. There are no unique striking features associated with this thrust.

Eastern Alps

The Eastern Alps comprize the Alps east of the Rhine River and north of the Periadriatic lineament, a family of strike slip faults straddling the southern belt of the Alps. Apart the Engadine and Tauern window, the Eastern Alps are made up of rocks derived from the Adriatic margin that now build the Austroalpine nappes. This nappe system formed in Late Cretaceous times owing to suduction of the Piemont-Ligurian ocean beneath the Adriatic margin of the Apulian continental plate (a promontory of the African plate). In Cenozoic times a more N-S oriented contraction deformed the nappe pile, displacing it in a northerly direction and deforming the basal thrust of the Australpine. A genereal cross section is given in Fig. 2.1-2c.

Northern Calcareous Alps / Inntal thrust

The Northern Calcareous Alps are a stack of thrust sheets made up of Mesozoic, mainly calcareous sediments that had been deposited on the Adriatic margin. In Late Cretaceous times, this cover was sheared off its crystalline substratum and transported over more than 100 km to the WNW. In the course of this nappe formation, the strata were internally shortened such that the entire nappe complex now contains several large-scale thrust sheets (Arlberg, Lechtal, Inntal thrust to name the most important thrust faults) and folds. Figure 2.1-19 is a general cross section taken from Eisbacher et al. (1990).

Fig. 2.1-18: View of the Inntal thrust (In) in Lachtal. Triassic carbonates of the Hauptdolomit formation (Tr) forms cliffs in the footwall and in the hanging wall of the thrust fault. The actual fault contact is concealed beneath the grass covered Cretaceous strata. Photo: A. Pfiffner.

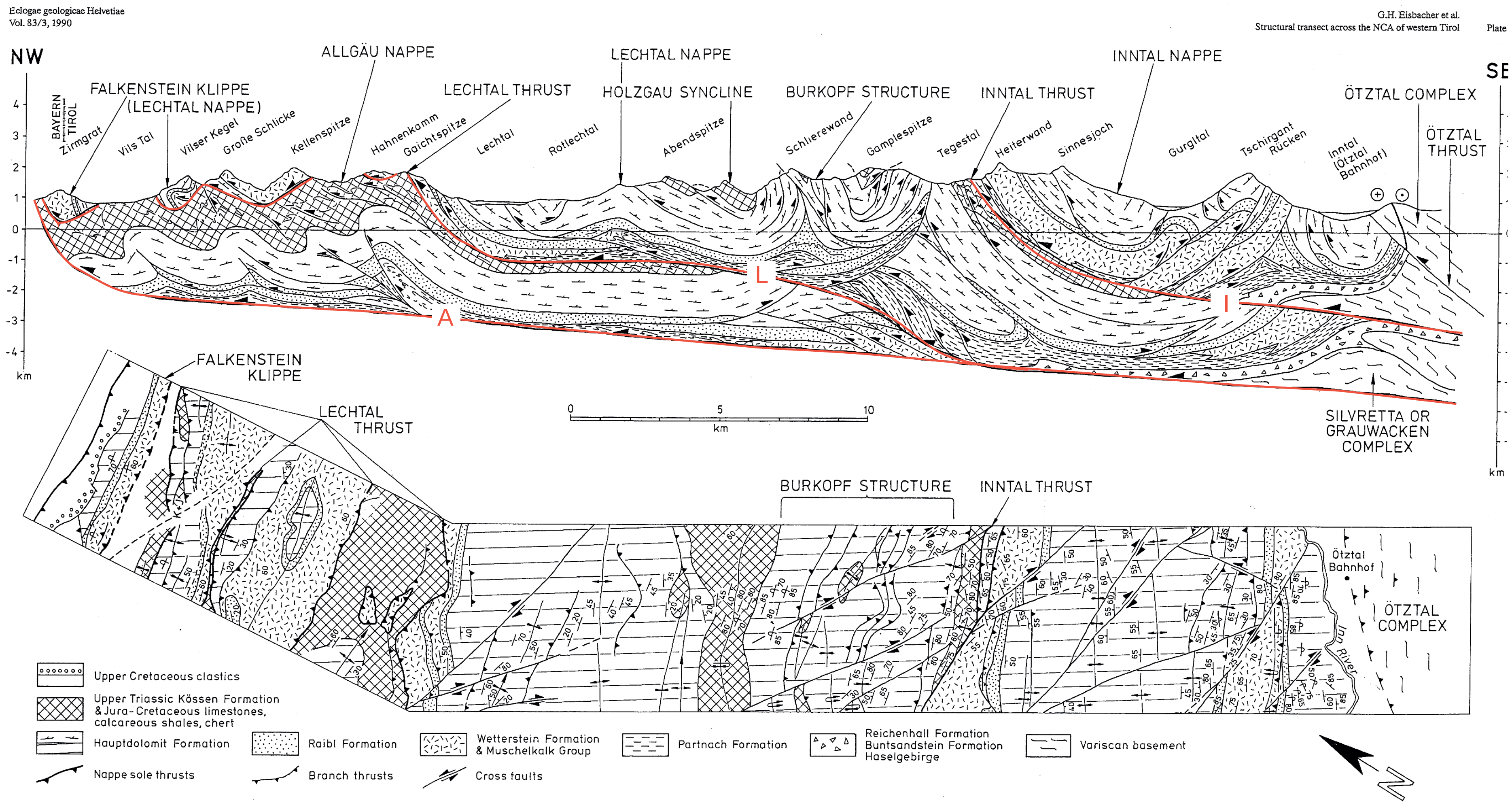


Fig. 2.1-19: Cross section through the Northern Calcareous Alps. From Eisbacher et al. (1990). Main thrust faults are, from bottom to top, Allgäu (A), Lechtal (L) and Inntal (I) thrust.

Tauern Window / Base Austroalpine and thrust faults in Penninic nappes

In the Hohe Tauern area crystalline basement derived from the European continental margin outcrops amidst Mesozoic sediments. These sediments include the autochthonous Mesozoic cover of this basement and a stack of Penninic and Austroalpine nappes. The crystalline basement and associated metasediments compare to the basement uplifts in the Western and Central Alps, and the Mesozoic cover sediments resembles those of the Helvetic zone in the Swiss Alps. The overlying, allochthonous Mesozoic Bündnerschiefer can be attributed to the Penninic nappes of the Western and Central Alps. They were deposited either in the Valais basin or in the Piemont ocean of the Penninic zone. Interlayered ophiolites of the Matrei zone are most likely remnants of the Liguria-Piemont ocean. The top most units pertain to the Austroalpine nappes and consist of crystalline basement rocks and, locally Paleozoic-Mesozoic sediments. They are derived from the Adriatic continental margin.
Fig. 2.1-20 is a cross section through the western Tauern window showing the folded thrust faults marking the boundary of the window. Thrust contacts between at base of Penninic and Austroalpine nappes nearly parallel to bedding in autochthonous cover of Helvetic. Some thrust

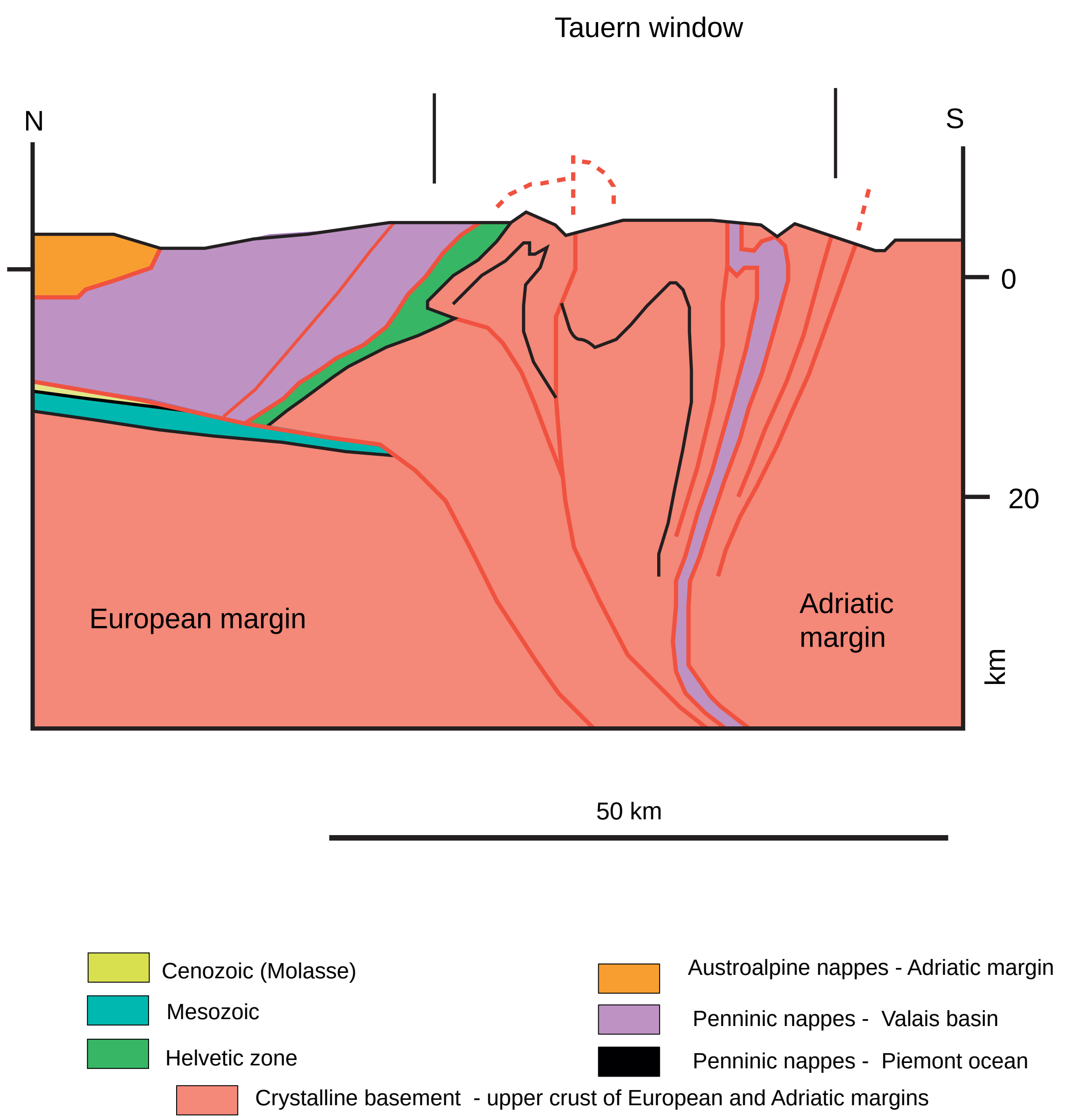


Fig. 2.1-20: Geological profile across the Tauern window showing the deformed nappe pile. From: Pifffner (2005).

sheets are dismembered into slices. All these thrusts were deformed passively when the Tauern basement uplift formed, i.e. Cenozoic age. Incipient age of thrusting was Late Cretaceous and WNW directed within the Austroalpine nappes. The Penninic nappes were emplaced later, in Early Cenozoic times and in a NNW direction. An important normal fault (Brenner fault) sliced through the nappe contacts on the western border of the Tauern window in Neogene times.

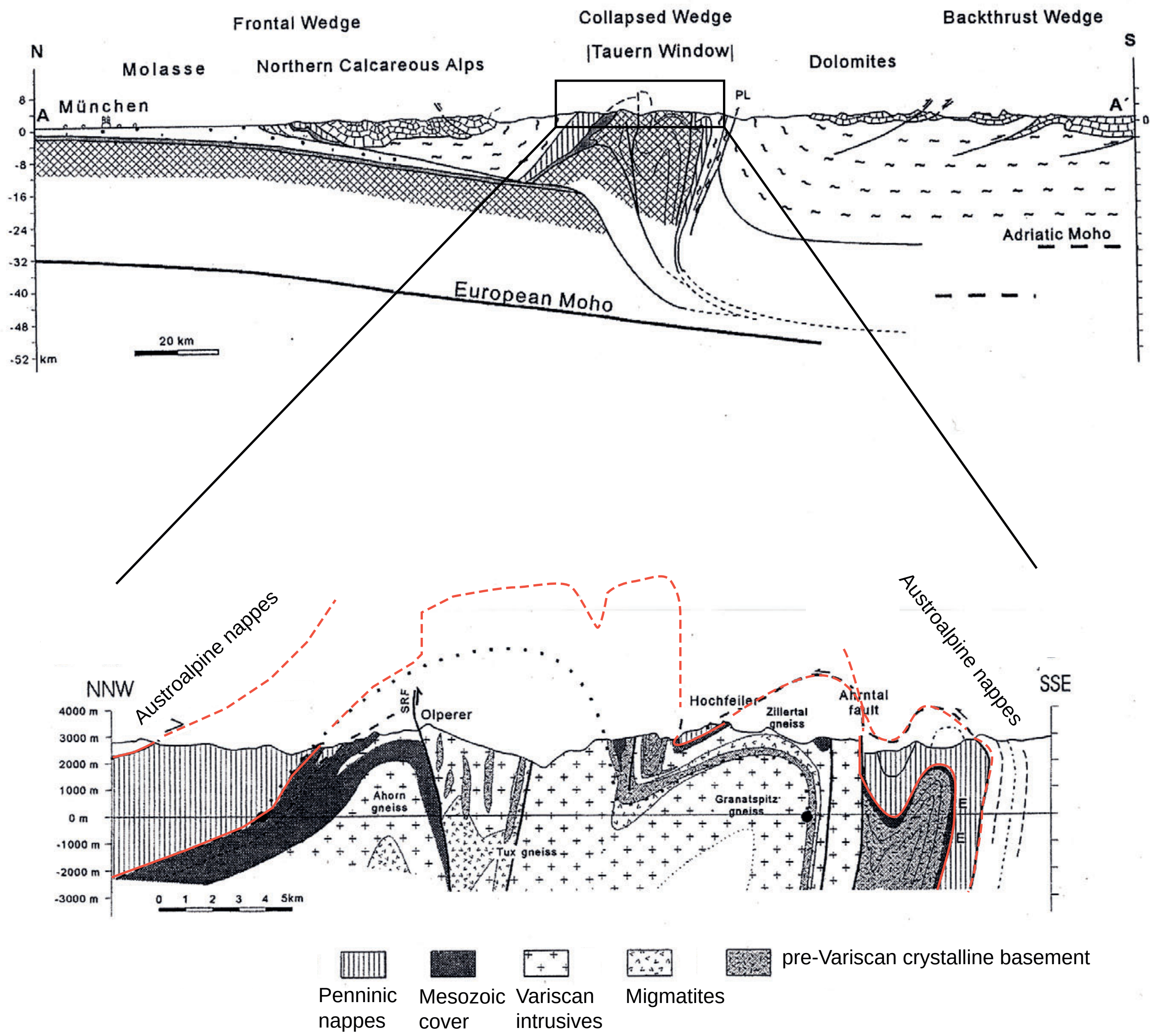


Fig. 2.1-20: Geological profile across the Eastern Alps and the Tauern Window. Adapted from Lammerer and Weger (1998). The Tauern Window has a core of crystalline basement rocks of the European crust forming a large-scala antiform. The basal thrusts of the Austroalpine and Penninic nappes outline this antiform, but in the window itself these nappes were eroded. The Penninic nappes have additional thrust faults in their interior not shown in this cross section.

2.2 Pyrenees

The Pyrenees are a young mountain chain that resulted from the oblique, left-lateral convergence between the Iberian and the European plates from Late Cretaceous times onward. After well over one hundred years of exploration, mapping and intense research including deep reflection seismic soundings, the degree of knowledge and detail in analysis is comparable to the Alps. The Alps and the Pyrenees share many common points : both orogens are bivergent with foreland basin "clastic wedges" and well developed, thin-skinned foreland fold-and-thrust belts on either side. The general character of the sedimentary rocks involved in the exernal zones is quite similar too. The Alps and the Pyrenees involve a passive margin series of sediments that were deposited along the southern margin of the larger European plate from Late Permian times onward. Both areas have undergone a very similar history of Variscan mountain building and were involved in a new, Alpine cycle of rifting – drifting in association with the opening of the Alpine Tethys and Atlantic oceans. A major décollement level for thin skinned tectonics in both Pyrenees and Alps are Triassic evaporites (so-called "German Keuper").

Figure 2.2-1 displays three crustal scale sections across the Pyrenees (from Barnolas & Pujalte 2004). They show that two continental blocks are adjacent to each other with thrusting to the north and the south. This structure formed by oblique convergence from Late Cretaceous onward (see e.g. Vera 2004).

When the internal zones of the two mountain ranges are compared, however, there are also marked differences. The most important one is the lack of a well defined "suture zone" with obducted remnants of oceanic crust, let alone rocks which underwent high-pressure/low temperature metamorphism associated with "Alpine", i.e. Cretaceous to Neogene deformations. Most models depict the Pyrenees as the result of an important horizontal shortening between Spain and France, with the Iberian lithosphere plunging northward down under the European one. It is not so clear, however, if this "subduction" ever involved any substantial amount of oceanic crust and lithosphere. In this sense, the Pyrenees do not qualify as a typical continent – continent collision orogen, but are rather to be considered as a very severely inverted intracontinental mountain range, with an important component of left lateral strike slip motion.

Gavarnie thrust

The thin-skinned thrust system of the southern flank of the Pyrenees belongs to one of the best studied foreland fold-thrust belts of the world. A Mediterranean climate, with a hot dry summer season is responsible for a thin cover of topsoil and sparse vegetation all along the foothills on the southern, Spanish side of the Pyrenees. This is responsible for excellent outcrop conditions, much appreciated by field geologists. Most of the thrusts proper are however not exposed at the earth surface, but inferred from the observation of folds. Extensive petroleum exploration within the foreland basins provides additional constraints from reflection seismic lines and drill holes. Accordingly, structural sections across the southern foreland of the Pyrenees are of high technical quality and they have been the subject of major publications in the (structural) geologic literature.

One of the outstanding features of the southern Pyrenean foothills, which has attracted the attention of the international community of structural and sedimentary geologists, is the fact that folding and thrusting have taken place simultaneously with sedimentation of clastic series deposited atop the evolving folds within a large intracontinental foreland basin in Eocene to Oligocene times. This locally allows for a quantitative study of the progressive evolution of anticlines and frontal thrusts with time. Comparable situations are rare within other orogens. Figure 2.2-2 (top) shows three representative structural sections across the southern foreland fold-thrust-belt of the Spanish Pyrenees. They highlight the involvement of Paleocene-Eocene foreland basin sediments

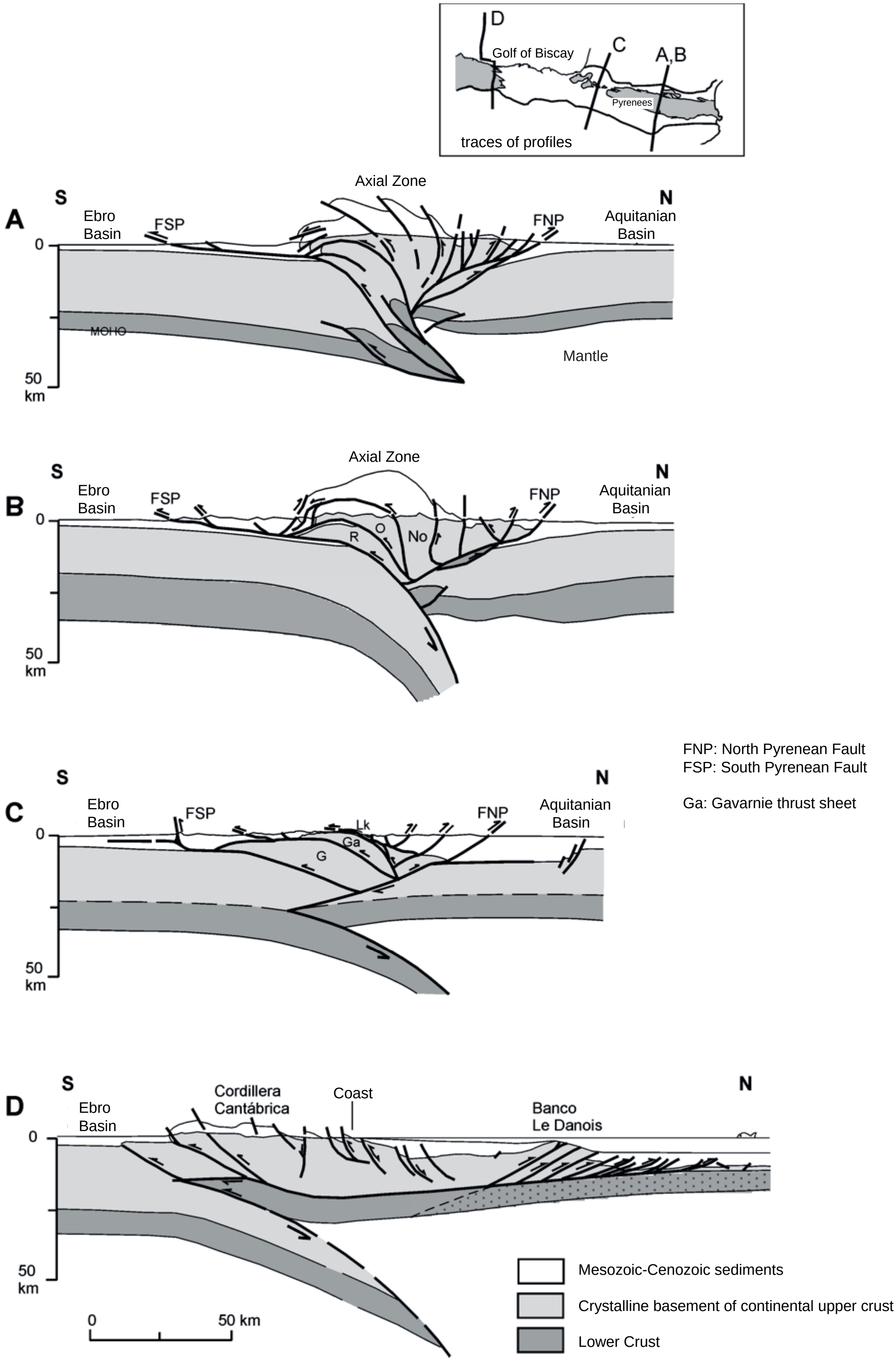


Fig. 2.2-1: Crustal scale sections across the Pyrenees. From: Barnolas & Pujalte (2004, fig. 3.57).

in thrusting and folding. Some of these structures are well documented as syn-sedimentary (Barnolas & Pujalte, 2004).

Backward, towards the so-called "Axial Zone" of the Pyrenees, crystalline basement is involved in crustal scale shortening in a more "thick skinned" fashion, where thrusts affect an important portion of the pre-Triassic upper crust of complex of Variscan origin. This situation again bears its close analogy with the Alps, where the so-called "external crystalline massifs" on the northern flank are responsible for a late domal uplift and deep concommittant erosion of the overlying nappe stack. As in the Alps, the best exposures of the Pyrenean thrust planes are found in this higher portion of the chain in Alpine outcrop and vegetation conditions.

A representative section across the Axial zone of the central Pyrenees is given in Figure 2.2-2 (bottom). In this section, the projected trajectory of the Gavarnie thrust describes a large-scale antiform above the Granodiorite massif of Maladeta (Barnolas & Pujalte, 2004). The Gavarnie thrust is the best example of such an antiformal structure within the Axial zone of the Pyrenees.

There are a series of striking similarities between the Pyrenean Gavarnie and the Alpine Glarus thrust. First of all, the overall geometry is quite similar in that both thrusts are exposed above a large scale antiformal structure that formed during later thrusting in its core. Both thrusts "rooted" within the central part of the orogen, at a former depth corresponding to more than 10 km, well within greenschist facies p-T conditions. Towards the foreland, both thrusts plunge below topography, where they are thought to connect with some of the more frontal, hinterland-dipping thrusts. The Gavarnie, just as the Glarus thrust, did not suffer any major deformation in relation with this later arching and uplift and both thrusts are exposed as sharp planar surfaces in the landscape.

A spectacular view of the Gavarnie thrust can be gained near Pic de Port Vieux. Here, a thin limestone band is an intensely sheared and deformed tectonite that marks the contact beween Silurian clastics and carbonates above and Cretaceous sediments in the footwall of the thrust (see Fig. 2.2-3a). A yellowish band consisting of a limestone outcrops along the thrust contact (Fig. 2.2-3b). In a close up view (Fig. 2.2-3c), this limestone tectonite is nearly indistinguishable from the Lochseiten calc mylonite found along the Alpine Glarus thrust.

The similarities between Glarus and Gavarnie go even further. Both thrust faults are lined with a thin layer of limestone tectonite – sandwiched between Paleozoic clastics in the hanging wall and generally younger sedimentary rocks in the footwall. This limestone tectonite has attracted the attention of structural geologists, and just as in the case of the Glarus thrust, large quantities of fluids were involved during thrusting along this contact as McCaig et al. (1995) could demonstrate. The same conclusion, namely the importance of water as an agent favoring large thrust displacements, has been reached by Teixell et al. (2000) for the Larra thrust, the next higher thrust above the Gavarnie thrust in the larger Pyrenean duplex system (see Fig. 2.2-4).
However, folds and thrusts above and beneath the Gavarnie thrust are not particularly visible, except to the trained eye of the geologist. In this respect, even in its best exposures the Gavarnie thrust is not comparable to the "magic" sharp horizontal line cutting through the top of the Glarus Alps.

<u>Geomorphic expression</u>
The central Pyrenees display a typical Alpine landscape with snow and glacier covered peaks, steep rocky cliffs and green meadows. The timber line at around 2000 m above sea level is located well below the highest peaks that reach up to 3408 m above sea level. Like the Alps, the Pyrenees attract tourists including hikers and mountain climbers. The "cirque de Gavarnie", located within the "Parc National des Pyrénées" is one of the main tourist attractions on the French side of the Pyrenees. On the southern side of the drainage divide, this national park adjoins the "Parque nacional de Ordesa y Monte Perdido", equally a major tourist attraction easily accessible within a few hours from the Spanish lowlands of the Ebro basin. The geomorphic and climatic contrast between

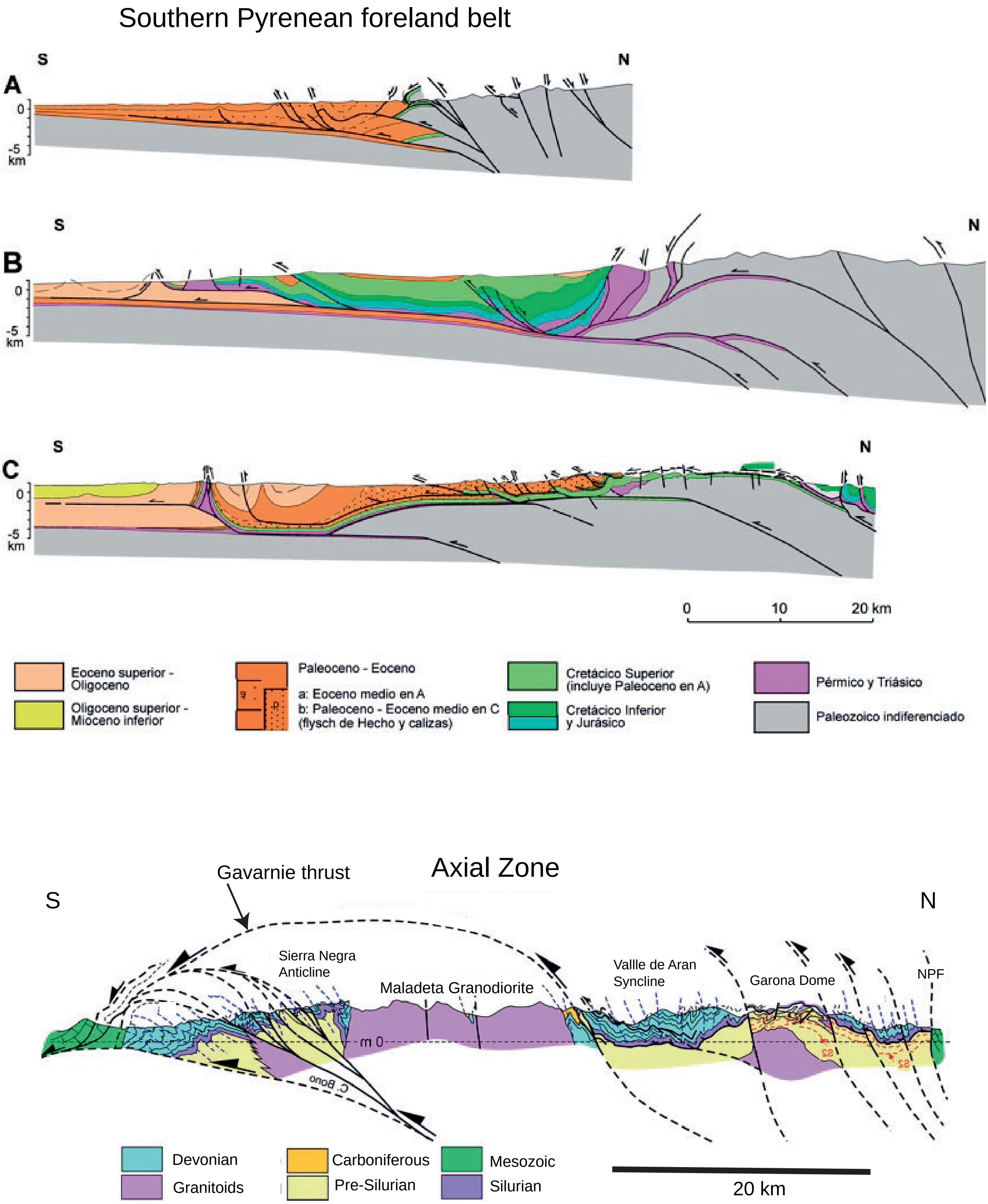


Fig. 2.2-2: Detailed cross sections through the Pyrenees. Adapted from Barnolas & Pujalte (2004). Top: Three representiative structural sections across the southern foreland fold-and thrust belt of the Spanish Pyrenees. Note the involvement of Paleocene-Eocene foreland basin sediments in thrusting and folding. Some of these structures are well documented as syn-sedimentary. Bottom: Representative section across the Axial zone of the central Pyrenees. Note the projected trajectory of the Gavarnie thrust that is describing a large dome-shape above Ganodiorte massif of Maladeta.

a) The Gavarnie thrust near Pic de Port Vieux: a thin limestone band (in the foreground) is an intensely sheared and deformed tectonite lining the contact beween Silurian clasitcs and carbonates (in the backgroud) above and Createours sediments in the footwall.

b) Outcrop of the Gavarnie thrust near Pic de Port Vieux. The yellowisch ban running from top right to bottom left is the limestone tectonic lining the Gavarnie thrust. Red beds in the hanging wall are Devonian in age thrust over black Cretaceours flysch in the footwall; the thrust direction was from right (north) to left (south).

c) Close up view of the Gavarnie limestone tectonic – a rock indistinguishable from the Lochseiten calc mylonite found along the Alpine Glarus thrust. Thrusting direction is top to the left (south).

Fig. 2.2-3: The Gavarnie thrust seen in the field. Photos: M. Burkhard.

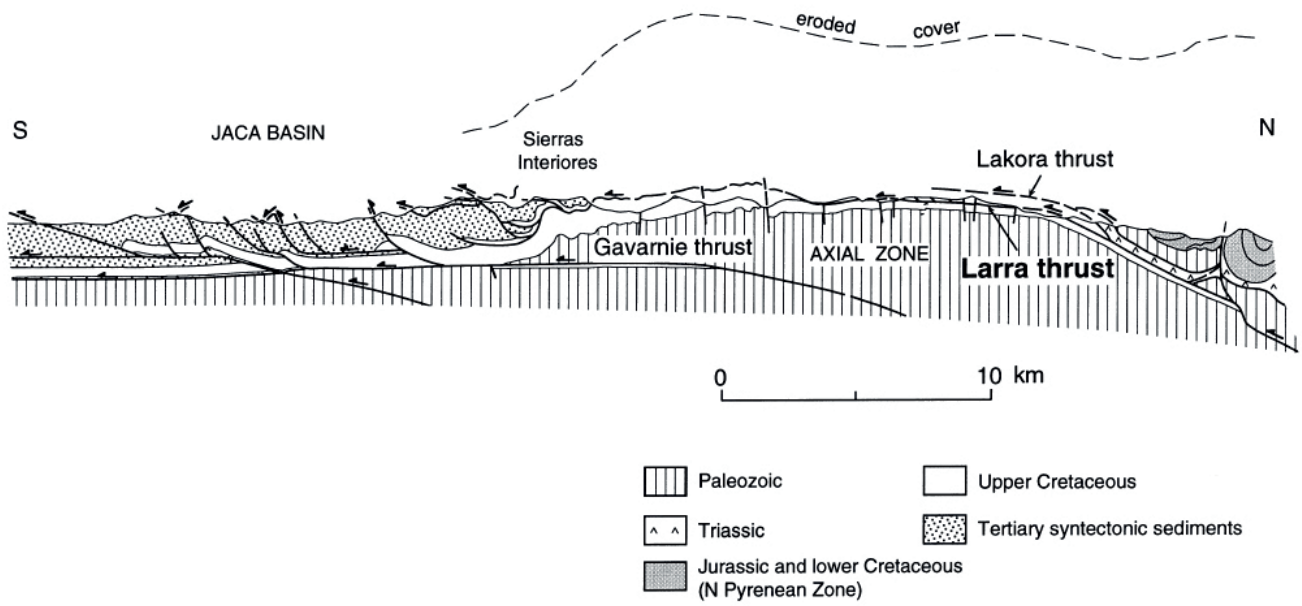


Fig. 2.2-4: Profile across the Sierras Interiores of the Central Pyrenees. From Teixell et al. (2000). The cross section shows the relationship between the Gavarnie and the higher Larra thrust.

the rather dry and barren southern foothills and the high Alpine peaks is quite spectacular, and this certainly makes the southern side of the Pyrenees very attractive.

Historical perspective

The geology of the Pyrenees has been studied for well over a century, mostly by French and Spanish geologists. The Pyrenees attracted an ever increasing number international geologists from the middle of the 20th century onward. Important discoveries and features include a narrow zone with outcrops of mantle rocks found along the North Pyrenean fault and an associated, but still quite enigmatic high-temperature metamorphic aureole. The deep structure of the Pyrenees has been clarified only in the late 1980's with the help of crustal scale seismic profiling by the ECORS Pyrenees Team (1988). The Pyrenees are now known in the geologic literature as type example of an intracratonic orogen developed along a former lithospheric strike slip plate boundary, but without any major subduction of oceanic lithosphere.

2.3 Caledonides

The Caledonides are a mountain range that formed after closure of the Iapetus Ocean and collision of the North American continental plate with the continental plate of Baltica and the Eastern Avalonian micro-continent some 400-450 million years ago. The orogen is now exposed on both sides of the North Sea in Europe (Scotland and Scandinavia), but also on both sides of the North Atlantic (Greenland and Appalachians). Numerous thrust faults emanated from the collision of smaller and continental fragments and continents.

Scottish Caledonides

In the Caledonides of Scotland, thrusting occurred mainly to the W or NW. As shown in Fig. 2.3.2-1, thrust faults forming duplexes with relatively small displacements are separated by major thrust faults (Glen Oykel, Ben More and Moine thrust). Vergence of thrusting is towards the west, i.e. thrust sheets were emplaced onto the ancestral North American craton. Contrary to this, vergence of thrusting is towards the east in the Scandinavia, making the Caledonides a symmetrical orogen.

Moine thrust

The Moine thrust puts Lewisian gneisses, metasediments and Cambrian quartzites onto a nappe stack made up of Lewisian gneisses and Cambro-Ordovician sedimentary strata. As discussed by Strachan et al. (2002), the thrust fault itself is associated with a mylonite belt attaining locally thicknesses of several hundreds of meters. The age of this mylonitization is 435-430 Ma (Silurian) and took place at mid-crustal levels. Transport was W-directed and the displacement can be estimated at 100 km.

Beneath the Moine thrust, Lewisian gneisses with a North American (Grenvillian) affinity and Torridonian to Cambro-Ordovician sedimentary rocks are intricately deformed. Thrusting is interpreted to have occurred in-sequence mostly, and the individual thrust faults are sharp thrusts with indications of brittle deformation (Strachan et al. 2002). It thus seems that these structures formed at relatively high crustal levels within anchizonal conditions at peak temperatures of around 275°C. The major lower thrust (or sole thrust) is localized in Cambrian Fucoid beds and quartzites in the north, and in shale horizons in the south. Locally the internal structure includes large-scale folds with inverted limbs, which can be interpreted as footwall ramp synclines.

Downward and in-sequence thrusting is demonstrated by the Moine thrust being passively folded above an antiformal stack in its footwall (Strachan et al. 2002) and by the fact that the Moine thrust sheet displays a higher degree of metamorphism than the rocks beneath. It thus seems that hot, mid-crustal rocks were transported along the Moine thrust to shallow level onto cooler rocks before thrusting propagated downwards into the footwall. However, in the case of the Glen Oykel and

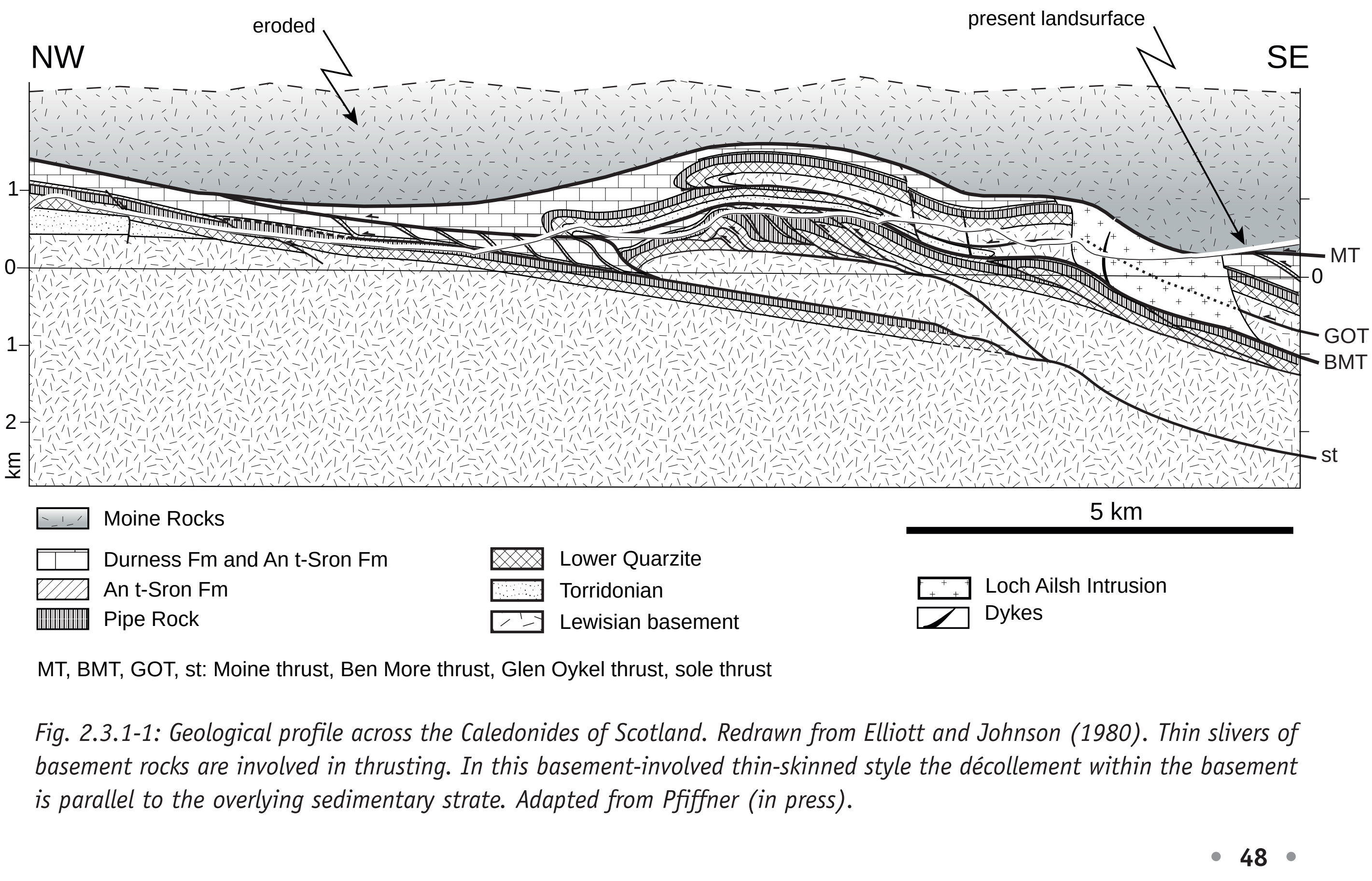


Fig. 2.3.1-1: Geological profile across the Caledonides of Scotland. Redrawn from Elliott and Johnson (1980). Thin slivers of basement rocks are involved in thrusting. In this basement-involved thin-skinned style the décollement within the basement is parallel to the overlying sedimentary strate. Adapted from Pfiffner (in press).

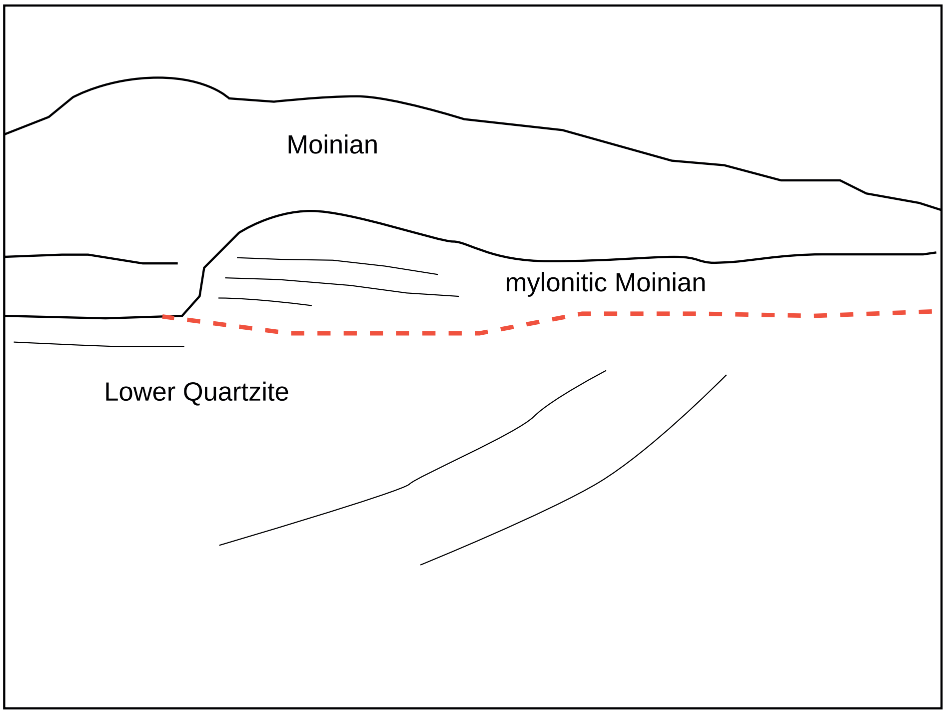


Fig. 2.3.1-2: Moine thrust at Loch Glencoul. Crystalline basement rocks of the Moine Thrust sheet overly Lower Quarzite and Lewisian basement rocks. The thrust contact is marked in the morphology as a flat surface. Photo: A. Pifffner.

Moin thrusts propagation was out of sequence (at least as far as the final motion along the Moine thrust is concerned). This is indicated by the Loch Ailsh intrusion, which post-dates the Glen Oykel thrust, but pre-dates the Moine and Ben More thrusts. Moreover, the intrusion points towards a warm crust within the growing orogen. As is evident from Figure 5, the major thrust faults are nearly parallel to each other and close to bedding-parallel. This parallelism, together with the brittle nature of many of the fault rocks seem to indicate that the thrust trajectories were less controlled by lithologic discontinuities, but rather by p-T conditions. Displacements along the thrust faults beneath the Moine thrust are between 1 km and 10 km only, which might explain the absence of thick mylonite belts, as is the case for the Moine thrust itself.

Fig. 2.3.1-3: Moine thrust at locality Knockan Crag. Crystalline basement rocks (Moinian) overly Paleozoic carbonates. The upper photograph is taken at the protected site showing a sharp thrust contact. The lower photograph is taken some 2 km farther N. The thrust contact follows the river. Photos: A. Pfiffner.

At outcrop, the Moine thrust representing the most important thrust fault in this orogen is recognized mainly by ist geomorphic expression (see Fig. 2.3.3-2). The mylonites along the thrust fault form a a shallow dipping surface with a steeper slope beneath and above. Owing to the climatic conditions the thrust fault itself is covered by vegetation. Singular, but nevertheless spectacular outcrops are found at Knocking Cragh. Here the thrust fault can be touched and the phenomenon is explained to the general public. It is also this site where the geologists in the 19th century were battling over the interpretation that older rocks lie on top of younger rocks. The importance of this site to the history of geology is comparable to the situation at the Glarus overthrust.

<u>Historical importance</u>

The Moine thrust is famous for the controversy around the interpretation of the ages of the rocks near the fault contact. R.I. Murchison and his collaborator A. Geikie from the Geological Survey held the view that the Moine rocks must be "Silurian", i.e. younger than rocks in beneath with a

Cambrian age. J. Nicol, Professor at Aberdeen, on the other hand had a different interpretation. He explained the juxtaposition of the strata by faulting. In his view, faulting put older rocks onto younger rocks. Nicol and Murchison visited NW Scotland in 1855 together to discuss the controversy. They could not reach an agreement and in the following their ways separated. Nicol was subsequently almost ridiculed by Murchison for his view on faulting and died 1879 as an unrecognized figure. Folowing the recognition of large-scale thrust surfaces, the Moine thrust belt in the Assynt and Eriboll districts was described in detail as one of the first worldwide by Callaway (1883) and Lapworth (1883). These discoveries led to a major mapping program by the Geological Survey, the results of which were eventually published in the epoch-making NW Highlands Memoir (Peach et al., 1907) and, particularly, the special geological map of the Assynt district (Flett, 1923).

Scandinavian Caledonides

Together with the Scottish Caledonides and the Appalachians, the Scandinavian Caledonides once formed a bivergent mountain belt. In Late Paleozoic and Mesozoic times, the opening of the North Sea and the Atlantic ocean dismembered this mountain range. In the part now found in Scandinavia, several thrust faults can be recognized. Thrusting occurred to the east (see Fig. 2.3.2-1).

Jotun thrust and/ Sparagmite nappe

A large basement block, the Jotun nappe, was thrust onto the margin of the Baltic shield, telescoping the latter's sedimentary cover. As a result, several duplexes of Paleozoic rocks were pushed in an easterly direction onto the craton. The rocks in the vicinity of the thrust faults were heavily deformed in the process. A well known example are the Bygdin conglomerates that outcrop in the footwall of the Jotun thrust (see Fig. 2.3.2-2). The explanation of the Jotun basement block as a displaced thrust sheet caused some discussion amongst geologists but was recognized early on.

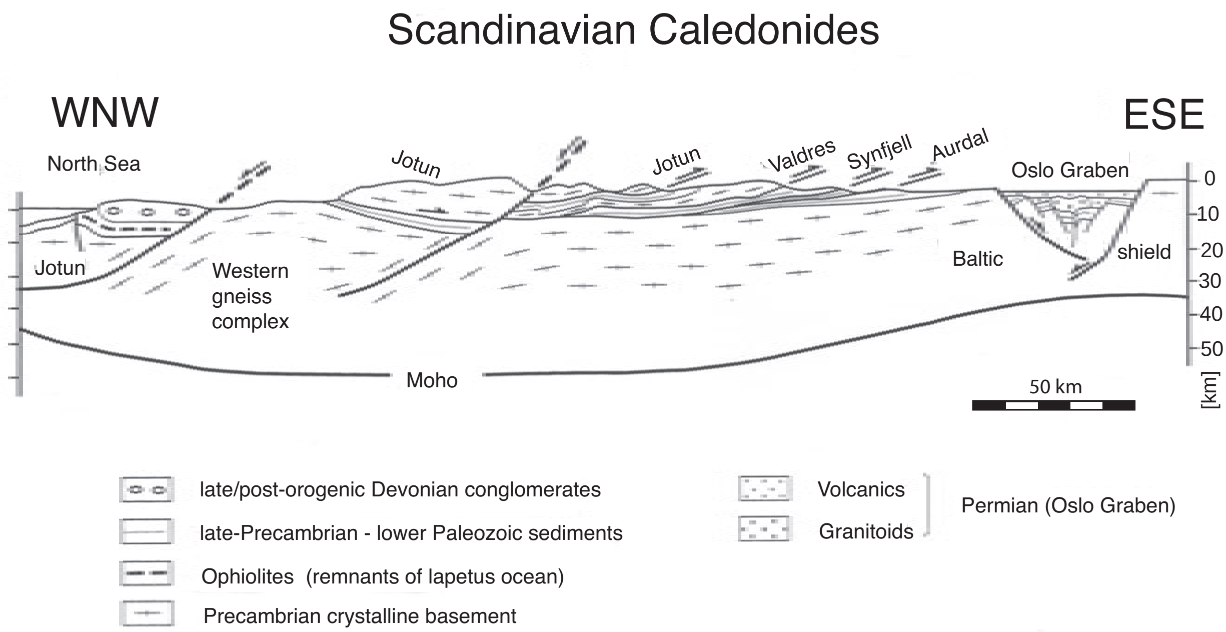
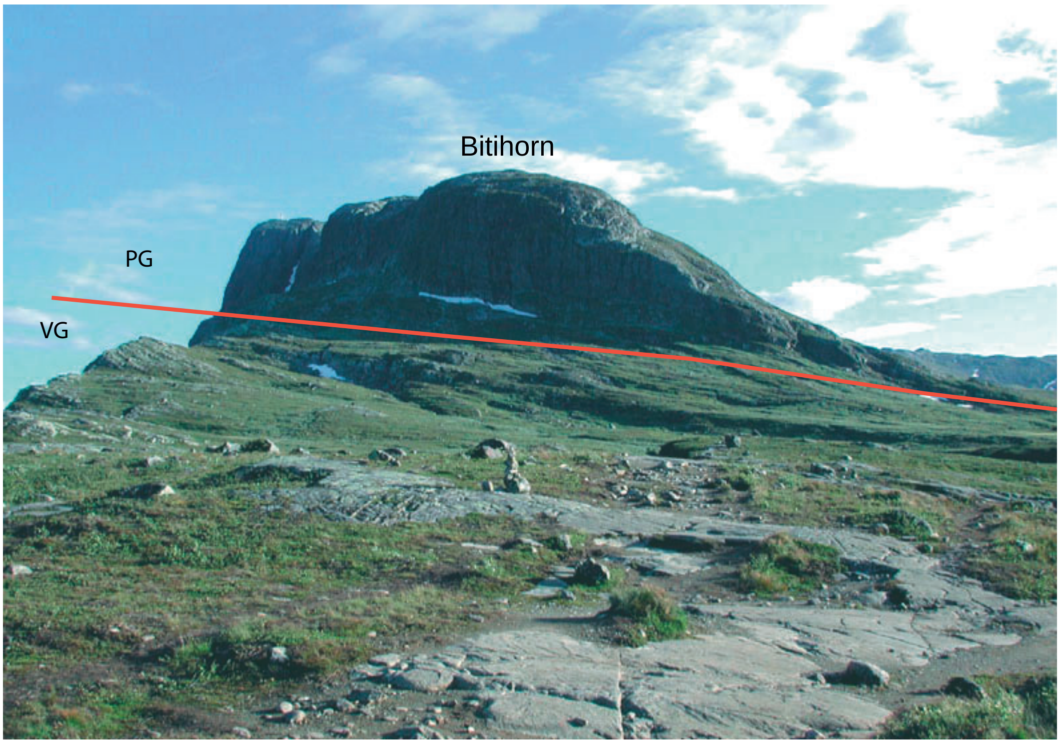


Fig. 2.3.2-1: Geological profile across the Scandinavian Caledonides. Aurdal and Synfjell thrust sheets are thrust eastward onto the Baltic shields and involve sedimentary rocks. The Valdres thrust sheet contains also some crystalline basement rocks. The Jotun thrust sheet only crystalline rocks. From: Pfiffner (2005).

At outcrop the Jotun thrust expresses it by the morphology, while the actual thrust plane is only locally exposed in more detail.

The "Sparagmite nappes" form a nappe system with several imbricate thrust faults. The Aurdal and Synfjell thrusts repeat Late Precambrian to Early Paleozoic strata – much of which belongs to the Sparagmite group. The Valdres thrust sheet involves crystalline basement as well. Similar to the situation along the Jotun thrust, a geologic map is needed to recognize the fault contacts in the field. Nappe structures were recognized in Scandinavia by Waldemar Brogger (University of Stockholm) in the Oslo area in 1882 and by Törnebohm ("Sparagmite nappes") in 1886.



The Jotun thrust puts Precambrian gneisses (PG) forming the Bitihorn onto sediments of the Valdres Group (VG) outcropping in the flat foreground. The Valdres Group contains the famous deformed Bygdin conglomerates. Photo: Arnt Flatmo.

Detailled view of Bygdin conglomerate containing highly stretched pebbles. These rocks were deformed in the footwall of the Jotun thrust.

Fig. 2.3.2-2: Jotun thrust in the Bygdin area (Valdres, Norway).

3 Asia

3.1 Himalayas

The Himalaya-Tibetan orogen resulted from the collision of the Lhasa Terrane with Eurasia in mid-Cretaceous times and the following collision with India from 65 Ma on (Patriat and Achache 1984, DeCelles et al. 2002, Steck 2003). As is evident from the recent seismicity and uplift, this collision is still active. Figure 3-1 is a cross section across the Himalayas and the Tibetan Plateau of Nepal and Tibet drawn after Cattin & Avouac (2000), DeCelles et al. (2001 and 2002) and Hauck et al. (1998). The cross section shows a continental crust beneath the Tibetan Plateau with an extraordinary thickness of 70-80 km, which has been determined by seismic experiments of the INDEPTH program (Zhao et al. 1993, Nelson et al. 1996, Hauck et al. 1998). Shortening within the Himalayas is estimated at 450 km (Steck 2003) to 670 km (DeCelles et al 2002), i.e. roughly the width of the Tibetan Plateau, which indicates a minimal shortening rate of 10-15 mm/yr. This is slightly lower than the 20 mm/yr estimated by Cattin & Avouac (2000) for Plio-Pleistocene movements. The Indus-Tsangpo suture with remnants of oceanic sequences is an important feature in the cross-section, which stems from the closure of the Neotethys Ocean in a N-dipping subduction zone at the southern margin of Eurasia. In Cenozoic times, this margin was formed by the Lhasa terrane, which had been accreted to the Eurasian plate in Early Cretaceous times.

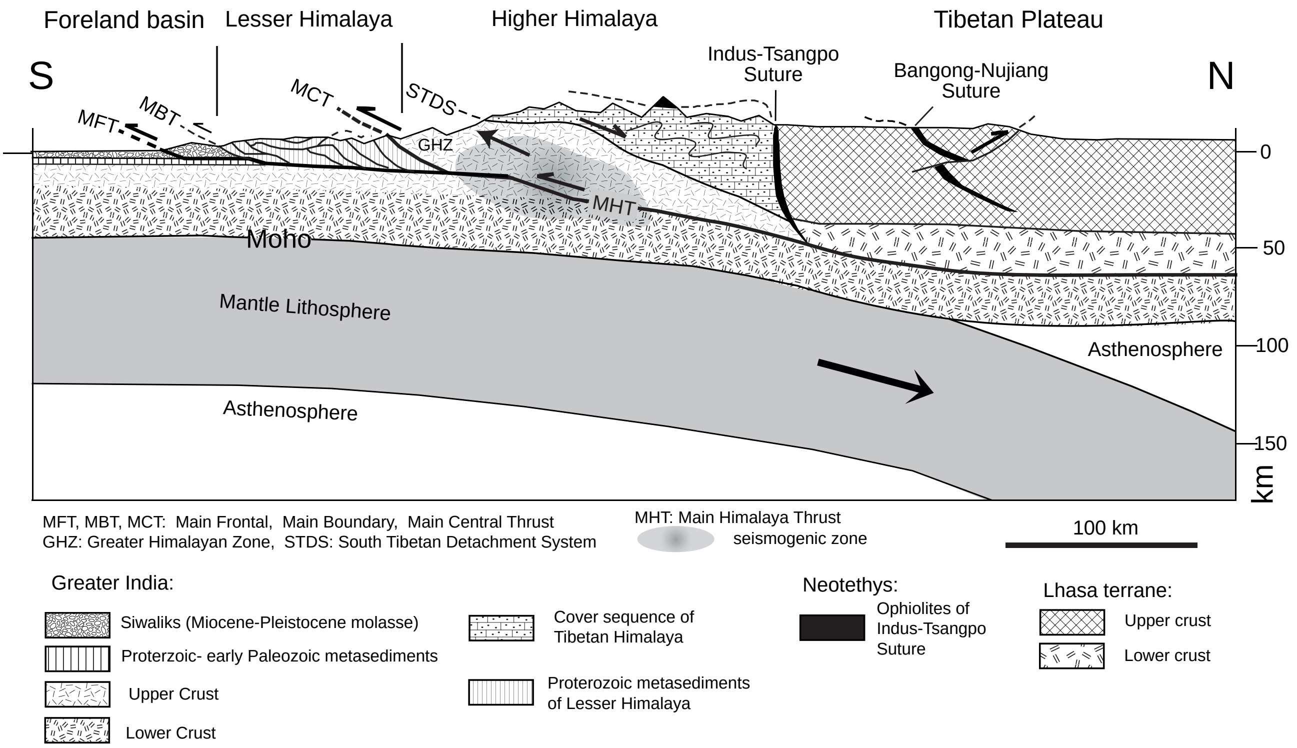
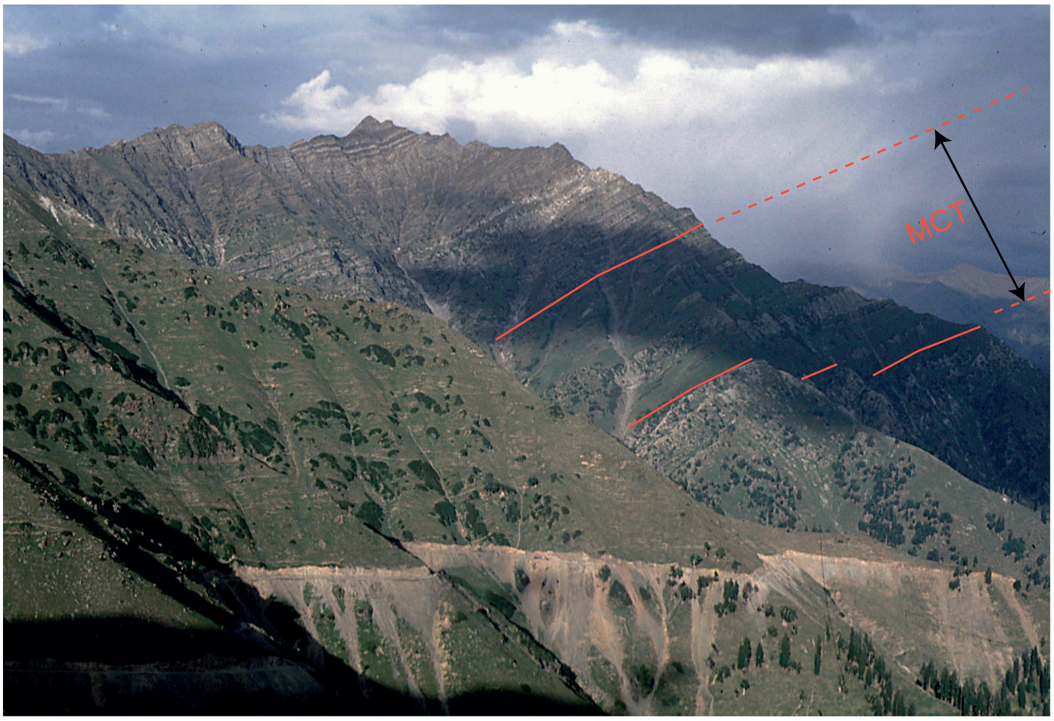


Fig. 3.1-1: Geological profile across the Himalayas of Nepal and Tibet, constructed from cross-sections by Cattlin & Avouac (2000), DeCelles et al. (2001 and 2002) and Hauck et al. (1998). Several major thrust faults affect the cover sequence of the leading edge of the Indian plate and merge depht into the Main Himalayan Thrust. The Main Central Thrust is also shown to merge into the Main Himalayan Thrust. The "Crystalline Nappe" in its hanging wall consists of crystalline basement rocks. The South Tibetan Detachment System, a normal Fault system, forms the top of this nappe. Coeval activity of the South Tibetan Detachment System and the Main Central Thrust squeezed out the "Crystalline Nappe". This "channel flow" was assisted by the presence of melts (leucogranites and migmatites). The lower of the leading edge of the Indian plate was inserted beneath the Tibetan Plateau, whereas the mantle lithosphere was delaminated and subducted. Adapted from Pfiffner (in press).

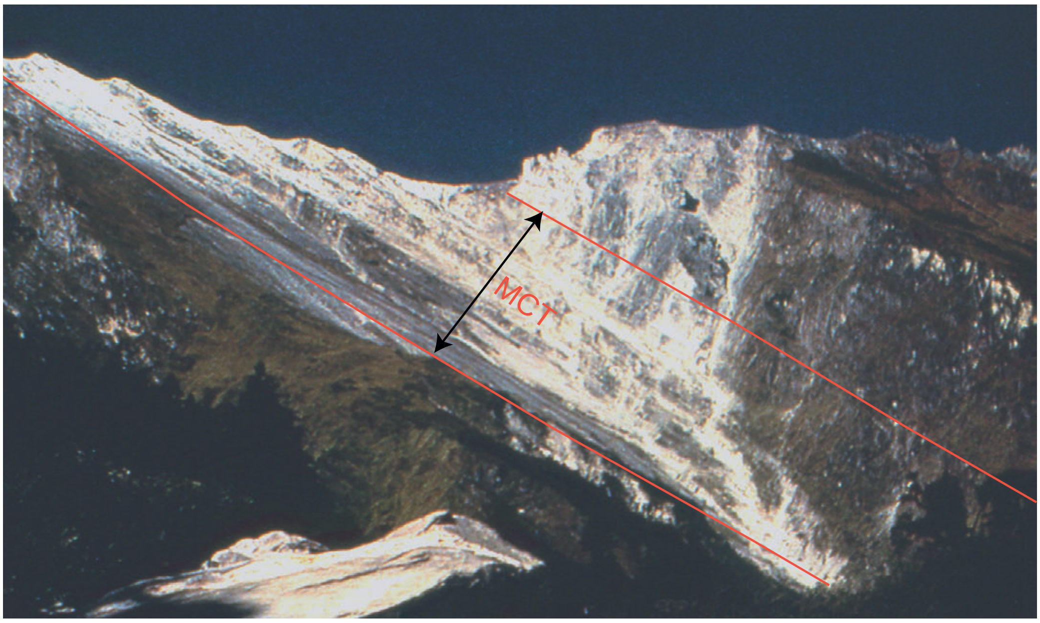
Main Central Thrust

The upper crust of the northern Indian plate was stacked southward by thrust faults leveling off at mid crustal level (see Fig. 3.1-1). These thrust faults encompass the Main Frontal thrust, which affects the foreland basin fill (the Siwaliks), the Main Boundary thrusts, which involves Proterozoic to early Paleozoic metasediments and of Greater India, and the Main Central thrust, which carries high-grade, upper crustal crystalline basement rocks, migmatites and leucogranites. The Main

Main Central Thrust



The Main Central Thrust in the Doda Valley near Kishtwar (Kashmir). Photo by Rainer Kündig.



The Main Central Thrust in Nepal. Photo by Rainer Kündig.

Fig. 3.1-2: The Main Central Thrust in the Himalayas.

Frontal and Main Boundary thrusts are interpreted to merge at depth, rejoin the Main Central thrust and to continue as a shallow dipping thrust (the Main Himalayan thrust) at mid crustal level. Finally, it is interpreted to continue as subhorizontal thrust separating two lower crustal sections across much of the Tibetan Plateau to the north. According to Catin & Avouac (2000) the Main Himalayan thrust forms a midcrustal ramp at the front of the Higher Himalaya, which is taken to be responsible for surface uplift in the moving hangingwall and the antiformal structure in the Lesser Himalaya. The Main Central thrust puts high grade, sillimanite-kyanite bearing crystalline basement rocks onto lower grade, garnet-biotite bearing metasediments (Gansser 1983). A ductile shear zone marks the Main Central thrust (see Fig. 3.1-2). The hanging wall of the Main Central thrust is referred to as "Crystalline nappe" or "High Himalayan nappe" or still "Greater Himalayan zone". It contains migmatites and leucogranites intruded into high grade metamorphic rocks. The "South Tibetan Detachment System", a structure that consists of normal faults with a shallow dip towards the north, forms the top of this unit. Metamorphic isograds are telescoped towards this contact. Based on p-T data, Searle et al. (2003) estimate the displacement along the normal fault to be between 100 and 200 km. The shallow-dipping north-directed "protrusion" of the entire assemblage between the Main Central thrust and the South Tibetan Detachment System is explained by "channel flow", a process describing melt-assisted expulsion of high grade metamorphics between two fault zones with opposite sense (see Fig. 3.1-1). Burchfiel and Royden (1985) explained the extension as a result of gravitational collapse rather than crustal extension, whereas Searle and Szulc (2005) favor a ductile channel driven by the effect of load represented by the higher elevation of the Tibetan Plateau and buoyancy driven by the thicker Tibetan crust as compared to the Indian foreland. In their view channel flow was lubricated by partial melts and leucogranite magmas.
Crustal thickening beneath the Tibetan Plateau is explained by a combination of upper crustal shortening and a doubling of the lower crust by DeCelles et al. (2002). According to their model, Indian and Greater Himalayan lower crust was inserted beneath the crust of the Tibetan Plateau. This signifies that the Main Himalayan thrust forms the décollement zone at the base of the Lhasa Terrane's lower crust. At the lithosphere scale, DeCelles et al. (2002) argue that a delamination occurred near the curst mantle boundary and that the mantle lithosphere sank into the asthenosphere. Pieces of the latter are taken to have sunk deeper into the mantle owing to slab detachment.

The well known Main Central thrust forms a shear zone with a substantial width, such that one cannot define anything like a thrust plane (see Fig. 3.1-2). The shear zone, although accommodating a large displacement, does not express it as a geomorphic feature. The thrust fault was recognized because it puts high-grade crystalline basement rocks onto definitely less metamorphosed metasediments.

3.2 Caucasus

The Caucasus, a straight mountain range between the Black Sea and the Caspian Sea, is the result of a collision of the Eurasian plate with the Arabian/Turkish plate. (see Polino, Stephenson and others, 2005). The collision occurred in Cenozoic times and led to the development of a foreland basin on both sides. The architecture of the basin on the northern side varies along strike, the Indola-Kuban fordeep in the west having a maximum thickness of 10 km of sediments, whereas the eastern part, the Terek-Caspian foredeep accumulated 12-14 km of sediments. The orogen is highly asymmetric as the cross section in Fig. 3.2-1 shows. The Lesser Caucasus, the southern part of the orogen, contains volcanics and is interpreted as a tectonic wedge formed on top of the subducting Arabian/Turkish plate and at the front of the upper, Eurasian plate. The High Caucasus contains back-thrusts, which put crystalline basement and Mesozoic sediments onto the Cenozoic clastic fill of the foredeep. This deformational style is particularly developed in the Dagestan thrust belt. But as Fig. 3.2-1 shows, the thrust faults are mainy "buried faults" and not observable at the surface.

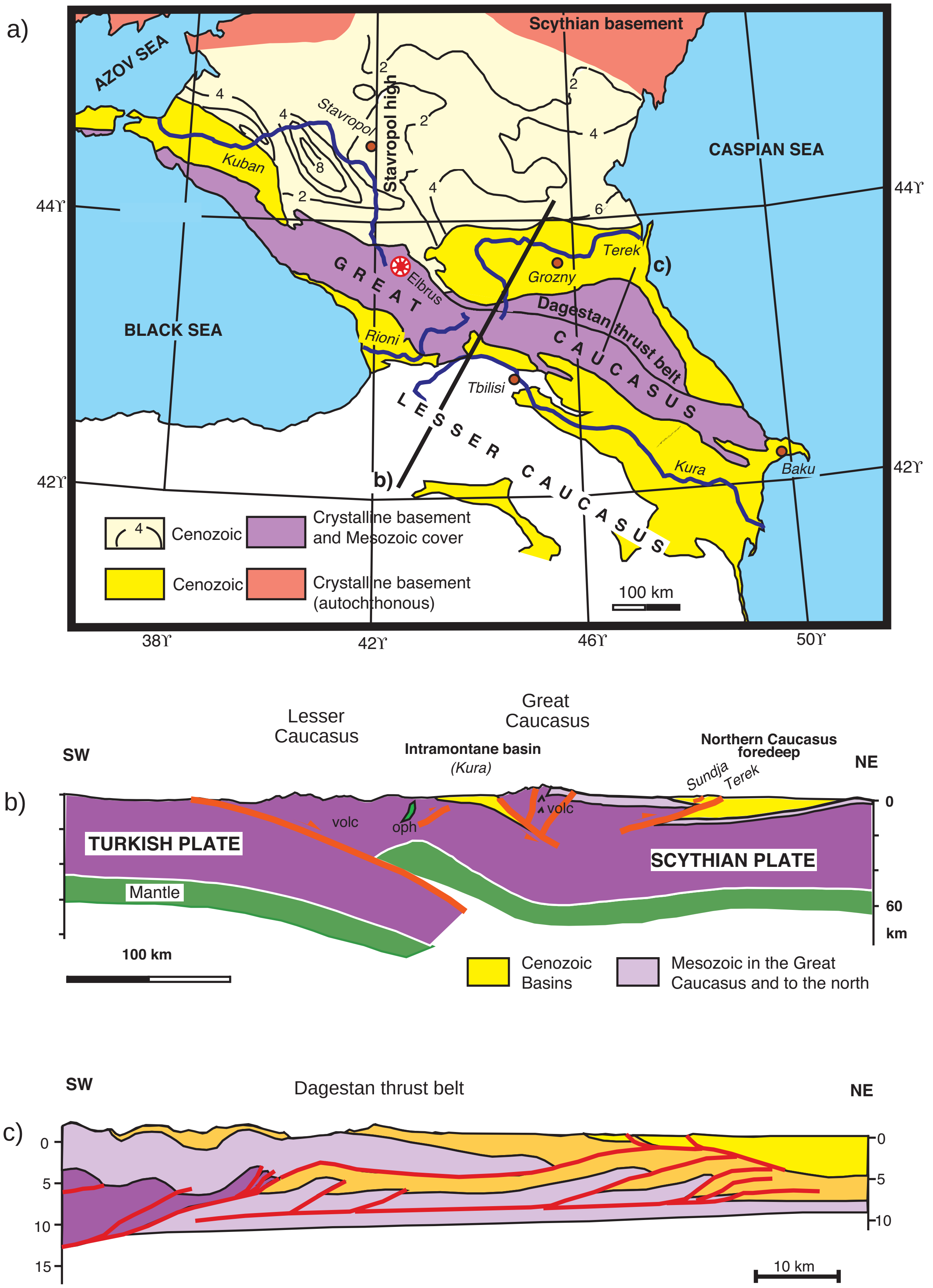


Fig. 3.2-1: Geological structure of the Caucasus mountains (after Polino, Stephenson et al. (2005); EUROPROBE website).
a) Tectoniv map of the Caucasus showing the foredeeps (yellow) and thedeformed Caucas sequence (violet).
b) General cross section showing the asymmetric struture of the Caucasus.
c) Detailed cross section of the Dagstan thrust belt. Thrust faults are mainly burried faults.

4 Africa

4.1 Atlas Mountains

The Atlas Mountain chain of NW Africa marks the limit between the stable african craton to the south and a broad belt of young, alpine deformations and plate mobility to the north. The Atlas chain is subdivided into several branches, each with its own history and structural characteristics. The Tunisian and Algerian so-called Tell-Atlas is mostly considered as a thin-skinned foreland fold-and-thrust belt of the larger Alpine collision belt. In constrast, the Moroccan Middle- and High-Atlas clearly as well as the Algerian Saharan Atlas, clearly formed in an intracratonic setting «within Africa». The Anti-Atlas adjacent to the south, despite summits reaching more than 3000 m altitude, belongs geologically speaking already to the stable African craton. The Anti-Atlas is indeed part of an older, variscan orogeny, time equivalent with the Appalachian mountain belt of North-America and the Hercynian chains of Europe. Figure 4.1-1 is a simplified geologic map of the Central high Atlas taken from Teixell et al. 2003) that contains also the traces of the cross sections shown in Fig. 4.1-2.

Thrust faults?

All of the Moroccan Atlas chains (High, Middle and Anti) are interpreted as intracratonic deformation belts. None of them is a contient-continent collisional orogen, and there are no indications for any substantial amount of lithospheric subduction in either of theses chains. Apart from the high Alpine relief with peaks of over 4000 m a.s.l, the High Atlas has little in common with other Alpine orogenic belts, be it the true collision belt of the Alps or the strike slip/intracontinental compression belt of the Pyrenees. In comparison with both of these, the High Atlas Mountain lakks any internal steep zone, and metamorphism barely reaches greenschist facies. Three representative sections across the High Atlas of Morocco are shown in Figure 4.1-2 (from Teixell et al. 2003). In Figure 4.1-3, a simplified, "balanced" cross section across the central High Atlas taken from Gomez et al. (2000) is shown. Overthrusts along flanks of mountain belt were determined by analysis of seismic reflection and well-log data.

The High and Middle Atlas fold belts involve an up to 8 km thick series of Mesozoic sediments as well as the underlying continental crust. Folds are mostly large upright synclines with wavelengths of several kilometers and amplitudes of up to 5 km, but anticlines are quite rare. Anticlinal hinges are mostly broken through in the middle and if they ever existed, fold closures have largely been removed by erosion. Anticlinal ridges are often cored with small bodies of basic intrusives, dating from the Early Jurassic rifting period. Overall, the High and Middle Atlas chains are bivergent fold belts, with a timid vergence to the north along the northern boder and a more pronounced vergence to the south along the southern border. Locally, these external folds seem to be detached from the underlying basement and display characteristic features of thin skinned foreland fold-and-thrust belts albeit of quite limited dimension. Foreland basins, filled with clastic wedges, are equally quite small when compared with the height of the chain.

The Atlas fold belts are the result of severe inversion of former continental rift basins and there seems to be no subduction of lithosphere involved. The High and Middle Atlas rift basins started opening in Late Triassic - Early Jurassic times as lateral branches of the Atlantic – Tethys rift system, but these Atlas branches were aborted by Middle Jurassic times. Intrusions at around 200 Ma include a regional set of basic dikes as well as small plutons found within the anticlinal cores of the present day fold belt. This magmatic activity is now generally seen as belonging to the larger Central Atlantic Magmatic Pronvince (CAMP), responsible for the initiation of continental breakup

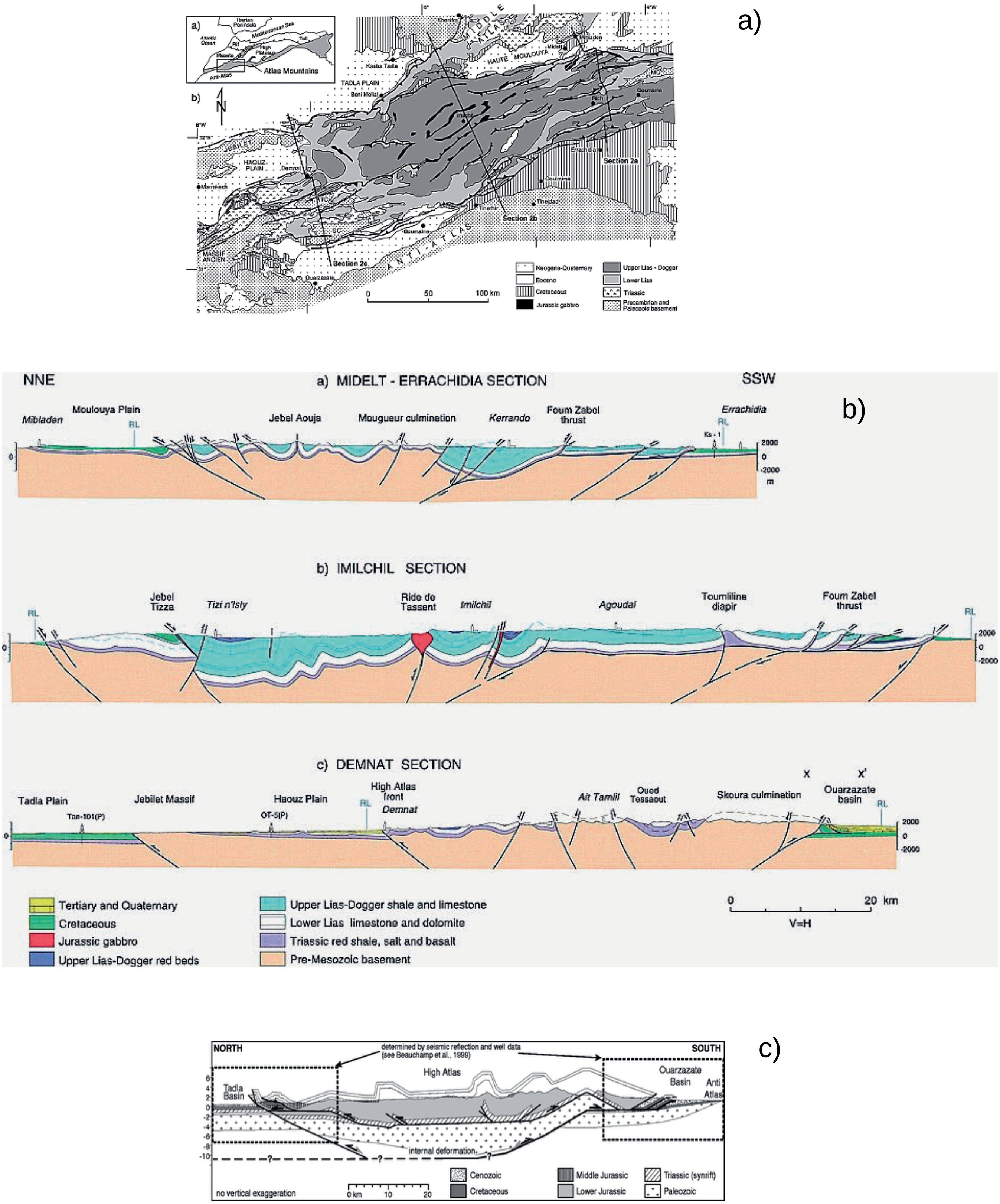


Fig. 4.1-1: Structure of the Atlas Mountains of Marocco.

a) Simplifield geologic map of the High Atlas Mountains of Marocco. From: Teixell et al. (2003) Lines are traces of cross sections shown in b).

b) Three representative cross sections across the High Atlas of Marocco. From: Teixell et al. (2003).

c) Simplified "balanced" cross section acrosss the central High Atlas. Overthrust along the flanks of the mountain belt were determined by analysis of seismic reflection data. From: Gomez et al. (2000).

of Pangea. A total thickness of up to 8 km of sediments accumulated during the Mesozoic within the aborted rift-arms of the High and Middle Atlas. Marine conditions prevailed in the eastern High Atlas basin from Liassic to Late Jurassic times, leading to the accumulation of several kilometers of alternating marls and limestones. The rift basins are filled in progressively, by continental redbeds dating from Jurassic to Late Cretaceous, mostly shed from the west. These redbeds contain dinosaur bonebeds and the High Atlas has provided a series of nearly complete dinosaur skeletons, including some the oldest known dinoaurs of the world (e.g. Monbaron et al. 1999).

At least two phases of inversion tectonics lead to folding and mountain building. A modest phase of inversion in Upper Cretaceous times is documented through progressive onlaps on local folds and a general unconformity at the base of Tertiary clastic wedges. The present day high topography, intense folding and partly thin skinned thrusting at the borders of the High Atlas chain are the result of a more severe inversion from Miocene times onward. There are indications for ongoing shortening and uplift (Meghraoui et al. 1998).

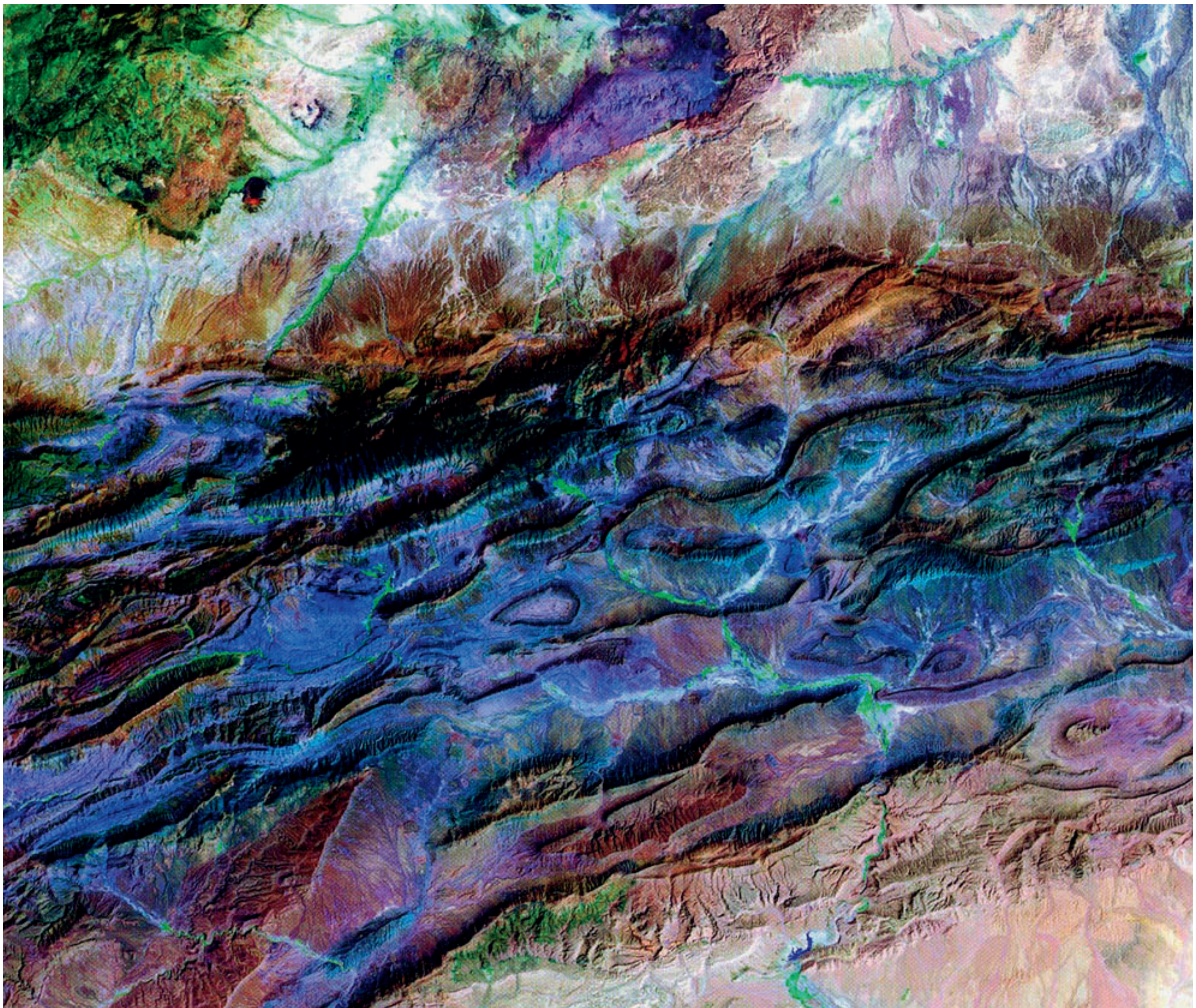


Fig. 4.1-2: Satellite image (Landsat, false color scene) of the eastern High Atlas. From: cover picture of AAPG Bulletin; Beauchamp et al (1996).

The total amount of shortening across the High Atlas chain is estimated to some tens of kilometers at most (Beauchamp et al. 1999; Gomez et al. 2000, Teixell et al. 2003), clearly much less than the Pyrenees, let alone the Alps. Deformation intensity, folding and thrusting are also clearly less important in the Atlas chains, compared with the Pyrenees, the Alps or the Appenines. Accordingly, nappes and thrusts in the Alpine sense are completely absent from the Atlas mountains, with the exception of the Tell-Atlas and Rif chains.

Geomorphic expression

The Atlas Mountains of Morocco are a major asset of Morocco's tourism industry. In spring time, lofty snow covered peaks contrast with lush green palm-tree oases set in a semi-desert, barren landscape, painted in a wide variety of red to tan colors. Deep scenic gorges are cut into this young mountain range and a network of paved roads and gravel roads allows access even to the seemingly far remote and higher realms. Not surprisingly then, motor tourism (4WD, quads), mountain biking, trekking and hiking are attracting ever increasing numbers of tourists. Visitors of the Atlas mountains are invariably impressed by the omnipresent « geology » : rocks are just everywhere and the variety in structure, color and bizarre erosion forms never fails to make a lasting impression. Geologists appreciate the excellent outcop conditions. The Atlas chains are famous for their fossils and for some rare minerals and in the geological community, the Atlas mountains are best known among stratigraphers, paleontologists and sedimentologist. The structural geologist knows the High Atlas as a fold belt with a limited amount of horizontal shortening. To the delight of the paleontologists, deformation intensity is generally very weak and thrusts are virtually absent in this

Fig. 4.1-3: Folds dominate the landscape of the Paleozoic Anti-Atlas Mountain range. The example shown here are Lower Cambrian carbonates of the Adoudounian formation near Tata. Photo: M. Burkhard.

chain. The recent discovery of a small frontal thin skinned foreland fold-and-thrust belt along the northern rim of the Souss Plain (Saint Bezar and Frizon de Lamotte 1998) remains a matter of local interest - for the specialists. Neither is the folding character of the chain obvious to the untrained eye – except for astronauts and members of the space station. To illustrate this, a satellite image (Landsat, false color scene) of the Eastern High Atlas is given in Figure 4.1-6 (from Beauchamp et al. 1996). Indeed, the synclinal folds are too large to be seen easily from the ground and most of the anticlines are heavily severed by faults and deeply eroded. Spectacular folds are cropping out in places within the Paleozoic Anti-Atlas, as shown in the photograph of Figure 4.1-7. Even the specialists have not yet identified any associated overthrust faults within the latter, however (Helg et al. 2004).

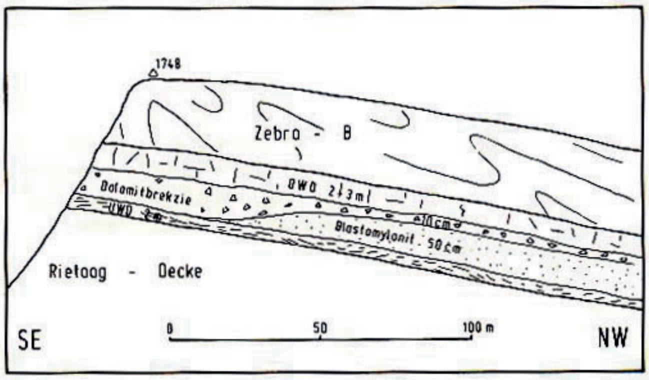
<u>Historical aspect</u>

The Atlas Mountains of North Africa have been explored since the late 19th century by geographers and geologists alike. The Moroccan Anti-Atlas chain displays among the best stratigraphic sections of the Paleozoic era, including a probably complete sedimentary record across the Late Proterozoic – Early Cambrian boundary, largely exposed in a vast area of the south-western Anti-Atlas. German stratigraphers have tried to establish reference sections for the international stratigraphic time table, without quite succeeding against the deeper marine, i.e. more complete sections exposed in China. Higher up in the stratigraphy of the Paleozoic, many of the Moroccan sections are world famous for their rich fauna of trilobites, orthocera and goniatites.

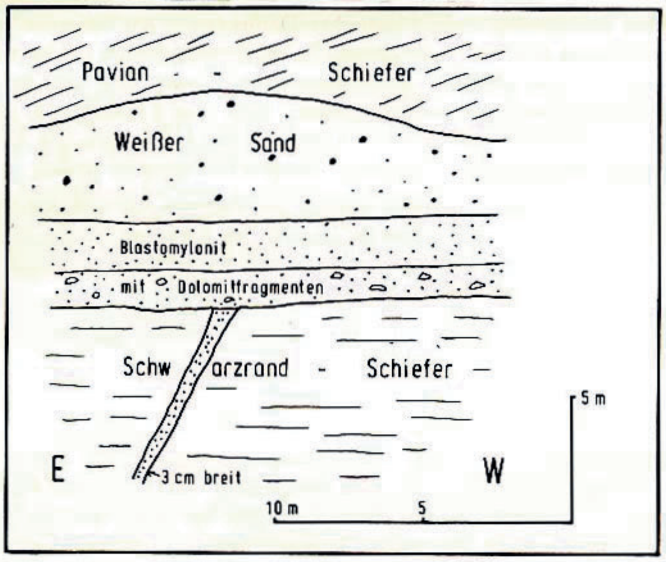
In terms of mountain building, tectonics and structural geology, however, the Atlas chains have barely been noticed by the international community. It is only very recently that this mountain belt has attracted some wider interest , mostly because of an enigmatic mismatch between the weak observed intensity of horizontal shortening, an apparent lack of crustal overthickening and nevertheless a high topographic relief (Beauchamp et al. 1996, Gomez et al. 2000, Teixell et al. 2003). International projects to elucidate this conundrum are currently in progress. A key question in any of these studies remains the deep structure of this Mountain belt : even data for the MOHO-depth below the Atlas Mountains of Morocco are currently still fraught with large uncertainties.

4.2 Naukluft Mountains

The Naukluft Nappe Complex is a far-traveled sheet of the Panafrican Damara Belt, beautifully exposed in Central Namibia. The allochthonous units consist of a lower nappe, the Rietoog nappe, which is made up of Nama limestones. The upper unit is the Naukluft nappe complex, which is made of dolomites and limestones mainly. The thrust zone at its base is very enigmatic. Münch (1978) has analyzed this zone and distinguished a highly deformed zone 1 to 30 m thick consisting of breccias, mylonites and dolomites which he interpreted as as lubricating layer at the base of the Naukluft nappe. Massive dolomite is a lithology that is not known to be suitable for accommodating large strains owing to its competent behavior. The foliated calcmylonites are similar in appearance to those found along the Glarus thrust. Münch (1978) came to the conclusion that the deformation mechanisms include brittle fracturing, shearing, cataclastic flow and viscous creep at elevated temperatures, an interpretation that is shared by Viola et al. (in press). This combination of frictional and viscous processes that accommodated displacement is similar to the situation at the Glarus thrust. However, the fault zone has a far more complex lithological composition and appearance in case of the Naukluft nappe complex.
Also, the outcrops of this thrust fault are located in an extremely remote area.



Geometry of the lubricting layer at outcrop scale.



Fissure in the footwall with fault rock ("blasto-mylonite").

Fig. 4.2-1: Lubricant layer at the base of the Naukluft nappe (Namibia). From: Münch (1978).

5 Americas

5.1 Andes

The Andes are the product of a long-lived subduction system. The structural and morphotectonic style varies considerably along strike from north to south (Kley et al. 1999, Ramos and Aleman, 2000). The segment of the Central Andes of Peru has the advantage that deeper levels of the orogen are exposed at the surface and in deeply incised river valleys. For example, the coastal Batholith (Pitcher et al. 1985) and the folded country rocks into which it intruded are beautifully exposed.

Central Andes of Peru. In the Central Andes of Peru two cordilleras, the Cordillera Occidental and the Cordillera Oriental represent the primary morphologic features. In this segment the Nazca Plate descends at a shallow dip beneath the South American plate and convergence is at high angle to the plate boundary. In concert with this shallow dip, volcanism ceased in Cenozoic times. The tectonic evolution of the Andes is summarized in Ramos & Aleman (2000) and Jaillard et al. (2000). Mégard (1978, 1984) discusses the structure and evolution of the Peruvian Andes in particular.

The cross section shown in Figure 5.1-1 is based on maps of the Peruvian Geological Survey (INGEMMET) and own fieldwork. It passes 30 km N of Lima. The offshore section including the geometry of the tip of the continental crust is taken from Hampel et al. (2004), the flat slab geometry from Ramos & Aleman (2000). The Cordillera Occidental consists of Paleozoic and Mesozoic strata, which are folded. The folds are symmetrical, upright folds with relatively long subvertical limbs and are intruded by the various intrusive complexes of the Coastal Batholith. Towards the NE, the folds grade into NE-verging overthrusts. Within the Coastal Batholith and along the transect considered here, Pitcher et al. (1985) mapped out a number of individual intrusions: the Patap Gabbro (>83 Ma), the Santa Rosa tonalite, granodiorite and diorite (80-90 Ma) and the Paccho (70 Ma) and Acos tonalites (Late Cretaceous- Early Cenozoic). The magmatic rocks are in places hardly younger than the folded Cretaceous sediments. Eocene-Miocene volcanics (Calipuy group) overly these intrusive bodies and the folded strata disconformably. The magmatic rocks do not show signs of deformation (e.g. horizontal shortening). This suggests that folding took place prior to or at least in an early stage of the magmatic acitivity associated with the Coastal Batholith. Thermal weakening possibly led to relatively homogeneous horizontal shortening and vertical stretching as indicated by the style of folding. This phase of folding has been referred to as Peruvian in the literature (Mégard 1978, Jaillard and Soler 1996, Jaillard et al. 2000). Disconformities between karstified Jurassic limestones in steeply dipping limbs and subhorizontal Eocene strata, together with Eocene volcanics overlying Cretaceous intrusive rocks suggest that rock uplift by vertical stretching and associated surface uplift was immediately followed by substantial erosion in Late Cretaceous to Paleogene times.

The structure style encountered in the Cordillera Oriental is of completely different nature. Here NE-verging shallow dipping thrust faults put Paleozoic and Mesozoic sediments onto the Cenozoic basin fill of the foreland basin, which evolved on the eastern margin of the Andes. Locally Pliocene strata are overthrust. This late phase of thrusting has been referred to as Quechuan phase (Jaillard et al. 2000). The shallow dipping thrusts are shown to merge at depth (similar to the situation in Bolivia; see Fig. 5.1-2). The associated displacement makes it likely that the thrust fault reaches back into the subsurface of the Cordillera Occidental. In Fig. 5.1-1 it is interpreted to die out (loose displacement) in the still hot lower crust beneath the magmatic arc of the Coastal Batholith. In the hanging wall of these thrusts, folding becomes more important towards the SW. Here a number of intrusions varying in age from Late Paleozoic to Cenozoic crosscut the folds in the Paleozoic respectively Mesozoic strata.

Between these cordilleras a zone of high elevation forms the Cordillera Central. Here, upright folds cut by steeply dipping faults of varying offset intensively fold Paleozoic and Mesozoic strata. Further to the NW, an important fault parallel to the strike of the Andes raises Cenozoic granitic rocks in the Cordillera Blanca to volcanic rocks of the same age to the same elevation. Similarly, in the transect of Huancayo, Late Proterozoic crystalline basement is brought next to hardly metamorphic Late Paleozoic sediments along a steeply dipping reverse fault striking parallel to the chain. Unlike these two examples, vertical offsets in the transect of Figure 5.1-1 do not seem to exceed one or two kilometers. The consistent map pattern however suggests that some of these faults may have important strike slip components. The young age of the shallow dipping thrust faults in the Cordillera Oriental are likely to be associated with their counterparts south of the Bolivian orocline (discussed in Fig. 5.1-5). In addition, paleobotanical data (Gregory-Wodzicki 2000) suggest that the Altiplano-Puna areas as well as the Cordillera Oriental reached their modern elevation after 10.7 Ma. It is thus likely that motion along the shallow dipping and steeply dipping faults both contributed to uplifting the Andean chain to its modern high elevation.

In the following, four important thrust faults are briefly discussed regarding their morphologic expression. Their imprtance is based on their map scale length, displacement and the contrasting rock types on either side of the fault.

The steeply dipping thrust fault that uplifts the Cordillera Blanca relative to the Cordillera Negra in NW Peru runs parallel to the valley in between the two ranges and passes through Huaraz. Although it raises intrusives of the Cordillera Blanca to 600 m a.s.l. and adjacent to contemporaneous volcanics outcropping at 5000 m a.s.l. in the Cordillera Negra, the fault is not visible at the surface. Southeast of Huaraz, an active fault displacing alluvial fans might represent a youngest segment of this fault (see Fig. 5.1-2).

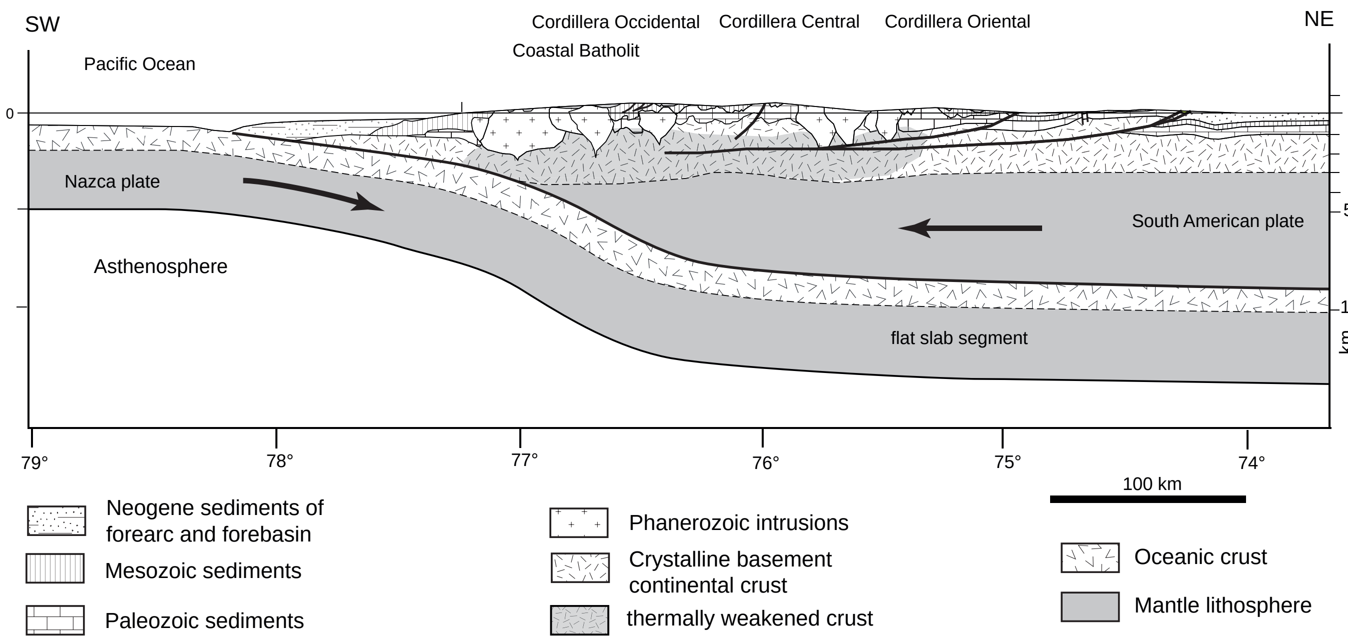


Fig. 5.1-1: Geological profile across the Central Andes of Peru. The Coastal Batholith in the Cordillera Occidental intruded into a folded sequence of Paleozoic and Mesozoic strata. Axial surfaces are mainly subvertical and may overly a thermally weakened crust thzat yielded in an overall pure shear style. In contrast, the Paleozoic-Cenozoic strata of the Cordillera Oriental are shortened by thrust faults that affect the underlying crystalline basement as well. The thrust faults are likely to extend westward into the thermally weakened crust beneath the Cordillera Occidental. At a lithosphere-scale, the subducted Nazca plate forms a flat slab segment beneath the Andes and the foreland. Adapted from Pfiffner (in press).

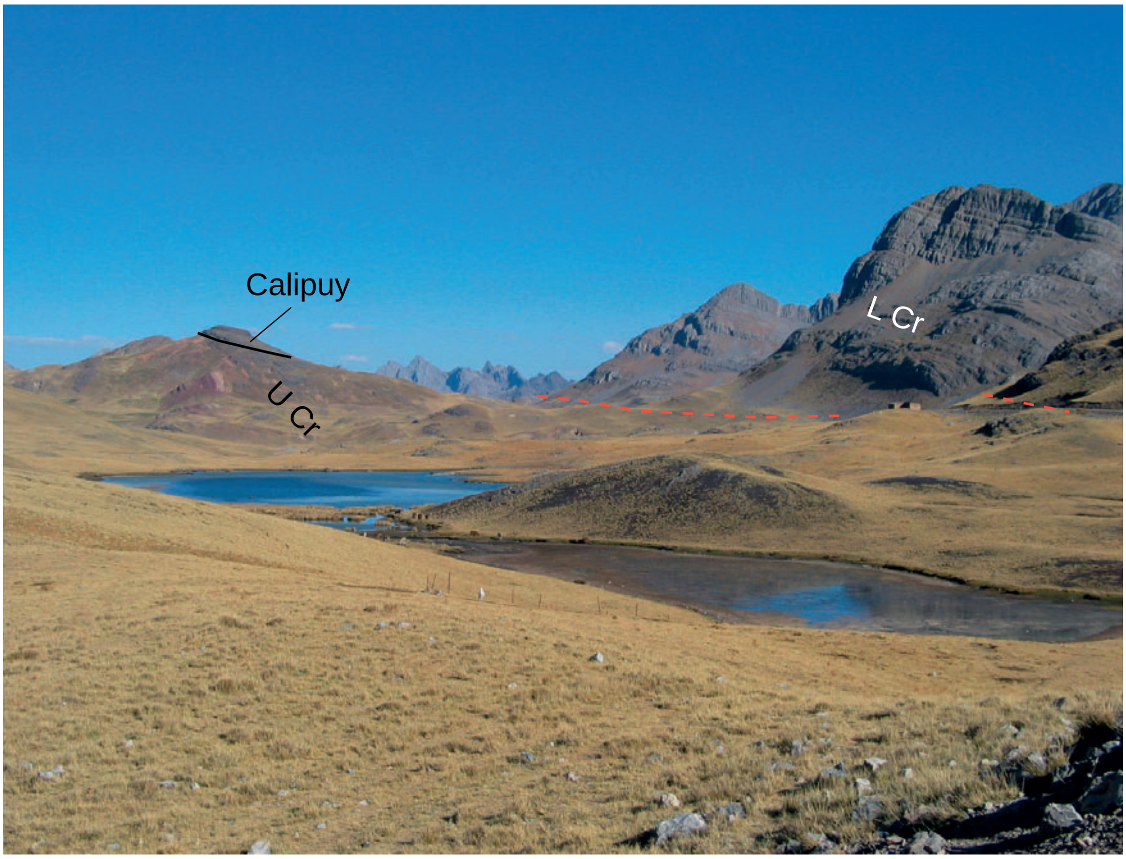


Fig. 5.1-2: Western Cordillera between Junin and Canta (Peru). Amajor thrust fault puts Lower Cretaceous limestones (L Cr) onto folded Upper Cretaceous strata (U Cr). Calipuy volcanis seal the folds. The thrust itself is hiddem beneath scree. Photos: A. Pfiffner.

Further southeast, in the Cordillera Occidental between Junin and Canta, thrust faults put lower Cretaceous carbonates onto upper Cretaceous and Cenozoic strata. Although the uplifted carbonates mark themselves morphologically in an impressive way (see Fig. 5.1-3), the fault contact is concealed by scree and not visible in the field.

In the Cordillera Oriental northeast of Huancayo, a steeply dipping thrust fault raises Neoproterozoic crystalline basement next to hardly metamorphic Late Paleozoic strata. The actual fault contact dos not express itself morphologically and can only be located by detailed mapping.

The thrust faults in the Subandean Ranges, where place Paleozoic-Mesozoic strata rest on Cenozoic foreland strata, are covered by the dense vegetation of the Amazonas Basin. Their existence was put into evidence by mapping, remote sensing and drilling. They are only visible on a geological map (Fig. 5.1-4).

Subandean Ranges in the Bolivia. The Subandean Ranges extends along the eastern margin of the Cordillera Oriental of the Andes, curving around the Bolivian orocline. Its internal structure is subject to lateral changes. The cross section shown in Figure 5.1-5 is based on work by Kley (1996) and McQuarrie & DeCelles (2001) and extends from the Altiplano across the Cordillera Oriental to the Subandean Ranges in southern Bolivia. In this transect, basement rocks include Proterozoic-Cambrian siliciclastic metasediments intruded by Mid-Cambrian granites. This basement is overlain unconformably by a Paleozoic-Cenozoic cover sequence containing several unconformities (see Kley 1996 and references therein). Shale units at the base of the Silurian and Permian-Triassic continental shales and evaporites form important décollement horizons. The cover sequence terminates with thick clastic foreland strata deposited from the Late Oligocene onward.

A complex interplay of folding and thrusting in the Paleozoic-Cenozoic strata encompasses both west and east-verging thrusting. The total shortening is estimated at 90-110 km in the Cordillera Oriental and 100 km in the Subandean Zone.The Subandean Ranges are an active east-verging thin-skinned fold-and-thrust belt accommodating 10-15 mm/yr of the 80 mm/yr convergence between the Nazca and the South American Plates (Norabuena et al. 1998). The imbricate thrusts of this belt level off at a décollement horizon (Silurian shales after Kley 1996), but displacement is transferred into the crystalline basement westward of the Subandean Ranges by low-angle thru-

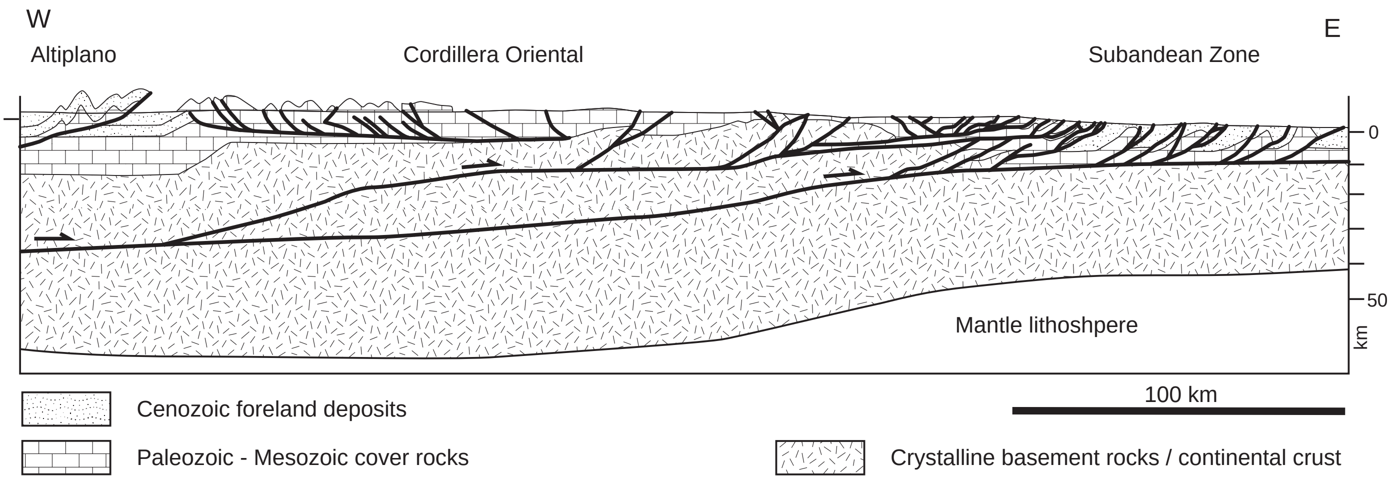


Fig. 5.1-3: Geological profile across the Subandean Ranges and the Cordillera Oriental of Bolivia, based on cross-sections by Kley (1996) and McQuarrie & DeCelles (2001). In the Subandean Zone, east-directed imbricate thrusting telescoped the Paleozoic-Cenozoic strata in a thin-skinned style. Towards the west, the décollement is within the crystalline basement. Two large thrust sheets, each 10 km thick an 200 km long, underly the Cordillera Oriental. In the shallow parts of the Cordillera Oriental, west-directed thrusting with a décollement in Ordovician strata affect the Paleozoic sequence. Upward these thrust faults loose displacement and end in the core of anticlines. Adapted from Pfiffner (in press).

sting (Kley 1996). As shown in Figure 20, basement-involved thin-skinned thrusting led to the development of up to 10 km thick basement thrust sheets transported to the west. Much of this displacement (60 km after Kley 1996, 100 km after McQuarrie & DeCelles 2001) took place from 5 Ma on and is held responsible for raising its hanging wall, the Altiplano and Cordillera Oriental to its present high elevation (McQuarrie & DeCelles 2001).

The Cordillera Oriental displays a westward verging fold-and-thrust belt of Paleozoic and Cenozoic strata (backthrust belt of McQuarrie & DeCelles, 2001). A décollement horizon is assumed in Ordovician strata. Imbricate thrusts branching off this décollement horizon lose displacement upward owing to coeval folding in the younger strata. The total shortening is estimated at 85 km and is interpreted to have occurred from Late Eocene to Early Miocene times. As discussed by McQuarrie & DeCelles (2001), the west-verging thin-skinned tectonics in the Cordillera Oriental facilitated the eastward emplacement of a 100 km long and 10 km thick basement (mega)thrust sheet. These authors suggest that the décollement of this (mega)thrust sheet was controlled by thermal weakening, which also explains why the décollement could take place over a considerable horizontal distance.

The groups of thrust faults have relatively small displacements individually and only the sole thrust, into which the merge, has a major thrust component. However, this sole thrust is nowhere exposed and might resemble a shear zone of some width ant depth. Thus, despite the fact that the smaller splay faults have some continuity along strike of the chain in map view, the same shallow structural level is exposed at aoutcrop everywhere. Moreover, many of these faults are postulated from the existsence of fold structures visible at the surface. Their appearance in cross sectional view might in some instances reflect the structural style suspected rather than the style observed at outcrop.

5.2 Rocky Mountains

The North American Cordillera is the product of a complex process involving subduction of oceanic lithosphere and the accretion of terranes spanning the Phanerozoic and late Precambrian (Oldow et al. 1989, Moores & Twiss 1995). The accretion of terranes involved also major strike slip movements. The orogen is bivergent with an active pro-wedge on the western side involving the transpressional subduction of the oceanic Pacific plate and a retro-wedge, which formed by compressional deformation of the North American craton and the accretion of terranes in mainly Mesozoic-Cenozoic times.
Figure 5.2-1 is a generalized cross section located in the southern part of the Canadian part of the Cordillera and was constructed from cross-sections by Price & Fermor (1985), Brown et al. (1986) and Oldow et al. (1989). It shows how the western margin of the North American craton is telescoped. A stack of crystalline basement nappes is overlain by the accreted Quesnel terrane. Cover rocks of the North American margin were detached from their basement and transported eastweards. The deformation front of the North American margin reached about 200 km onto the craton as shown by the Foreland Belt. The décollement level is suspected at the crust/mantle boundary in the west (below the Coast Belt and the Intermontane Belt) and then climbs across the crust in the Omineca Belt. In this sense, the Omineca Belt represents a transition from the thick-skinned style governing the accretion of terranes and the thin-skinned style expressed by the Foreland Belt. The basal detachment of the allochthonous slices sheared off the western margin of the North American craton is located in the Late Proterozoic Windermere Supergroup. The thrust faults are shown to merge at depth. Displacements along these thrust faults sum up to hundreds of kilometers. The question then arises where this displacement goes. Oldow et al. (1989) evoke the concept of "orogenic float" to explain the assemblage of terranes. According to this concept, the incoming plate is delaminated, the crustal sections of the terranes are accreted to the margin, and the mantle lithosphere is subducted. In such a process a major décollement must be active along the crust

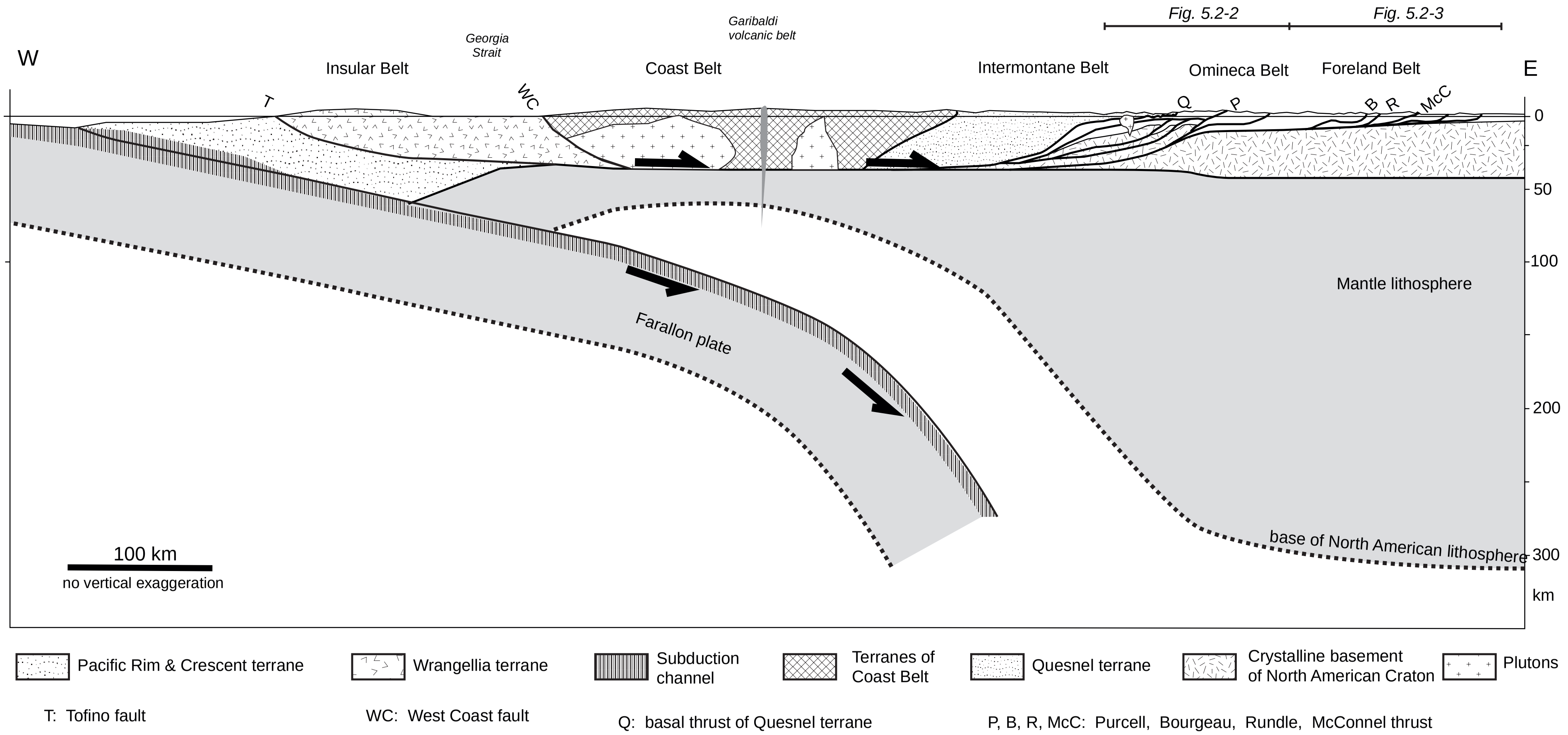


Fig. 5.2-1: Generalized geological profile across the North American Cordillera, based on Price & Fermor (1985), Brown et al. (1986) and Oldow et al. (1989). Delamination of the incoming lithosphere led to the subduction of the mantle lithosphere, while the crust was accreted th the North American Craton as "orogenic float". East-direct thrusting shortened the western margin of the North American Craton. To the west, a thick-skinned tectonic style affected the craton's outer margin and the accreted terranes of the Intermontane and Coast Belts. Towards the east, the basal décollement climbs section within the Omineca and Foreland Belt. The deformation front reached some 200 km into the craton. Adapted from Pfiffner (in press).

mantle boundary, possibly as a broad shear zone. Such a shear zone could compensate much of the displacement of the merging thrust faults of the Omineca and adjacent Foreland Belt.The concept of "orogenic float" assumes that the mantle lithosphere was subducted at the leading edge of the Farallon plate.

Omineca Belt. The cross section shown in Figure 5.2-2 covers the Omineca Belt of the Cordillera only. The NE part of the section is redrawn from Price & Fermor (1985). In the SW part, the section is inspired by the work of Brown et al. (1986) and Gibson et al. (2005). The basement slices beneath the Quesnel terrane represent an equivalent of the Monashee complex outcropping farther north, and the fault in their hanging wall corresponds to the Monashee décollement. The Omineca Belt consists of metamorphosed crystalline basement rocks and overlying cover rocks of the western margin of the North American craton (see Tempelman et al. 1992 and references therein). This margin was shortened and thickened by collision and convergence with the Intermontane Superterrane during Middle Jurassic and later time. The structural style is characterized by mainly east-verging thrusting and folding which produced a number of culminations exposing crystalline basement which was uplifted more than 20 km. Examples of such culminations include the Purcell anticlinorium and Porcupine fan structure in Figure 16. As discussed by Simony in Tempelman et al. (1992), in the core of the Purcell anticlinorium several phases of ductile folding affected the Upper Proterozoic metasediments of the Windermere Supergroup. Metamorphic isograds crosscut the early folds but are folded themselves by the later phase folds. In case of the Porcupine fan structure located to the east of the Purcell anticlinorium, internal deformation includes imbricate thrusting and folding. The décollement occurred within the Cambrian strata. At the trailing edge of the thrust sheet, in the footwall of the thrust fault emerging in the Rocky Mountain Trench, early formed thrust faults are backfolded by the by the Porcupine Creek Fan Structure. West of the Purcell anticlinorium, west-verging structures on the western flank of the Selkirk Allochthon are mid-Jurassic in age, while on the eastern flank, an Early to Late Cretaceous event overprinted the Jurassic structures (Gibson et al. 2005). Still farther west, in the Kootenay Arc and Quesnel terrane, Jurassic (and Cretaceous) granites intrude Paleozoic strata and crosscut the internal structure of

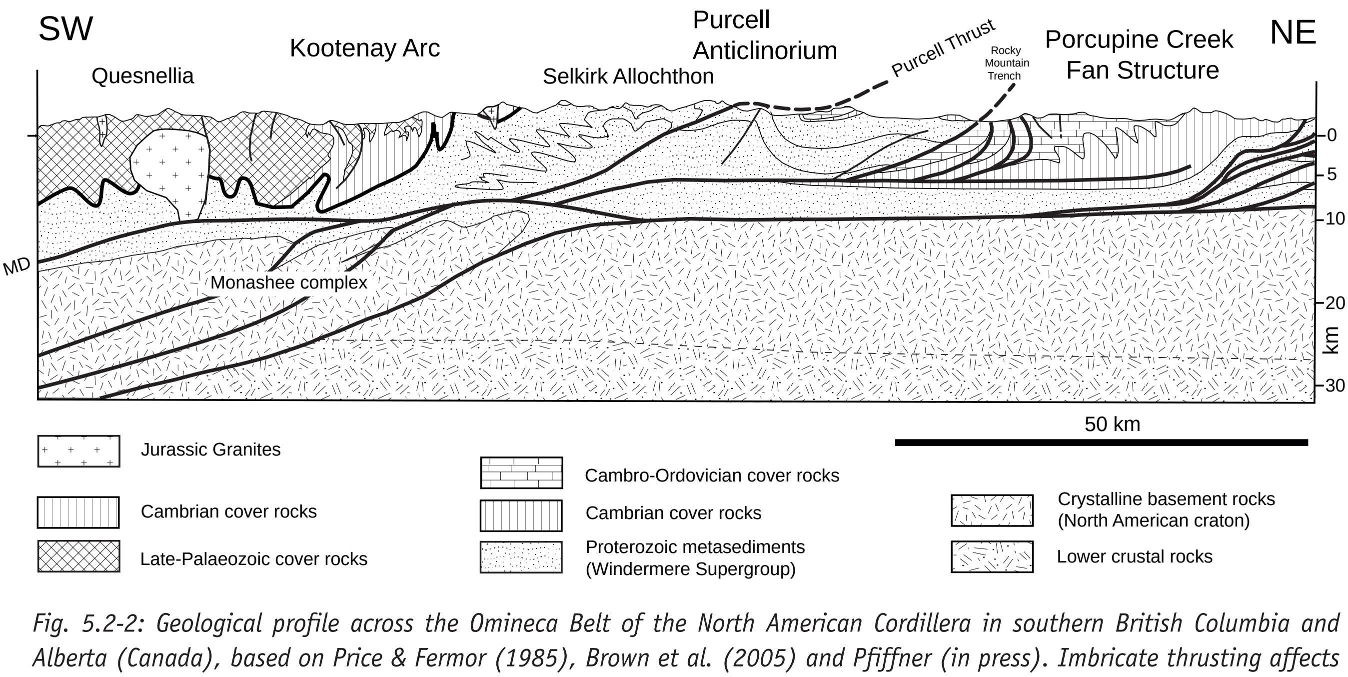


Fig. 5.2-2: Geological profile across the Omineca Belt of the North American Cordillera in southern British Columbia and Alberta (Canada), based on Price & Fermor (1985), Brown et al. (2005) and Pfiffner (in press). Imbricate thrusting affects the western margin of the North American craton. The basal detachment climbs from the lower crust eastward to the base of the Windermere metasediments and them to the base ao the Cambrian sediments. Thrusting ins NE directed. Pervasive ductile folding deforms the basal thrust of the Quesnel terrane and early formed thrust sheets in the Purcell Anticlinorium and the Porcupine Creek Fan Structure.

the host rocks. Discordant contacts occur to the west, while more concordant contacts prevail along the eastern border with high-grade granitoid gneisses and foliated granitic rocks.

Altogether, the Omineca Belt displays imbricate thrusting that affects the western margin of the North American craton. The basal detachment climbs from the lower crust eastward to the base of the Windermere metasediments and then to the base of the Cambrian sediments. Thrusting is NE directed. Pervasive ductile folding deforms the basal thrust of the Quesnel terrane and early formed thrust sheets in the Purcell Anticlinorium and the Porcupine Creek Fan Structure.

Purcell thrust

The Purcell thrust represents an important structure within the Omineca Belt. It puts Proterozoic metasediments onto Cambro-Ordovician strata as shown in Figure 5.2-2. In many instances, however, it runs within the Proterozoic and hence does not express itself morphologically. The Rocky Mountain trench on the other hand, is a geomorphic feature that can be followed over large dfistances. But in this case, the fault itself and the adjacent fault rocks are not observable at outcrop. Moreover, the fault is believed to have an important strike slip component, i.e. not representing a major thrust fault.

The Foreland Belt. The geologic profile across the Rocky Mountains shown in Fig. 5.2-3 (redrawn from Price & Fermor 1985) displays the imbricate thin-skinned style of the Foreland Belt, which consists of the Alberta Foothills, the Front Ranges and the Main Ranges. The internal structure of the fold-and-thrust belt is well known from petroleum exploration and has been discussed in detail by e.g. Gabrielse & Yorath (1991) and Oldow et al (1989) and references therein. Within the Foothills, Mesozoic sandstones form a multifold nappe stack. A classical triangle zone forms the boundary to the undeformed foreland strata overlying the North American craton, with a detachment horizon within Cretaceous strata. The basal thrust extends subhorizontally westward beneath the adjacent Front Ranges. Within the Front Ranges, Paleozoic-Mesozoic carbonates are thrust eastward along bedding parallel thrust faults, which level off westward beneath the Main Ranges. Within the latter, Late Proterozoic metasediments are involved in a thin-skinned style and the imbricate thrust sheets give way to ductile folding in the Porcupine Creek fan structure and the Purcell Anticlinorium (shown in Fig. 5.2-3). In the latter, folding occurred under high-grade conditions and affected isograds in the later stage of the orogeny (Simony in Gabrielse & Yorath 1991). As discussed by Price (1981), the décollement horizon within the Foreland Belt climbs section going east. Parallel to this, important thickness changes and lateral facies changes influence the style of internal deformation. The fold-and-thrust belt grew eastward with time. Thrusting was M. Jurassic to E. Cretaceous in the Main Ranges, L. Cretaceous to E. Eocene in the Foothills. A similar style and sequence of thrusting exists farther south, in the Sevier fold-and-thrust belt of Wyoming-Idaho-Utah and has been described in a classic study by Royse et al. (1975).

Lewis and McConnell thrusts

Famous thrust faults in the Foreland Belt of the Rocky Mountains include the Lewis thrust and McConnell thrust. Both are part of a family of thrust faults that displace thrust sheets relatively long and wide compared to their thickness. The internal deformation of these thrust faults is moderate, such that in most instances the sedimentary strata are in an upright position despite the large displacement that affected them. Despite the fact that thrust surfaces are only rarely exposed, thrusting was recognized early on. The Lewis thrust forms the boundary of the Front Ranges. The latter's geomorphic expression is due to the Paleozoic carbonates forming impressive cliffs as opposed to the underlying Cretaceous clastics that appear often as forested ranges of lesser elevation (see Fig. 5.2-4). Towards the south, the Lewis thrust steps down into a deeper level.

A primary feature of these thrust faults is their extension along strike in map view. Downward, the faults level off and merge into a basal detachment that is recognized in seismic sections but is nowhere to be seen at the surface. The faults are bedding parallel at the surface and thus exhibit the same structural level everywhere. A deeper level can only indirectly be observed if the more internal units (towards the Omineca belt) are considered, units that were exhumed from greater depths but which involve different lithologic units.

The Lewis thrust is exposed in the World Heritage property "Waterton Glacier International Peace Park, Canada/USA". The situation is summarized in an excellent manner on the Glacier National Park website:

> "The Lewis Overthrust of Waterton/Glacier provides scientists with insight about the massive dynamics of geologic processes that are going on today in other parts of the world, such as the Andes and the Himalaya Mountains. Because of the high degree of preservation of the original rock characteristics, the recent glacial sculpturing of the rocks, and the access by roads and trails, this major geologic structure in Waterton/Glacier Park is available for study by scientists from around the world.
>
> The Lewis Overthrust began 170 million years ago, when a collision of the Earth s crustal plates elevated numerous mountain chains and formed the ancestral Rocky Mountains. Ever-increasing stresses near the end of this great event shoved a huge rock wedge, several miles thick and several hundred miles wide, eastward more than 50 miles. Large masses of relatively stronger rocks were shoved over softer and more easily deformed rocks. Erosion stripped away the upper part of the original rock wedge and exposed the rocks and structures visible in the park today. Rarely have rocks of such ancient age been thrust over rocks that are so much younger. The overlying Proterozoic rocks are over 1,500 million years older than the underlying Cretaceous age rocks.
>
> Thus, the Lewis Overthrust is significant as a structural feature, for the extent of lateral displacement (up to 80 kilometers), and because it has functioned to expose ancient sediments possessing an unparalleled degree of preservation.
>
> Of particular scenic and geologic note is Chief Mountain, a spectacular monolith towering above the prairie along the eastern margin of Waterton/Glacier. Chief Mountain is an erosionally isolated remnant of the eastern edge of the upper plate of the Lewis Overthrust -- a feature known as a Klippen ranking with the Matterhorn as an example of this structural and erosional phenomenon."

The geomorphic expression is evident in the photographs shown in Fig. 2.5.

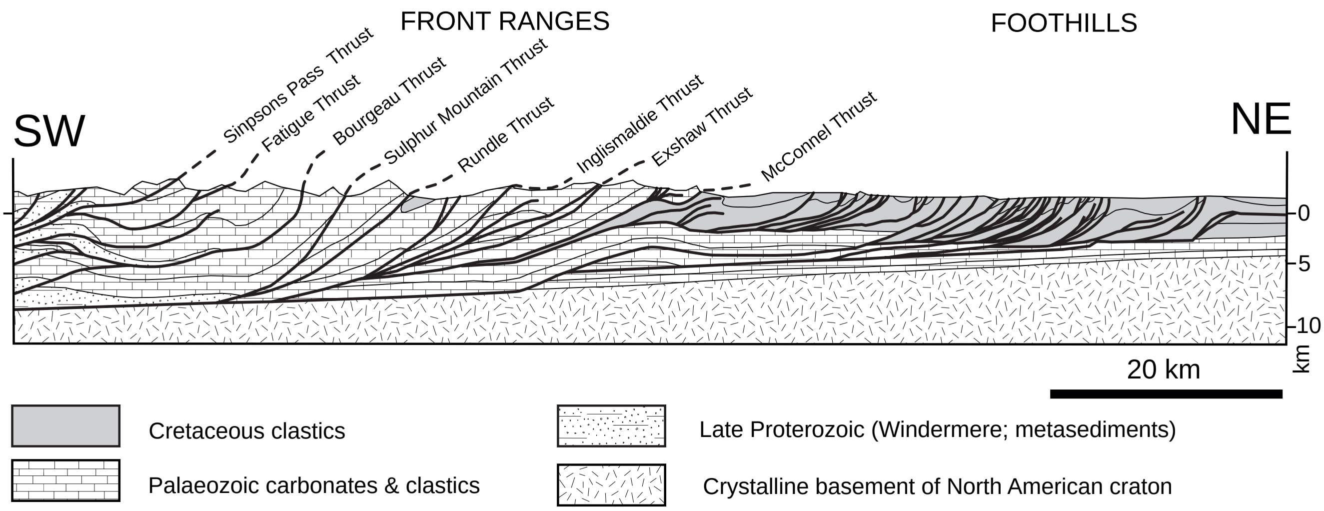


Fig. 5.2-3: Geological profile across the Foreland Belt of the North American Cordillera in southern Alberta (Canada). Redraw from Price & Fermor (1985). Imbricate thrusting telescoped the Paleozoic sequence in the Front Ranges with the basal detachment located in the Proterozoic Windermere metasediments. A similar thin-skinned style shortened the Paleozoic-Mesozoic sequence of the Foothills province. Here, the décollement steps up from the Windemere and basal Paleozoic strate to the base of the Cretaceous. Adapted from Pfiffner (in press).

Fig. 5.2-4a: Lewis thrust (L) at Crowsnest Mountain (Rocky Mountains / Front Ranges), Alberta (Canada). Devonian carbonates forming the Crowsnest Mountain overly Cretaceous sandstones. Photo: A. Pfiffner.

Fig. 5.2-4b: Lewis thrust (L) in southern Alberta. Paleozoic carbonates forming the Front Ranges (visible in the background) overly Cretaceous sandstones of the Foothills Province outcroping in the forested area and in the foreground. Photo: A. Pfiffner.

Fig. 5.2-5a: Lewis thrust (L) at St. Mary Lake in Montana (Rocky Mountains / Front Ranges, USA). Proterozoic meta-sediments forming high mountains in the background overly upper Cretaceous strata outcropping in the forested area near lake shore. Photo: A. Pfiffner.

Fig. 5.2-5b: Lewis thrust at Chief Mountain (Montana) in Waterton Glacier International Peace Park (Canada/USA). Photo: courtesy of Glacier International Park.

Fig. 5.2-6: McConnell thrust (MC) at Yamnuska (also called Mt. Laurie) in Alberta

Fig. 5.2-7: Castle Mountain thrust (CM) at Castle Mountain in Alberta (Canada). Proterozoic strata and Canmbrian carbonates forming Castle Mountain overly Cambrian strata outcropping in the forested area in the forground. Photo: A. Pfiffner.

Keystone thrust

The Keystone thrust near Las Vegas, Nevada, is a spectacular example of a thrust fault. It pertaines to the Sevier fold-and-thrust belt, the southern continuation of the Rocky Mountain Foreland Belt of Canada discussed above. The thrust fault was active mainly about 70 Myrs ago during the Sevier orogeny (mountain-building episode). Movement along the Keystone thrust appears to have been nearly 100 km. Fig. 5.2-8 shows dark-gray Cambrian limestone of the Bonanza King Formation overlying pink Aztec Sandstone of Jurassic age. This area is preserved in the Red Rock Canyon National Conservation Area.

Owing to the arid climatic conditions and the local relief, the Keystone thrust is visible in three dimensions in a superb fashion. Similar to the Lewis thrust and other thrusts of this mountain range, the deeper continuation of the fault is not exposed (as opposed to the Glarus thrust).

Heart Mountain detachment

The Heart Mountain detachment fault is famous for the deformation mechanisms associated with motion along the fault. A key publication by Hubbert & Rubey (1959) explored the influence of fluids being responsible for the reduction of frictional strength along faults. The Heart Mountain detachment is a normal fault associated with the collapse of a volcanic edifice. The fault itself is very difficult to see in the field. Research concentrates on the fault rocks, and these too show poor outcrop conditions.

Fig. 5.2-8: Keystone thrust putting Paleozoic strata (dark) onto Jurassic sandstones (light) west of Las Vegas, Nevada. Photo: K. Hamblin.

5.3 Appalachians

The Appalachians resulted from a number of Paleozoic orogenies that occurred during closure of the Iapetus Ocean and the collision of microcontinents (terranes) and the African plate with the North American plate. In the course of these collisions crystalline basement blocks were thrust onto the Paleozoic sequences deposited on the shelf of the North American craton. An excellent overview of the orogen can be found in Hatcher et al. (1989). The seismic surveys in the framework of COCORP revealed the enormous amount of overthrusting of the North American craton by various units.

Southern Appalachians. Figure 5.3-1, adapted from Hatcher et al. (1989), is a general section across the Southern Appalachians. It shows the large displacement of the Blue Ridge basement block, which was sheared off the SE margin of the North American craton and thrust over the adjacent Grenvillian crystalline basement and its Paleozoic cover, coming to rest on the inner margin of the allochthonous Valley and Ridge province. Whereas early workers (e.g. Cloos 1947) emphasized the ductile nature of the structures formed by the basement-cover contact, later workers highlight the imbricate structure of the basement block depicted in Fig. 6. The thickness of the basement thrust sheets is on the order of 5 km. Although the structures formed at the edge of the thinned craton (Hatcher 1989) it is unknown which type of lithology or layering was controlling the detachment.

Fig. 5.3-1: Geological profile across the Southern Apalachians, redrawn and simplified from Hatcher et al. (1989). Crystalline basement of the margin of the North American craton is thrust onto the craton itself in a style conformable to basement-involved thin-skinned tectonics. The décollement horizon climbs northwestward into the Paleozoic sedimentary strata resulting in a thin-skinned tecotnic style within the Valley and Ridge Province and the Cumberland Plateau. The accreted terranes at the rear (Innere Piedmont and Avalonia) are thrust onto the North American craton.

Valley and Ridge Province of the Southern Appalachians. The last of the orogenies affecting the Appalachians, the Alleghanian orogeny, compressed the sedimentary strata overlying the Grenvillian crystalline basement of the North American craton. The strata involved are of Paleozoic age and were deposited in a Paleozoic shelf sea grading upward into a foreland sequence. The shelf sequence includes thick carbonate units that acted as mechanically strong members, separated by more shaly units. As discussed by Hatcher et al. (1989), the basal detachment stepped upward in the transport direction following different stratigraphic levels. Fault related folds as already recognized by Rich in 1934 characterize internal shortening of the sedimentary sequence. Thrust faults in the external part, the Plateau, thrust faults are widely spaced, whereas the internal part, the Valley and Ridge province, closely spaced thrust faults associated with duplex structures are typical.

Fig. 5.3-2 shows a cross section across this thin-skinned fold-and-thrust belt. The Pine Mountain thrust displaced a broad syncline (Cumberland Plateau) and dipping strata are confined to where the thrust breaks surface In the internal part on the other hand, imbricate stacking is shown by the Clinchport, Copper Creek, Saltville and Pulaski thrusts. The structure in the adjacent Blue Ridge Province is characterized by numerous thrust faults forming duplex at depth. Here the thrust faults sole into the basal detachment in the Cambrian Rome Formation. At outcrop, the Rome Formation contains evaporites transformed into cargneules (Diegel 1988). The total displacement of these thrust faults is 100 to 260 km. In the roof of this duplex, Late Proterozoic-Cambrian strata form an upper duplex with a basal detachment reaching down into Grenvillian basement. This structure forms the transition to basement-involved thin-skinned tectonics, which brought basement rocks

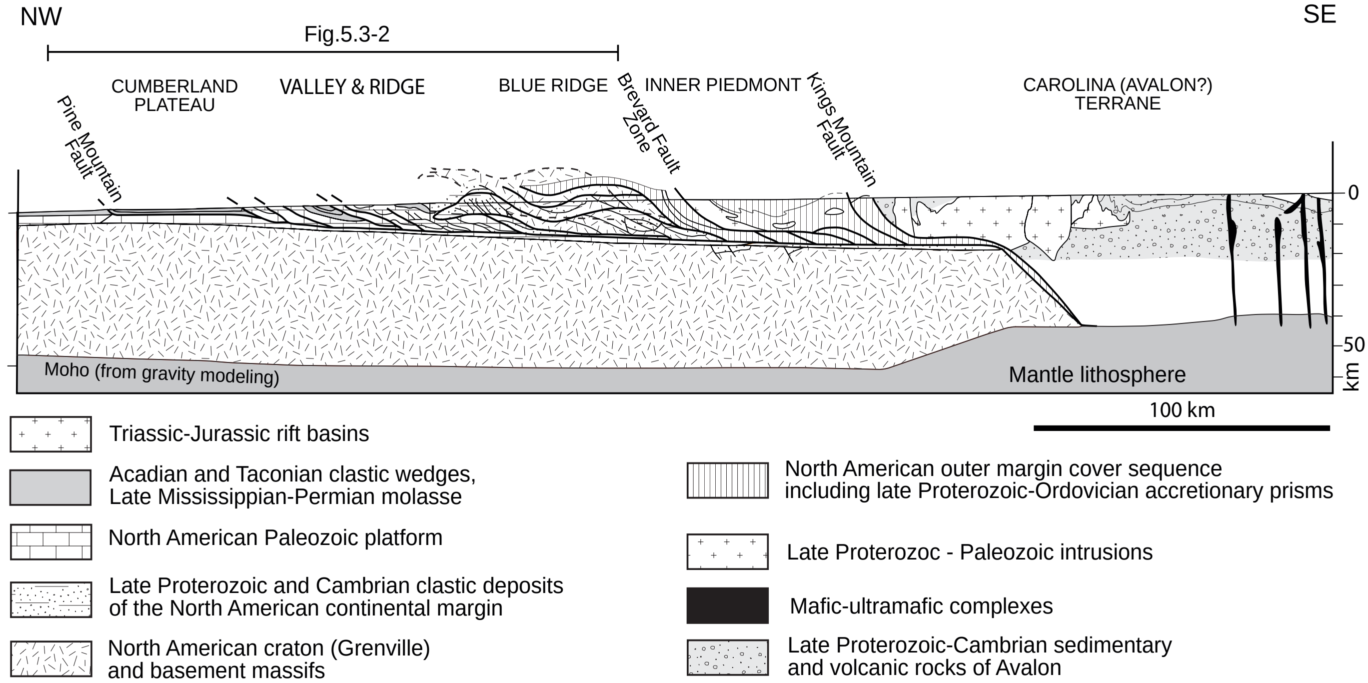


Fig. 5.3-1: Geological profile across the Southern Appalachians, redrawn and simplified from Hatcher et al. (1989). Crystalline basement of the margin of the North American craton is thrust onto the craton itself in a style conformable to basement-involved thin-skinned tectonics. The décollement horizon climbs northwestward into the Paleozoic sedimentary strata resulting in a thin-skinned tectonic style within the Valley and Ridge Province and the Cumberland Plateau. The accreted terranes at the rear (Innere Piedmont and Avalonia) are thrust onto the North American craton. Adapted from Pfiffner (in press).

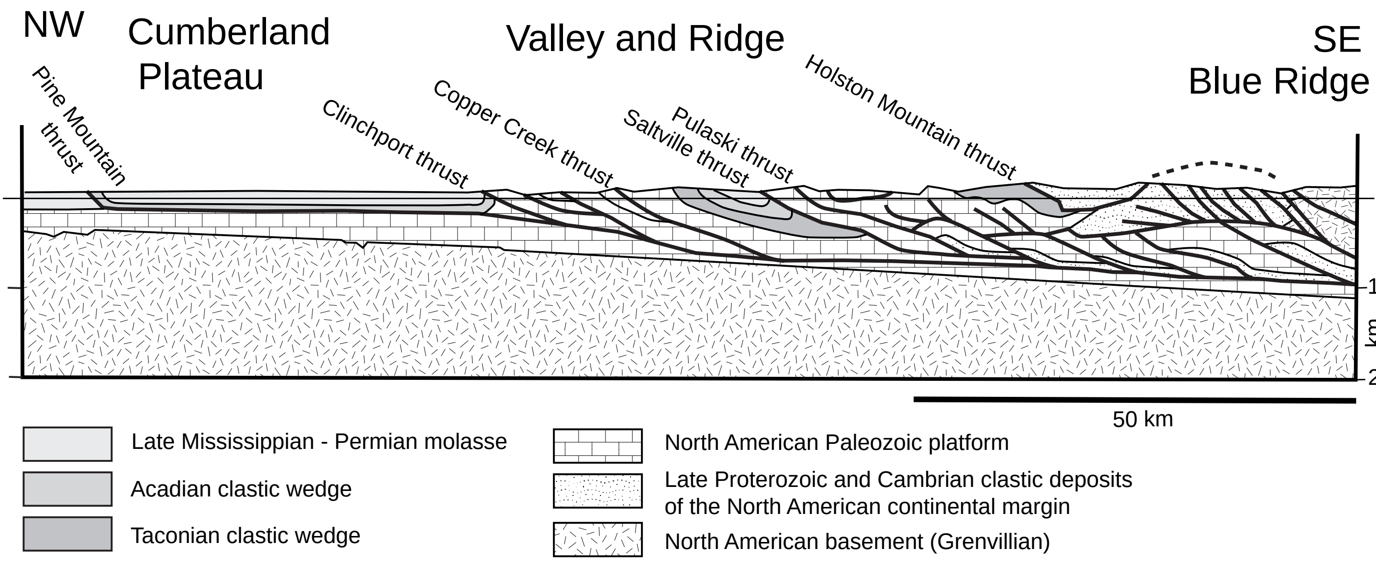


Fig. 5.3-2: Shows a cross section across this thin-skinned fold-and-thrust belt. The Pine Mountain thrust displaced a broad syncline (Cumberland Plateau) and dipping strata are confined to where the thrust breaks surface in the internal part on the other hand, imbricate stacking is shown by the Clinchport, Copper Creek, Saltville and Pulaski thrust. The structure in the adjacent Blue Ridge Province is characterized by numerous thrust faults forming duplex at depth. Herre the thrust faults sole into the basal detachment in the Cambrian Rome Formation. At outcrop, the Rome Formation contains evaporites transformed into cargneules (Diegel 1988). The total displacement ot these thrust faults is 100 to 260 km. In the roof of this duplex, Late Proterozoic-Cambrian strata form an upper duplex with a basal detachment reaching down into Grenvillan basement. This structure forms the transition to basement-involved thin-skinned tectonics, which brought basement rocks to the Blue Ridge. These basement rocks represents the tip of a large intact composite crystalline basement sheet issued from the Alleghanian collision (Hatcher et al. 1989). Adapted from Pfiffner (in press).

to the surface in the Blue Ridge. These basement rocks represents the tip of a large intact composite crystalline basement sheet issued from the Alleghanian collision (Hatcher et al. 1989).

Pine Mountain thrust

Important thrust faults include the Pine Mountain thrust (see Fig. 5.3-2) and the Hunter Valley thrust. As is the case with the outcrop conditions in general in the Appalachians, the thrust faults are not really visible at outcrop. They need to be mapped out in detail. Moreover, the thrust faults can be traced by means of mapping over large distances along strike. Observation at the surface is always at the same structural level. I.e. these thrust faults do not give clues as to how the rocks along the fault deformed under higher grade conditions (temperature and pressure) as is the case for the Glarus overthrust. The morphologic expression of these faults is limited to the expression of the folds associated with the thrust faults.

The geomorphic expression of thrust faults in the Appalachians is an indirect one. It it the folds that are in part intricately related to thrust faults that led to the term "Valley and Ridge". The thrust faults themselves are sometimes revealed by the fault rock (e.g. the evaporites of the Rome formation). Nevertheless, the large-scale extension of these folds (ord ridges) caught the eye of the geologists of the 19th century already, long before aereal photographs or satellite images were available.

From a historical point of view the Appalachians were one of the orogens where early workers became aware of thrust faulting. An excellent review of the growth of geological knowledge in the Appalachians is given by Rodgers (1970). The Rogers brothers (Rogers W.B. & Rogers H.D.) observed changes is fold amplitudes and dispacements of thrust faults. In their interpretation, published in 1843, the thrust faults were steeply dipping, and it was not until the discoveries of shallow dipping thrust faults in Scandinavia, Scotland and Switzerland that their shallow dip was appreciated. The Rogers brothers argued that the observed folds and (steep) thrust faults could not be the result of vertical motions alone, but that horizontal stresses were necessary. These stresses they derived from volcanic erruptions.

6 Australia and New Zealand

6.1 Macdonnell Ranges

The Macdonnell Ranges in central Australia represents an example of an intracratonic mountain belt that resulted from the. Paleozoic Alice Springs orogeny. Figure 6-1, drawn after Teyssier (1985), shows the general structure of the Arunta block and the adjoining Amadeus Basin, both located in the eastern part of the Macdonnell Ranges. As can be seen in Figure 6-1, the Arunta Block consists of a stack of high-grade crystalline basement nappes, the Arltunga nappe complex. To the south of this complex, clastic sediments accumulated in the Amadeus Basin, a foreland basin which evolved during nappe stacking in the Arltunga nappe complex (Dunlap et al. 1995). Within the Arltunga nappe complex, granulite facies lower crustal rocks define a stack of lower crustal thrust sheets (Teyssier 1985), which imply that the associated thrust faults reach down to the base of the continental crust. The total displacement along these faults is estimated at a minimum of 50-100 km. The sediments of the Amadeus Basin on the other hand, are detached from their crystalline substratum and were dislocated in a thin-skinned manner southward (see Fig. 6-1). The basal detachment of these sediments is deformed by the underlying stack of basement thrust sheets suggesting that in a first phase the sediments were detached and thrust southward, followed by a phase of crustal shortening within the lower and upper crustal rocks which eventually deformed the overlying thin-skinned fold-and-thrust belt.

The Arltunga nappe complex is located in a rather remote area some 100 km east of Alice Springs in the center of the continent. The area was first visited by white settlers exploiting gold. Outcrop conditions are good, but spectacular view limited owing to the relatively low local relief and the vegetation in this semi-arid region.

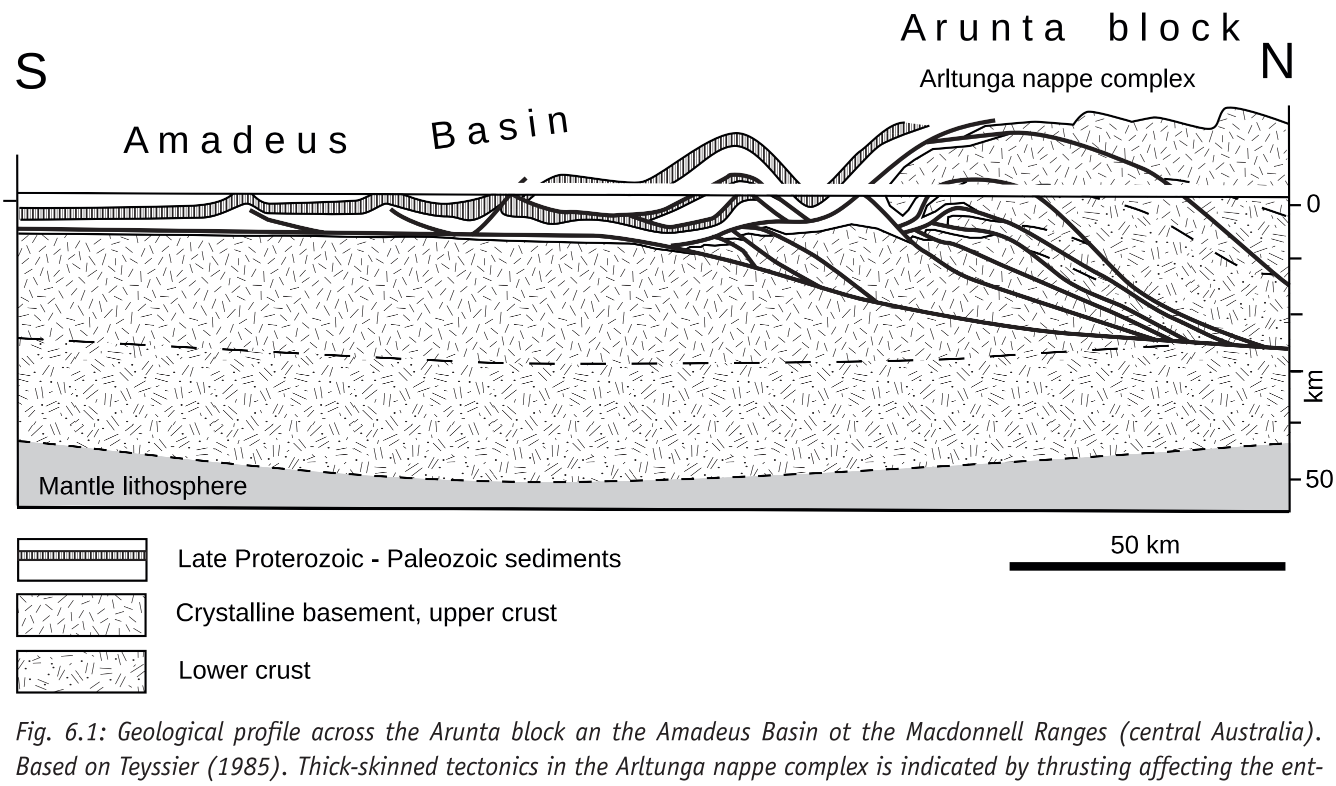


Fig. 6.1: Geological profile across the Arunta block an the Amadeus Basin ot the Macdonnell Ranges (central Australia). Based on Teyssier (1985). Thick-skinned tectonics in the Arltunga nappe complex is indicated by thrusting affecting the entire crust. In contrast, the basin fill of the Amadeus basin is deformed in a thin-skinned fashion. Adapted from Pfiffner (in press).

6.2 Southern Alps of New Zealand

The Southern Alps of New Zealand represent an active mountain range that experiences ongoing uplift and deformation. This mountain belt forms in response to the motion between the Australian plate, represented by the Tasman Sea, and the Pacific plate, represented by the Southern Island. The Alpine fault is the most important expression of the plate boundary at the surface. Deformation due to the convergence of the two plates led to the development of additional faults and folds within the Southern Alps. The seismic activity testifies to the ongoing plate motions. In the area of the South Island, the Australian plate sinks eastward beneath the Pacific plate. Going north a polarity change occurrs, such that in the Taupo area on the North Island, the Pacific plate sinks westward beneath the Australian plate. Plate motion is not perpendicular to the plate boundary. It rather has an important strike slip component. The Alpine fault therefore has a transpressional nature, i.e. most of the movement along this fault corresponds to a nearly horizontal displacement. This explains why the Alpine fault is nearly vertical, and in this sense it differs from the thrust faults discussed in this comparative study (the Alpine fault is not a thrust fault).

Nevertheless the Alpine fault is an important fault and well known in the international community of geosciences. It also has an importance for societal aspects: the town of Wellington is built on the fault zone and seismologists expect a magnitude 8 or 9 earthquake to occurr in the future.

Te Wahipounamu property

On South Island, the Alpine fault crosses the Te Wahipounamu property. The latter has been established based on criteria like landscape, morphology, vegetation and fauna and is undoubtedly an asset to the World Heritage. The Alpine fault plays a subordinate role in this property. The fault itself has been mapped out by geologists. This work is still ongoing. One of the reasons for this is that the fault is very difficult to locate exactly because of the vegetation and scree cover. In this sense its value does not compare to e.g. the Gavarnie, Glarus or Livingstone thrusts with their superb outcrop conditions.

7 Comparison

In this section we attempt to compare the various objects treated in the preceding chapters in terms of criteria discussed in the UNESCO document by Dingwall et al. (2005). We found the following four criteria to be most useful for a comparison of thrust faults: Scientific Value, Scenic Value, Geomorphic Expression and Educational Value. To assess these criteria, we defined subcriteria that allow an objective evaluation. These subcriteria are listed in Table 1 along with the conditions for fulfillement of each subcriterion. From the sum of the subcriteria fulfilled we derive a ranking for each of the four main criteria. Here the ranking "excellent" is given only if most of the subcriteria were evaluated as "excellent". The rankings of the four main criteria are given in Table 2. Table 2 should not be read per se and without the explanations given here, which are based on the analysis presented in the preceding chapters.

7.1 Scientific value

The scientific value was evaluated based on properties of thrust faults with regard to (1) the direct relationship to plate motions, (2) the process of mountain building, (3) the magnitude of displacement, (4) the deformation of the rocks beneath and above the faults and (5) the deformation mechanisms active along the fault surface.
Several of the examples discussed in the descriptive part of this study fulfill most, but not all of the criteria (1) through (5).
Subcriteria (1) through (3) are met more or less entirely by the basal thrusts of the Helvetic, Penninic and Austroalpine nappes in the Western Alps, the Swiss Alps and the Eastern Alps. The same holds for the Moine and Jotun thrusts of the Caledonides, the Main Central Thrust in the Himalayas, thrusts in the Andes, the Purcell and Lewis thrusts of the North American Cordillera, the Pine Mountain thrust in the Appalachians, the Arltunga nappe complex in Australia and the South Alpine Fault in New Zealand.
On the other hand, subcriteria (4) and/or (5) are not fulfilled in the very same cases, because deformation structures in the footwall (beneath) and/or the hanging wall (above) of the faults cannot be observed in a direct way, or that deformation mechansisms in the fault zone are not directly accessible to observation. The Glarus thrust, however, meets all these subcriteria simultaneously!

7.2 Scenic value

The scenic value may be assessed by (6) the natural beauty of the thrust fault, (7) the beauty and quality of the structures beneath and above the thrust fault, and (8) the three-dimensionality of exposure. Subcriterion (6) is fullfilled by the Glarus thrust, the Säntis and Drusberg thrusts, the basal thrust of the Austroalpine nappes (Matterhorn and Graubünden area), the Gavarnie thrust in the Pyreneees, the Moine thrust in Scotland, thrust faults in the Western Cordillera of the Peruvian Andes, the Lewis (and McConnell) thrust, and the Livingstone thrust in the North American Cordillera.
Subcriterion (7) is not quite met by the basal thrust of the Australpine nappes, Moine thrust, the thrusts in the Western Cordillera of Peru and the Lewis and Livinstone thrusts.
Subcriterion (8) is not completely fullfilled by the Säntis and Drusberg thrusts, the Moine thrust and the thrust faults in the Western Cordillera of Peru. The Glarus thrust and the Gavarnie thrust the meet all these subcriteria simultaneously and unequivocally!

7.3 Geomorphic expression

For the geomorphic expression we used (9) the geomorphic expression of the fault in the landscape and (10) the presence of spectacular and visually striking phenomena as subcriteria. Subcriterion (9) is met my many thrust faults even if the fault surface itself is not directly exposed at the surface. For example, the Lewis thrust is outlined at varous locations by cliff forming rocks in the hanging wall rocks (Proterozoic rocks of Paleozoic carbonates) and Cretaceous strata in the footwall that form gentle slopes covered with vegetation. Other faults do not meet subcriterion (9) because they are not associated with a particular geomorphological "anomaly". Examples include the Roselend thrust, the Wildhorn, the Doldenhorn and the Morcles thrust in the Alps, the Main Central Thrust in the Himalayas (for most of its length), the faults in the Atlas mountains and the Naukluft mountains, the thrust faults in the Eastern Cordillera of the Peruvian Andes, the faults in the Omineca Belt of the North American Cordillera, the basal thrust of the Arltunga nappe complex in Australia and the Alpine Fault in New Zealand.
Subcriterum (10) requires the presence of spectacular abrupt color changes or a sharp contact manifested by small scale geomorphic features. Of all the many thrust faults analyzed, it is the Livingstone thrust, the Gavarnie thrust and the Glarus thrust which clearly meet this subcriterion, and all three also meet subcriterion (9).

7.4 Educational value

The educational value is evaluated on the basis of (11) the historic geological context of the object, (12) the potential of public awareness of the object. In subcriterion (11) it is the question around the history of science (recognition of thrust faults) that plays an important role. In the (Southern) Appalachians (Rogers and Rogers 1843, and Rodgers 1949) the discussion turned around thick-skinned tectonics (folds in the sedimentary strata that also involve crystalline basement rocks) and thin-skinned tectonics (folds carried by thrust faults involving only the sedimentary strata or thin slices of crystalline basement rocks). In Scandinavia, Törnebohm (1896) recognized thrust faults in the Sparagmite nappe. Both these examples meet subcriterion (11), but none of the other subcriteria. The most famous controversies regarding subcriterion (11) were fought out around the Moine thrust and the Glarus thrust and the basal thrust of the Penninic nappes in the Prealps (Swiss Alps).
Subcriterion (12) is important for the policy of protection (does the first-time-visitor leave the place with the conviction that the site must be safeguarded for future generations?); it is also related to the accessibility of the site. Examples that meet subcriterion (12) include the Lewis thrust in the Waterton Glacier International Peace Park (Canada/USA), the Gavarnie thrust in the Pyrenees' Mont Perdu (France/Spain) and the Alpine Fault (although it is not a thrust fault) in Te Wahipounamu (New Zealand) to name protected areas. A number of other thrust faults from non-protected areas could be added to this list. Hower, it seems to us that only the Moine thrust, the basal thrust of the Penninic nappes in the Swiss Prealps and the Glarus thrust really meet both subcriteria unevoqually and simultaneously.

7.5 Conclusion

Our evaluation suggests that the Glarus thrust reaches the ranking "excellent" regarding all four criteria and thus fulfills the condition of "Outstanding Universal Value". It is the only object evaluated that simultaneously fulfills the conditions of all the subcriteria considered in the comparative analysis. Moreover, it ranks first amongst all the objects in the great majority of the subcriteria. This comparative analysis clearly indicates that the nominated property "Glarus overthrust" merits to be inscribed in the World Heritage List.

Table 1: Subcriteria and conditions for fulfillment

Criterion		Subcriterion	Conditions for fulfillment of subcriterion
Scientific Value	1	relation to plate motions	The thrust fault may directly be linked to the plate motions responsible for the formation of the fault.
	2	mountain building processes	The thrust fault demonstrates how surface uplift and hence high elevation of the plate margin(s) is created.
	3	magnitude of displacement	The displacement along the thrust fault is of considerable magnitude, typically more than 30 km (the average thickness of the crust).
	4	deformation beneath and above	The structural style of the rocks beneath and above the thrust fault includes significant folding and thrusting, possible associated with pervasive, ductile or brittle deformation.
	5	deformaton mechanisms in the rocks along the thrust fault	It is possible to study the deformation mechanisms (viscous creep by intracrystalline deformation, brittle-plastic flow, pressure solution, fracturing) in the rocks along the thrust fault. The thrust fault exhibits a in the ideal case a spectrum of low temperature to high temperature behavior.
Scenic Value	6	natural beauty of thrust fault	The thrust fault itself forms a unique feature in the landscape that strikes the eye of non-geologists. The beauty is undelain by pronounced differences in color of the rocks above and beneath, or along the thrust fault.
	7	beauty and quality of structures beneath and above	The fold and thrust structures above and beneath the thrust fault are themselves outstanding examples of compressional structures in mountain belts. They should have struck the eyes of structural geologists and laymen as singular features.
	8	three-dimensionality of exposure	The thrust fault should be exposed such that its shape is clearly visible in three dimensions over an area of tens of kilometers. This typially requires an important relief.
Geomorphic expression	9	thrust fault in landscape	The thrust fault marks itself in the landscape such that the geomorphic feature strikes the eye of non-geologists. These features are unequivocally linked to the primary object.
	10	spectacular and visually striking phenomena	The thrust fault is marked in the landscape by prominent color changes, by ledges or important changes in slope angles that can easily be traced over many kilometers and across mountains. These features may be present in combination.
Educational Value	11	historic geological context	The thrust fault should have played an important role in the history of science, in particular related to the understanding of the deformation of the Earth's crust in response to the motion of tectonic plates.
	12	potential to stimulate public awareness	The thrust fault must be readily accessible to the general population and must be able to convey an understanding for natural science in general and the processes of mountain building in particular. It should convince the occasional visitor that the property merits to be preserved for future generations.

Table 2: Ranking of thrust faults

		Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	Roselend thrust	2	3	2	3	10	7
	Digne thrust	3	3	1	2	9	6
Swiss Alps	Glarus thrust	1	1	1	1	4	**1**
	Drusberg-Säntis thrust	2	1	2	3	8	5
	Axen thrust	2	2	2	3	9	6
	Wildhorn thrust	2	2	2	3	9	6
	Morcles & Doldenhorn thrusts	2	3	3	3	11	8
	Base Préalpes Médianes	1	2	2	2	7	4
	Matterhorn / Base Austroalpine	1	1	2	2	6	**3**
	Rätikon / Base Austroalpine	1	1	3	3	8	5
	Engadine / Base Austroalpine	1	2	3	3	9	6
Eastern Alps / Austria	Inntal thrust	3	3	2	3	11	8
	Hohe Tauern / Penn & Austroalpine	1	2	3	2	8	5
Pyrenees	Gavarnie thrust	2	1	2	2	7	4
Caledonides	Moine thrust / Scotland	1	1	2	1	5	**2**
	Jotun thrust / Bygdin, Norway	1	2	2	2	7	4
Himalayas	Main Central thrust	1	2	3	3	9	6
Atlas Mountains / Morocco	High Atlas & Anti-Atlas	3	3	3	3	12	9
Naukluft Mountains	Namibia	3	3	3	3	12	9
Andes	Western Cordillera Peru	2	1	2	3	8	5
	Eastern Cordillera Peru	1	4	3	4	12	9
	Subandine Zone Bolivia	2	2	3	3	10	7
Rocky Mountains	Omineca Belt	1	3	3	2	9	6
	Foreland Belt / Lewis thrust	1	1	2	2	6	**3**
	Livingstone thrust	2	1	1	2	6	**3**
Appalachians	Pine Mountain thrust	1	3	3	2	9	6
Alice Springs / Australia	Arltunga nappe	1	3	3	3	10	7
Southern Alps New Zealand	Southalpine fault	2	3	3	2	10	7

Ranking: excellent = 1, very good = 2, good = 3, fair = 4

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Annex CA1: Reviews

Annex CA1.01: Prof. Dr. Jonas Kley (Friedrich-Schiller-Universität Jena, Germany):
Review of "Comparative study on thrust faults" by O.A. Pfiffner, M. Burkhard and S.M. Schmid.
Date: August 2006.

Annex CA1.02: Prof. Dr. Steven F. Wojtal (Oberlin University, Ohio, USA):
Review of "Comparative study on thrust faults" by O.A. Pfiffner, M. Burkhard and S.M. Schmid.
Date: July 2006.

Annex CA1.01: Prof. Dr. Jonas Kley (Friedrich-Schiller-Universität Jena, Germany): Review of "Comparative study on thrust faults" by O.A. Pfiffner, M. Burkhard and S.M. Schmid.

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IG UNESCO-Welterbe
„Glarner Hauptüberschiebung"
c/o David Imper
Untergasse 19
CH-8888 Heilig

Jena, den 10. August 2006

Review of „Comparative study on thrust faults" by O.A. Pfiffner, M. Burkhard and S.M. Schmid

This report examines the characteristics of the regional Glarus thrust fault in Switzerland to show that it is of Outstanding Universal Value and merits inclusion in UNESCO´s world heritage list. All three authors are internationally renowned experts in the fields of Alpine tectonics and structural geology in general. They have combined their professional expertise and collected an impressive amount of thoroughly documented and amply illustrated case studies on large thrust faults from around the world. From the comparison of these examples the authors make their case that the Glarus overthrust is indeed unique in many aspects. In order to enable a systematic evaluation, four parameters were chosen from an existing list of criteria that can be judged with a reasonable degree of objectivity in the case of faults: (1) scientific value, (2) scenic value, (3) geomorphic expression, and (4) educational value.

As to the **scientific value**, it is clear that thrust faulting is too varied a phenomenon to be exhaustively illustrated on a single example. In that sense the Glarus thrust represents an excellent demonstration of thrust faulting associated with continental collision, but does not rank scientifically higher than, say, a lesser fault in an intracontinental setting. However, the range of structural phenomena that can be observed at and near the Glarus fault is clearly outstanding. Due to its subhorizontal orientation and long exposure the effects of temperature and fluid pressure gradients on deformation become evident from the complex combination of brittle and ductile structures. Although it has been the target of many meticulous studies the Glarus thrust still poses challenges to our understanding of faulting. It is of outstanding scientific value both in terms of the answers it has provided and of the questions that still linger.

The **scenic value** of the Glarus thrust –if referring to the structure itself, not just the landscape where it is embedded- is rather underplayed than exaggerated in the study. A comparison of the many photographs shows one major difference between the Glarus thrust and almost any other fault discussed: the Glarus thrust as exposed in the Tschingelhoren area (Fig. 2.1-6c and on the cover) *will strike even a very casual observer and can be immediately recognized as an important discontinuity*. All other examples, with the possible exception of the McConnell thrust (Fig. 5.2-6) require some understanding of the regional stratigraphy (the normal sequence of strata) to recognize that something is "wrong" here. Many large faults are covered by debris and look disappointing, at least to a layman.

The **geomorphic expression** is closely related to and difficult to separate from the scenic value (although somewhat dependent on definition). The three-dimensional exposure of the Glarus thrust is spectacular and its visibility enhanced by the contrasting rock types across the fault which are sculpted differently by erosion. The geomorphic expression of thrust-related uplift as an ongoing process is lacking on the now inactive Glarus thrust. Good examples of this can be seen in arid, tectonically active regions where there is a one-to-one relation between structure and topography, like Central Asia or the Andean foreland (discussed in the report). However, the faults themselves are typically not or poorly exposed.

1

Friedrich-Schiller-Universität Jena

The **educational value** of the Glarus thrust is very high for several reasons, some of them already mentioned above: First of all, it is very easy to see in the landscape. Some locations where you can stand on the fault and see it in the distance at the same time (Fig. 2.1-6d) provide a direct, intuitive 3D impression of what the feature really is: a plane, not just a line. Starting there it will be easy to explain that the Alps, as many other mountain belts, are in fact "a pile of peels" as H. Laubscher once put it. At the same time it can be perceived that these "thin" crustal slivers are actually enormous masses of rock on a human scale. The present-day observer can share some of the disbelief and wonder of many early geologists that overthrusts of such dimensions should be possible, but can then proceed to see how they now fit into modern theories of mountain building and plate tectonics. There is an added benefit to the Glarus property in this respect: It was one of the important sites where earlier concepts of overfolding were replaced by a thrust fault interpretation and where this paradigm change is beautifully documented in old illustrations. It is also an example of how science –ideally- works: a new idea is so striking that it even convinces the proponents of the old one it replaces. Apart from the historical aspect the Glarus overthrust also provides a direct link to a forefront of modern research where material science blends with geology. The sharpness of the fault is a very direct, visual experience; yet the reasons for this extreme strain concentration are still not fully understood. So the Glarus area is of interest to those superficially interested in geology (ever wondered why there are mountain ranges in the first place?) and professionals alike. A final point not unimportant for the educational value is the accessibility of the region.

In summary, the conclusion reached in Pfiffner et al.´s "Comparative study on thrust faults" is sound: *the Glarus thrust is a truly outstanding example of a large-scale thrust-fault*, matched by very few, if any, other fault in the world. I fully agree with the authors that this property deserves to be inscribed in the UNESCO world natural heritage list.

Jena, 31.3. 2006

(Prof. Dr. Jonas Kley)

Annex CA1.02: Prof. Dr. Steven F. Wojtal (Oberlin University, Ohio, USA): Review of "Comparative study on thrust faults" by O.A. Pfiffner, M. Burkhard and S.M. Schmid.

OBERLIN

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Dr. David Imper
Dipl. Natw. ETH Geologe CHGEOL

Dear Dr. Imper

I write belatedly with the review of the *Comparative Study on Thrust Faults* by O. Adrian Pfiffner, Martin Burkhard, and Stefan M. Schmid. Let me state at the outset that all three authors are among the most highly respected geoscientists conducting research on the character of thrust faults, on their tectonic setting, and on their significance in the formation of mountain belts. Each author is known around the world for the thoroughness and care with which they collect geologic field data, for their acumen at using laboratory data and theoretical analyses to interpret those data, and their ability to draw these analyses well-supported, logical and insightful inferences on the development of structural features and how those structural features contribute to the tectonic history of regions. Their *Comparative Study on Thrust Faults* is, in my view, an excellent example of objective scientific analysis of the significance of thrust faults as structural features in mountain belts and of the assessment of the significance of the Glarus overthrust as one of the classic 'type' examples of a thrust fault. In my view, their conclusion that the Glarus overthrust is a feature of outstanding universal value is fully supported by the *Comparative Study on Thrust Faults*. The *scientific value* of the Glarus overthrust lies in both the level of detail with which the authors have been able to enumerate its geometry, geological character, and tectonic significance. The *scenic value* is clear in the pristine character of the alpine setting of the proposed property. For both geologists and lay persons, the strong contrast of the color and character of the rock units juxtaposed across the Glarus thrust in the proposed property means that the overthrust has an unusual clarity of *geomorphic expression*. Taken together, these characteristics lend unusual *educational value* to the proposed property. When one takes account that the proposed property comprises the location of the first thrust fault ever described, the added value of the historical import of the property yields an educational value without rival in the world. The remainder of this letter I endeavor to identify several specific points that support the statements I have made in this opening paragraph, but I cannot state more directly that the *Comparative Study on Thrust Faults* has convinced me that the proposed property readily meets the criteria outlined for outstanding universal value.

In section 2.1 *Alps* of chapter 2 (*Europe*) of the *Comparative Study on Thrust Faults*, the authors describe the geometry and explain briefly the geologic history of the Alpine Mountain chain. With their proximity to some of the oldest centers of academic endeavor, it is not surprising that the Alps are so well known despite the many stages in their evolution. The successive stages give rise to daunting complexity of surface geology in many portions of the belt. Moreover, the deep structure of the belt, beautifully illustrated in the profiles in Figure 2.1-

2, shows the effects of overprinting successive phases of crustal shortening. Within this context, as Figure 2.1-4 shows, the Glarus thrust is a significant geological element even at the scale of the crust and lithosphere, and it has a relatively straightforward geometry. In Figures 2.1-5(a) to (e), the authors illustrate this magnificent structural element is displayed within the proposed property. The proposed property contains abundant features illustrating the effects of pronounced shear deformation on the folds and faults beneath the Glarus. Still, the Glarus thrust itself is readily seen, as is shown clearly in Figures 2.1-5e, 2.1-6c, and 2.1-6d. Finally, also found on the proposed property is the well-known Lochseiten calcmylonite, which was one of the first thrust-zone mylonites to be described. Numerous studies of this unit, some completed by the authors, have inferred different micro-mechanisms by which this mylonite could accrue the deformation required to accommodate movement of the hanging wall of the Glarus thrust over such great distances. Whatever the final determination on the mechanism by which this unit deformed, the significance of this particular rock unit is nonetheless an additional factor contributing to the educational value of the proposed property. As the authors explain in the second half of section 2.1, none the numerous other thrust faults in the Alps have the combination of tectonic importance, clarity of exposure, and historical importance to rival the Glarus in terms of its importance. In the second European mountain belt examined, the Pyrenees, there is a single candidate that compares in any way with the numerous Alpine thrust faults – the Gavarnie thrust. As the authors indicate in section 2.2 *Pyrenees*, this thrust is well-exposed and shares many characteristics with the Glarus thrust. In my view it is not as clearly exposed or as well studied as the Glarus. In any case, it does not have the historical significance of the Glarus thrust. The Moine thrust, outlined in section 2.3 *Caledonides*, has a historical significance that rivals that of the Glarus thrust, but it is neither so uniformly well-exposed nor as visually-striking as the Glarus thrust. Of all the thrust faults found within Europe, then, I concur with the authors that the Glarus thrust is exceptional in having extraordinary scenic and educational value.

Of the thrust faults exposed in Asia (chapter 3), only the Main Central thrust in the Himalayas has scenic value comparable to the Alpine examples. In the last two decades, structural geologists have directed concerted effort to understand the geology and tectonics of the Himalayas. As the authors note, we geologists have recently begun to appreciate the unusual characteristics of the juxtaposition Main Central thrust and South Tibetan detachment. As the evidence that this is a locus of channel flow accumulates, this location has acquired iconic status. In this sense, this location has the potential to be considered for the World Heritage List. This does not, however, detract in any way from the qualities of the Glarus thrust or make the Glarus in any way less worthy of listing.

The short length of the authors chapter 4 (*Africa*) is an accurate reflection of the continent's lack of classic examples of thrust faults, a fact that I had not fully appreciated prior to undertaking this review. On the other hand, there are several classic thrusts exposed in the Americas. Thrust faults are particularly striking features in the Cordillera, the belt of mountainous terrain that extends along the western edge of North America from Alaska to Mexico, through Central America, and then along the western edge of South America from the equator to its southernmost tip. As the authors note, none of the thrust faults in the South American portion of this magnificent belt have the combination of scenic and educational value that compares with any of the several Alpine thrusts. On the other hand, there are several spectacular thrust faults exposed in the portion of the Rocky Mountains that straddle the U.S.-Canadian border. Of these, the Lewis and McConnell thrusts deserve special mention for their combination of geomorphic expression and historical significance. As is apparent in Figures 5.2-4, 5.2-5, and 5.2-6, these thrusts have impressive outcrop expression. Furthermore, geologic study of these two thrust faults has contributed to our understanding of the mechanics of thrust emplacement, the role of thrust faulting in crustal shortening, and the critical role that thrust faults play in synorogenic sedimentation during mountain building. It is not surprising, then, that much of the length of these two structures is included in national, state, and provincial parks or to learn that one portion of the Lewis thrust is listed as a World Heritage site. As the authors state, significant thrust faults also occur at different locations along the length of the Appalachian Mountains. Given the long history of geological study of the Appalachians, some Appalachian thrust faults are well-known around the world. Studies of the Pine Mountain and Cumberland Plateau thrust faults published in the first half of the 20th century, for example, were key to understanding the geometry of thrusts exposed elsewhere. Due to the relatively subdued topographic expression and the climate in this belt, there are no truly spectacular scenic exposures of these two thrusts, or of others in the Appalachians.

Australia has a single thrust belt associated with the Alice Springs orogeny. The thrusts associated with Artlunga nappe complex have recently been studied carefully and yielded interesting information on the character of deformation within thrust sheets. Like the Appalachian examples, however, the age of this belt leads to subdued topographic expression and does not yield particularly scenic exposures of thrusts. As the authors note, relatively young mountains in New Zealand yield spectacular scenery, but this scenery does not have the correlation to thrust faulting of the proposed property.

To reiterate my earlier statement, I concur with the authors that the Glarus overthrust is a feature of outstanding universal value. Geologists know well the geometry, geological character, and tectonic significance of the Glarus overthrust. Exposures of the Glarus thrust are visually striking for both geologists and lay persons. Furthermore, the Glarus thrust was the first thrust fault ever described. As the authors have made very clear in their *Comparative Study on Thrust Faults*, the proposed property readily meets the criteria outlined for outstanding universal value required to be inscribed on the World Heritage List.

If there is any other way that I can support this nomination, please let me know.

Sincerely,

Steven F. Wojtal
Longman Professor of Natural Sciences
Chair, Department of Geology

Annex CA2: Support letters

Annex CA2.01: Prof. Dr R. Ferreiro Mählmann (Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, Darmstadt, Germany)
Date: 29th of June 2005

Annex CA2.02: Dr Meinert Rahn (Mineralogisch-Geochemisches Institut, Universität Freibung, Freiburg i. B., Germany)
Date: 22th of June 2005

Annex CA2.03: Prof. Dr E. Seibold (Universität Freiburg, Freiburg i. B., Germany)
Date: 30th of September 2005

Annex CA2.04: Prof. Dr. B. Stoekhert (Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Bochum, Germany)
Date: 23th of June 2005

Annex CA2.05: Prof. Dr Giorgio V. Dal Piaz (Dipartimento di Geologia, Paleontologia e Geofisica, Università degli Studi di Padova, Padova, Italy)
Date: 29th of September 2005

Annex CA2.06: Prof. Dr Andrew Mccaig (Institute of Geological Sciences, Leeds University, Great Britain)
Date: 23th of June 2005

Annex CA2.07: Prof. Dr G. Gee, Department of Earth Sciences, Uppsala University, Uppsala, Sweden)
Date: 5th of October 2005

Annex CA2.08: V. E.Khain (Institut of the Lithosphere, Academician of the Russian Academy of Sciences, Moscow, Russia)
Date: 3rd of November 2005

Annex CA2.09: Prof. Dr Hejing Wang (School of Earth and Space Sciences, Peking University, Beijing, People's Republic of China)
Date: 24th of June 2005

Annex CA2.10: Dr Julia Kramer (Economic Geology Research Institute, University of the Witwatersrand, Johannesburg, South Africa)
Date: 23th of June 2005

Annex CA2.11: William S. Fyfe (Department of Earth Sciences, The University of Western Ontario, Ontario, Canada)
Date: 30th of August 2005

Annex CA2.12: Prof. A. Bally (Dept. of Earth Science, Rice University, Houston, Texas, U.S.A.)
Date: 12th of October 2005

Annex CA2.13: Prof. Dr Terry Engelder (Department of Geosciences, The Pennsylvania State University, Pennsylvania, U.S.A.)
Date: 1st of July 2005

Annex CA2.14: Prof. Dr William A. Thomas, Department of Geological Sciences, University of Kentucky, Lexington, Kentucky, U.S.A.)
Date: 1st of September 2005

Annex CA2.01: Support letter Prof. Dr R. Ferreiro Mählmann (Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, Darmstadt, Germany)

Von: Rafael Ferreiro Mählmann [ferreiro@geo.tu-darmstadt.de]
Gesendet: Mittwoch, 29. Juni 2005 23:25
An: Imper@impergeologie.ch
Betreff: IG Kandidatur UNESCO-Welterbe Glarner Hauptüberschiebung

Sehr geehrter Herr Imper, Mittwoch 29.06.2005

Ich habe erfahren, daß Sie im Zusammenhang mit der IG Kandidatur UNESCO-Welterbe Glarner Hauptüberschiebung die Koordination leiten. Wir haben kürzlich vernommen, daß die Glarner Hauptüberschiebung nicht zur Aufnahme in die Welterbeliste empfohlen wird (leider sind mir die Gründe unbekannt bzw. ich habe zu wenig Informationen über die Ablehnung). Dies ist für uns kaum verständlich (abgesehen man kann eine Bedrohung des Geologischen Denkmals völlig ausschließen), sind doch Deckenüberschiebungen in ihrem naturlandschaftlichen Kontext nirgendwo auf der Welt so schön aufgeschlossen und das Phänomen von Deckenüberschiebungen einfacher erklärber als in Glaner Land (hier müßten die drei betroffenen Knatone Graubünden, St. Gallen und Glarus aktiv sein). Die Glarner Hauptüberschiebung ist wissenschaftshistorisch von eminenter Bedeutung und einer der weltweit wichtigsten Schauplätze der Deckentektonik. Sie ist heute noch Gegenstand bedeutender Forschungsabeiten (auch an der TU Darmstadt wird an der Glaner Hauptüberschiebung gearbeitet) und meiner Meinung nach gehört die Glarner Hauptüberschiebung unbedingt auf die Liste des UNESCO-Welterbes. Alle zwei bis drei Jahre führen wir im Studiengang Angewandte Geowissenschaften (Dipl. Ing. Geol.) eine Exkursion an die ausgezeichneten Aufschlüsse im Glaner Land durch.

Herzliche Grüße und viel Erfolg,

Rafael Ferreiro Mählmann
Prof. Dr. Rafael Ferreiro Mählmann
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Annex CA2.02: Support letter Dr Meinert Rahn (Mineralogisch-Geochemi-sches Institut, Universität Freibung, Freiburg i. B., Germany)

Von: Rahn Meinert [Meinert.Rahn@hsk.ch]
Gesendet: Mittwoch, 22. Juni 2005 09.31
An: Imper@impergeologie.ch
Cc: josef mullis
Betreff: Glarus thrust

Dear Dr. Imper,

I have received news that the Swiss proposal of the Glarus thrust as a UNESCO world heritage candidate has failed to gain support by the preparatory authorities in advance to the upcoming session of the World Heritage Committee in Durban, South Africa.

Let me express my strong astonishment about this decision. Thousands of geologists world-wide have visited the Glarus thrust in Switzerland and its spectacular outcrops, and they all have agreed on its uniqueness and on the fact that this feature has had a major impact on our understanding of geological processes.

History tells us that the Glarus thrust has been subject of an intense scientific debate among Swiss and European geologists in the 19th century. In 1884, Michel Bertrand, a French geologist, used the Swiss geological maps and profiles of the Glarus area to come up with the idea of a large thrust plane to explain the present situation. This was a revolutionary concept and the hour of birth of the "nappe" structure in geology, a concept that has since found its application in all orogens of this planet and has completely changed our understanding on mountain chain formation. The nappe concept finally has had a major influence to the break through of the concept of plate tectonics some 80 years later.

In the 20th century the area of the Glarus thrust was mapped in detail and the scientific community started to quantify its shape (Schmid 1975), its structural evolution (e.g. Milnes and Pfiffner 1977), its unique example of inverse metamorphism (e.g. Frey 1988), its importance as an indicator of post-metamorphic transport (e.g. Rahn et al. 1995), its importance as a reference horizon for latestage exhumation (e.g. Rahn et al. 1997, Rahn & Grasemann 1999). The scientific work along the thrust plane has not ceased, but is more active than ever before, because we are just about to realize that most major aspects of thrust plane formation are not yet resolved.

To me, after 20 years of geological education and work and after a large quantity of attended international excursions, the Glarus thrust still represents a unique feature, exceptionally suited to explain fundamental geological concepts to amateurs and professionals and to elucidate the history of geological thinking.

I highly recommend to the authorities of the World Heritage Committee to positively respond to the candidature of this geological feature for inclusion on their World Heritage List.

Sincerely,

PD Dr. Meinert Rahn
Mineralogisch-Geochemisches Institut
der Albert-Ludwigs-Universität
Albertstrasse 23b
DE - 79104 Freiburg i. Brsg.

Annex CA2.03: Support letter Prof. Dr E. Seibold (Universität Freiburg, Freiburg i. B., Germany)

Von: Familie Seibold Freiburg [seibold-freiburg@t-online.de]
Gesendet: Donnerstag, 29. September 2005 19.48
An: Imper@impergeologie.ch
Betreff: Glarus Main Thrust

Dear colleague,

You have asked me for some comments to the Glarus Thrust.

As former president of the International Union of Geological Sciences I can assure you of the worldwide importance of this outstanding geological phenomenon of alpine type mountains. It offers a spectacular demonstration of a fundamental earth sience process for everyone. Additionally, it illustrates the historically classic discussion in the 19th century between the two eminent Swiss scientists Escher von der Linth and Albert Heim with their perception of the "Glarus Double Fold" and the French Marcel Bertrand who favoured the thrust idea.

With my best regards,
sincerely,

Eugen Seibold

Annex CA2.04: Support letter Prof. Dr. B. Stoekhert (Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Bochum, Germany)

David Imper

Von:	Bernhard Stoeckhert [Bernhard.Stoeckhert@ruhr-uni-bochum.de]
Gesendet:	Donnerstag, 23. Juni 2005 06:18
An:	Imper@impergeologie.ch
Betreff:	UNESCO Welterbe

An:

David Imper, Regionalmanagement Untergasse 19, CH-8888 Heiligkreuz.

betrifft: IG Kandidatur UNESCO-Welterbe Glarner Hauptüberschiebung

Den Vorschlag, die Glarner Hauptüberschiebung in die Welterbeliste aufzunehmen, möchte ich nachdrücklichst unterstützen. Diese unvergleichlich eindrucksvolle und auch für den Laien in Entwicklung und Bedeutung nachvollziehbare geologische Struktur hat für die Entwicklung des Verständnisses der Menschheit für die Erdkruste, auf der und von der sie lebt, eine herausragende Rolle gespielt. An dieser Stelle wurde erstmals erkannt, dass die die Erdkruste weitaus beweglicher ist, als es sich Menschen bis dahin vorstellen konnten, nur eben in anderen Zeitskalen. Diese Erkenntnis ist weit über die wissenschaftsgeschichtlichen Aspekte hinaus von Bedeutung. Die Erkenntnis, dass menschliches Leben auch von Vorgängen in anderen als den geläufigen menschlichen Zeitmaßstäben kontrolliert wird (siehe 26.12.2004) ist weltweit von der Menschheit kaum verinnerlicht, obschon essentiell für ihren Fortbestand. Eine geologische Struktur, an der der Kontrast in den menschlichen und geologischen Zeitmaßstäben und die Tatsache, dass Menschen die meisten geologischen Vorgänge nur als eine Art Blitzlichtaufnahme wahrnehmen können, eindrucksvoll und anregend demonstriert werden können, verdient daher besondere Aufmerksamkeit. Eine Aufnahme in das Welterbe hätte eine nicht hoch genug einzuschätzende Außenwirkung und wäre daher in höchstem Maße wünschenswert.

Bernhard Stöckhert
(Professor für Geologie, Ruhr-Universität Bochum)

Annex CA2.05: Support letter Prof. Dr Giorgio V. Dal Piaz (Dipartimento di Geologia, Paleontologia e Geofisica, Università degli Studi di Padova, Padova, Italy)

Von: Giorgio Vittorio Dal Piaz [giorgio.dalpiaz@unipd.it]
Gesendet: Donnerstag, 29. September 2005 22:01
An: imper@geopark.ch
Betreff: Glarus main thrust

Dear Imper,

since as a student in Geological Science I studied how and where the nappe theory was conceived, knowing that it mainly fluorished in the Glarona Alps and then developed in the Penninee zone and throughout the entire Alps, thanks to the genious of Shardt, Lugeon, Argand and others Alpine geologists, I realized that the mountains where the intimate structure of this collisional belt was unravelled must rightly be considered as a monument of the human creativity.
Therefore, let me join to you and strongly support the Glarus main thrust would be included into the UNESCO Scientific Warld Heritage.

Separately, I send you some reprints of historical papers which emphasize the role of thrusts in the development of the nappe theory and plate tectonics.

Best regards

Giorgio V. Dal Piaz

Annex CA2.06: Support letter Prof. Dr Andrew Mccaig (Institute of Geological Sciences, Leeds University, Great Britain)

Von: Andrew Mccaig [andrew@earth.leeds.ac.uk]
Gesendet: Donnerstag, 23. Juni 2005 11:46
An: Imper@impergeologie.ch
Betreff: Glarus Thrust as a World Heritage Site

Dear Dr Imper,

I understand the Glarus Thrust has been proposed as a World Heritage Site. I would like to offer my full support to this proposal

I had the privilege of visiting the Glarus Thrust a few years ago in the company of Martin Burkhard and others, and was a co-author on a recent paper on fluid flow through the thrust (Badertscher, N.P., Abart, R., Burkhard, M and McCaig, A.M. (2002) Fluid flow pathways along the Glarus overthrust derived from stable and Sr-isotope patterns. American Journal of Science 302, 465-516).

The Glarus Thrust is one of the most famous views in world geology, used in publications and websites throughout the world as a type locality (see, for example http://earth.leeds.ac.uk/faults/index.htm). It was first described by Escher in 1841, then by Heim in 1919-22, and it featured in E.B. Baileys seminal work "Tectonic Essays", first published in 1935, which served to introduce this locality to the English-speaking world. No-one who sees the Glarus Thrust can doubt the existence of major overthrust faults, yet this was one of the major formative controversies in the history of Earth Sciences.

From an academic viewpoint, the Glarus thrust with its knife edge thrust plane is a key endmember locality for understanding the rheology of overthrust sheets. It is also an important example for understanding fluid flow and permeability generation in faults (see references in the paper cited above). The Glarus area is a type locality for "flysch", again a term which has been exported from Switzerland and is used all over the world.

I am also very familiar with the Bay of Islands area in West Newfoundland, which was justifiably made a World Heritage Site some years ago. In my opinion The Glarus area is equally important.

yours sincerely

Andrew McCaig

Annex CA2.07: Support letter Prof. Dr G. Gee, Department of Earth Sciences, Uppsala University, Uppsala, Sweden)

Von: Davis Gee [david.gee@geo.uu.se]
Gesendet: Mittwoch, 5. Oktober 2005 14:22
An: imper@geopark.ch
Betreff: Your letter

Dear David,

You didn't need to regret troubling us.

It's a pleasure to write in support of this proposal to make Glarus into a World Heritage site. I guess UNESCO argue that the overthrust wont go away if we don't honour it - and only geologists will visit this Mekka! I wonder whether you don't have to tackle it another way - that Global Change is in the ground beneath our feet and not just in the hydrosphere, biosphere and atmosphere; that thousands of people die every year from ground movements - earthquakes, avalanches and volcanoes, e.g. Tangshan 250.000 in 1976 or the Sumatra earthquake in January. On Glarus, we can show people how dynamic the Earth is and how important it is to see things at the surface that went on at depth both millions of years ago and earlier this year; certainly also now as I write. We need to emphasize that Glarus is not just a great and extremely important site for the history of geological thinking, but a place to enhance awareness of Earth dynamics. We know that there is a 70% chance that Istambul will be hit by a mag. 8 earthquake within the next 30 years and that this will probably result in the death of 50.000 people and damage of USD 50 Billions. If you are in Turkey, you have a good chance to see the faults cutting through the roads and mosques and feel its importance. In Europe we've forgotten the Lisbon earthquake and the tsunami that followed, that destroyed most of the city, caught most of the Catholics in the churches and profoundly influenced the thinking of the times for Kant to Voltaire and many others. These things don't happen very often, but they will inevitably get worse as population (and urbanization) grows. UNESCO knows that education and awareness are important; that destruction hits the Undeveloped World hardest and that the "Developed" elite have a big responsibility to move towards mitigation. UNESCO know that the amount of money invested in measures to reduce poverty and build up our weaker societies is small by comparison with the cost of the devastation when these natural disasters happen.

Maybe something along these lines would persuade UNESCO that Glarus is more than just a "Monument for the Converted"; that it has real significance for society as a whole.

As usual, in haste,

Yours,
David Gee

David G. Gee
Professor
Department of Earth Sciences
Uppsala University
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tel. +46 18 471 23 80
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Annex CA2.08: Support letter V. E.Khain (Institut of the Lithosphere, Aca-demician of the Russian Academy of Sciences, Moscow, Russia)

Von: Rubanik [rubanik@ilran.ru]
Gesendet: Mittwoch, 2. November 2005 09.45
An: imper@geopark.ch
Betreff: glarus main thrust support

Dear colleagues,

I fully support the idea of the inclusion of the Glarus Main Thrust into the Scientific World Heritage of UNESCO.

Indeed, the Glarus Main Thrust is classical not only for Europe.
The problem of thrusts is one of the most important in geology. I agree that the significance of thrust phenomena in understanding the structures and development of the Earth is very important. It has a scientific and educational significance.

I would like to mention that in Scotland the analogous Moine thrust was included into the UNESCO Scientific World Heritage long ago.

I hope that my statement would help you with a resubmission of your application.

Sincerely yours,

Professor Victor E.Khain

Academician of the Russian Academy of Sciences

Annex CA2.09: Support letter Prof. Dr Hejing Wang (School of Earth and Space Sciences, Peking University, Beijing, People's Re-public of China)

Von: 58186 [hjwang@pku.edu.cn]
Gesendet: Freitag, 24. Juni 2005 06:26
An: Imper
Betreff: Support the Glarus thrust to the list of UNESCO World Heritage

Dear David Imper,
(Regionalmanagement Untergasse 19, CH-8888 Heiligkreuz.
Candidature committee UNESCO World Heritage Glarus Main Thrust)

It is so sad to hear the news that the Glarus Main Thrust has not been recommended for admission to the World Heritage List. This is hardly understandable to us. As what we known, the Glarus Main Thrust system is a wonderful and beautiful nappe stacking system not only in the scene of geology but also in the scene of the geography. Such a nappe stacking system and its natural context you will never find elsewhere in the world.

Geologically, in eastern Switzerland, the Glarus thrust divided the Helvetic zone into the Helvetic nappes (above) and the Infrahelvetic complex (below) two parts with 40km displacement and the Penninic nappes were thrust onto the Helvetic zone during the Alpine collision. Rocks of the Helvetic zone were buried, deformed and metamorphosed up to lower greenschist facies during this course and recorded so much important information on the structural geology, metamorphism and tectono-thermometric history of Alps. Never can one find out such clear stacking system and clear rock-recordings elsewhere in the world, which offer such lot of subjects for geologists to study from very early of the human being's history until now. Therefore, the Glarus Main Thrust is one of the most important historic locations of science.

In my opinion the Glarus Main Thrust should be admitted to the World Heritage List.

Yours sincerely

Prof. Dr. Hejing Wang
School of Earth and Space Sciences
Peking University
Beijing 100871
People's Republic of China

Annex CA2.10: Support letter Dr Julia Kramer (Economic Geology Research Institute, University of the Witwatersrand, Johannesburg, South Africa)

Von: Julia Kramer [Julia.Kramer@unibas.ch]
Gesendet: Donnerstag, 23. Juni 2005 12:07
An: Imper@impergeologie.ch
Betreff: Glarner Hauptüberschiebung

To whom it may concern

As I've heard from colleagues, the Glarus thrust ("Glarner Hauptüberschiebung" in German), located in central Switzerland, has been chosen not to be recommended as a UNESCO World Heritage Site. As a structural geologist with 14 years of field experience in the European Alps, Southern Africa and the Eastern Himalaya, I think that the Glarus thrust is the most beautifully exposed natural example of thrust tectonics I have come across so far.

Furthermore the sharp contact between the dark hanging-wall and the bright-coloured footwall rocks is so obvious and visible from far away that it even achieves natural attention by the public– locals, skiing, hiking and climbing guests alike. The Glarus thrust thereby serves as an intuitively comprehensible example for the process of continental collision, nappe stacking, and the formation of the European Alps to interested non-professionals alike.

The Glarus thrust is subject of ongoing scientific research and is certainly as important for the understanding of orogenic processes in general and the Alpine orogenesis as is the UNESCO World Heritage Site of the Dwars river gorge in South Africa for the understanding of magmatic processes and ore deposit formation.

For the above reasons I would like to support a recommendation for the acceptance of the Glarus thrust as a UNESCO World Heritage Site.

Sincere regards,
Dr. Julia Kramer

Dr. Julia Kramer
Postdoctoral Researcher

Economic Geology Research Institute
University of the Witwatersrand
Johannesburg, South Africa

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Mobile: +27-72-997 50 72
http://www.wits.ac.za/geosciences/

Annex CA2.11: Support letter William S. Fyfe (Department of Earth Sciences, The University of Western Ontario, Ontario, Canada)

The UNIVERSITY *of* WESTERN ONTARIO

Department of Earth Sciences • Faculty of Science

2005 08 30

Dr. David Imper
IG Kandidatur UNESCO
Heiligkrenz. Mels SG.
Switzerland.

Dear Sir,

I understand that a large group of your local geologists have supported the proposal that the Glarus Overthrust be confirmed as a UNESCO World Natural Heritage Site.

Many years ago, I was in the field with many distinguished Swiss, European, geologists and we visited a number of classic sites. There is no doubt that when one considers processes on our convecting, cooling planet, the Swiss Alps are on all lists of classic observational sites.

A few years ago, I was asked to review Swiss proposals for sites for nuclear waste disposal. One of the greatest questions in our energy systems is "where is the best place on our planet to bury nuclear waste?" Having reviewed the Swiss proposal my conclusion was "do not put nuclear waste in the Swiss Alps". Where we have new mountains we have seismic activity, earthquakes, and fluid motions from many depths in the outer layers of our planet. All people must understand such phenomena.

The Glarus region has been, for many years, a classic region to study processes in the outer layers of our planet. We must all understand such processes and how they relate to our new development systems. A very important feature of the World Heritage proposal for Glarus is that it is a site which can be used for education. I have found great satisfaction in taking all people, citizens, engineers, politicians and, in particular, school children to such sites. They must be preserved! We all must know what is under our feet!

I fully support the heritage site proposal for the Glarus region. We must do more to preserve such classic sites in the world, and the Swiss Alps are a classic.

With hope for your support.

Yours truly,

William S. Fyfe FRSCan, FRSNZ, FRS
Professor Emeritus (Geology)

Western

WILLIAM S. FYFE
C.C., F.R.S., F.R.S.C., F.R.S.N.Z., M.R.S.C.
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Annex CA2.12: Support letter Prof. A. Bally (Dept. of Earth Science, Rice University, Houston, Texas, U.S.A.)

RICE

DEPARTMENT OF EARTH SCIENCE
WIESS SCHOOL OF NATURAL SCIENCES

Houston , October 12 2002

**IN SUPPORT OF THE PROPOSED "GLARUS MAIN THRUST" "
IG UNESCO WORLD HERITAGE SITE**

A.W,BALLY

Harry Carothers Wiess Professor Emeritus
Dept. of Earth Science MS-126, Rice University
Houston ,Texas 77251 -1892
e-mail : bally@rice.edu

The proposed " Glarus Main thrust " IG UNESCO WORLD HERTAGE site is of immense importance to the history of the Earth Sciences .Since the early 1880'ies the Glaronese Thrust was at the center of the many debates associated with the origin of mountain ranges. The area remains one of the great attractions for hundreds of visiting earth scientists , as well as for many laymen interested in the origin of mountains .Nowhere else in the world are large -scale overthrusts as spectacularly displayed and that easily accesible !

Why should anybody care about the origins of mountains and overthrusts ?
Historically , mountains divided people , but also brought them together . Folks were divided by different languages , cultures and goals . Initially , mountains helped to contain larger wars.However , with increased trade , mountain passes , and eventually tunnels provided opportunities for various forms of transport and communication . Thus people were brought together by overcoming the many challenges presented by the mountains that separated them . To begin with, the fear of mountains was great , the scenery was wild and scary , and so many disasters such avalanches , landslides and floods threatened .Understanding the nature and origin of these disasters brought about their mitigation , while at the same time establishing bonds across the mountain ranges .
The Swiss people learned to live in these mountains by always trying to maintain a healthy balance that preserved much of nature, while still trading and above all keeping the peace. An important part of this process was an effort to also understand the plants , animals with all their ecological interactions .
The compressional origin of mountains is of paramount importance for the earth sciences and the key to that insight is closely tied to the acceptance of large-scale overthrusts that displace huge volumes of rocks over tens and sometime

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hundreds of kilometers . Even today , this concept remains mindboggling to the layman yet , as we now undersrtand it , it is a key corollllary to modern plate tectonics . These geologic observations and the grand theories that tie them together would all be unthinkable without the discovery of the great overthrust of Glarus.All this is an inportant part of the great scientific heritage of mankind.

The discovery and confirmation of the Glarus Overthrust is unique in the annals of the earth sciences and also serves as an early example of international cooperation and interaction among earth scientists This epic was best described in 1935 in the Tectonic Essays of the great Scottisch geologist E.B. Bailey.He describes how it involved the initial discovery in 1841 of the great overthrust by the Glarus geologist A Escher von der Lindt and the publication of his map in 1848 , his interaction with and the field visitt of the famous British geologist R. Murchison , a controversy between the Swiss Allbert Heim and the German A. Rothpletz , the genius of the French Geologists Marcel Bertrand who in 1884 resolved the controversy and finally the great Austrian synthesist Eduard Süss ,who was able to put this important discovery into a world-wide perspective. 1884 was also the year when Peach and Horne confirmed the great overthrusts in Scotland .The new concept spread swifly and crossed the ocean into North America with the 1861 discovery , in Quebec ,of the important Appalachian thust by W.E Logan (the Logan line) and in the 1887 of the overthrusts by R. McConnell . To conclude the discovery Glarus Overthrust was crucially important for the development of modern orogenic tectonics .
It may well be that the Glarus overthrust was first recognized because it's exposures are larger and more spectacular than the ones that were discovered subsequently , elsewhere. However, the area was also more easily accessible than the other areas . Even today these two reasons offer the most compelling rationale for declaring the area an IG UNESCO WORLD HERITAGE SITE.

The Glaronese Alps and the mountains of the adjacent cantons are also unique because , in my judgement , they are the best- documented , beautifully and abundantlly illustrated mountain region of the world .Over one hundred and fifty years of painstaking mapping and geological work by Swiss geologists produced some of the finest and most detailed geological maps of this area Furthermore, many spectacularly beautiful panoramic drawings (some old , some new) are available These permit the visitor to study them from many different viewpoints . Over the years most oif this material was published in Switzerland ,in relatively small editions and it is likely that a judicious choice of the very best of this material may get reprinted for a much wider distribution , when the IG UNESCOWORLD HERITAGE SITE has been approved .Thus , what the Grand Canon is for stratigraphers and geomorphologists , the Glarus site may well become the "must-visit " site for structural geologists and tectonic experts, worldwide .

The Glarus Overthrust Heritage Site also offers an outstanding perspective of the development of the Passive Margin of the ancient Tethys ocean . The long-distance transport of huge masses of rocks originally deposited on continent/ ocean margins is best illustrated by the Glaronese overthrust , and the associated folds. Outcropping stratigraphic sections of the Permian to Upper Cretaceous are the telescoped segments of the northern passive margin of the western Tethys .Their basic reconstruction was first done by Arnold Heim in 1916 and subsequent studies all over the Alps have greatly ampliified this context .Thus ,not only do we get insights into mountain systems and their formation , but we also were able to access and reveal in exposures the typical deeper submarine parts of todays passive margins ,like the ones marking the continent/ocean boundaries of Atlantic Ocean . All this offers another illustration of the consequences of modern plate tectonics . Note here, that todays submarine passive margins are of great economic importance , as they may contain significant , as yet undiscovered , hydrocarbon resources. Their scientific understanding is equally important to evaluate climate modifications through time.

Many easy routes make this area widely accessible and very much " lived in " by people that always loved their surrounding mountains. To be sure in the U.S. and Canada we have many spectacular Natural Parks . At least two of these display good examples of overthrusts . Yet none of these examples have as important a place in the history of our science as the Glarus area , nor do they offer so many spectacular views of all the associated structures that underlie and underlie the major overthrust .
The beautiful North American National Park sites ,have become "quasi- pristine" as each summer so many of them are invaded every by huge mobs of visitors. However , aside from tourism , they are , by design , not part of a wider and differentiated economy .The proposed Glarus IG UNESCO WORLD HERITAGE SITE differs from conventional national parks , because people actually live and work in the many small towns and villages and in the mountains.They always were proud to respect nature , and to nurture a subtle and careful balance with nature , even though their valleys eventually became accessible by trains , cars ,trucks etc,. Interestingly, the area is not one of the principal touristic centers of Switzerland and remains somewhat " off the beaten track " , even so the area has a solid but ,not extravagant, touristic infrastructure Instead of a jetset you'll find working people who care for their mountains .
I am a loyal member of the " Nature Conservancy " an internationally active organization that aims at preserving nature ,while still allowing reasonable development . This is done while working with the local populations and their

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government . In the process they purchase significant tracts of land worldwide , and allow for sensible economic development near and within these tracts . The beauty of this proposed IG UNESCO WORLD HERTAGE SITE is that so much of its preservation , was and still is due to the good instincts of a native population , that nevertheless was able to develop a sensible and live economy involving small industries as well as a viable , but not overwhelming, touristic infrastructure . Also, if one wanted "to get away from it all" , the proposed area is superb ,as it permits to contemplate with leasure and understand mountains , their structure , their ecology and their people in quiet spots in the mountains ; many of them are only accessible by hiking along beautiful and safe mountain trails .

<u>The proposed area may also serve as a realistic model for the balanced economic development of mountain areas in developing countries</u> .In a world with an ever increasing population , it would appear to be plausible to have some heritage sites located in mountains that subsist quite well on a viable and broadly based economy , instead of an exclusively touristic economy . All this , while offering one of the finest I object lessons on mountain building in the world While the Grand Canon permits to understand the nature of geological strata ,Yellowstone and Iceland and Hawaii permit to understand volcanic phenomena ,the " Glarus Main Thrust " area is the , premier site to teach , understand and illuminate the origin of mountains, as well as the nature of typical ancient passive margins .

<u>Teachers could not find many better examples , to introduce young people to the challenges and beauty of mountains</u> ! The proposed site is ideally suited to explain to small classes the quintessence of mountain building , tectonics and stratigraphy At the same time the international character of the history of the overthrust discovery and the debates surrounding the Glarus area , does serve as key model to illustrate the importance and excitement associated with the use of scientific method in an international dialogue .

During much of my career , I was an explorationist working with oil companies worldwide .Early on ,for over a dozen years , I was deeply involved with exploration of the Canadian Rocky Mountains foreland folded belt . Together with my colleagues ,we discovered some major gas fields , including one located very close to the Glacier National Peace Park . Indeed ,the producing structure extends underneath the well-known Lewis overthrust . I like to think that we were able to find and exploit this gas field in an environmentally responsible manner . In this same context we also undertook extensive and detailed mapping of the Canadian Rocky Mountains and foothills all the way up to the Arctic Ocean .

With less economic success , we also explored the structures associated with the old" Logan line" of Quebec. It would have been inconceivable for me to creatively participate in all this exciting work , without having considerable familiarity with the classical Glarus overhrust area and its extensively published documentation .

Subsequentlly , either as an explorationist or else later as an advisor to my students I had the chance to work in considerable detail on the folded belts of the Canadian Arctic , the U.S , Mexico ,Venezuela , Morocco , Spain , Italy , Turkey , India , Indonesia , Taiwan and very recently Central China . Furthermore I had a more casual exposure to many other foreland folded belts. Therefore , I believe that I am able to fairly judge the relative merits of various possible sites for an IG UNESCO WORLD HERITAGE SITE that would display and document overthrusting and the many other important aspects associated with it. From the above it is evident , that I take it as given that understanding mountain building processes and the great importance of overthrusts , is indeed a crucial part of our scientific and cultural heritage . To illustrate this point I cannot think of a better candidate than the proposed Glarus area .

From 1978 to 1983 I have served as a member and for the last three of these years I was Chairman of the UNESCO sponsored Scientific Committee of the Internal Correlation Program (IGCP) From 1990 – 1992 I was President of ICSU sponsored Bureau of the Inter-Union Commission of the Lithosphere . I still try remain informed about these programmes ,which I support , because I believe in the goals of UNESCO . I am convinced that the proposed site would fit the high standards set by the fine programs of the UNESCO ogranisation . For all these reasons I support the application of "The Glarus Main Thrust" area to become a IG UNESCO WORLD SITE , with great enthusiasm. The open , international and tolerant outlook of the people of Glarus is well symbolized by the fact that they display the picture of yje medieval Irish Saint Fridolin on their Cantonal flag . I trust that my colleagues in Switzerland will be most cooperative with UNESCO . I also have no doubt that the proposed site will become a precious jewel in the crown UNESCO's World Heritage Sites . My good Swiss colleagues would deservedly be greatly honored by a favorable decision , that at the same time also would do honor to UNESCO and its organizations .

Respectfully submitted , Albert W. Bally

Albert W. Bally
Harry Carothers Wiess Professor Emeritus

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Annex CA2.13: Support letter Prof. Dr Terry Engelder (Department of Geosciences, The Pennsylvania State University, Pennsylvania, U.S.A.)

Von: Terry Engelder [engelder@geosc.psu.edu]
Gesendet: Freitag, 1. Juli 2005 22.34
An: Imper@impergeologie.ch
Cc: josef mullis
Betreff: Re: Glarus Main Thrust, Recommendation

David:

The Glarus Thrust ranks along with the world's most important outcrops in terms of mankind's understanding of geological processes (during the 19th century). I would include very few other locations in the world when identifying equally important outcrops. These might include Hutton's Old Red Sandstone unconformity in Scotland to name one from the 18th century and Alvarez's Scalgia Rossa outcrop at Gubbio for the discovery of a mechanism for dinosaur extinction to name one from the 20th century.

Sincerely,

Terry Engelder
336 Deike Building
Department of Geosciences
The Pennsylvania State University
University Park, Pennsylvania 16802
U.S.A.
Phone: 814-865-3620
Fax: 814-863-7823

Annex CA2.14: Support letter Prof. Dr William A. Thomas, Department of Geological Sciences, University of Kentucky, Lexington, Kentucky, U.S.A.)

Von: Prof. Adrian Pfiffner [pfiffner@geo.unibe.ch]
Gesendet: Donnerstag, 1. September 2005 11:45
An: Imper@impergeologie.ch
Betreff: Fwd: Re: Glarus thrust as UNESCO World Heritage Site

Dear Adrian,

This is to express the support of The Geological Society of America for the establishment of the Glarus thrust as a UNESCO World Heritage Site. In addition to being a scenic exposure, the Glarus thrust has played an important role in the initial understanding of thrust tectonics. Because of the excellent exposure and clear geologic relationships, this site will be instructive to the general public, as well as to geoscientists. For these reasons, we support the proposal to designate this as a World Heritage Site.

Sincerely,

Bill Thomas

William A. Thomas
President, The Geological Soceity of America

William A. Thomas
Hudnall Professor
Department of Geological Sciences
University of Kentucky
101 Slone Building
Lexington, Kentucky 40506-0053
telephone 859-257-6222
fax 859-323-1938

Annex CA3: Support letters from the Swiss Geoscience organisations

Annex CA3.01: Schweizerische Geologische Gesellschaft (Swiss Geological Society): Prof. Dr. St. Schmid, president.
Letter of Support regarding the nomination of the Glarus overthrust site for the list of UNESCO World heritage
Date: September 2004.

Annex CA3.02: Schweizerische Geologische Kommission der Schweizerischen Akademie der Naturwissenschaften scnat (Swiss Geological Commission of Swiss Academy of Sciences scnat): Prof. Dr. H. Weissert.
Glarner Hauptüberschiebung: Nomination for the List of UNESCO World Natural Heritage.
Date: September 2004.

Annex CA3.03: IUGS Switzerland: PD Dr. H. Stünitz, president.
Date: August 2006.

Annex CA3.04: GEOforumCH: Prof. Dr. W. Häberli, president, & Dr. P. Dèzes, executive secretary.
Support letter for the candidacy of the Glarus overthrust site.
Date: August 2006.

Annex CA3.05: Schweizerische Arbeitsgruppe Geotope und Schweizerische Arbeitsgruppe Geopark des GEOforumCH der Schweizerischen Akademie der Naturwissenschaften scnat (Swiss Geotope and Geopark Working Group of the GEOforumCH and Swiss Academy of Sciences scnat):
Prof. Dr. E. Reynard, president.
Support letter for the candidacy of the Glarus overthrust site.
Date: August 2006.

Annex CA3.06: ICAS (Commission interacadémique Recherche alpine – Swiss Alpine Studies): Prof. H. Veit, president.
Letter of Support regarding the nomination of the Glarus overtrust site for the list of UNESCO World Heritage.
Date: August 2006.

Annex CA3.07: CIPRA Schweiz (Commission Internationale pour la Protection des Alpes – International Commission for the Protection of the Alps) :
Dr. C. Neff, Co-president.
Letter of letter for the nomination of the Glarus overthrust site for the list of UNESCO World Heritage.
Date: August 2006.

Annex CA3.08: Stiftung Landschaftsschutz Schweiz SLF (Swiss Foundation for Landscape Conservation):
Dr. R. Rodewald, director.
Support letter for the nomination of the Glarus overthrust site for the UNESCO World Heritage list.
Date: August 2006.

Annex CA3.09: Schweizerische Arbeitsgemeinschaft für die Berggebiete SAB (Swiss Center for Mountains Regions):
T. Egger, director.
Letter of support
Date: August 2006.

Annex CA3.01: Schweizerische Geologische Gesellschaft (Swiss Geological Society): Prof. Dr. St. Schmid, president: Letter of Support regarding the nomination of the Glarus overthrust site for the list of UNESCO World heritage

SGG ⚒ SGS

SCHWEIZERISCHE GEOLOGISCHE GESELLSCHAFT
SOCIETE GEOLOGIQUE SUISSE

Basel, 28.9.04

Letter of Support regarding the nomination of the Glarus overthrust site for the list of UNESCO World heritage

The Managing Committee of the Swiss Geological Society strongly supports the nomination of the area of the Glarus overthrust for several reasons, the most important being that the nomination of this site is of world-wide scientific interest, both in terms of the history of science, and also, in terms of ongoing research on the mechanics of large overthrusts.

A large number of internationally renowned persons visit this site every year. The reasons for this are two-fold. On the one hand this large overthrust is of breathtaking simplicity in that it exposes a razor-sharp cut of enormous dimensions, truly in 3 dimensions and mostly at high altitude, hardly being overprinted by later movements. On the other hand, the mechanics of such large overthrusts are still much disputed, as was the case since the middle of the 19th century. Interestingly, this thrust received increased scientific interest over the past decade. All this proves that the Glarus overthrust is truly unique on international standards. Visitors and ongoing researchers all agree that they do not know of a similarly fascinating orogen-scale scenario elsewhere.

The beauty of the outcrop also fascinates non-geologists, the outcrops being extremely impressive. Non-geologists can easily be introduced into the physical principles of mountain building. They can also easily be made aware of the fact that the area played (and still plays) a key role in the history of science on a truly international level.

All in all the Swiss Geological Society is convinced that the proposed nomination is of truly outstanding universal value.

The president of the Swiss Geological Society

Prof. Stefan Schmid
Geologisch-Paläontologisches Institut
Bernoullistr. 32
CH-4056 Basel

Annex CA3.02: Schweizerische Geologische Kommission der Schweizerischen Akademie der Naturwissenschaften scnat (Swiss Geological Commission of Swiss Academy of Sciences scnat): Prof. Dr. H. Weissert, president: Glarner Hauptüberschiebung: Nomination for the List of UNESCO World Heritage.

Schweizerische Akademie der Naturwissenschaften SANW
Académie suisse des sciences naturelles ASSN
Swiss Academy of Sciences SAS

Schweizerische Geologische Kommission & Comité national de Géologie
Commission Géologique Suisse
Commissione Svizzera di Geologia

Zürich, 13.9.2004

Glarner Hauptüberschiebung: Nomination for the list of UNESCO World Natural Heritage

A letter of support by the Swiss Geological Commission

The region of Sargans with the Glarus overthrust offers us an exceptional view into the history of mountain building. The prominent line marking the Glarus thrust can be traced from the Graubünden Mountains into the region of Glarus and Sargans. This thrust provides us insight into the deep mountain building factory. It tells us about colliding continental plates and about mountain building processes. It reminds us of the immense forces which finally resulted in a mountain range like the Alps. Other mountain ranges preserve similar signatures of plate tectonics and mountain building but this region is peculiar also because of its history.

Early geologists investigating the Alps at the beginning of the 19th century were puzzled by the easily visible line cut into the mountains of the Glarus region. They considered it as possible that, as a consequence of mountain building forces, rock material was not just folded but was piled up in a nappe stack. This observation ultimately led to the modern understanding of mountain building; not deep vertical forces from the earth interior but immense lateral forces were involved in the construction of mountains. The older theory that mountains were the consequence of a shrinking earth could be abandoned as well. The observations that the Alps were a thrust belt opened the door to a new understanding of global tectonics. But it took more than another century after Escher's early observations in the Glarus region until plate tectonics offered a new theory of mountain building, which was consistent with the observation of thrusts made by geology pioneers in the Alps.

The Glarus thrust can be described as the typical thrust telling us about the beginning of modern geological thinking and about evolving concepts in the investigations of mountains. The thrust remains of interest for researchers studying now the mechanisms of thrusting which occurred 30 million years ago in the, at that time, deeply buried mountain building factory. The signatures of processes written into the rocks are now easily visible not only for the scientist but for all visitors of these mountains in eastern Switzerland. A look into deep earth history in Glarus reminds us how short the history of geological sciences still is and it brings us to one of the birthplaces of geological sciences. In addition, the spectacular thrust makes us think about the unthinkable: the immense time and forces involved in mountain construction.

H. Weissert

Prof. Dr. Helmut Weissert. President Swiss Geological Commission

Präsident:
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Annex CA3.03: IUGS Switzerland: Prof. Dr. H. Stünitz, president.

IUGS - Switzerland
President: Dr. Holger Stünitz
Dept. of Geosciences
Basel University
Bernoullistr. 32
CH-4056 Basel
Switzerland

David Imper
IG UNESCO Kandidatur Weltnaturerbe Glarner Hauptüberschiebung
Untergasse 19
CH-8888 Heiligkreuz/Mels

Basel, 18-Aug-2006

Dear Dr. Imper,

On behalf of the Swiss national committee of IUGS I fully support the idea to initiate the Glarus Thrust as a World Heritage Site. The Swiss National Committee gives his support unanimously and wholeheartedly - the decision was made with enthusiasm and without hesitation.

As the comparative study of similar thrusts from all over the world has shown, the Glarus Thrust is not only a remarkable and uniquely well exposed nappe contact embedded in a spectacular landscape and natural surrounding, it also has been the site at which the nappe theory was first formulated and the tectonic thrust concept was discovered. Since the first recognition of a tectonic contact at the Glarus Thrust, this unique structure has been studied intensively and still is - despite its clear and undisputed recognition as the classic thrust - an object for on-going studies of great importance.

The initiation of the Glarus Thrust as a World Heritage Site would not only help to preserve the natural wonder and site of a major scientific achievement, it would also help to foster future research activities at this very important location of geological science.

Best regards

Holger Stünitz

PD Dr. Holger Stünitz
President of IUGS Switzerland

Annex CA3.04: GEOforumCH: Prof. Dr. W. Häberli, President, & Dr. P. Dèzes, Executive Secretary: Support letter for the candidacy of the Glarus overthrust site.

sc | nat

GEOforumCH
Forum Geosciences
Platform of the Swiss Academy of Sciences

IG UNESCO-Weltnaturerbe
Glarner Hauptüberschiebung
David Imper, Geschäftsstelle
Untergasse 19
CH-8888 Heiligkreuz/Mels SG

Bern, 07.08.06

Support letter for the candidacy of the Glarus overthrust site

Sir,

The Swiss Academy of Sciences and its platform for geosciences GEOforumCH, fully supports the candidacy of the Glarus overthrust for its inclusion on the UNESCO World Heritage List.

In our opinion, the Glarus overthrust fully meets the selective criteria required for being declared a site of outstanding universal value.

Not only is the Glarus overthrust, in its shrine formed by the Swiss Eastern Alps, a site of breathtaking natural beauty but it is also a site of outmost scientific importance.

From an historical perspective, the Glarus overthrust, due to the unique quality of its outcrops and accessibility, has played a key-role in the development of our understanding of mountain-building processes and more specifically, of thrusts and nappes formation.

Because the Glarus overthrust is such an outstanding example of a major tectonic structure, it offers nowadays a unique possibility also for non-specialists to understand the processes that contribute to the formation of orogens and an opportunity to get a feeling of the enormous forces at play within the Earth's crust during plate collisions.

The location of the Glarus overthrust in a natural environment mostly preserved from human impact and thus rich and diverse in its flora and fauna contributes to the uniqueness of this site.

We sincerely hope that the UNESCO will share our opinion regarding the unique value of the Glarus overthrust and be willing to include this site on its World Heritage List.

Yours sincerely

Wilfried [signature]

Prof. Dr. Wilfried Haeberli
President of GEOforumCH

Pierre Dèzes

Dr. Pierre Dèzes
Executive director

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Annex CA3.05: Schweizerische Arbeitsgruppe Geotope und Schweizerische Arbeitsgruppe Geopark des GEOforumCH der Schweizerischen Akademie der Naturwissenschaften scnat (Swiss Geotope and Geopark Working Group of the GEOforumCH and Swiss Academy of Sciences scnat): Support letter for the candidacy of the Glarus overthrust site.

sc | nat GEOforumCH Forum Geosciences Platform of the Swiss Academy of Sciences	**Arbeitsgruppe Geotope Schweiz** **Groupe de travail pour les géotopes en Suisse** **Gruppo di lavoro per i geotopi in Svizzera**

Prés. : Prof. Emmanuel Reynard, Institut de Géographie, Université de Lausanne
Bâtiment Anthropôle, 1015 Lausanne, 021 692 30 65, 079 331 72 44, emmanuel.reynard@unil.ch

Lausanne, August 21, 2006

David Imper

IG UNESCO World Heritage Candidature
Glarner Hauptüberchiebung

Untergasse 19
CH-8888 Heiligkreuz / Mels SG

Support letter for the candidacy of the Glarus overthrust site

Dear David

It is with great pleasure that we recommend the "Glarner Hauptüberschiebung" (Glarus overthrust) for the recognition as a World Heritage Site.

In the late nineties, during our work on the national Swiss Geosite inventory, we realized that at least three of the objects have much more than only a national significance. These objects were the geologically and geomorphically impressive Jungfrau-Aletsch-Bietschhorn area, the outstanding Triassic fossil site of Monte San Giorgio and the Glarus overthrust. As a result, we contacted both, local committees and the Federal Government, to motivate them to promote these three objects for the Word Heritage List. We have realized with great pleasure, that UNESCO has already recognized two of the objects, and we hope, that also the Glarus overthrust will soon get the appreciation it deserves.

The reason why we regard the Glarus overthrust as a universal outstanding geosite is twofold.

On one hand, the Glarus overthrust is one of the few large scale thrusts in the world which outcrop nearly completely from its roots to the leading edge. The thrust brings together rocks of very different ages and, additionally, of different composition and colour. It is therefore clearly visible not only to specialists but also to a broad public. Many picturesque rock formations are related to the thrust, e.g. the natural window of the "Martins Gap" or the "Tschingelhörner", which result from a different resistance to erosion of hanging and foot wall. At a closer look, the "Lochsite" mylonite separating the hanging from the foot wall, shows structures both of viscous and brittle deformation, obvious, once again, not only to scientists but also to amateurs. Thus, all geologists agree that they have not seen many thrusts in the whole world that come close to the Glarus overthrust, regarding extent, outcrop conditions, geological structures and scenic beauty.

Furthermore, the thrust is embedded in a landscape of natural magnificence, mainly preserved from human impact, and of great scientific and cultural interest. Noteworthy among others are the sedimentary record of the European Southern Margin development from the Permian to the Palaeogene, the spectacular outcrops and dramatic scenery documenting the Alpine nappe tectonics, and the impressive remnants of the Ice Ages. Historic mining activities relate between the geosphere and human activities. The variety of landforms is reflected in a rich and diverse flora and fauna as well as a differing social and cultural development in the adjacent valleys.

However, the fact that makes the Glarus overthrust really unique is its role in the history of Geoscience. The Glarus overthrust was cradle and touchstone of many theories on Alpine mountain building, mega-nappe formation, low angle thrusting and formation of mylonites. In terms of tectonics and rock mechanics, it is a high place of research starting with the work of Hans Conrad Escher von der Linth in 1807. In 1841, his son Arnold Escher interpreted the thrust as a double fold with strongly thinned inverse limbs, a concept which was adapted by many investigators of other mountain ranges. In 1884, Marcel Bertrand recognized the „Glarner Hauptüberschiebung" as a thrust of some 30 km transport distance. Thus, the concept of alpine nappe tectonics was born, a concept which was later applied successfully to many other orogenic belts. The paradoxe of far range low angle thrust was solved only some 100 years later, once again at the Glarus overthrust. The discovery of grain boundary migration as an infinite low strength deformation mechanism was the key for understanding many other thrust phenomena all over the world. This explains that the Glarus overthrust is not only an outstanding and unique nature phenomenon but also an important field laboratory for actual and future generations of earth scientists, and, last but not least, a cultural monument, documenting the development of science during the last two centuries.

As a consequence, we fully support the candidacy of the Glarus overthrust for its inclusion on the UNESCO Natural World Heritage List. We are convinced that the Glarus overthrust fully meets the selective criteria required to be declared a site of outstanding universal value. And we truthfully hope that the UNESCO will share our opinion.

Yours sincerely,

Emmanuel Reynard

President of the Swiss working group for geotopes

Swiss Academy of Sciences

Annex CA3.06: Commission interacadémique Recherche alpine ICAS (Swiss Alpine Studies): Letter of Support regarding the nomination of the Glarus overtrust site for the list of UNESCO World Heritage.

ICAS Swiss Alpine Studies
A Commission of the Swiss Academy of Sciences
and the Swiss Academy of Humanities and Social Sciences

Berne, 21.8.2006

Letter of Support regarding the nomination of the Glarus overtrust site for the list of UNESCO World heritage

The Swiss Interacademic Commission for Alpine Studies (a Commission of the Swiss Academies of Sciences and of Social Sciences and Humanities) would like to support the nomination of the Glarus overtrust as a UNESCO World heritage site for scientific reasons.

The outstanding significance for geological research has been already outlined by geologists. Furthermore, this area offers a large range of topics in the context of interdisciplinary mountain research focusing on sustainable regional development, as landscape development, natural risks and spacial planning, further use of forests, touristic development, historical evolution of settlements and farm houses, impacts of global change etc. The Scientific Advisory Committee with scientists from different disciplines and from surrounding and Swiss research institutions is already established and will promote such research.

As we know from other protected areas or World heritage sites in the Alps, such areas are attracting scientists and research. Research is offering qualitatively good jobs in the region and is an important partner for the management of the site, for information activities as well as for environmental and economic innovation in the context of regional development.

Finally, a Swiss research network of protected areas with national or international recognition is going to be established. The Glarus World heritage site would be a significant partner in this network.

With kind regards

Porf. Heinz Veit, president

ICAS Interakademische Kommission
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Annex CA3.07: Commission Internationale pour la Protection des Alpes CIPRA Suisse (International Commission for the Protection of the Alps): Letter of letter for the nomination of the Glarus overthrust site for the list of UNESCO World Heritage.

CIPRA
Schweiz
Suisse
Svizzera
Svizra

Berne, 22th august 2006

Letter of Support regarding the nomination of the Glarus overthrust site for the list of UNESCO World Heritage

CIPRA Switzerland, a national representation of CIPRA International, the International Commission for the Protection of the Alps, strongly supports the nomination of the area of the Glarus overthrust for its inclusion on the UNESCO World Heritage List.

The Glarus overthrust is a site of world-wide scientific interest and of breathtaking natural beauty. All over the Alpine region but also all over the world this site is unique. Besides the geologically outstanding value the site and its natural environment are mostly preserved from human impacts. The richness and diversity in its flora and fauna contribute to the uniqueness.

With the establishment of a UNESCO Natural Heritage Site the area now largely enjoying binding protection will be interlinked with an intercantonal Development Plan. This will enhance the protection and preservation-status. Furthermore the UNESCO Label gives the opportunity to promote sustainable tourism and raise awareness of region's wonder. In our opinion, the educational process associated with the nomination is important and contributes to promote the concerns of nature and landscape.

As the local population was involved at a very early stage in the processes of policy development and decision making the project is very well accepted by the public. That is the best basis for a sustainable development of the site.

All this proves that the Glarus overthrust is worth being nominated for the list of UNESCO World Heritage and we sincerely hope that the UNESCO will share our opinion.

Best regards

Co- President CIPRA Switzerland

Ch. Neff

Christine Neff

Schwarzenburgstr. 11
3007 Berne
031 377 00 77

Annex CA3.08: Stiftung Landschaftsschutz Schweiz SLF (Swiss Foundation for Landscape Conservation): Support letter for the nomination of the Glarus overthrust site for the UNESCO World Heritage list.

Stiftung Landschaftsschutz Schweiz

sl fp

Fondation suisse pour la protection et l'aménagement du paysage

IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung
David Imper, Geschäftsstelle
Untergasse 19
CH-8888 Heiligkreuz/Mels SG

Berne, 22th august 2006
ro/sl 8

Support letter for the nomination of the Glarus overthrust site for the UNESCO World Heritage List

Dear Sir

The Swiss Foundation for Landscape Conservation is the main private national organization in the field of landscape protection in Switzerland and has already been involved in the successful candidature of the Jungfrau-Aletsch-Bietschhorn-Region for the UNESCO World Heritage List (WHL). After studying the proposal documents and in particular the Management Plan, we support the candidacy of the Glarus overthrust . The particular interests of the property are, besides the unique geological characteristics, the very large (in comparison with the dense Swiss special conditions!) almost untouched area that is free of urban and touristic impacts. The special landscape qualities are the big size of unspoilt area, the absence of mass tourism activities, settlements, big roads, important power lines or other industrial infrastructures, as well as the awareness of silence. The site is determined by a long and considerably detectable natural and cultural history.

Schwarzenburgstrasse 11 · 3007 Bern · Tel. 031 377 00 77 · Fax 031 377 00 78
e-mail: info@sl-fp.ch · www.sl-fp.ch · PC: 30-366174-9

2

Supported by the local and cantonal authorities, several legal conservation acts and the Master Plans of the concerned cantons protect the whole area. Due to the federalism, the communal, cantonal and federal levels of nature and landscape protection in the World Heritage region are closely interconnected. This international agreements and national and cantonal constitutional and legal foundations are combined. In addition to the nationally protected areas there are cantonally and communally protected nature and landscape zones. The protection is further strengthened by the provisions of water protection, agricultural, forestry and hunting legislation. In addition, efforts of private conservation organizations played a decisive role in the designation of many areas and sites subject to national and cantonal protection.

The management plan provides a guarantee for a concerted action for a sustainable landscape conservation in full coherence with the concerned population and authorities.

We are fully convinced of the high quality of the candidature of the Glarus overthrust for the insertion into the WHL and we confirm herewith our deep support.

Yours, sincerely

SWISS FOUNDATION FOR LANDSCAPE CONSERVATION

The director:

Raimund Rodewald, Dr. phil. Biol.

Annex CA3.09: Schweizerische Arbeitsgemeinschaft für die Berggebiete SAB (Swiss Center for Mountains Regions): Letter of support.

Schweizerische Arbeitsgemeinschaft für die Berggebiete (SAB)
Groupement suisse pour les régions de montagne (SAB)
Gruppo svizzero per le regioni di montagna (SAB)
Gruppa svizra per las regiuns da muntogna (SAB)

CH-3001 Bern · Seilerstrasse 4 · Postfach 7836 · Tel. 031 382 10 10 · Fax 031 382 10 16
Internet: http://www.sab.ch E-Mail: info@sab.ch Postkonto: 50 - 6480-3

IG UNESCO Kandidatur
Weltnaturerbe Glarner
Hauptüberschiebung
David Imper
Untergasse 19
8888 Heiligkreuz / Mels

Berne, 16.08.2006

Letter of support

Dear Mr. Imper

It is my great pleasure to announce you, that the Swiss centre for mountain regions (SAB) supports the candidacy of the Glarus overthrust as a World Heritage Site.

Actually, several Swiss mountain regions are facing huge challenges. According to our own survey, 13 of the 54 Swiss mountain regions noted a decrease in population during the period 2000 – 2004. Of these regions, the mountain region Glarner Hinterland / Sernftal was one of the most concerned with an annual decrease of more than -1,0%. This decrease is due to a deep economic change which affects above all monostructured regions or regions, which are out of commuting distance from metropolitan areas such as Zurich. In this context we regard new approaches such as the creation of regional parks and the labelling of UNESCO World Heritage Sites as a promising solution. They offer new solutions to territorial governance on the regional level. Furthermore, the recognition as a World Heritage site can help develop economic activities in these regions. Cooperation across municipal and cantonal boarders is sometimes perceived as difficult. We from SAB are convinced, that such co-operations are a necessity, because smaller structures do often not have the required critical mass. The Glarus overthrust can be an important motor for developing this cooperation around the concerned mountain range.

The management plan contains goals and measures for all relevant topics. For the further process – after a hopefully positive candidacy – we regard the participatory process as of utmost importance. People and enterprises in the region around the Glarner overthrust must be implied in the process of elaborating and realising concrete measures. For the candidacy and the further process lying ahead, we whish you all the best.

Yours sincerely

Thomas Egger, director of SAB
Member of the board of Euromontana

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of the Environment,
Transport, Energy and Communications DETEC

Federal Office for the Environment FOEN
Nature and landscape division

CH-3003 Berne, FOEN, WB

IUCN
World Headquarters
David Sheppard
Head, Programme on Protected Areas
Rue Mouverney 28
CH-1126 Gland

Reference: G485-1298
Your reference:
Our reference: WB
Contact person: WB
Berne, November 30, 2007

"Swiss Tectonic Theatre"
Complements to the nomination (draft versions 30 November 2007)

Dear Mr Sheppard, dear David
Dear Mr. Bomhard, dear Bastian

We refer to your letter dated from 2 November 2007 concerning the IUCN Evaluation of the „Glarus overthrust“ (Switzerland) and requesting supplementary information to the nomination.

First of all we would like to express our thanks to the IUCN and its experts Mr. Pedro Rosabal and Dr. James Powell for their excellent co-operation during the evaluation mission from 18th to 20th September 2007. The discussions have been held in a open-minded atmosphere, in which new aspects of the site developed into very useful suggestions to improve the nomination - namely the need to broaden the focus of the nomination to demonstrate the significance of the site in the context of mountain building processes and in enhancing the understanding of plate tectonics. In this context has been raised the need for reconsidering the proposed name for the nominated property to better reflect these topics.

As you emphasized these two key issues in the mentioned letter, we reconsidered both issues and we are now able to submit different complements in a draft version in order to allow the first IUCN World Heritage Panel next week to discuss on a broaden focus of the nomination.

Therefore we are strengthening the discussions to find a suitable name for the nominated site even if discussions about names are in general difficult and often base on emotions.

Bruno Stephan Walder
FOEN, Nature and landscape division, 3003 Berne
Telephone +41 31 322 80 77, Telefax +41 31 324 75 79
Bruno.Walder@bafu.admin.ch
http://www.environment-switzerland.ch

The stakeholders such as service sector, politicians and scientists have to be consulted to find a name that will be widely accepted. We carried out this task in the meantime.

A big step towards a new name was undertaken at the assembly of the delegates of all the 19 communities involved on November 22nd which empowered the managing committee of IG UNESCO-World Heritage Site Glarus overthrust to choose an appropriate name.

We have to admit, that no suitable name considered satisfactory by all the stakeholders could be found until now, but we are convinced, that we will be able to propose a suitable name by February 2008.

The favorite is still the name suggested by Dr. J. Powell: „**Swiss Tectonic Theatre**" (optional Alpine Tectonic Theatre), but certain groups consider that the term „theatre" could evoke missleading allusions. Further suggestions are the following: „Swiss Mountain Building Scenery" (optional Alpine Mountain Building Scenery or Alpine Mountain Building Arena). For these reasons we only use the name „Swiss Tectonic Theatre" as **a working title**. The logo with the name „Glarus overthrust" will be changed as soon as the new name is choosen.

The following documents will complete the nomination and emphasize the outstanding universal value of the nominated property in the context of mountain building processes and enhancing the understanding of plate tectonics as well:

- **Complement CA01**: Complement to the Nomination
  (Suggestion of Mr. P. Rosabal and Dr. J. Powell on the occasion of the Evaluation mission, confirmed in the letter IUCN)
  The results and conclusions raising from the adaptation of the „Comparative study on thrust faults: The Glarus overthrust" lead to this complement of the nomination.
- **Complement CA 02**: Complement to the „Comparative study on thrust faults: The Glarus overthrust" (Suggestion of Mr. P. Rosabal and Dr. J. Powell on the occasion of the Evaluation mission, confirmed in the letter IUCN)
  The authors of the „Comparative study on thrust faults: The Glarus overthrust", Prof. A. Pfiffner und Prof. St. Schmid (Prof. M. Burkhard has died in 2006 in a climbing accident), broaden the focus on the Glarus overthrust, claiming it to be of outstanding universal value not only in the context of all thrust faults but also in reflecting a similar significance in the context of mountain building processes and in understanding plate tectonics.
- **Complement CA02a**: Letter of support from Wolfgang Eder
  (Suggestion of Mr. P. Rosabal and Dr. J. Powell on the occasion of the Evaluation mission)
- **Complement CA02b**: Website of the American Museum of Natural History.
- **Complement CA03**: Power-Point-Presentation with selected pictures and graphs (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB01**: Final programm of the IUCN Evaluation mission
  (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB02**: Final list of participants at the events during the IUCN Evaluation mission (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB03**: All Power-Point-Presentations during the IUCN-Evaluation mission (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB04**: DVD, containing movie „Glarner Hauptüberschiebung / Glarus overthrust" (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)

- **Complement CB05**: Power-Point-Presentation with additional aerial views from the surroundings of the so-called „Magic Line" (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB06**: 8 Posters (requested by Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB07**: Cover picture and overview of the new brochure (Suggestion of Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)
- **Complement CB08**: Prof. A. Pfiffner: Mountain Building in the Swiss Tectonic Theatre (Suggestion of Mr. P. Rosabal and Dr. J. Powell at the Evaluation mission)

We hope that these documents provide you with the requested information to further evaluate this nomination. We are looking forward to receiving feedback and further information in December 2007 in order to integrate them in the final complements by the end of February 2008.

Should you have any questions concerning these complements, please contact Mr. Carlo Ossola (Tel: +41 31 322 93 73, Fax +41 31 324 75 79, email: carlo.ossola@bafu.admin.ch).

Kind regards

Federal Office for the Environment FOEN

Bruno Stephan Walder
Head, Natural Heritage Section

Enclosures:
- mentioned

Copy to (by email):
- Swiss National Commission for UNESCO, Ms. Madeleine Viviani, Secretary General
- UNESCO World Heritage Centre, Ms. Mechtild Rössler and Mr. Alessandro Balsamo
- H.E. Mr. Ernst Iten, Ambassador and Permanent Delegate of the Swiss Confederation to UNESCO, Paris
- Mr. David Imper, IG UNESCO-World Heritage Site Glarus overthrust, Heiligkreuz

UNESCO World Heritage site

“Swiss Tectonic Theatre”

Mountain Building Processes rendered visible by the Glarus overthrust in the Swiss Alps

Complement

to the

Nomination of the

Glarus overthrust

as a UNESCO World Heritage site

(FOEN, August 2006)

Draft version: 2007-11-30

The need suggested by the evaluators of IUCN to broaden the focus on the global importance of the Glarus overthrust towards the significance of the nominated property of the “Swiss Tectonic Theatre” in the context of mountain building processes and in particular in enhancing the understanding of plate tectonics implies additional information in chapter 3 (Justification for Inscription).

Chapter 3 (Justification for Inscription)

In the „Compliment to the Comparative study on thrust faults: The Glarus overthrust” with the title „Swiss Tectonic Theatre – Mountain Building Processes rendered visible by the Glarus overthrust in the Swiss Alps“ the authors, Prof. A. Pfiffner (University of Berne) and Prof. S. Schmid (University of Basel) make evident that the Glarus overthrust is not only the most spectacular thrust fault but that the whole nominated property, by its rich diversity of extraordinary well exposed tectonic structures, was and still is one of the best places worldwide to enhance the understanding and interpretation of the mechanism of mountain building and of plate tectonics.

Thus since decades, the nominated property is visited as the typical example to illustrate mountain building processes and to explore mechanisms of mountain building. The American Museum of Natural History in New York has reconstructed the Lochsite exposure in a plaster cast, in accordance with the original outcrop. At a prominent place in the Museum, the exposure answers the question *„What causes ocean basins, mountains, and continents?“* A lot of international textbooks such as “Earth” by Richard Fortey (Supplement S11 to the nomination documents of august 2006) state: *„ … This (the Glarus overthrust) was the key that unlocked the mystery of the Alps: from Glarus to the world.“*

In „Complement to the Comparative study on thrust faults: The Glarus overthrust” with the title „Swiss Tectonic Theatre – Mountain Building Processes rendered visible by the Glarus overthrust in the Swiss Alps“ the authors conclude:

“Based on a comparison of a large number of mountain ranges worldwide in regard to their suitability to illustrate mountain building processes that is based on four criteria, namely Scientific value, Scenic value, Geomorphic expression and Educational value, we are convinced that the “Swiss Tectonic Theatre” merits to be included the in the UNESCO list of World Natural Heritage.

The “Swiss Tectonic Theatre” offers a truly three-dimensional view of a wealth of features related to Mountain Building and Plate Tectonics: crustal shortening leading to one of the most spectacular thrusts that crops out well at high altitudes, manifestations of uplift and erosion shaping ridges and valleys. The apparent simplicity of one gigantic thrust visible over kilometric distances offers a splendid visualization of our dynamic Earth that is continuously re-shaped by plate tectonic processes driven by the deep earth as well as surface processes primarily driven by the action of water, glaciers and gravity.”

Complement to the "Comparative study on thrust faults: The Glarus overthrust"

UNESCO World Heritage site

"Swiss Tectonic Theatre"

Mountain Building Processes rendered visible by the Glarus overthrust in the Swiss Alps

O. Adrian Pfiffner [1)] & Stefan M. Schmid [2)]

Draft version: 2007-11-30

1) University of Bern
2) University of Basel

The central document of the World Heritage nomination „Swiss Tectonic Theatre“ (formerly called „Glarus overthrust“)* is the „Comparative analysis of thrust faults“ by the three university professors A. Pfiffner (University of Bern), M. Burkhard** (University of Neuchâtel) and S. Schmid (University of Basel), which was peer reviewed by international experts. This comparative analysis demonstrated the Outstanding Universal Value of the Glarus overthrust and its top ranking amidst thrust faults worldwide.

In the fall of 2007, P. Rosabal and Dr. J. Powell inspected the proposed property on behalf of the IUCN. In a letter dated Nov. 2, 2007, based on the impression gained by the IUCN experts, the national party was encouraged to widen the scope of the property and to include its importance in regard to mountain building processes and plate tectonics.

This report takes up this point and discusses the link between thrust faults and mountain building as well as plate tectonics in a general way and in conjunction with the proposed property.

* The UNESCO World Heritage nomination was submitted in 2006 with the name „Glarus overthrust“. The IUCN proposed in their letter of Nov. 2, 2007 to find a more suitable name enclosing a wider spectrum of topics including mountain building. The national party discussed this aspect intensively and came up with alternatives. The name should be correctly adapted to the property, help the local population to identify itself with it, but also be attractive. At this point, „Swiss Tectonic Theatre“ found some acceptance, although some of the persons involved in the process of name finding found the word „theatre“ not ideal. We continue the quest, and at this stage we refrain to make continuous changes in the working title. We are confident to come up with a valid name by February 2008.

** Martin Burkhard was killed in a tragic accident while collecting rock samples in August 2006.

"Swiss Tectonic Theatre"
Mountain Building Processes rendered visible by the Glarus overthrust in the Swiss Alps

Introduction

The beautifully exposed Glarus overthrust in the Swiss Alps allows a direct observation of the processes of mountain building and plate tectonics. In a comparative analysis, Pfiffner, Burkhard & Schmid (2006) have shown that the Glarus overthrust is a feature of Outstanding Universal Value. In this study we show that the Glarus overthrust has formed in response to plate tectonic processes, which are still active today. In general terms, plate tectonic processes are responsible for the formation of mountain ranges (see Box 1). The Glarus overthrust shows this link between plate tectonics and mountain building in a very direct and spectacular way.

Box 1: Plate Tectonics and Mountain Building
Mountain ranges form at plate margins. When plates converge, their margins are squeezed and telescoped. Shortening and thickening of the plate margins affects the entire earth's crust and is accomplished by faulting and folding. The activity of a thrust fault results in upward motion of kilometer sized blocks and thus leads to an immediate higher elevation of the former land surface. The thickened crust is buoyant and thus leads to still more uplift of the land surface. Higher elevations trigger higher precipitations, and these in turn provoke incision of valleys and erosion. The local relief (high mountain ridges, deep valleys) is induced by mountain building, but is essentially a function of erosion by rivers, glacieres and rock fall, just to name the most important agents of erosion. Hence, high elevations are the response to a particular process of plate tectonic processes, namely thrusting and folding at a convergent plate margin. Geologists refer to this process as mountain building. In this sense, mountain building processes are directly linked to the activity of faults with an upward motion (thrust faults and stike slip faults with reverse fault component).

This comparative study provides arguments as to why the three-dimensional Alpine arena around the Glarus overthrust in Switzerland particularly well illustrates such mountain building processes at plate margins, be it thrusting and folding, or consecutive massive erosion. For this reason, this arena is considered a feature of Outstanding Universal Value. This statement is substantiated by a direct comparison with other mountain ranges from all over the world. This inevitably leads to a ranking of objects. Apart from being alien to the culture of geologists, this bears the risk of subjectivity. We are aware of this, and we are also aware of the fact that there are other exceptionally beautiful landscapes and other exceptionally interesting thrust faults and associated structures around.

In the following we will assess and compare objects in a way as objective as possible. We do so by comparing mountain ranges worldwide using a number of objective criteria in a transparent manner. As requested by Dingwall et al. (2005) we include properties already inscribed in the World Heritage List, which have some features in common with the proposed property “Swiss Tectonic Theatre”.

Our criteria are:

The Scientific Value of the object concerning the process of mountain building associated with the convergence of tectonic plates, including faulting, seismicity, uplift and erosion.

The Scenic Value (natural beauty) of the object, including beauty and outcrop quality of structural features (thrust faults and folds).

The Geomorphic Expression in the landscape by spectacular and visually striking phenomena, and the presently ongoing processes shaping the mountain range.

The Educational Value, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

The four criteria are subdivided into subcriteria each. These totally 12 subcriteria allow a qualitative, but also a somewhat quantitative evaluation of the individual objects.

Table 1: Subcriteria and conditions for fulfilment

Criterion		Subcriterion	Conditions for fulfilment of subcriterion
Scientific Value	1	relation to plate motions	The mountain range may directly be linked to the plate motions.
	2	uplift processes	The mountain range is undergoing active uplift and demonstrates how surface uplift results in high elevation.
	3	magnitude of uplift	The mountain range has a considerable local relief.
	4	thrust faults and folds	Thrust faults and folds form a major component of internal deformation associated with mountain building
	5	exhumation of high-grade rocks	metamorphic rocks that had been deeply buried by geodynamic processes were subsequently exhumed by uplift and erosion linked to the mountain building process
Scenic Value	6	natural beauty of mountain range	The mountain range itself has superb landscapes that strikes the eye of non-geologists. The beauty is underlain by deep valleys and high rugged peaks.
	7	thrust faults and folds	The fold and thrust structures are well exposed in the mountain range. They should strike the eyes of structural geologists and laymen as singular features.
	8	three-dimensionality of exposure	Folds and thrust faults should be exposed such that its shape is clearly visible in three dimensions over an area of tens of kilometers. This typically requires an important relief.
Geomorphic expression	9	ongoing erosion	The mountain range is presently undergoing active erosion as shown by geomorphic features on the valley flanks
	10	erosion in the past 1 million years	The mountain range contains deeply incised valleys that formed in response to fluvial and glacial erosion as well as mass wasting.
Educational Value	11	historic geological context	The mountain range should have played an important role in the history of science, in particular related to the understanding of how mountain ranges are formed
	12	potential to stimulate public awareness	The mountain range must be readily accessible to the general population and must be able to convey an understanding for natural science in general and the processes of mountain building in particular. It should convince the occasional visitor that the property merits to be preserved for future generations.

Mountain Ranges and mountain building processes

In order to cover mountain ranges worldwide we consider all the mountain ranges with an important relief and folds and thrusts associated with mountain building processes. The relief of a mountain range is usually directly a function of the age of the mountain range. Thus juvenile and active mountain ranges such as the Alpine-Himalayan system or the North American Cordillera – Andes system have high elevations and high relief owing to incision by rivers. In contrast, older mountain ranges, such as the Paleozoic Appalachians and Caledonides are worn down by erosion and the crustal root creating buoyant rise has largely been removed in the 400 million years since the formation of these mountain ranges.

Ongoing mountain building processes demonstrate themselves by seismicity and active uplift. These processes cease to function once the mountain range comes of age. Mountain building processes mark themselves by the presence of thrust faults within the mountain range. The effect of erosion expresses itself by the occurrence of metamorphic rocks at the surface. These metamorphic rocks formed in the deeper part of the mountain range and were subsequently exhumed by erosional and tectonic removal of the rocks above.
For the analysis of mountain building processes we can rely largely on the data gathered in the comparative analysis concerning thrust faults by Pfiffner, Burkhard & Schmid (2006).

Comparison

In this section we attempt to compare various mountain ranges worldwide in terms of criteria discussed in the UNESCO document by Dingwall et al. (2005). We found the following four criteria to be most useful for a comparison of mountain ranges in regard to mountain building processes: Scientific value, Scenic value, Geomorphic expression and Educational value. To assess these criteria, we defined subcriteria that allow an objective evaluation: a subcriterion is fulfilled if the object evaluated is judged “excellent”. Table 1 lists these subcriteria and the associated conditions of fulfilment. It is then the sum of these evaluations that were used to give a ranking to the four main criteria. Here the ranking “excellent” is given only if most of the subcriteria were evaluated as “excellent”. The rankings of the four main criteria are given in Table 2. Table 2 should not be read per se and without the explanations given here.

Table 2: Ranking of mountain building aspects

	Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	2	3	2	2	9	5
Swiss Alps	1	1	1	1	4	**1**
Eastern Alps / Austria	2	2	2	2	8	4
Pyrenees	2	2	1	2	7	3
Caledonides	3	2	3	2	10	6
Caucasus	2	1	1	2	6	**2**
Himalayas	2	2	1	2	7	**3**
Atlas Mountains	3	3	3	3	12	8
Naukluft Mountains	4	2	3	3	12	8
Andes	2	1	1	2	6	**2**
North American Cordillera	2	2	2	2	8	4
Appalachians	3	3	3	2	11	7
Macdonell Range / Australia	3	2	2	3	10	6
Southern Alps NZ	2	2	1	2	7	**3**

Ranking:
excellent = 1
very good = 2
good = 3
fair = 4

In the following we restrict our discussion to the mountain ranges that ranked 1st, 2nd and 3rd based on our analysis

Scientific value

The mountain ranges Caucasus, Himalaya, Andes and Southern Alps (NZ), all related very directly to plate tectonics, are undergoing uplift at present, possess an impressive elevation and relief and contain thrust faults and folds. But the thrust faults visible at the surface disappear abruptly to depth and do not reveal processes going on at depth. An exception may be found in the Southern Alps (NZ) where high-grade rocks that were once at 18 km depth outcrop at the surface and show the ductile nature of deformation along the South Alpine fault. But the fault itself is best observed on areal photographs and only in a few locations may the latest brittle overprint be seen directly at outcrop.

In the case of the proposed property “Swiss Tectonic Theatre”, all the subcriteria are fulfilled. The later updoming of the Glarus thrust and the removal of 12-15 km of rocks above it expose a continuous 15 km thick cross section through the Earth’s crust and allow to observe at surface mountain building processes (thrusting) that were active in the deep part of the mountain range. **The outstanding feature to do with the scientific value is the apparent simplicity of this spectacularly exposed overthrust that can be followed for some 35 km parallel to the direction of the up-thrusted block**. Rather than exposing a complicated system of thrusts, the Glarus arena visualizes one single thrust, to be followed across several mountain crests and valleys. The physical mechanism which allowed for such displacements to take place within a narrow zone of deformation is still subject of highly interesting debates, that can be conveyed to the interested visitor.

Scenic value

The mountain ranges Caucasus, Himalaya, Andes and Southern Alps (NZ) all offer spectacular views of landscapes, thrust faults and folds. However, none quite matches the proposed property if all subcriteria are taken.

The proposed site “Swiss Tectonic Theatre” offers a **spectacular and truly a three-dimensional view** of all parts of mountain building processes and thrust faults. The scenery not only allows for easy comprehension of the 3-dimensional nature of the Glarus overthrust over large (several kilometers) distances from single viewpoints, the rugged topography also allows for an assessment of the enormous rock volumes that were eroded since these mountains formed by thrusting and folding, driven by the subsequent and presently still going uplift. Also, the geomorphic expressions of the proposed site are manifold. The lithological differences between individual formations are nicely reflected by the geomorphic character of the earth’s surface, contrasts in color as well changes in the character of the vegetation. The manifestations of erosion are manifold and shaped by glacial as well as fluviatile erosion, including large landslides and/or rock fall.

Geomorphic expression

The mountain ranges Caucasus, Himalaya, Andes and Southern Alps (NZ) all display ongoing erosion in the past million years and at present. They therefore ranked along with the proposed property as “excellent” (1).

Educational value

The mountain ranges Caucasus, Himalaya, Andes and Southern Alps (NZ) all contributed somewhat to the history of science. But compared to the Appalachians, the Caledonides or the Alps this impact was modest and they thus rank “very good” (2).

The proposed property on the other hand played a crucial role in the history of science. Firstly the site gave rise to highly interesting debates amongst the pioneers in geology in the 19th century from all over Europe, debates that give insight into the evolution of ideas that ultimately led to the breakthrough of Plate Tectonics. Particularly French and English geologists were led around by the local geologists. These debates finally led to the recognition of very large displacements along thrust faults, displacements that could not be explained by thermal contraction of the earth any more. Secondly, the visitor of this arena will be able to grasp the mobilistic view of the planet earth, which found its ultimate explanation very much later, namely by the Plate Tectonics Paradigm. It is this mobilistic aspect of a dynamic earth, that impresses all visitors of this spectacular arena, be it in the past or at present.

It may be noted here, that the educational value will be enhanced by activities aimed at the general public in the framework of the management plan.

In this context it has to be mentioned that a full sized replica of the famous Lochsite outcrop, where the Glarus thrust is beautifully exposed, may be found in the American Museum of Natural History (Rose Center for Earth and Space, Hall of Planet Earth). The Lochsite outcrop was chosen to exemplify how mountains form.

Conclusion

Based on a comparison of a large number of mountain ranges worldwide in regard to their suitability to illustrate mountain building processes that is based on four criteria, namely Scientific value, Scenic value, Geomorphic expression and Educational value, we are convinced that the “Swiss Tectonic Theatre” merits to be included in the UNESCO list of World Heritage.

The “Swiss Tectonic Theatre” offers a truly three-dimensional view of a wealth of features related to Mountain Building and Plate Tectonics: crustal shortening leading to one of the most spectacular thrusts that crops out well at high altitudes, manifestations of uplift, erosion and re-deposition shaping ridges and valleys. The apparent simplicity of one gigantic thrust visible over kilometric distances offers a splendid visualization of our dynamic earth that is continuously re-shaped by Plate Tectonic Processes driven by the deep earth as well as surface processes primarily driven by the action of water, glaciers and gravity.

Complement to the Nomination of the

Swiss Tectonic Arena Sardona

(formerly Glarus overthrust)

as a UNESCO World Heritage site

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

February 2008

The Glarus overthrust on the Piz Sardona. Aerial Photo: R. Homberger, Arosa.

Nomination prepared by the federal Office for the Environment (FOEN), Berne, Switzerland

February 2008

Content & Layout:
IMPERGEOLOGIE AG, Heiligkreuz

Frontpage:
IG UNESCO-World Heritage site Glaris overthrust, Switzerland
Top: Glarus overthrust on the Ringelspitz
(Photograph: D. Imper, Heiligkreuz)
Middle: Glarus overthrust on the Tschingelhoren
(Photograph: H. Rhyner, Elm)
Top: Glarus overthrust on the Graue Hörner
(Photograph: D. Kalberer, Heiligkreuz)

The evaluators of IUCN suggested broadening the focus on the global importance of the Glarus overthrust towards the significance of the nominated property of the “Swiss Tectonic Arena Sardona” in the context of mountain building processes and in particular in enhancing the understanding of Plate Tectonics. Therefore additional information in chapter 3 is supplied (Justification for Inscription, Supplement 1).

Chapter 3 (Justification for Inscription)

In the „Complement to the Comparative study on thrust faults: The Glarus overthrust” titled „Swiss Tectonic Arena Sardona – Mountain Building Processes rendered visible by the Glarus overthrust and associated structures“ the authors, Prof. O.A. Pfiffner (University of Berne) and Prof. S.M. Schmid (University of Basel) make evident that the Glarus overthrust is not only the most spectacular thrust fault worldwide but that the whole nominated property, by its rich diversity of extraordinary well exposed tectonic structures, was and still is one of the best places worldwide to enhance the understanding and interpretation of the mechanism of mountain building and of Plate Tectonics:

> *“The “Swiss Tectonic Arena Sardona” offers a truly three-dimensional view of a wealth of features related to Mountain Building and Plate Tectonics: crustal shortening leading to one of the most spectacular thrusts that crops out well at high altitudes, manifestations of uplift, erosion and re-deposition shaping ridges and valleys. The apparent simplicity of one gigantic thrust visible over kilometric distances offers a splendid visualization of our dynamic earth that is continuously re-shaped by Plate Tectonic Processes driven by the deep earth as well as surface processes primarily driven by the action of water, glaciers and gravity.”*

Thus since decades, the nominated property is visited as the typical example to illustrate mountain building processes and to explore mechanisms of mountain building. The American Museum of Natural History in New York has reconstructed the Lochsite exposure in a plaster cast, in accordance with the original outcrop (Supplement 2). At a prominent place in the Museum, the exposure answers the question *„What causes ocean basins, mountains, and continents?“* A lot of international textbooks such as “Earth” by Richard Fortey (Supplement S11 to the nomination documents of August 2006) state: *„ … This (the Glarus overthrust) was the key that unlocked the mystery of the Alps: from Glarus to the world.“*

In the „Complement to the Comparative study on thrust faults“ the authors conclude finally:

> *“Based on a comparison of a large number of mountain ranges worldwide in regard to their suitability to illustrate mountain building processes that is based on four criteria, namely Scientific value, Scenic value, Geomorphic expression and Educational value, we are convinced that the “Swiss Tectonic Arena Sardona” merits to be included in the UNESCO list of World Heritage.”*

Supplement 1: Chapter 3 of the “Nomination of the Glarus overthrust as a UNESCO World Heritage site” of August 2006

Supplement 2: Website of the American Museum of Natural History

Supplement 3: Letter of support from Prof. Dr. W. Eder

Supplement 1: Chapter 3 of the “Nomination of the Glarus overthrust as a UNESCO World Heritage site” of August 2006

3 Justification for Inscription

The IUCN report entitled "Geological World Heritage: A Global Framework" (DINGWALL, WEIGHELL & BADMAN 2005) establishes a valuable framework for nominations of this kind. This document, together with the World Heritage Centre's new "Operational Guidelines for the Implementation of the World Heritage Convention" (UNESCO, 2005), provides the basis for the revised submission.

According to DINGWALL, WEIGHELL & BADMAN (2005), the following preliminary steps are essential for a successful World Heritage nomination concerning geological and geomorphological phenomena:

a) fully consider the use of alternative designation options, through national or international programmes.

   In this connection – also as recommended by the IUCN in 2005 (IUCN 2005) – the establishment of a UNESCO Geopark has been investigated in detail. Since 1999, the Sarganserland-Walensee-Glarnerland GeoPark has been developed in the whole of Glarus canton and in the entire Sarganserland-Walensee region. This GeoPark covers a significantly greater area than the nominated property and includes many other sites of geological and cultural heritage interest.

   As a result of the investigations – including a visit to the European Geoparks Network Conference in Lésvos in the autumn of 2005, with a presentation of the Sarganserland-Walensee-Glarnerland GeoPark – it has been decided that membership of the European Geoparks Network is an interesting option for the Sarganserland-Walensee-Glarnerland GeoPark as a whole and should be further pursued. However, a UNESCO Geopark nomination should complement – rather than replacing – the nomination of the Glarus overthrust as a World Natural Heritage site. The examples of Lésvos (Greece) and the Geopark Bergstrasse-Odenwald with the Messel Pit Fossil Site (Germany) show that valuable synergies may develop between World Heritage sites and Geoparks.

   The core area of the Sarganserland-Walensee-Glarnerland GeoPark, the nominates World Heritage site Glarus overthrust, contains what is surely a globally unique concentration of superbly exposed geotopes, together with habitats meriting protection. Additionally the area was – and still is – of high importance for research in geosciences. The "Glarus overthrust" property should therefore be inscribed on the list of UNESCO World Heritage sites. World Heritage status would enable the property to enjoy better and more lasting protection than is possible within the Sarganserland-Walensee-Glarnerland GeoPark.

b) consider if a property merits nomination under criterion viii (alone or in combination with other criteria) or if the geological and geomorphological values are better represented as supporting biodiversity, cultural or landscape values.

   The results of these investigations are presented in Section 3a.

c) undertake a rigorous global comparative analysis to ensure that a property does have global significance.

   In order to assess whether the property is of "Outstanding Universal Value", an in-depth "Comparative Study on Thrust Faults" (PFIFFNER et al. 2006, Suppl. S03) was commissioned from the structural geologists Professors A. Pfiffner, S. Schmid and M. Burkhard. This study, which was reviewed (Suppl. S03) by Professor J. Kley (Jena, Germany) and Professor S. Wojtal (Oberlin, Ohio, US), shows that the Glarus overthrust is unique worldwide in terms of the values assessed – scientific value, scenic value, geomorphic expression and educational value.

   The detailed results of this analysis are presented in Section 3b.

For geological sites, a list of thirteen themes was proposed by DINGWALL, WEIGHELL & BADMAN (2005). The nominated property includes valuable geotopes in the following categories: Tectonic and structural features (1), Mountain systems (3), Stratigraphic sites (4), Fossil sites (5), Fluvial, lacustrine and deltaic systems (6), Caves and karst systems (7), Glaciers and ice caps (10), and Ice Ages (11). The global uniqueness of the nominated World Heritage site "Glarus overthrust" relates to the wealth of well-exposed geological phenomena and in particular structural geological phenomena, with the unique Glarus overthrust.

In the list of existing World Heritage properties with earth science features of outstanding universal value (DINGWALL, WEIGHELL & BADMAN 2005, Appendix 1, Tables 1 and 2), "Tectonic and structural features" (theme 1) are somewhat underrepresented. Reference is made to this theme for the following properties in the provisional assessment:

- 3 sites listed under "Principal features of outstanding universal value": Gros Morne National Park – Canada, Macquarie Island – Australia, Three Parallel Rivers of Yunnan Protected Areas – China.
- 1 site listed under "Possible features of outstanding universal value": Uluru-Kata Tjuta National Park – Australia
- 3 sites (Canaima National Park – Venezuela, Lorentz National Park – Indonesia, Purnululu National Park – Australia) listed under "Other significant features".

In the list of "World Heritage natural and mixed properties with significant earth sciences values, but which are inscribed on the World Heritage List for other reasons (provisional assessment)", no properties are included under this theme.

3.a Criteria under which inscription is proposed (and justification for inscription under these criteria)

The Glarus overthrust not only meets the two criteria specified in paragraph 77 of the Operational Guidelines (UNESCO 2005), but also fulfils the integrity condition of paragraphs 87–95. The nomination of the Glarus overthrust for inscription on the World Heritage List is based on arguments presented under three main headings: aesthetics (Criterion vii), geological structures (Criterion viii) and history of geology (Criterion viii).

Criterion (vii): *"contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance"*

The extraordinary aesthetic value is based on the excellent visibility of the Glarus overthrust, surrounded by imposing peaks with small glaciers and various landscapes and biotopes, formed in thousands of years. Many major overthrusts, both in the Alps and elsewhere, are only identifiable on the basis of detailed cartographical and geological studies (e.g. dating of rock samples). By contrast, the Glarus overthrust is readily visible with contrasting colours as a well-defined line – the so-called magic line – extending across the landscape for dozens of kilometres. It is also a conspicuous feature when viewed from a distance – from a valley or mountain vantage point – and has been depicted by artists over the centuries (Fig. 02-11).

Criterion (viii): *"be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features"*

On account of the specific lithological characteristics and the interaction between metamorphism and tectonics which is best understood at this site, the Glarus overthrust is globally unique. From the northern to the southern limits of the property, one encounters rocks that, during the period of thrust activity, lay at a depth of 5 km or 12–16 km below the Earth's surface. This represents a cross section through the entire upper crust – a globally unique geological phenomenon. As well as the Glarus overthrust, the property includes nappe contacts between the Glarus and Mürtschen thrust sheets and between the Mürtschen and Säntis thrust sheets, which are exposed and readily observable. This geological diversity, the wide range of elevations and the on-going morphodynamic processes create a wide variety of landscapes and valuable habitats for species typical.

Thanks to the excellent exposures and accessibility of the Glarus overthrust, numerous eminent geologists have visited this region since the early nineteenth century to carry out research. Many revolutionary discoveries concerning the formation of mountains have been based on observations made at this site. The significance of this natural phenomenon has been further enhanced by the controversies that ensued, particularly at the end of the nineteenth century. Particularly noteworthy is the fact that, on the basis of observations made at the Glarus overthrust, nineteenth-century geologists were forced to overturn the prevailing orthodoxy on mountain formation and postulate the occurrence of events on a scale that was inconceivable at that time – decades before the theory of plate tectonics was first propounded. Ultimately, this fundamental geological theory – now taught in schools – only gained widespread acceptance in the 1960s. As a result of earlier studies, the geology of the site is very well known, which provides a sound basis for contemporary and future research. Intensive research is still being conducted at the Glarus overthrust with the aim of elucidating the causal mechanisms and processes involved in overthrusts and mountain building.

Although overthrusts can also be observed elsewhere (Suppl. S03), these sites lack the unique perspective afforded by the topography of the nominated property. This is true in particular of the Helvetic nappes of Western Switzerland. In other cases, overthrusts are largely obscured by vegetation (Appalachians, pre-Andean Cordillera ranges, Canadian Rockies, Scottish Caledonides), or the thrust zones are covered by debris from the erosion of neighbouring mountains (Himalayas, parts of the Rockies).

Fig. 03-01: The Glarus overthrust is readily discernible from afar. Under the overthrust a dark strip of flysch runs into the thick limestone mass between the overthrust with Verrucano *(top)* and flysch. Photograph: H. Rhyner, Elm.

Outstanding Universal Value of Thrust Faults

Thrust faults are faults in the Earth's crust where one rock unit is moved on top of another unit over distances of tens or hundreds of kilometers. Thrust faults are a direct expression of the dynamics of convergent tectonic plates. They are also directly responsible for the formation of mountain belts. Their outstanding universal value is based on the direct relationship to plate tectonics and on the origin of mountain belts.

Plate tectonics shape the interior and the surface of our planet Earth and explain not only the distribution of oceans and land, but also the water depth of the oceans and the elevations of land areas. Mountain ranges, including volcanoes, are the principal features on land that are directly related to plate tectonics. At boundaries between converging plates, the Earth's crust is undergoing horizontal compression. The ensuing contractional deformation leads to narrow belts of high elevations that straddle the plate boundary. Examples include the Andes of South America, the North American Cordillera or the Alpine-Himalayan system.

The uplift of the land surface to a narrow mountain range is mainly caused by horizontal shortening and stacking of the rock units in the contact zone between the two plates. The single most important features responsible for moving blocks of rock units upward toward the surface are thrust faults. These faults originate at depths of more than 10 km beneath the surface and usually reach upward to breach the surface. Downward, major thrust faults merge into the interface between the two converging plates, a contact referred to as Wadati-Benioff zone. It is in this zone that major earthquakes are triggered. Examples include the Alaska earthquake of 1964 or the Sumatra earthquake of 2004 that caused a devastating tsunami.

In a few and rare cases, deformation at the plate interface deforms the plate boundary and associated thrust faults. Through this process, their deeper levels, once located more than 15 kilometers deep in the crust, as well as higher levels become directly accessible to observation at the surface. These thrust faults, including the Glarus thrust, are thus singular witnesses of the processes that are going on at depth at plate interfaces and processes that give rise to the formation of mountain belts.

3.c Comparative analysis (including state of conservation of similar properties)

The Glarus overthrust is a major fault in the Earth's crust that can be followed in the field over tens of kilometers. Besides the fault itself, there are a number of structural features like folds, imbricate thrust sheets and highly deformed rocks that outcrop beneath and above the fault. These structures can be observed in an area of impressive relief, where rivers and glaciers carved out deep valleys running in various directions. As a consequence these structural features are exposed in three dimensions.

Thrust faults are recognized in most orogens, i.e. mountain ranges formed by convergence between tectonic plates. They correspond to crustal blocks moving up along the fault plane in response to horizontal shortening caused by the convergence of two plates. The exposure or visibility of thrust faults depend much on local climatic conditions and on the elevations of the mountain range. The Glarus overthrust is an example of a thrust fault that exhibits the fault plane and the mechanism how the rocks reacted to the motion of the plates in a particularly instructive and grandiose way.

The comparative study accompanying this document (Suppl. S03) discusses the arguments for considering the Glarus overthrust to be a feature of Outstanding Universal Value. For this purpose, a direct comparison has to be made with other thrust faults and comparable structures. The various sites are assessed and compared as objectively as possible. This is done by comparing the well-known thrust faults in mountain ranges worldwide using a number of objective criteria in a transparent manner. As requested by Dingwall et al. (2005), properties already inscribed in the World Heritage List, which have some features in common with the proposed property "Glarus overthrust", are included. This particular type of comparison is rendered difficult by the circumstances given by the perimeter of the properties. For existing properties, the exact definition of the perimeter is not part of the protection regulations, whereas for the nominated property "Glarus overthrust" this is the case.

The criteria used are (PFIFFNER et al. 2006):

- The Scientific Value of the object concerning the process of overthrusting associated with the convergence of tectonic plates, and the process of mountain building in general.
- The Scenic Value (natural beauty) of the object, including beauty and outcrop quality of structural features (overthrusts and folds beneath and above the Glarus thrust).
- The Geomorphic Expression in the landscape by spectacular and visually striking phenomena.
- The Educational Value, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

To assess these four criteria, subcriteria are defined in each case, permitting an objective evaluation: a subcriterion is fulfilled if the object evaluated is judged "excellent". The sum of these evaluations is then used to rate the four main criteria. The rating "excellent" is given only if most of the subcriteria were evaluated as "excellent". The ratings for the four main criteria are given in Tab. 03-01.

Geomorphic expression

For the geomorphic expression we used (9) the geomorphic expression of the fault in the landscape and (10) the presence of spectacular and visually striking phenomena as subcriteria. Subcriterion (9) is met my many thrust faults even if the fault surface itself is not directly exposed at the surface. For example, the Lewis thrust is outlined at varous locations by cliff forming rocks in the hanging wall rocks (Proterozoic rocks of Paleozoic carbonates) and Cretaceous strata in the footwall that form gentle slopes covered with vegetation. Other faults do not meet subcriterion (9) because they are not associated with a particular geomorphological "anomaly". Examples include the Roselend thrust, the Wildhorn, the Doldenhorn and the Morcles thrust in the Alps, the Main Central Thrust in the Himalayas (for most of its length), the faults in the Atlas mountains and the Naukluft mountains, the thrust faults in the Eastern Cordillera of the Peruvian Andes, the faults in the Omineca Belt of the North American Cordillera, the basal thrust of the Arltunga nappe complex in Australia and the Alpine Fault in New Zealand.

Subcriterum (10) requires the presence of spectacular abrupt color changes or a sharp contact manifested by small scale geomorphic features. Of all the many thrust faults analyzed, it is the Livingstone thrust, the Gavarnie thrust and the Glarus thrust which clearly meet this subcriterion, and all three also meet subcriterion (9).

Fig. 03-05: As the Glarus overthrust exposures on the Tristelhorn are situated at around 3000 m a.s.l., they are particularly suitable for study. Photograph: D. Imper, Heiligkreuz.

Educational value

The educational value is evaluated on the basis of (11) the historic geological context of the object, (12) the potential of public awareness of the object. In subcriterion (11) it is the question around the history of science (recognition of thrust faults) that plays an important role. In the (Southern) Appalachians (Rogers and Rogers 1843, and Rodgers 1949) the discussion turned around thick-skinned tectonics (folds in the sedimentary strata that also involve crystalline basement rocks) and thin-skinned tectonics (folds carried by thrust faults involving only the sedimentary strata or thin slices of crystalline basement rocks). In Scandinavia, Törnebohm (1896) recognized thrust faults in the Sparagmite nappe. Both these examples meet subcriterion (11), but none of the other subcriteria. The most famous controversies regarding subcriterion (11) were fought out around the Moine thrust and the Glarus thrust and the basal thrust of the Penninic nappes in the Prealps (Swiss Alps).

Subcriterion (12) is important for the policy of protection (does the first-time-visitor leave the place with the conviction that the site must be safeguarded for future generations?); it is also related to the accessibility of the site. Examples that meet subcriterion (12) include the Lewis thrust in the Waterton Glacier International Peace Park (Canada/USA), the Gavarnie thrust in the Pyrenees' Mont Perdu (France/Spain) and the Alpine Fault (although it is not a thrust fault) in Te Wahipounamu (New Zealand) to name protected areas. A number of other thrust faults from non-protected areas could be added to this list. Hower, it seems to us that only the Moine thrust, the basal thrust of the Penninic nappes in the Swiss Prealps and the Glarus thrust really meet both subcriteria unevoqually and simultaneously.

Fig. 03-06: The Lochsite has been reconstructed at the American Museum of Natural History in New York. Photograph: S. Hesske, Pfäfers.

Conclusion

The Comparative Study suggests that the Glarus thrust reaches the ranking "excellent" regarding all four criteria and thus fulfills the condition of "Outstanding Universal Value". It is the only object evaluated that simultaneously fulfills the conditions of all the subcriteria considered in the comparative analysis. Moreover, it ranks first amongst all the objects in the great majority of the subcriteria. This comparative analysis clearly indicates that the nominated property "Glarus overthrust" merits to be inscribed in the World Heritage List. (PFIFFNER et al. 2006).

Tab. 03-01: Result of the "Comparative Study on Thrust Faults" (PFIFFNER et al. 2006, Suppl. S03).

		Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	Roselend thrust	2	3	2	3	10	7
	Digne thrust	3	3	1	2	9	6
Swiss Alps	Glarus thrust	1	1	1	1	4	**1**
	Drusberg-Säntis thrust	2	1	2	3	8	5
	Axen thrust	2	2	2	3	9	6
	Wildhorn thrust	2	2	2	3	9	6
	Morcles & Doldenhorn thrusts	2	3	3	3	11	8
	Base Préalpes Médianes	1	2	2	2	7	4
	Matterhorn / Base Austroalpine	1	1	2	2	6	**3**
	Rätikon / Base Austroalpine	1	1	3	3	8	5
	Engadine / Base Austroalpine	1	2	3	3	9	6
Eastern Alps / Austria	Inntal thrust	3	3	2	3	11	8
	Hohe Tauern / Penn & Austroalpine	1	2	3	2	8	5
Pyrenees	Gavarnie thrust	2	1	2	2	7	4
Caledonides	Moine thrust / Scotland	1	1	2	1	5	**2**
	Jotun thrust / Bygdin, Norway	1	2	2	2	7	4
Himalayas	Main Central thrust	1	2	3	3	9	6
Atlas Mountains / Morocco	High Atlas & Anti-Atlas	3	3	3	3	12	9
Naukluft Mountains	Namibia	3	3	3	3	12	9
Andes	Western Cordillera Peru	2	1	2	3	8	5
	Eastern Cordillera Peru	1	4	3	4	12	9
	Subandine Zone Bolivia	2	2	3	3	10	7
Rocky Mountains	Omineca Belt	1	3	3	2	9	6
	Foreland Belt / Lewis thrust	1	1	2	2	6	**3**
	Livingstone thrust	2	1	1	2	6	**3**
Appalachians	Pine Mountain thrust	1	3	3	2	9	6
Alice Springs / Australia	Arltunga nappe	1	3	3	3	10	7
Southern Alps New Zealand	Southalpine fault	2	3	3	2	10	7

Ranking: excellent = 1, very good = 2, good = 3, fair = 4

3.d Integrity and/or Authenticity

The Glarus overthrust exposures are mainly situated between the Rhine, Seez/ Walensee and Linth valleys, i.e. within the nominated property. The Glarus overthrust is exposed from Pizol to Lochsite near Sool/Schwanden over a distance of 30 km, running from west to east, and from Flims to Schwendi in the Weisstannental over a distance of 20 km from north to south. It is also the key scenic element of the landscape.

The nominated property encompasses the most important exposures of the Glarus overthrust, all of which developed naturally, as a result of erosion, rather than being artificially created by human influences. Particularly fine exposures of the Glarus overthrust within the proposed site are to be found at the following localities:

- Ringelspitz group (Ringelspitz, Glaserhorn, Tristelhorn; Figs. 03-05, 05-02)
- Pizol region (Figs. 03-02)
- Foostock, eastern and southern sides, Weisstannental (Figs. 02-03, 03-04)
- Lochsite near Schwanden, Sernftal (Figs. 03-03, 05-05)
- Tschingelhoren (Figs. 02-07, 02-11, 03-01)
- Sardona group (Gross Schibe, Piz Sardona, Piz Segnas, Piz Atlas, Piz Dolf (Figs. 02-05, 02-14, 02-16)
- Fil de Cassons – Crap da Flem (Figs. 02-24)

At outcrop, the geological phenomena are very well exposed and visible. The importance of these exposures is underlined by the fact that the American Museum of Natural History in New York had a cast of the Lochsite outcrop (Fig. 03.06) made so that a full-scale reconstruction of this geologically and historically significant site could be carried out abroad. To understand phenomena and processes such as the course and formation of the overthrust, large-scale deformation features, metamorphic grade or isotope composition, it is however indispensable to study the exposures over a wide area.

Sources CLOUTIER, R. & LELIEVRE, H. (1998), DINGWALL, P., WEIGHELL, T. & BADMAN, T. (2005), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2004), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2005), GEOPARK SARGANSERLAND-WALENSEE-GLARNERLAND (2006), IMPER, D. (2003a), IMPER, D. (2003b), IMPER, D. (2004a), IUCN (2005), PFIFFNER, O. A., BURKHARD, M. & SCHMID, S. M. (2006), PHILIPS, A. (2002), SAEFL (2003), THORSELL, J. (2005), UNESCO WORLD HERITAGE CENTER (2005).

Annexes A01, A04.1, A04.2, A05, A06, A07

Supplements S01, S02, S03, S04, S05.1, S05.2, S08, S10.2, S11, S12

Supplement 2: Website of the American Museum of Natural History

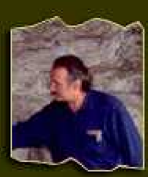
Alps Expedition: Mold of Mountain Fold

September 1998

Ed Mathez journeys with a team of mold makers and Museum colleagues to the Alps near Zurich, Switzerland to make a cast of an outcrop. The Alps were formed by continental collision 40 million years ago. The mold of the Alps mountain fold will be displayed in the "What causes ocean basins, mountains, and continents?" section of the exhibition because it shows how rocks deform by folding during mountain building.

A view up the Glarus Valley in Eastern Switzerland, near the tiny town of Schwenden.

photo credit: Craig Chesek, © American Museum of Natural History

Link: http://www.amnh.org/rose/hope/creatinghope/expeditions/q2_ex8_main.html

Supplement 3: Letter of support from Wolfgang Eder

Dr. F. Wolfgang Eder
Former UNESCO Director "Earth Sciences"

Guest Professor, University München, Germany
Guest Professor, Kyoto University, Japan

UN "International Year of Planet Earth",
Member of Board: Representative of Europe & Germany

UNESCO "Global Network of National Geoparks"
Member of the Honorary Committee

TO WHOM IT MAY CONCERN

Subj.: Glarus Overthrust Switzerland for World Heritage

I, the undersigned former Director of UNESCO's Division of Earth Sciences, hereby would like to express my sincere support for the inscription of the Glarus Overthrust on the World Heritage List under criterion (vii and viii).

The Glarus Overthrust system is, as it was rightly stated in documents of the 2004 and recent application for World Natural Heritage nomination, a unique property of globally outstanding importance that should receive the international accolade as World Heritage Site.

In accordance with IUCN's technical evaluation of 2004 one has to admit that there are numerous thrust structures around the world's mountainous belts that compare with the Glarus Overthrust. But, this is not surprising due to the phenomenon of global plate tectonics and their surface features related to "Deep Earth" endogenic processes.

Apart from its attractive geo-scenic character in Europe's most diverse mountain belt, the Alps, the "outstanding universal value" and "uniqueness" of the Glarus Overthrust stems from the fact that it is the first case ever described in the literature (H.C Escher, and lateron Arnold Escher, 1845) as a geological overthrust structure. The Glarus Overthrust, well exposed in the region, e.g. the Lochsite, served and still serves as a classical example of specific geo-tectonic features that helped to elucidate and reveal the processes of plate tectonics.

The global recognition and value of this property could be best increased and promoted as international important research, teaching and historical site by protecting it as World Heritage site as outstanding part of the "GeoPark Sarganserland-Walensee-Glarnerland". The complementary well-functioning partnership of a World Heritage Site and a Geopark has been proven through other examples, like the World Natural site "Messel Fossil Pit" and the GeoPark "Odenwald-Bergstrasse" in Germany.

(Munich, 16 September 2007, signed F. Wolfgang Eder)

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Complement to the
“Comparative study on thrust faults:
The Glarus overthrust”

UNESCO World Heritage Candidate

“Swiss Tectonic Arena Sardona”

Mountain Building Processes rendered visible by the Glarus overthrust and associated structures

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

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February 2008

Layout:
IMPERGEOLOGIE AG, Heiligkreuz

Frontpage:
Aerial View of the Glarus overthrust at the Sardona Group from the west
Photo: R. Homberger, Arosa

Table of Contents

Summary

This study broadens the focus of the nomination of the property "Swiss Tectonic Arena Sardona" (formerly called "Glarus overthrust") to include the aspect of mountain building processes and Plate Tectonics. Mountain ranges world wide were analyzed by means of a set of criteria and sub-criteria to allow an objective comparison of mountain ranges and parts thereof.

This comparative analysis underlines that the nominated property "Swiss Tectonic Arena Sardona" offers a unique and truly three-dimensional view of a wealth of features related to Mountain Building and Plate Tectonics. The apparent simplicity of one gigantic thrust visible over kilometric distances offers a splendid visualization of our dynamic earth that is continuously re-shaped by Plate Tectonic Processes driven by the deep earth as well as surface processes primarily driven by the action of water, glaciers and gravity. In this sense the nominated property ranks first in the mountain ranges of our planet.

1 Introduction

The basic scientific document that was submitted within the nomination documents dated August 2006 to UNESCO for the nomination of the property „Swiss Tectonic Arena Sardona" (formerly called „Glarus overthrust")[1] as a UNESCO World Heritage site is the „Comparative analysis of thrust faults: The Glarus overthrust" by the three university professors A. Pfiffner (University of Bern), M. Burkhard[2] (University of Neuchâtel) and S. Schmid (University of Basel). This document was peer reviewed and supported by the international experts Prof. Dr. J. Kley (Jena Germany) and St. Wojtal (Ohio, USA). In this comparative study, the authors evaluated the scientific value, the educational value, the scenic value and the geomorphic expression of the most impressive overthrusts worldwide and were able to document the Outstanding Universal Value of the Glarus overthrust and its top ranking amidst thrust faults worldwide.

In September 18-20 of 2007, P. Rosabal and Dr. J. Powell inspected the proposed property on behalf of the IUCN. In a letter dated November 2nd, 2007, based on the impression gained by the IUCN experts, the national state was encouraged to "broaden the focus of the nomination" and to "demonstrate the significance of the nominated property in the context of mountain building processes and in particular in enhancing the understanding of Plate Tectonics".

The state party and the "IG Kandidatur UNESCO-Weltnaturerbe Glarner Hauptüberschiebung", therefore asked the authors of the mentioned comparative study, Prof. O.A. Pfiffner and Prof. S.M. Schmid, to cast an extended view of the property as suggested by the IUCN experts after their visit. This view is formulated in this complement to the comparative Study of 2006. In order to document the close relationship between the two documents, the authors chose the same structure for this complement.

This report "Complement to the "Comparative study on thrust faults: The Glarus overthrust" - Mountain Building Processes rendered visible by the Glarus overthrust and associated structures" extends the original treatment of the Glarus overthrust and discusses the link between thrust faults and mountain building as well as Plate Tectonics in a more general way and in conjunction with the proposed property.

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[1] The UNESCO World Heritage nomination was submitted in 2006 with the name „Glarus overthrust". The IUCN (D. Sheppard) proposed in their letter of November 2nd, 2007 to search for a more suitable name enclosing a wider spectrum of topics including mountain building. The state party discussed this aspect intensively with the representatives of the property and came up with alternatives. The new name should be correctly adapted to the property, allow the local population to identify itself with it, but also be attractive. An extended process including the local and regional stakeholders and the state party, the new name „Swiss Tectonic Arena Sardona" was widely accepted.

[2] Martin Burkhard was killed in a tragic accident while collecting rock samples in August 2006.

1.1 Aim of this study

The nominated property in the eastern Swiss Alps with the beautifully exposed Glarus overthrust allows the direct observation of many geological phenomenons that relate to processes of mountain building and Plate Tectonics. In a comparative analysis, Pfiffner, Burkhard & Schmid (2006) have shown that the Glarus overthrust is a feature of Outstanding Universal Value.

The aim of this study is to demonstrate that the nominated property with the Glarus overthrust has formed in response to plate tectonic processes, which are still active today. In general terms, plate tectonic processes are responsible for the formation of mountain ranges (see Box 1). The nominated property shows this link between Plate Tectonics and mountain building in a very direct and spectacular way.

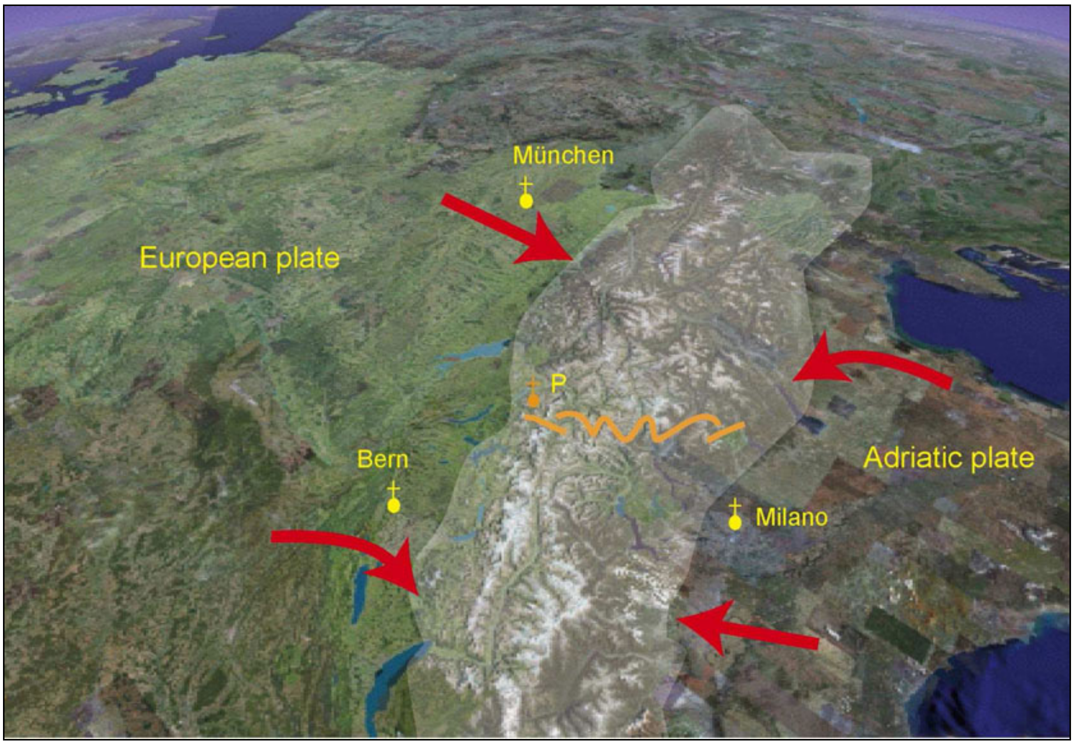
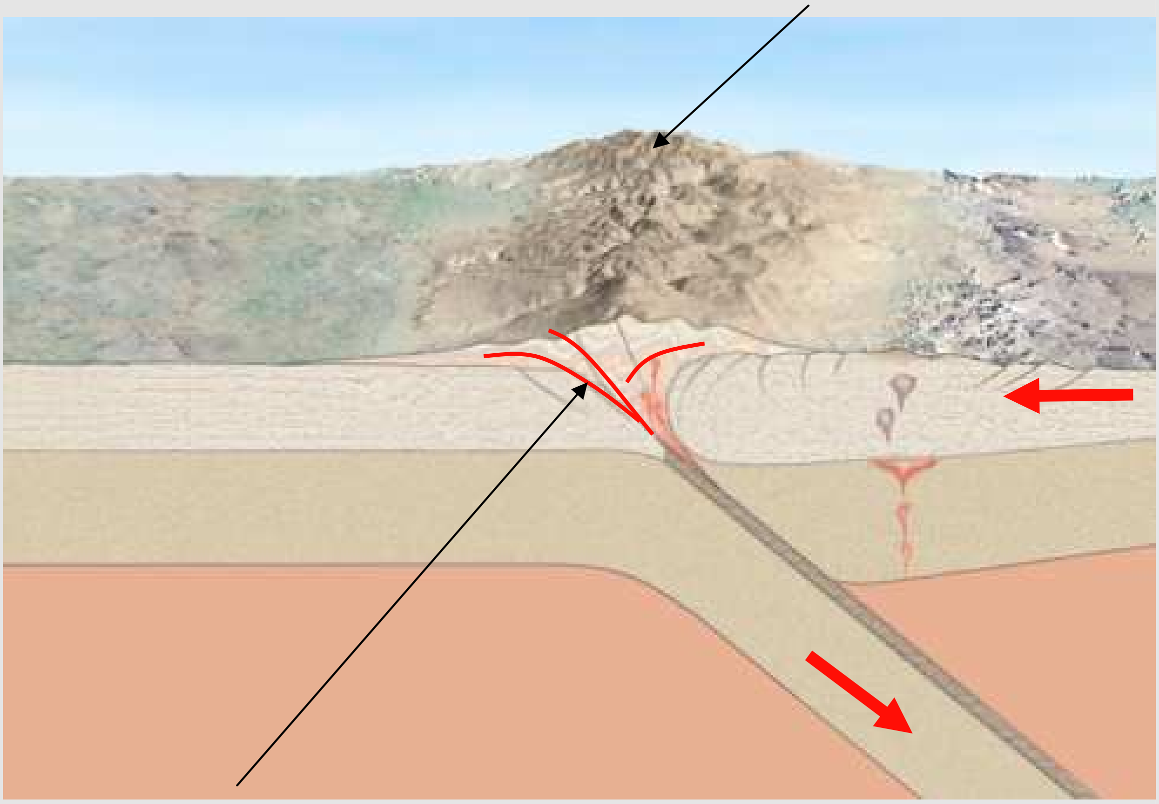


Fig. 1.1-1: Satellite image showing the Alpine mountain range that resulted from the collision between the European and Adriatic plates. P marks the location of the nominated property.

Box 1: Plate Tectonics and Mountain Building

Mountain ranges form at plate margins. When plates converge, their margins are squeezed and telescoped. Shortening and thickening of the plate margins affects the entire earth's crust and is accomplished by faulting and folding. The activity of a thrust fault results in upward motion of kilometer sized blocks and thus leads to an immediate higher elevation of the former land surface. The thickened crust is buoyant and thus leads to still more uplift of the land surface. Higher elevations trigger higher precipitations, and these in turn provoke incision of valleys and erosion. The local relief (high mountain ridges, deep valleys) is induced by mountain building, but is essentially a function of erosion by rivers, glaciers and rock fall, just to name the most important agents of erosion. Hence, high elevations are the response to a particular process of plate tectonic processes, namely thrusting and folding at a convergent plate margin. Geologists refer to this process as mountain building. In this sense, mountain building processes are directly linked to the activity of faults with an upward motion (thrust faults and stike slip faults with reverse fault component).

The squeezed margins form a mountain range



Thrust faults in the interior of the mountain range

1.2 Structure of this study

This complement to the comparative study provides arguments as to why the three-dimensional Alpine arena around the Glarus overthrust in Switzerland particularly well illustrates such mountain building processes at plate margins, be it thrusting and folding, or consecutive massive erosion. For this reason, this “Arena” is considered a feature of Outstanding Universal Value. This statement is substantiated by a direct comparison with other mountain ranges from all over the world. This inevitably leads to a ranking of objects. Apart from being alien to the culture of geologists, this bears the risk of subjectivity. The authors are aware of this and also of the fact that there are other exceptionally beautiful landscapes and other exceptionally interesting thrust faults and associated structures around.

First the main criteria and the sub-criteria were evaluated and adapted to make sure that they correspond to the main objective of a comparison of mountain ranges. As main criteria the ones from the comparative study were found to be adequate. They are:

- Scientific value
- Scenic value
- Geomorphic expression
- Educational value

However, owing to the enlarged subject, new sub-criteria had to be specified (see Table 1 in section 1.3).

In contrast to the comparative study, only the most important mountain ranges were analyzed for each of the main criteria. This still ensured that the most prominent mountain ranges of our globe were considered in the evaluation (see Table 2 in section 4).

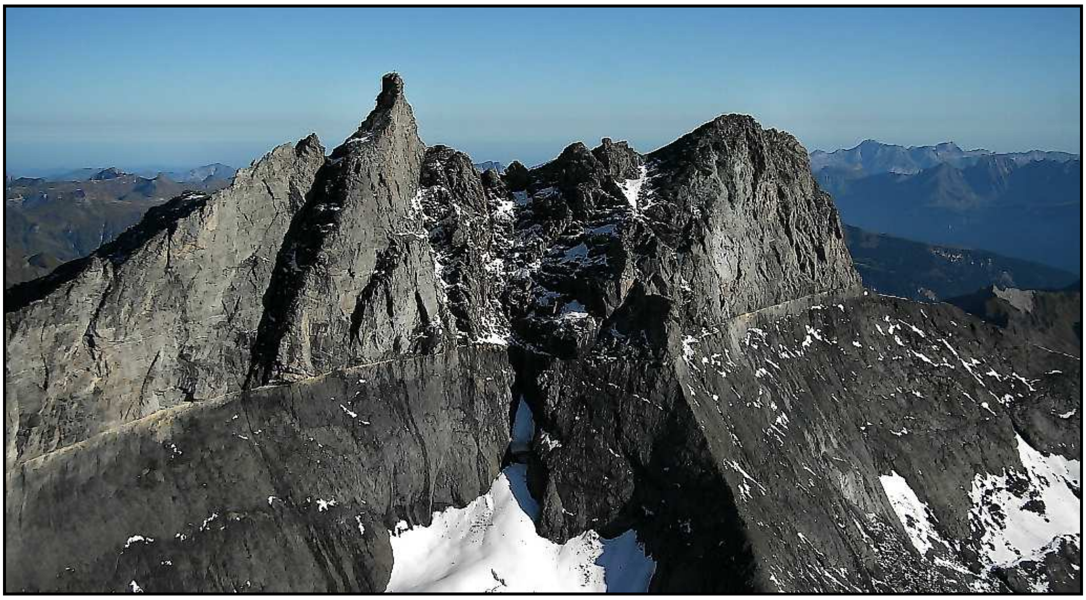


Fig. 1.2-1: The Glarus overthrust reaches over 3100 m a.s.l. at the summit area of Ringelspitz / Piz Barghis (3247 m a.s.l.). Aerial Photo: R. Homberger.

1.3 Comparison scheme

In the following the authors will, similar to the „Comparative analysis of thrust faults", assess and compare objects in a way as objective as possible. This is done by comparing mountain ranges worldwide using a number of objective criteria in a transparent manner. As requested by Dingwall et al. (2005), properties already inscribed in the World Heritage List, which have some features in common with the proposed property "Swiss Tectonic Arena Sardona" are also included.

The criteria are:

The ***Scientific Value*** of the object concerning the process of mountain building associated with the convergence of tectonic plates, including faulting, seismicity, uplift and erosion.

The ***Scenic Value*** (natural beauty) of the object, including beauty and outcrop quality of structural features (thrust faults and folds).

The ***Geomorphic Expression*** in the landscape by spectacular and visually striking phenomena, and the presently ongoing processes shaping the mountain range.

The ***Educational Value***, including the historic geological context, accessibility and the potential of the property to render the general public aware of the main object and the reason why it is important to protect it for future generations.

The four criteria are subdivided into sub-criteria each. These totally 12 sub-criteria allow a qualitative, but also a somewhat quantitative evaluation of the individual objects.

Fig. 1.2-1: The Glarus overthrust at Pizol Mountain with the Pizol Glacier. Aerial Photo: R. Homberger.

Table 1: Subcriteria and conditions for fulfilment

Criterion		Subcriterion	Conditions for fulfilment of subcriterion
Scientific Value	1	relation to plate motions	The mountain range may directly be linked to the plate motions.
	2	uplift processes	The mountain range is undergoing active uplift and demonstrates how surface uplift results in high elevation.
	3	magnitude of uplift	The mountain range has a considerable local relief.
	4	thrust faults and folds	Thrust faults and folds form a major component of internal deformation associated with mountain building.
	5	exhumation of high-grade rocks	Metamorphic rocks that had been deeply buried by geodynamic processes were subsequently exhumed by uplift and erosion linked to the mountain building process.
Scenic Value	6	natural beauty of mountain range	The mountain range itself has superb landscapes that strikes the eye of non-geologists. The beauty is underlain by deep valleys and high rugged peaks.
	7	thrust faults and folds	The fold and thrust structures are well exposed in the mountain range. They should strike the eyes of structural geologists and laymen as singular features.
	8	three-dimensionality of exposure	Folds and thrust faults should be exposed such that its shape is clearly visible in three dimensions over an area of tens of kilometers. This typically requires an important relief.
Geomorphic expression	9	ongoing erosion	The mountain range is presently undergoing active erosion as shown by geomorphic features on the valley flanks.
	10	erosion in the past 1 million years	The mountain range contains deeply incised valleys that formed in response to fluvial and glacial erosion as well as mass wasting.
Educational Value	11	historic geological context	The mountain range should have played an important role in the history of science, in particular related to the understanding of how mountain ranges are formed
	12	potential to stimulate public awareness	The mountain range must be readily accessible to the population and must be able to convey an understanding for natural science in general and the processes of mountain building in particular. It should convince the occasional visitor that the property merits to be preserved for future generations.

2 Mountain Ranges and mountain building processes

In order to cover mountain ranges worldwide we consider all the mountain ranges with an important relief and folds and thrusts associated with mountain building processes. The relief of a mountain range is usually directly a function of the age of the mountain range. Thus juvenile and active mountain ranges such as the Alpine-Himalayan system or the North American Cordillera – Andes system have high elevations and high relief owing to incision by rivers. In contrast, older mountain ranges, such as the Paleozoic *Appalachians* and *Caledonides* are worn down by erosion and the crustal root creating buoyant rise has largely been removed in the 400 million years since the formation of these mountain ranges.

Ongoing mountain building processes demonstrate themselves by seismicity and active uplift. These processes cease to function once the mountain range comes of age.

Mountain building processes mark themselves by the presence of thrust faults within the mountain range. The effect of erosion expresses itself by the occurrence of metamorphic rocks at the surface. These metamorphic rocks formed in the deeper part of the mountain range and were subsequently exhumed by erosional and tectonic removal of the rocks above.

Fig. 2-1: Folding in the Verrucano-Formation in the summit flank of Piz Segnas. Photo: R. Homberger.

3 Comparison

In this section, various mountain ranges worldwide are compared in terms of criteria discussed in the UNESCO document by Dingwall et al. (2005). Similar to the "Comparative analysis of thrust faults", the following four criteria are most useful to ensure an objective scientific comparison of mountain ranges in regard to mountain building processes:

- Scientific value
- Scenic value
- Geomorphic expression
- Educational value

To allow an evaluation criteria, subcriteria are defined, which are particularly suited to the enlarged vision of mountain building. In our analysis, a subcriterion is fulfilled only if the object evaluated is judged "excellent". Table 1 in section 1-3 lists these subcriteria and the associated conditions of fulfillment. It is then the sum of these evaluations that were used to give a ranking to the four main criteria. Here the ranking "excellent" is given only if most of the subcriteria were evaluated as "excellent".

The rankings of the four main criteria are given in Table 2 in section 4. Table 2 should not be read per se and without the explanations given here in section 3.

3.1 Scientific value

The mountain ranges *Caucasus*, *Himalaya*, *Andes* and *Southern Alps (NZ),* all related very directly to Plate Tectonics, are undergoing uplift at present, possess an impressive elevation and relief and contain thrust faults and folds. But the thrust faults visible at the surface disappear abruptly to depth and do not reveal processes going on at depth. An exception may be found in the *Southern Alps (NZ)* where high-grade rocks that were once at 18 km depth outcrop at the surface and show the ductile nature of deformation along the *South Alpine fault*. But the fault itself is best observed on arial photographs and only in a few locations may the latest brittle overprint be seen directly at outcrop.

In the case of the world heritage site "Jungfrau-Aletsch-Bietschhorn" in the Western Swiss Alps (called JAB subsequently), the link to plate tectonic and mountain building processes is not prominently visible. The Doldenhorn and Axen thrusts are observable in a few outcrops at the margin of the property and as such not prominently visible. The JAB property however has an impressive relief and exposes granitic rocks in the central part that were exhumed from 12 to 15 km depth.

In the case of the proposed property *"Swiss Tectonic Arena Sardona"*, all the subcriteria are fulfilled. The later updoming of the Glarus thrust and the removal of 12-15 km of rocks above it expose a continuous 15 km thick cross section through the Earth's crust and allow to observe at surface mountain building processes (thrusting) that were active in the deep part of the mountain range. **The outstanding feature related with the scientific value is the apparent simplicity of this spectacularly exposed overthrust that can be followed for some 35 km parallel to the direction of the up-thrusted block**. Rather than exposing a complicated system of thrusts, the nominated property visualizes one single thrust, to be followed across several mountain crests and valleys. The physical mechanism which allowed for such displacements to take place within a narrow zone of deformation is still subject of highly interesting and controversial debates, that can be conveyed to the interested visitor.

But also the rock units beneath and above the Glarus thrust display features that relate to the collision of two plates. The rocks were intricately folded, faulted and squeezed in the process of the collision of the plates. Such folds may for example be seen in the Mürtschenstock (see Figure 3.1-1), the Piz Segnas (Fig. 2-1), whereas folds and thrusts combined are recognizable in the Crap Mats.

Fig. 3.1-1: Folding in the Mürtschenstock Group. Aerial Photo: R. Homberger.

Precise leveling has revealed that the area of the property is undergoing ongoing uplift (see Fig. 3.1-2). This, combined with the associated seismicity testifies that the mountain building processes are still active today.

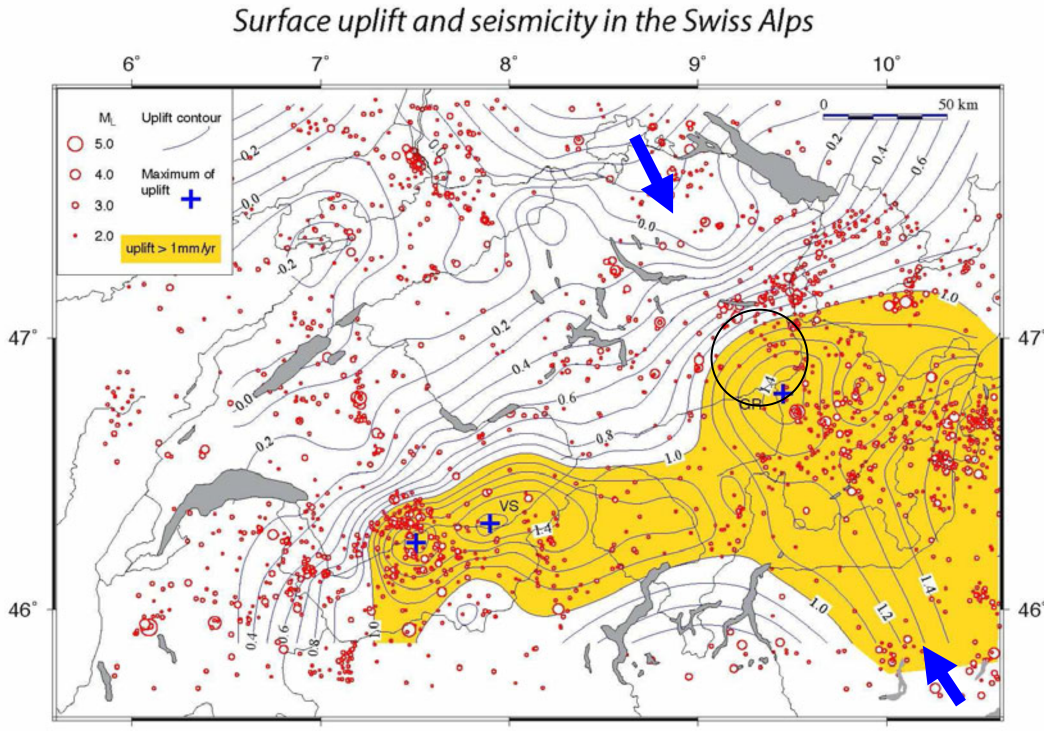


Fig. 3.1-2: Surface uplift in the yellow area is more than 1 mm/yr. The map illustrates that the nominated property is at present undergoing uplift and is located within a seismically active area. The blue arrows indicate active convergence between Europe and Africa. The circle indicates the location of the nominated property.

Fig. 3.1-3: The Glarus thrust at Gross Schibe. The knife sharp line marks the latest ruptrure along the Glarus thrust. Photo: D. Imper.

3.2 Scenic value

The mountain ranges *Caucasus*, *Himalaya*, *Andes* and *Southern Alps (NZ)* all offer spectacular views of landscapes, thrust faults and folds. However, none quite matches the proposed property if all subcriteria are considered.

The Jungfrau-Aletsch-Bietschhorn property in the western Swiss Alps offers a superb glacially formed scenery. Together with the active glaciers the visitor gets a true three-dimensional view of the processes related to erosion and sculpturing in high Alpine terrain. Thrust faults and folds are less prominent than in the landscape.

The proposed site "Swiss Tectonic Arena Sardona" offers a **spectacular and truly a three-dimensional view** of all parts of mountain building processes and thrust faults. The scenery not only allows for easy comprehension of the 3-dimensional nature of the well-known Glarus overthrust over large (several kilometers) distances from single viewpoints, the rugged topography also allows for an assessment of the enormous rock volumes that were eroded since these mountains formed by thrusting and folding, driven by the subsequent and presently still going uplift. Also, the geomorphic expressions of the proposed site are manifold. The lithological differences between individual formations are nicely reflected by the geomorphic character of the earth's surface, contrasts both in color as well as in changes in the character of the vegetation. The manifestations of erosion are manifold and shaped by glacial as well as fluviatile erosion, including large landslides and/or rock fall.

Fig. 3.2-1: View from Gross Schibe towards the east, the deeply incised Calfeisen valley. Photo: D. Imper.

3.3 Geomorphic expression

The mountain ranges *Caucasus*, *Himalaya*, *Andes* and *Southern Alps (NZ)* all display ongoing erosion in the past million years and at present. They therefore ranked along with the proposed property as “excellent”. The same holds true for the JAB property in the western Swiss Alps.

Fig. 3.3-1: The impressive Glarus Overthrust at the Tschingelhoren (aerial view to the east). Aerial Photo: R. Homberger.

3.4 Educational value

The mountain ranges *Caucasus*, *Himalaya*, *Andes* and *Southern Alps (NZ)* all contributed somewhat to the history of science. But compared to the *Appalachians*, the *Caledonides* or the *Alps* this impact was modest and they thus rank “very good”. For the Jungfrau-Aletsch-Bietschhorn (JAB) property in western Switzerland, the contribution to the history of science in mountain building is marginal. However, public awareness of creating a high mountain range and glacial sculpturing of a mountain range is excellent in the case of the JAB property.

The nominated property on the other hand played a crucial role in the history of science. Firstly the site gave rise to highly interesting debates amongst the pioneers in geology in the 19th century from all over Europe, debates that give insight into the evolution of ideas that ultimately led to the breakthrough of Plate Tectonics. Particularly French and English geologists were led around by the local geologists. These debates finally led to the recognition of very large displacements along thrust faults, displacements that could not be explained by thermal contraction of the earth any more. Secondly, the visitor of this arena will be able to grasp the mobilistic view of the planet earth, which found its ultimate explanation very much later, namely by the Plate Tectonics Paradigm. It is this mobilistic aspect of a dynamic earth, that impresses all visitors of this spectacular arena, be it in the past or at present.

It may be noted here, that the educational value will be enhanced by activities aimed at the general public in the framework of the management plan.

In this context it has to be mentioned that a full sized replica of the famous Lochsite outcrop, where the Glarus thrust is beautifully exposed, may be found in the American Museum of Natural History (Rose Center for Earth and Space, Hall of Planet Earth). The Lochsite outcrop was chosen to exemplify how mountains form.

Fig. 3.4-1: Panoramic view of the Tschingelhoren looking west. Photo: R. Homberger.

Fig. 3.4-2: Students at the famous Lochsiten locality listenting attentatively to the explanation on why older rocks came to ly on top of younger rocks. Photo: D. Kalberer.

Box 2: Educational value well exposed outcrops regarding the understanding of excellent outcrops for the understanding of geological processes

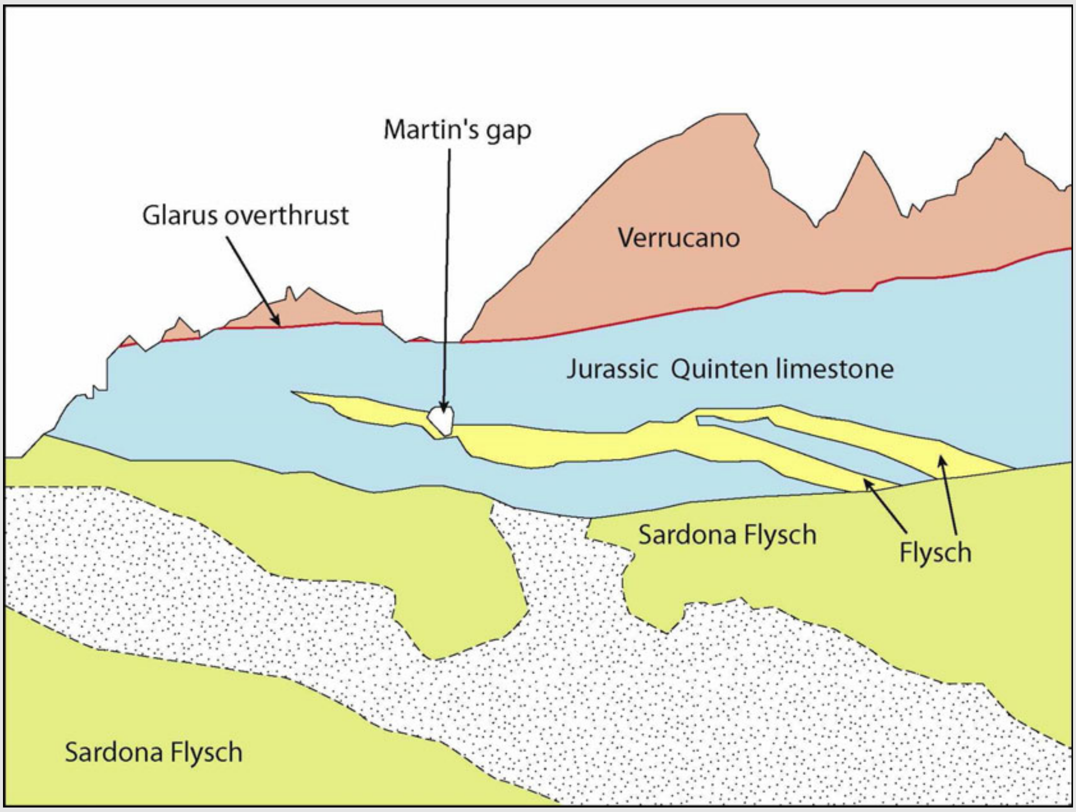
Good outcrops of geological phenomena are essential for research and teaching. At these locations, features indicative for past processes can be demonstrated to students and laypersons. Already the British geologist Charles Lyell (1797-1875) recognized the importance of observations at outcrops. The science of geology has much in common with detective work: we see the result of processes that happened in the past at isolated locations. From these observations we try to reconstruct the evolution of our planet Earth. As Charles Lyell noted in the early 19th Century, „the present is the key to the past".

Geological excursions are an essential part of the study curricula in Earth sciences. Many of the geological phenomena cannot be demonstrated in a laboratory or in a class course. Only if a phenomenon has been shown to a student in the field, it is later possible to recognize the same phenomenon elsewhere and independantly. Excursions represent highlights for the students. On a field trip they can put their hand on science, guided by a one-to-one supervision by their teachers. Theories presented in class courses become easier to be grasped and „rocks become alive".

Similarly, when geological knowledge is transferred to interested laypersons, outcrops are the best way to pass on the message. The problem is right there, it can be seen and touched.

In some instances, high quality photographs taken in the field help to transmit the message, but they can never replace the value of real field trip. These photographs depend on the availability of superb outcrops. An example is given in the photograph below.

The Glarus thrust and associated structures in the Tschingelhoren. Photo: H. Rhyner.



Line drawing explaining rock units seen in photograph above.

4 Conclusion

Based on a comparison of a large number of mountain ranges worldwide in regard to their suitability to illustrate mountain building processes that is based on four criteria, namely Scientific value, Scenic value, Geomorphic expression and Educational value, we are convinced that the "Swiss Tectonic Arena Sardona" merits to be included in the UNESCO list of World Heritage.

Table 2: Ranking of mountain building aspects

	Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	2	3	2	2	9	5
Western Swiss Alps (JAB)	2	1	1	2	6	**2**
Eastern Swiss Alps (Sardona)	1	1	1	1	4	**1**
Eastern Alps / Austria	2	2	2	2	8	4
Pyrenees	2	2	1	2	7	3
Caledonides	3	2	3	2	10	6
Caucasus	2	1	1	2	6	**2**
Himalayas	2	2	1	2	7	**3**
Atlas Mountains	3	3	3	3	12	8
Naukluft Mountains	4	2	3	3	12	8
Andes	2	1	1	2	6	**2**
North American Cordillera	2	2	2	2	8	4
Appalachians	3	3	3	2	11	7
Macdonell Range / Australia	3	2	2	3	10	6
Southern Alps NZ	2	2	1	2	7	**3**

Ranking: excellent = 1, very good = 2, good = 3, fair = 4

The "Swiss Tectonic Arena Sardona" offers a truly three-dimensional view of a wealth of features related to Mountain Building and Plate Tectonics: crustal shortening leading to one of the most spectacular thrusts that crops out well at high altitudes, manifestations of uplift, erosion and re-deposition shaping ridges and valleys. The apparent simplicity of one gigantic thrust visible over kilometric distances offers a splendid visualization of our dynamic earth that is continuously re-shaped by Plate Tectonic Processes driven by the deep earth as well as surface processes primarily driven by the action of water, glaciers and gravity.

5 References Cited

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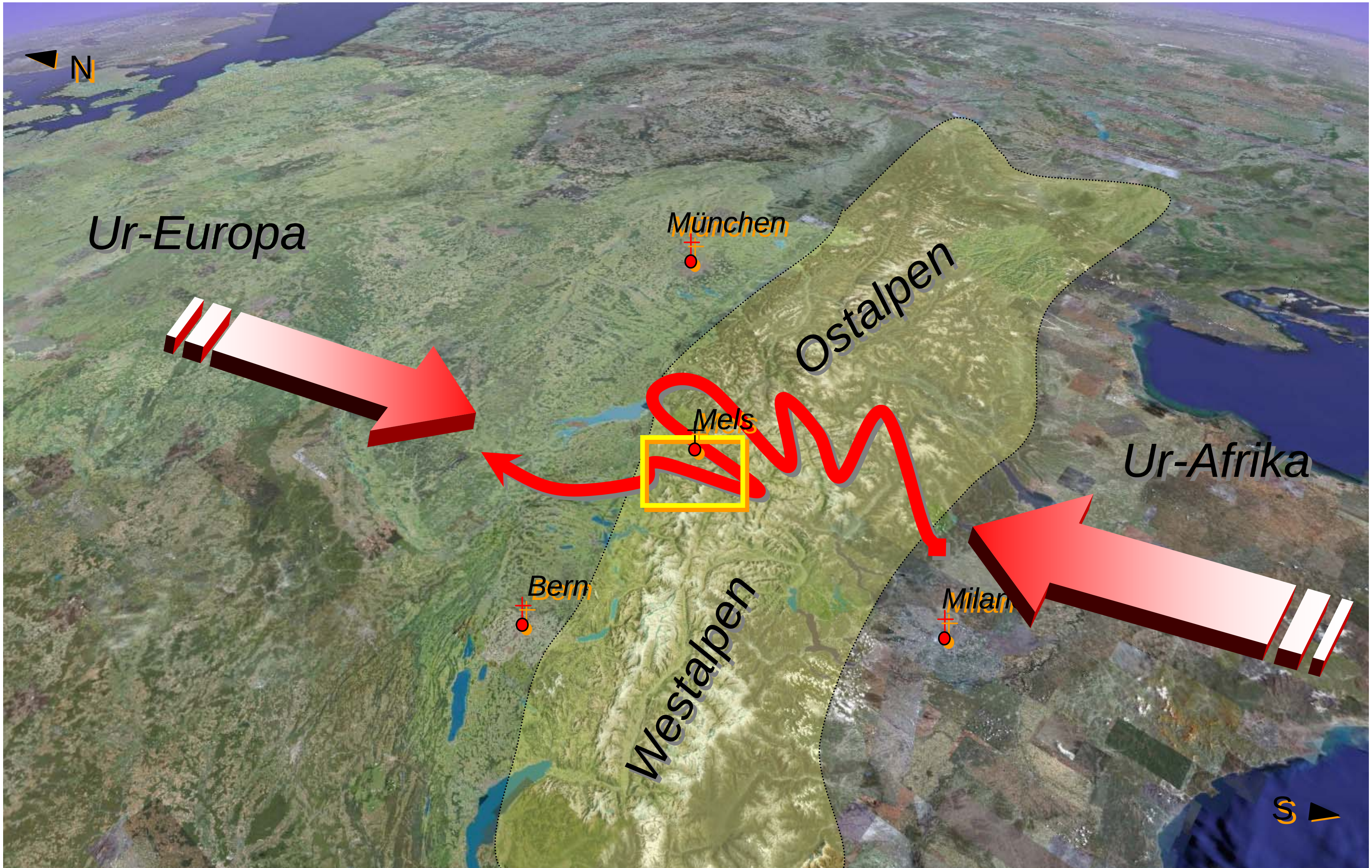
Swiss Tectonic Arena Sardona

Best pictures

Glarus overthrust: from space to Earth...



Glarus overthrust: topographic view

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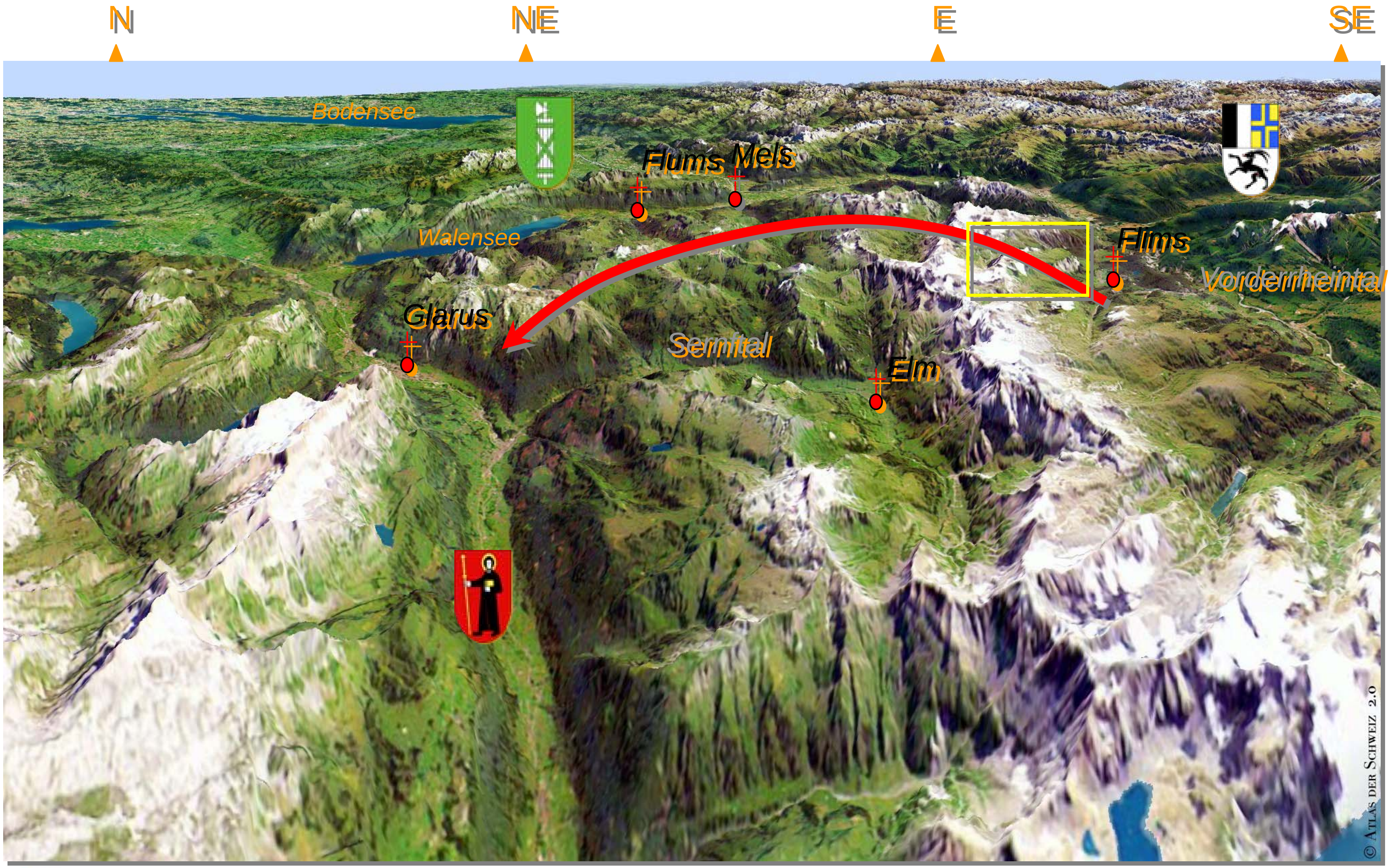

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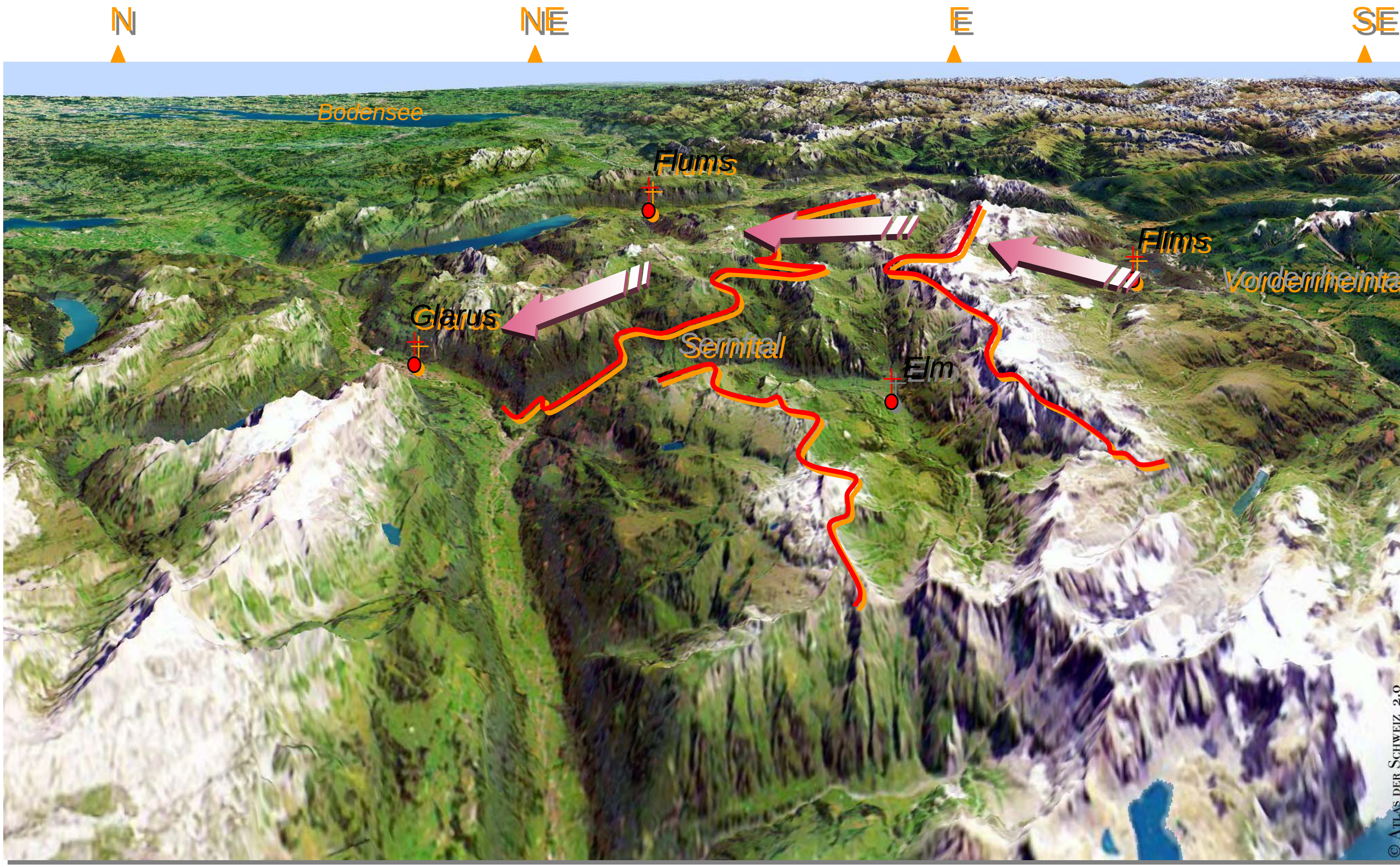
Glarus overthrust

Glarus overthrust: topographic view

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate



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Glarus overthrust: geologic overview

Swiss Tectonic Arena Sardona
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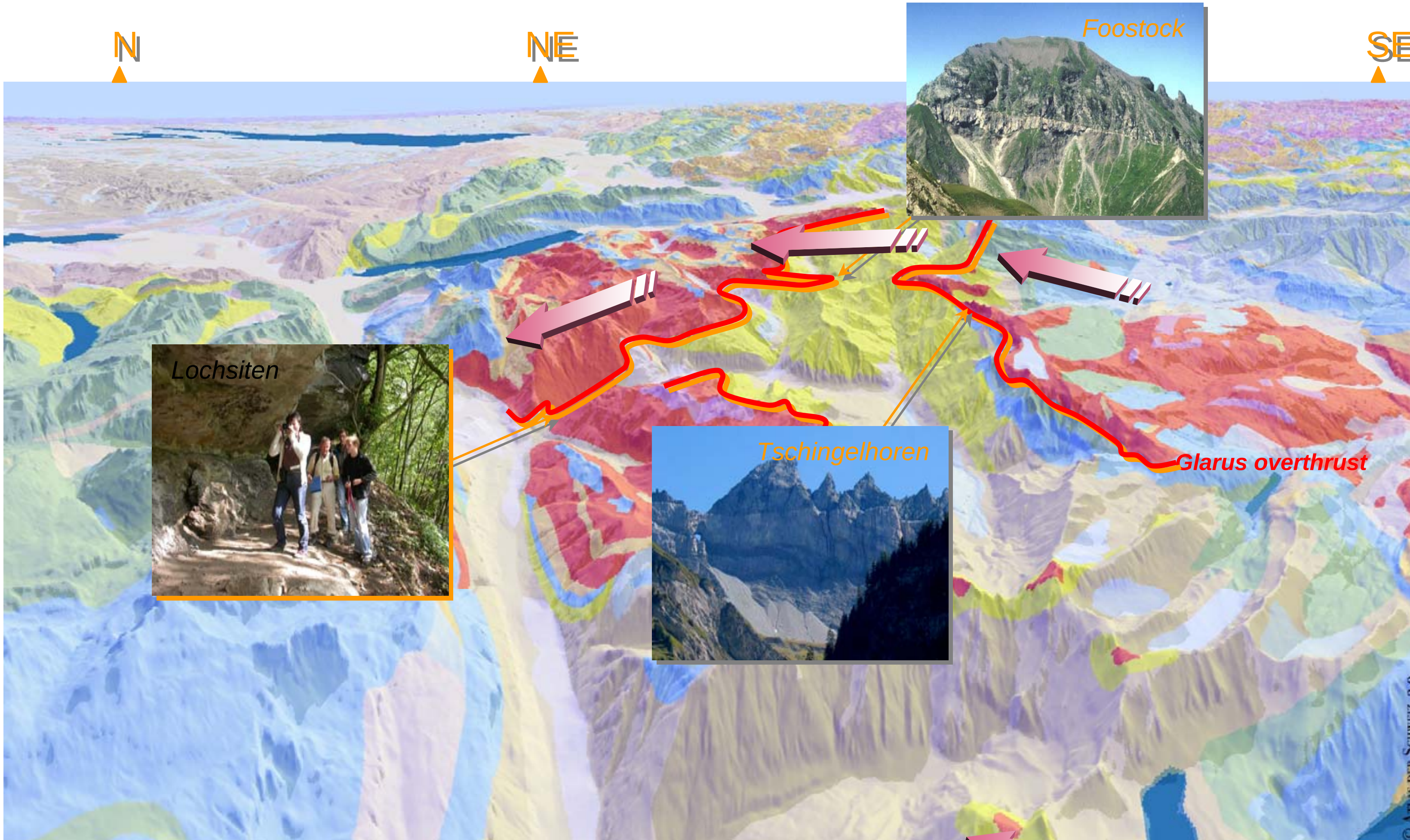

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Tertiär (50 - 35 Mio)

Kreide (140 - 65 Mio)

Jura (210 - 140 Mio)

Perm (250 - 300 Mio)

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Glarus overthrust: the magic outdoor arena

Scenic value + Geomorphic expression —> Nr. 1

Alps Expedition: Mold of Mountain Fold

September 1998

Ed Mathez journeys with a team of mold makers and Museum colleagues to the Alps near Zurich, Switzerland to make a cast of an outcrop. The Alps were formed by continental collision 40 million years ago. The mold of the Alps mountain fold will be displayed in the "What causes ocean basins, mountains, and continents?" section of the exhibition because it shows how rocks deform by folding during mountain building.

A view up the Glarus Valley in Eastern Switzerland, near the tiny town of Schwenden.

photo credit: Craig Chesek, © American Museum of Natural History

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The Magic Line

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Education

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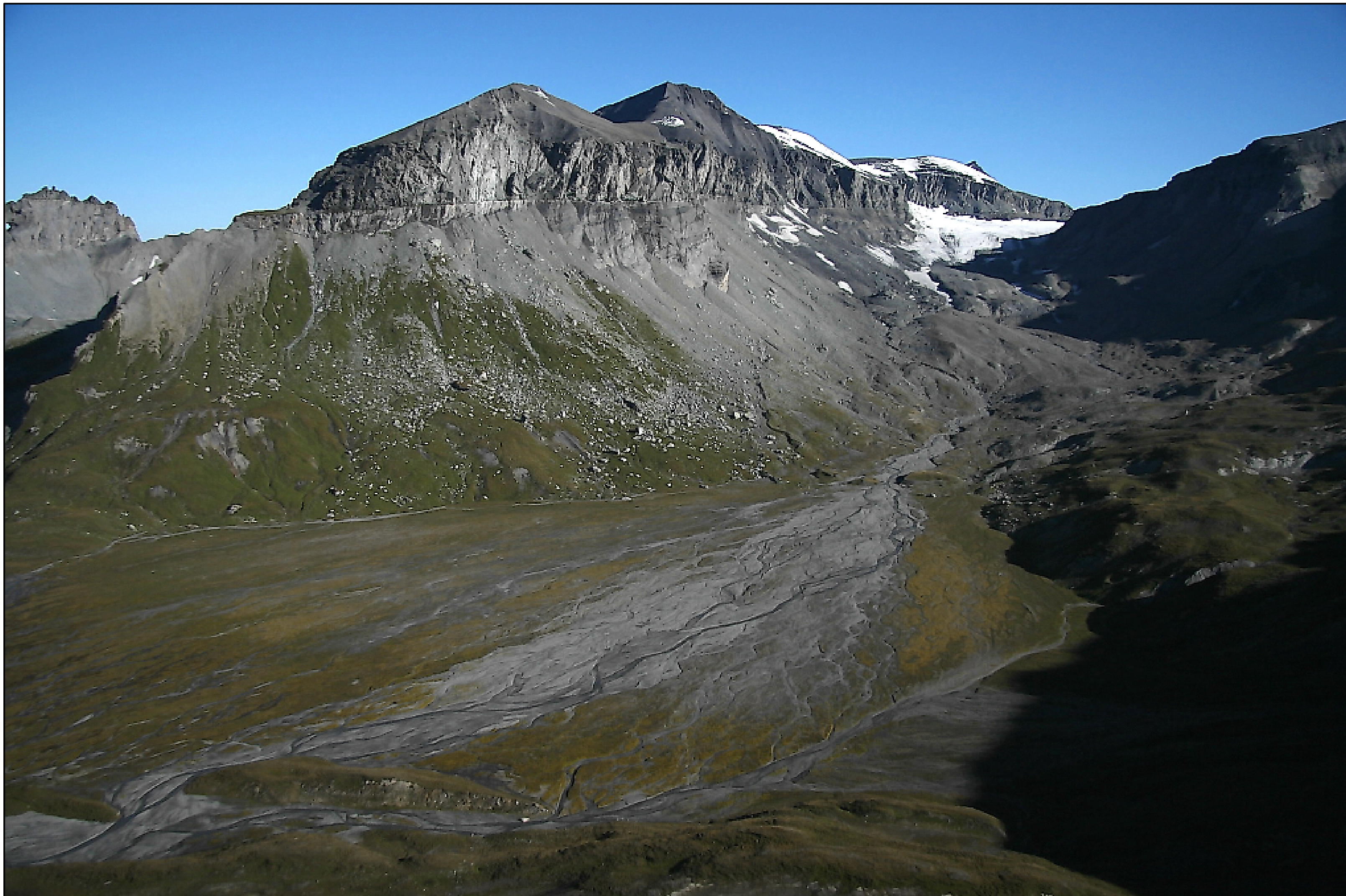
The Magic Line



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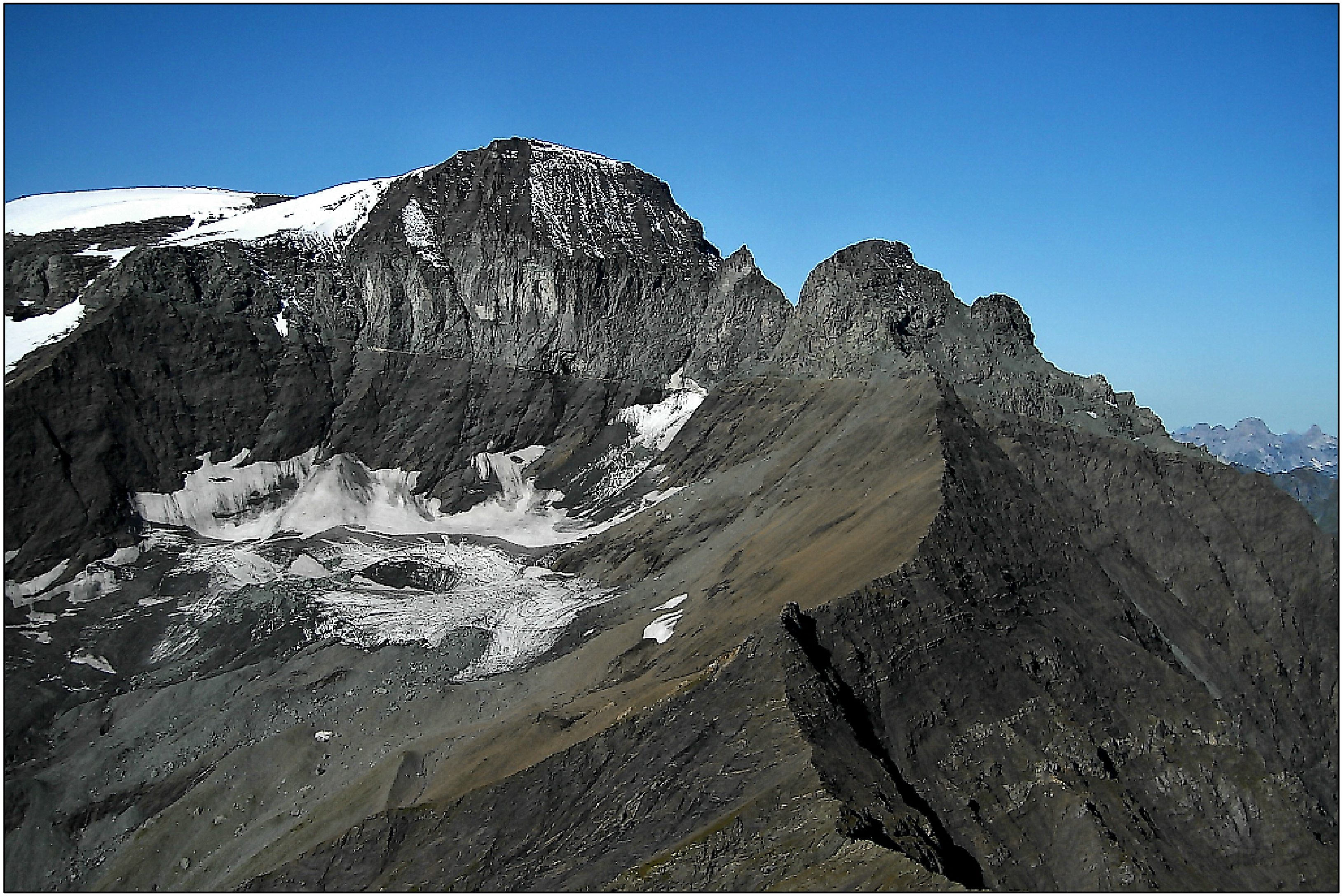
The Magic Line



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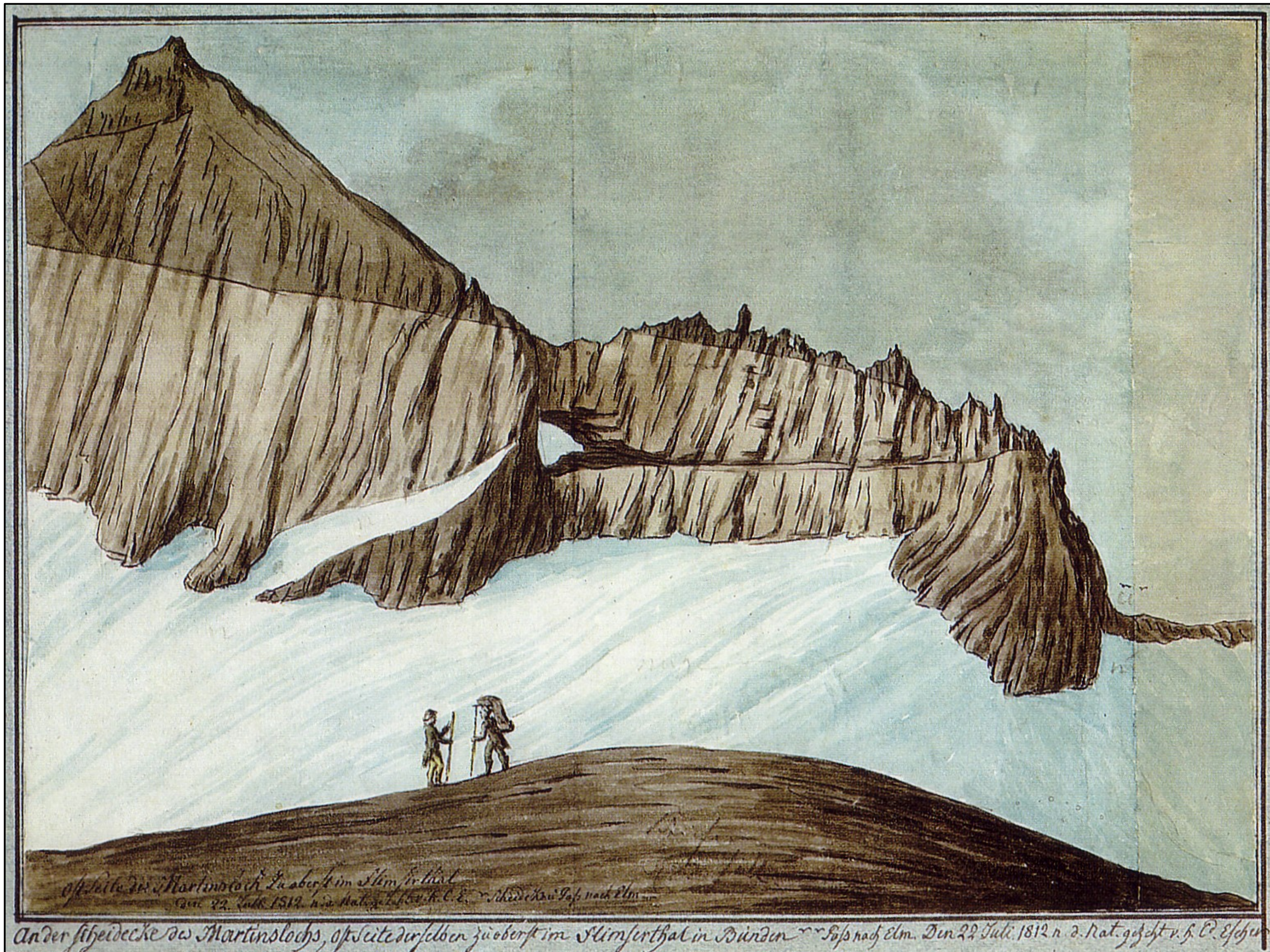

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Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Department of the Environment,
Transport, Energy and Communications
Federal Office for the Environment FOEN

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Evaluation mission of the World Heritage Nomination Glarus Overthrust (Switzerland) 18th to 20th of September 2007

Program for Mr. Pedro M. Rosabal González and Dr. James Powell

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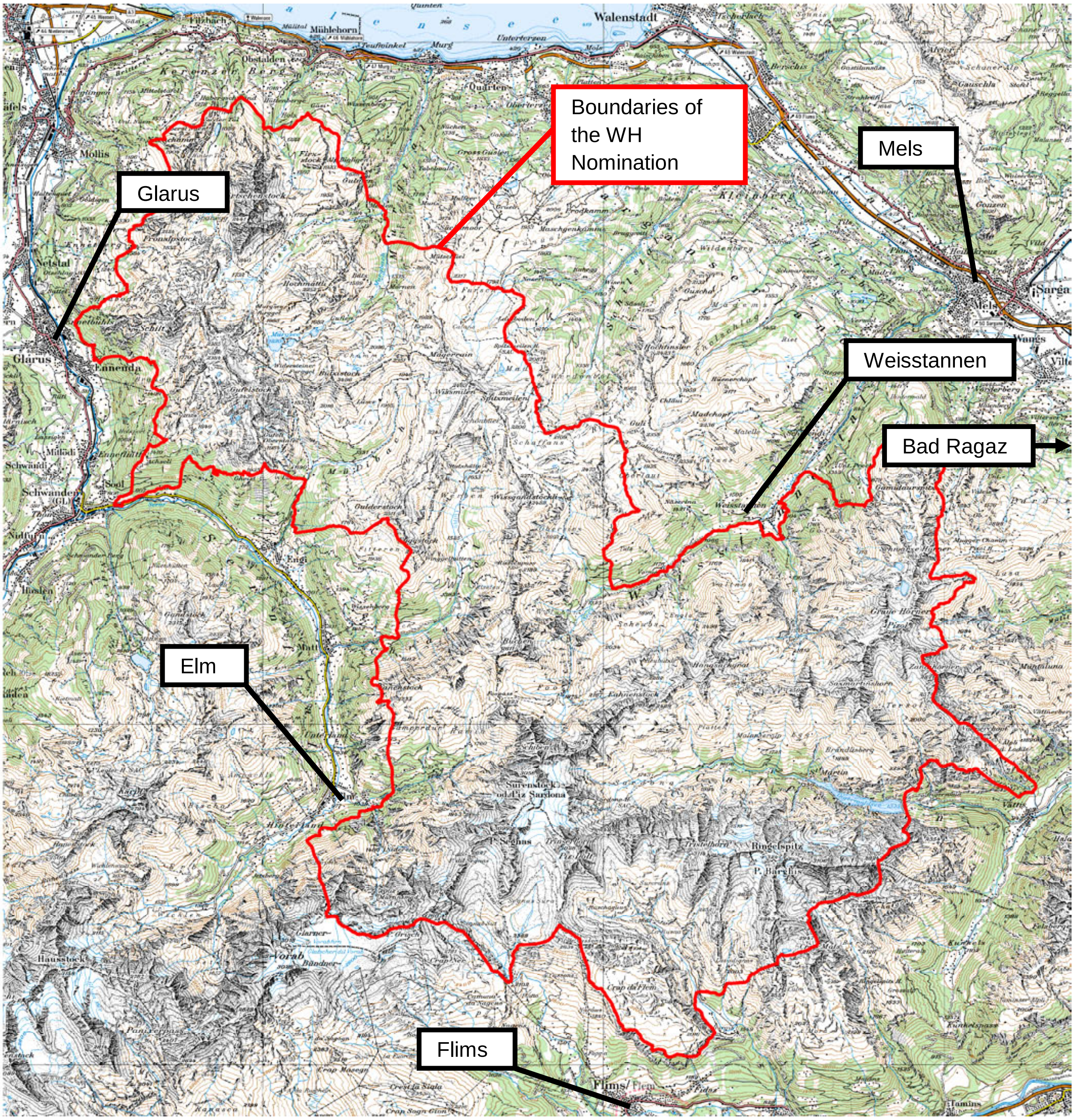

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Swiss Tectonic Arena Sardona
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Thuesday, September 18th

Glarus side and discussion with representatives

Time	Activities	Information
7.42 a.m.	Departure from Gland	By train
11.35 a.m.	Arrival at the train station in Glarus	Possibility to leave the package in the bus, walk to the restaurant
11.45 a.m.	Welcome in the restaurant Glarnerhof in Glarus	Participants: M. Viviani-Schärer (Swiss UNESCO Commission), H. Dürst (Glarus canton), B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), F. Marti-Egli (WHC GO), D. Imper (WHC GO)
00.15 p.m.	Lunch in the restaurant Glarnerhof in Glarus	
1.30 p.m.	Introduction: geographical and structural overview	
2.00 p.m.	Travel to Elm	By bus
2.30 p.m.	Coffee break: with view of the Glarus overthrust and the Elm landside at the Hotel Elmer	Participants: Dr. J. Powell (IUCN), P.M. Rosabal (IUCN), M. Viviani-Schärer (Swiss UNESCO Commission, B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), A. Wernle (GeoPark guide), D. Imper (WHC GO)
3.15 p.m.	Travel to Lochsite	By bus
3.30 p.m.	Visit of Lochsite: Glarus overthrust, geology and geohistory	Participants: Dr. J. Powell (IUCN), P.M. Rosabal (IUCN), M. Viviani-Schärer (Swiss UNESCO Commission, B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), Prof. A. Pfiffner (University of Berne), D. Imper (WHC GO)
4.30 p.m.	Travel to Bad Ragaz	By bus
5.30 p.m.	Check-in at the Hotel Hof, Bad Ragaz	Grand Hotels Bad Ragaz CH-7310 Bad Ragaz Telephone +41 (0)81 303 30 30 Fax +41 (0)81 303 30 33
6.30 p.m.	Travel to Bad Pfäfers (old thermal baths of Pfäfers)	By bus
7.00 p.m.	Visit of the gorge of Tamina by the restaurant Altes Bad Pfäfers	
7.30 p.m.	Apéro and discussions with the representatives of cantons and communities involved in the nomination at the restaurant Altes Bad Pfäfers	E. Iten (Swiss Ambassador at UNESCO Paris), W. Geiger (vice-director FOEN), B. Walder (FOEN), C. Ossola (FOEN), J. Mürner (FOC), M. Viviani-Schärer (Swiss UNESCO Commission), RR W. Haag (St. Gallen canton), RR C. Lardi (Grisons canton), RR M. Dürst (Glarus canton), Prof. A. Pfiffner (Univ. Bern), F. Marti-Egli (WHC GO), D. Imper (WHC GO), other representatives
8.00 p.m	Dinner at the restaurant Altes Bad Pfäfers	
10.00 p.m	Travel to Bad Ragaz, Overnight stay at the Hotel Hof, Bad Ragaz	

Wednesday, September 19th,

Film of the overthrust and walk on the Grison side, presentation and scientific discussion

Time	Activities	Information
8.00 a.m.	Travel to Flims	By bus
9.00 a.m.	Projection: Film of the Glarus overthrust	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. P. Baumgartner (Grisons canton), L. Filli (Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), A. Gisler (Flims Laax Falera Tourism Company), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
9.15 a.m.	Geology of the Glarus overthrust	
9.45 a.m.	Coffee break	
10.15 a.m.	Discussion: management plan tourism, Park Hotel Waldhaus, Flims	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. P. Baumgartner (Grisons canton), L. Filli (Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), A. Gisler (Flims Laax Falera Tourism), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
11.45 a.m.	Travel to restaurant Startgels	
0.15 p.m.	Lunch, restaurant Startgels	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. P. Baumgartner (Grisons canton), L. Filli (Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), M. Kuratli (Flims commune), A. Gisler (Flims Laax Falera Tourism), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
1.30 p.m.	Travel to Cassonsgrat	By aerial passenger line
2.00 p.m.	Walk: Cassonsgrat (2634 m osl.)	Short Walk on Cassonsgrat (2634 m osl.): Topics: Glarus overthrust, geomorphology, tourism. Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), A. Gisler (Flims Laax Falera Tourism), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
3.30 p.m.	Travel to Flims	By aerial passenger line
4.00 p.m.	Travel to Bad Ragaz	By bus
4.30 p.m.	Arrival in Bad Ragaz at the Hotel Hof	
5.00 p.m.	Travel to Mels	By bus
5.30 p.m.	Presentations and discussion: Restaurant Waldheim, Mels	Participants: B. Walder (FOEN), C. Ossola (FOEN), Prof. A. Pfiffner (Univ. Bern), PD Dr. M. Rahn (Univ. Freiburg i.Br.), Prof. M. Maisch (Univ. Zürich), Dr. S. Hesske (Univ. Zürich), Dr. P. Fricker, Em. Prof B. Messerli, Prof. J. Mullis (Univ. Basel), P. Zopfi (Glarus canton), D. Imper (WHC GO)
8.00 p.m.	Dinner, Restaurant Waldheim, Mels	
10.00 p.m.	Overnight stay at the Hotel Hof, Bad Ragaz	

Thursday, September 20th

Walk on the St. Gallen side, final discussion

Time	Activities	Information
7.45 a.m.	Travel to Wangs	By bus
8.00 a.m.	Flight – Overview from the air of the geological nature of the site	By helicopter. Participants : Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
8.00 a.m.	Travel to Pizol-Pizolhütte	By funicular
8.45 a.m.	Walk: Pizolhütte	Pizolhütte (2222 m osl.) – Wildseeluggen (2493 m osl.) – Pizolhütte. Walk: 2 hours. Topics: Glarus overthrust, glacio-geomorphology, mountain farming, tourism, federal game reserve "Graue Hörner" Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), G. Ackermann (St. Gallen canton), R. Wildhaber (St. Gallen canton), V. Pavlovic (St. Gallen canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
0.15 p.m.	Travel to Wangs (Wangs – Pizol)	By funicular
0.45 p.m.	Travel to Bad Ragaz	By bus
1.00 p.m.	Lunch in Bad Ragaz, Hotel Hof	
2.30 p.m.	Final discussion, Hotel Hof	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), L. Filli (Grisons canton), P. Zopfi (Glarus canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
4.00 p.m.	Press conference	Participants : NR S. Cathomas (Grison canton), B. Walder (FOEN), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
5.30 p.m.	Departure from Bad Ragaz to Gland	By train

Fig. 1 – Glarus overthrust: Pizol (2844 m o.s.l.) and Pizol glacier

Fig. 2 – Glarus overthurst: east wall of Ringelspitz (3247 m ü. M.)

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

IUCN Evaluation Mission September 18 th - 20 th

Pedro Manuel Rosabal González

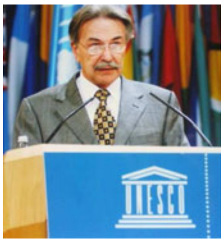
IUCN-Hauptsitz
Programm Schutzgebiete
Leitung IUCN-Evaluation

IUCN Headquarters
Programme on Protected Areas
Lead evaluator

James Powell, Dr.

IUCN Experte in Geologie
Beratender Geologe
Experte IUCN-Evaluation

IUCN-Expert in Geology
Consultant in Geology
Co-evaluator



Ernst Iten

Botschafter
Ständiger Delegierter der Schweiz bei der UNESCO

Ambassador
Permanent Delegate of Switzerland to UNESCO

Madeleine Viviani-Schärer

Generalsekretärin der Schweizerischen UNESCO-Kommission

Secretary General of the Swiss Commission for UNESCO

Willi Haag, Regierungsrat

Vorsteher des Baudepartementes des Kantons St. Gallen

Council of the Government of the St.Gallen canton
Head of the Departement of Construction Canton St.Gallen

Claudio Lardi, Regierungsrat

Vorsteher des Erziehungs- Kultur- und Umweltschutzdepartements des Kantons Graubünden

Council of the Government of the Graubünden Canton
Head of the Departement of Education Culture and Environment

Marianne Dürst, Regierungsrätin

Vorsteherin des Departements Volkswirtschaft und Inneres des Kantons Glarus

Council of the Government of the Glarus canton
Head of the Departement of Economic and Home Affairs

Hansjörg Dürst

Ratsschreiber des Kantons Glarus

State Secretary of the Glarus canton

Fritz Marti

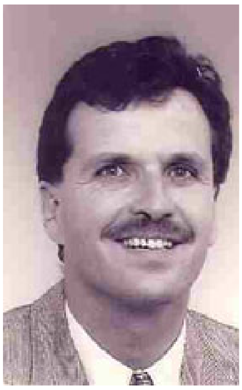
Präsident der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung

President of the World Heritage Candidate Glarus overthrust

Sep Cathomas

Nationalrat
Vizepräsident der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung

Member of the national Parliament
Vice-President of the WH Candidate Glarus overthrust

 Ferdinand Riederer Gemeindepräsident der Gemeinde Pfäfers Head of the Pfäfers commune	 Markus Gassmann Gemeinderat der Gemeinde Flims Council of the Flims commune
 Dr. Willy Geiger Vizedirektor des Bundesamtes für Umwelt Vice director, Federal Office for the Environment	 Bruno Stephan Walder Leiter der Sektion Naturerbe des Bundesamtes für Umwelt Head of Natural Heritage Section of the Federal Office of Environment
 Carlo Ossola Wissenschaftlicher Mitarbeiter des Bundesamtes für Umwelt Scientific officer of the Federal Office of Environnement	 David Imper Geologe und Projektleiter der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung Geologist and General Secretary of the World Heritage Candidate Glarus overthrus
 Dr. Jakob Marti Leiter des Amtes für Umweltschutz des Kantons Glarus Head of the office for the Environment of Glarus canton	 Peter Zopfi Amt für Umweltschutz des Kantons Glarus Office for the Environment of Glarus canton
 Peter Baumgartner, Dr. Leiter des Amtes für Natur und Umwelt des Kantons Graubünden Head of the office for the protection of Nature and the Environment of the Graubünden canton	 Ladina Filli Amt für Natur und Umwelt des Kantons Graubünden Office for the protection of Nature and the Environment of Graubünden canton

Guido Ackermann

Leiter des Amtes für Jagd und Fischerei des Kantons St. Gallen

Head of the office for wildlife and fishery of the St. Gallen canton

Alfred Brülisauer, Dr.

Leiter der Fachstelle für Natur- und Landschaftsschutz des Kantons St. Gallen

Head of the nature and landscape conservation office of the St. Gallen canton

Vojislav Pavlovic

Lehrer/Berater Fachstelle Pflanzenbau und Umwelt LZSG
Leiter Kräuterakademie

Teacher and advisor at the center of agriculture of the St. Gallen canton
Head of the academy of herbs

Rolf Wildhaber

Wildhüter des

Gamekeeper

Adrian Pfiffner, Prof.

Institut für Geologie, Universität Bern
Präsident des Wissenschaftlichen Beirates

Institute of Geological Sciences, Universitity of Bern
Head of the scientific Board of the WHC GO

Josef Mullis, Prof.

Geologisches Institut der Universität Basel
Mitglied des Wissenschaftlichen Beirates

Institute of Geological Sciences, Universitity of Basel
Member of the Scientific Board of the WHC GO

Peter Fricker, Prof.

Ehemaliger Direktor des Schweizerischen Nationalfonds und der europäischen Wissenschaftsstiftung

Former CEO of the Swiss National and European Science Foundation (Strasbourg)

Bruno Messerli, em. Prof.

Ehemaliger Präsident des Internationalen Geographenverbandes
Mitglied der IUCN-Kommission Schutzgebiete

Former President of the International Geographical Union
Member of the World Commission for Protected Areas (IUCN)

Max Maisch, Prof.

Geographisches Institut, Universität Zürich-Irchel
Mitglied des Wissenschaftlichen Beirates

Department of Geography, University of Zurich
Member of the Scientific Board of the WHC GO

Meinert Rahn, Dr.

HSK, Leiter Sektion Geologische Tiefenlagerung
Privatdozent an der Universität Freiburg i. Br.

HSK, Head Section on Geological Disposal
Lecturer at Freiburg University, Germany

	Stefan Hesske, Dr. Institut für Gymnasial- und Berufspädagogik an der Universität Zürich (Geographie) Institute for Teacher Education, section Geography, University of Zurich		Andreas Wernle Global Head eBusiness GeoPark-Guide Global Head eBusiness GeoPark-Guide
	Helen Cabalzar Präsidentin der Flims Laax Falera Tourismus AG President of the Flims Laax Falera Tourism company		André Gisler Geschäftsführer der Flims Laax Falera Tourismus AG Managing Director of the Flims Laax Falera Tourism company

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Tuesday September 18 th

Pedro Manuel Rosabal González

IUCN-Hauptsitz
Programm Schutzgebiete
Leitung IUCN-Evaluation

IUCN Headquarters
Programme on Protected Areas
Lead evaluator

James Powell, Dr.

IUCN Experte in Geologie
Beratender Geologe
Experte IUCN-Evaluation

IUCN-Expert in Geology
Consultant in Geology
Co-evaluator

Madeleine Viviani-Schärer

Generalsekretärin der Schweizerischen UNESCO-Kommission
Secretary General of the Swiss Commission for UNESCO

Hansjörg Dürst

Ratsschreiber des Kantons Glarus

State Secretary of the Glarus canton

Fritz Marti

Präsident der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung

President of the World Heritage Candidate Glarus overthrust

David Imper

Geologe und Projektleiter der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung
Geologist and General Secretary of the World Heritage Candidate Glarus overthrus

Carlo Ossola

Wissenschaftlicher Mitarbeiter des Bundesamtes für Umwelt

Scientific officer of the Federal Office of Environnement

Bruno Stephan Walder

Leiter der Sektion Naturerbe des Bundesamtes für Umwelt

Head of Natural Heritage Section of the Federal Office of Environment

Dr. Jakob Marti

Leiter des Amtes für Umweltschutz des Kantons Glarus

Head of the office for the Environment of Glarus canton

Peter Zopfi

Amt für Umweltschutz des Kantons Glarus

Office for the Environment of Glarus canton

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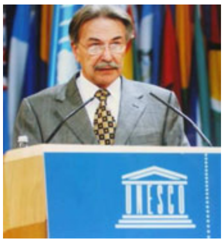

Ernst Iten

Botschafter
Ständiger Delegierter der Schweiz bei der UNESCO

Ambassador
Permanent Delegate of Switzerland to UNESCO

Marianne Dürst, Regierungs-rätin

Vorsteherin des Departements Volkswirtschaft und Inneres des Kantons Glarus

Council of the Government of the Glarus canton

Head of the Departement of Economic and Home Affairs

Willi Haag, Regierungsrat

Vorsteher des Baudepartementes des Kantons St. Gallen

Council of the Government of the St.Gallen canton
Head of the Departement of Construction Canton St.Gallen

Claudio Lardi, Regierungsrat

Vorsteher des Erziehungs- Kultur- und Umweltschutz-departements des Kantons Graubünden

Council of the Government of the Graubünden Canton
Head of the Departement of Education Culture and Environment

Ferdinand Riederer

Gemeindepräsident der Gemeinde Pfäfers

Head of the Pfäfers commune

Dr. Willy Geiger

Vizedirektor des Bundesamtes für Umwelt

Vice director, Federal Office for the Environment

IUCN Evaluation Mission, Altes Bad Pfäfers, September 18 th 2007

Guido Ackermann	St.Gallen canton
Dr. Peter Baumgartner	Graubünden canton
Dr. Alfred Brülisauer	St.Gallen canton
Helen Cabalzar	Flims Laax Falera Tourismus AG
Roman Cathomas	Laax commune
Dr. Pierre Dèzes	Executive Director GEOforumCH
Marianne Dürst	Council of the Government of the Glarus canton
Walter Elmer	Elm commune
Dr. Mark Feldmann	Committee GeoPark Sarganserland-Walensee-Glarnerland
Ladina Filli	Committee GeoPark Sarganserland-Walensee-Glarnerland
Markus Gassmann	Flims commune
Dr. Willi Geiger	Vice director Federal office for the Environment
André Gisler	Flims Laax Falera Tourismus AG
Willi Haag	Council of the Government of the St.Gallen canton
Ruedi Hauser	Glarus canton
Oberst i Gst Werner Hürlimann	Military
David Imper	General Secretary of WHC GO, President GeoPark SWG
Botschafter Ernst Iten	Swiss Ambassador at UNESCO in Paris
Willi Jerger	Bad Ragaz commune
Ignaz Kalberer	World Heritage Candidate Glarus Overthrust
Hansruedi Kamm	Filzbach commune
Dr. Andreas Kühni	Head Swiss Geological Survey
Claudio Lardi	Council of the Government of the Graubünden canton
Bernhard Lehnherr	Vilters-Wangs commune
Kaspar Marti	Management GeoPark SWG
Fritz Marti-Egli	President WHC GO / Vice-President GeoPark SWG
Armin Meier	Tamins commune
Dr. Jürg Paul Müller	Scientiflic Advisory Committee WHC GO
Prof. Josef Mullis	Scientiflic Advisory Committee WHC GO
Johann Mürner	Section for Cultural Heritage and Historic Monuments
Carlo Ossola	Federal office for the Environment
Dr. Roger Peterer	St.Gallen canton
Prof. Adrian O. Pfiffner	Scientiflic Advisory Committee WHC GO

Dr. James Powell	IUCN
Hans Rhyner	Committee GeoPark Sarganserland-Walensee-Glarnerland
Ferdinand Riederer	Pfäfers commune
Pedro Manuel Rosabal González	IUCN
Bruno Röthlisberger	Committee GeoPark Sarganserland-Walensee-Glarnerland
Peter Senti	Flums commune
Guido Städler	President Sarganserländische Talgemeinschaft
Hansjürg Streiff	Engi commune
Hans Telli	Trin commune
Peter P. Tschirky	Grand Hotels Bad Ragaz
Madeleine Viviani	Swiss UNESCO -Commission
Bruno Walder	Federal office for the Environment
Erich Zoller	President Region Sarganserland-Walensee
Peter Zopfi	Glarus canton

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Wednesday September 19 th

Pedro Manuel Rosabal González

IUCN-Hauptsitz
Programm Schutzgebiete
Leitung IUCN-Evaluation

IUCN Headquarters
Programme on Protected Areas
Lead evaluator

James Powell, Dr.

IUCN Experte in Geologie
Beratender Geologe
Experte IUCN-Evaluation

IUCN-Expert in Geology
Consultant in Geology
Co-evaluator

Markus Gassmann

Gemeinderat der Gemeinde Flims

Council of the Flims commune

Bruno Stephan Walder

Leiter der Sektion Naturerbe des Bundesamtes für Umwelt

Head of Natural Heritage Section of the Federal Office of Environment

Carlo Ossola

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Amt für Umweltschutz des Kantons Glarus

Office for the Environment of Glarus canton

Peter Baumgartner, Dr.

Leiter des Amtes für Natur und Umwelt des Kantons Graubünden

Head of the office for the protection of Nature and the Environment of the Graubünden canton

Ladina Filli

Amt für Natur und Umwelt des Kantons Graubünden

Office for the protection of Nature and the Environment of Graubünden canton

 Adrian Pfiffner, Prof. Institut für Geologie, Universität Bern Präsident des Wissenschaftlichen Beirates Institute of Geological Sciences, Universitity of Bern Head of the scientific Board of the WHC GO	 Helen Cabalzar Präsidentin der Flims Laax Falera Tourismus AG President of the Flims Laax Falera Tourism company
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Swiss Tectonic Arena Sardona
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Wednesday September 19 th

 Pedro Manuel Rosabal González IUCN-Hauptsitz Programm Schutzgebiete Leitung IUCN-Evaluation IUCN Headquarters Programme on Protected Areas Lead evaluator	 James Powell, Dr. IUCN Experte in Geologie Beratender Geologe Experte IUCN-Evaluation IUCN-Expert in Geology Consultant in Geology Co-evaluator
 Bruno Stephan Walder Leiter der Sektion Naturerbe des Bundesamtes für Umwelt Head of Natural Heritage Section of the Federal Office of Environment	 Carlo Ossola Wissenschaftlicher Mitarbeiter des Bundesamtes für Umwelt Scientific officer of the Federal Office of Environnement
 Peter Zopfi Amt für Umweltschutz des Kantons Glarus Office for the Environment of Glarus canton	 Peter Fricker, Prof. Ehemaliger Direktor des Schweizerischen Nationalfonds und der europäischen Wissenschaftsstiftung Former CEO of the Swiss National and European Science Foundation (Strasbourg)
 Bruno Messerli, em. Prof. Ehemaliger Präsident des Internationalen Geographen-verbandes Mitglied der IUCN-Kommis-sion Schutzgebiete Former President of the International Geographical Union Member of the World Commission for Protected Areas (IUCN)	 David Imper Geologe und Projektleiter der IG UNESCO-Weltnaturerbe Glarner Hauptüberschiebung Geologist and General Secre-tary of the World Heritage Candidate Glarus overthrus

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Institut für Geologie, Universität Bern
Präsident des Wissenschaftlichen Beirates

Institute of Geological Sciences, Universitity of Bern

Head of the scientific Board of the WHC GO

Josef Mullis, Prof.

Geologisches Institut der Universität Basel
Mitglied des Wissenschaftlichen Beirates

Institute of Geological Sciences, Universitity of Basel

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Institute for Teacher Education, section Geography, University of Zurich

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Thursday September 20 th

Pedro Manuel Rosabal González

IUCN-Hauptsitz
Programm Schutzgebiete
Leitung IUCN-Evaluation

IUCN Headquarters
Programme on Protected Areas
Lead evaluator

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Beratender Geologe
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Präsident des Wissenschaftli-chen Beirates

Institute of Geological Scien-ces, Universitity of Bern

Head of the scientific Board of the WHC GO

Alfred Brülisauer, Dr.

Leiter der Fachstelle für Na-tur- und Landschaftsschutz des Kantons St. Gallen

Head of the nature and land-scape conservation office of the St. Gallen canton

Vojislav Pavlovic

Lehrer/Berater Fachstelle Pflanzenbau und Umwelt LZSG
Leiter Kräuterakademie

Teacher and advisor at the center of agriculture of the St. Gallen canton

Head of the academy of herbs

Guido Ackermann

Leiter des Amtes für Jagd und Fischerei des Kantons St. Gal-len
Head of the office for wildlife and fishery of the St. Gallen canton

Rolf Wildhaber

Wildhüter des

Gamekeeper

Overview

D. Imper, Management

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

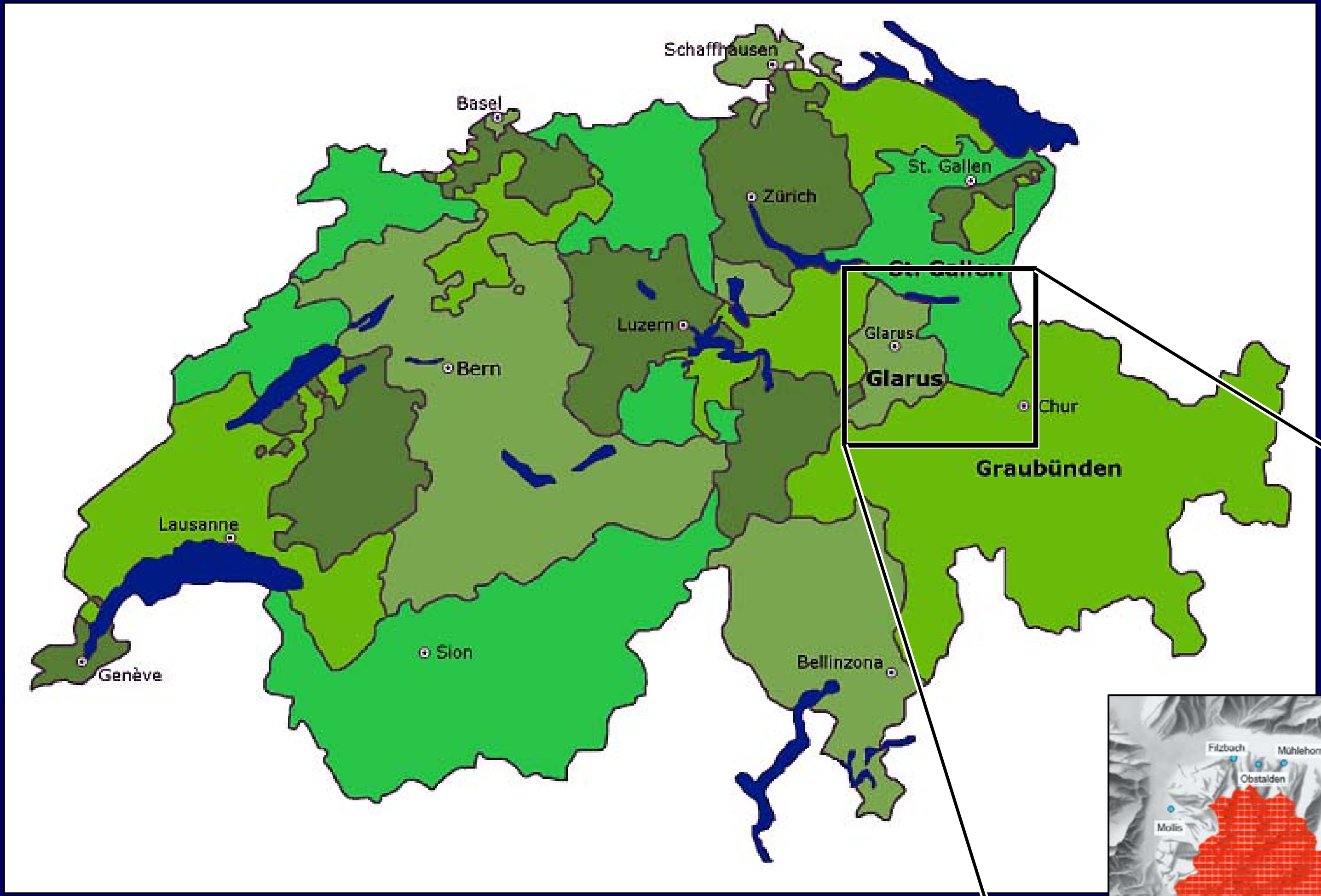
Swiss Confederation

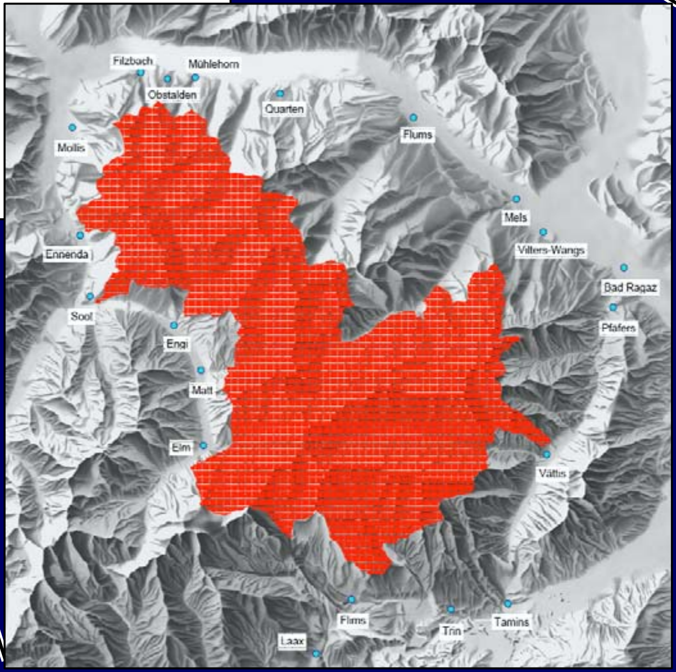
Department of the Environment,
Transport, Energy and Communications
Federal Office for the Environment FOEN

**Evaluation mission of the World Heritage Nomination Glarus Overthrust (Switzerland)
18th to 20th of September 2007**

Program for Dr. James Powell and Mr. Pedro M. Rosabal González

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

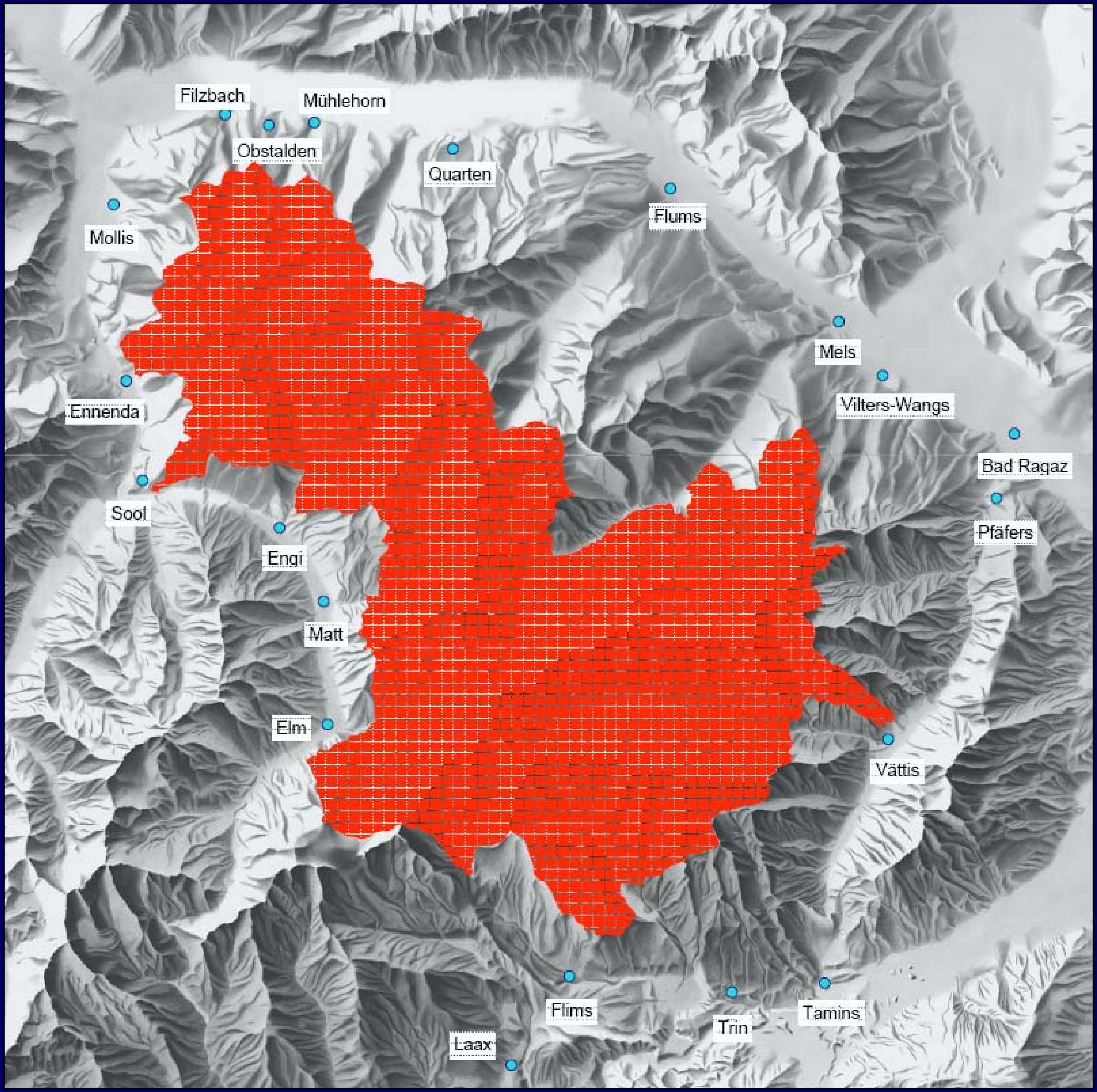




Location of the property

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Location of the property



Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Ownership I

Details of the distribution of territory and population among the cantons of St. Gallen, Glarus and Graubünden

Canton	Area (km^2)	Proportion of total area of site (%)	Population*	Proportion of total population (%)*
St. Gallen	156.29	47.46	26,042	63.03
Glarus	127.48	38.71	9,300	22.51
Graubünden	45.57	13.84	5,974	14.46
Total	**329.34**	**100.00**	**41,316**	**100.00**

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Ownership II

Details of the distribution of territory and population among the communes concerned.

St Gallen canton:

Commune	Area (km^2)	Proportion of total area of site (%)	Population*	Proportion of total population (%)*	Votes
Pfäfers	55.58	16.88	1,754	4.37	3
Bad Ragaz	1.00	0.30	4,929	12.27	2
Vilters-Wangs	6.25	1.90	3,891	9.69	1
Mels	64.09	19.46	7,837	19.51	4
Flums	12.12	3.68	4,882	12.15	2
Quarten	17.25	5.24	2,749	6.84	1

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Ownership III

Glarus canton:

Commune	Area (km^2)	Proportion of total area of site (%)	Population*	Proportion of total population (%)*	Votes
Mühlehorn	2.85	0.87	441	1.10	1
Obstalden	18.75	5.69	434	1.08	1
Filzbach	6.37	1.93	542	1.35	1
Mollis	1.68	0.51	2,974	7.40	1
Ennenda	12.38	3.76	2,808	6.99	1
Sool	9.35	2.84	303	0.75	1
Engi	21.83	6.63	656	1.63	2
Matt	24.39	7.41	381	0.95	2
Elm	29.88	9.07	761	1.89	2

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Ownership IV

Graubünden canton:

Commune	Area (km^2)	Proportion of total area of site (%)	Population*	Proportion of total population (%)*	Votes
Laax	0.23	0.07	1,150	2.86	1
Flims	20.29	6.16	2,549	6.35	2
Trin	21.48	6.52	1,108	2.76	2
Tamins	3.57	1.08	1,167	2.91	1

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Agreement on joint protection of the UNESCO World Heritage site "Glarus overthrust"

Glarus canton

St. Gallen canton

Graubünden canton

Agreement on joint protection of the UNESCO World Heritage site "Glarus Overthrust"

UNESCO-World Heritage site "Glarus Overthrust"

Projekt the communes of Laax, Flims, Trin, Tamins, Pfäfers, Bad Ragaz, Vilters-Wangs, Mels, Flums, Quarten, Mühlehorn, Obstalden, Filzbach, Mollis, Ennenda, Sool, Engi, Matt and Elm

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

General Provisions (Zweckartikel)

Art. 1: Purpose

1) The purpose of this agreement is to ensure that joint action is taken to conserve and manage the natural monument “Glarus Overthrust” as a UNESCO World Heritage site, together with the surrounding landscape and habitats.

2) The boundary of this natural monument is defined with the aid of a perimeter in Appendix 1a/b, which forms an integral part of the present agreement.

3) Sites of geological importance (“geotopes”), biotopes and the landscape within this natural monument are to be conserved over the long term.

4) As far as is consistent with the conservation of the geotopes, biotopes and landscape, the region and its natural aesthetic features are to be accessible to visitors and available for sustainable, appropriate use.

5) A declaratory listing of uses that are permissible under current legislation is to be found in Appendix 2. This Appendix will be updated in the event of changes to legislation.

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Appendix 02: **Types of land use within the boundary of the UNESCO World Heritage site "Glarus overthrust"**

N.B.: This list is issued without prejudice to higher-level legislation. Additional federal, cantonal and communal regulations concerning protection, especially those specified in cantonal master plans, will take precedence.

In the assessment, types of use were rated as follows: desirable – permissible – not desirable – not permissible

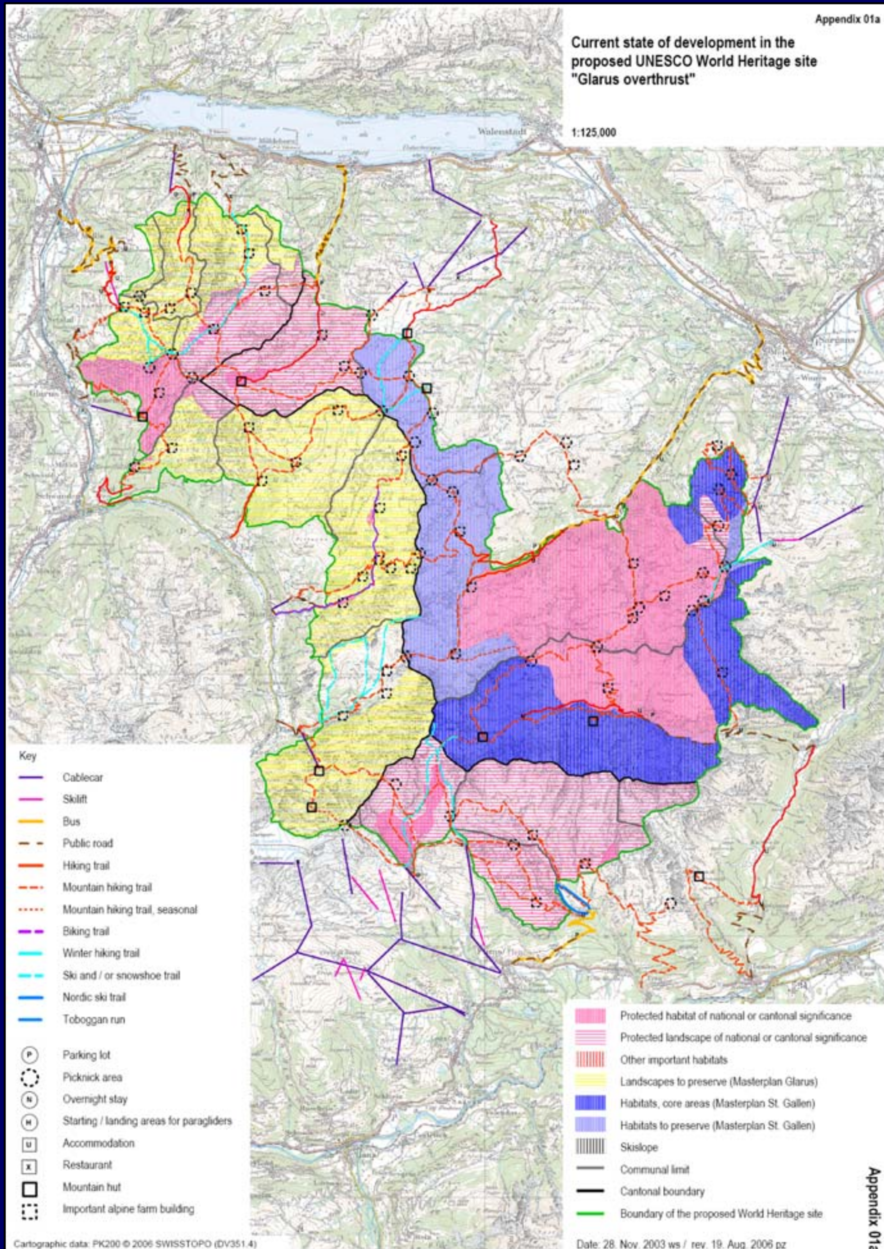
Non-tourist-related uses

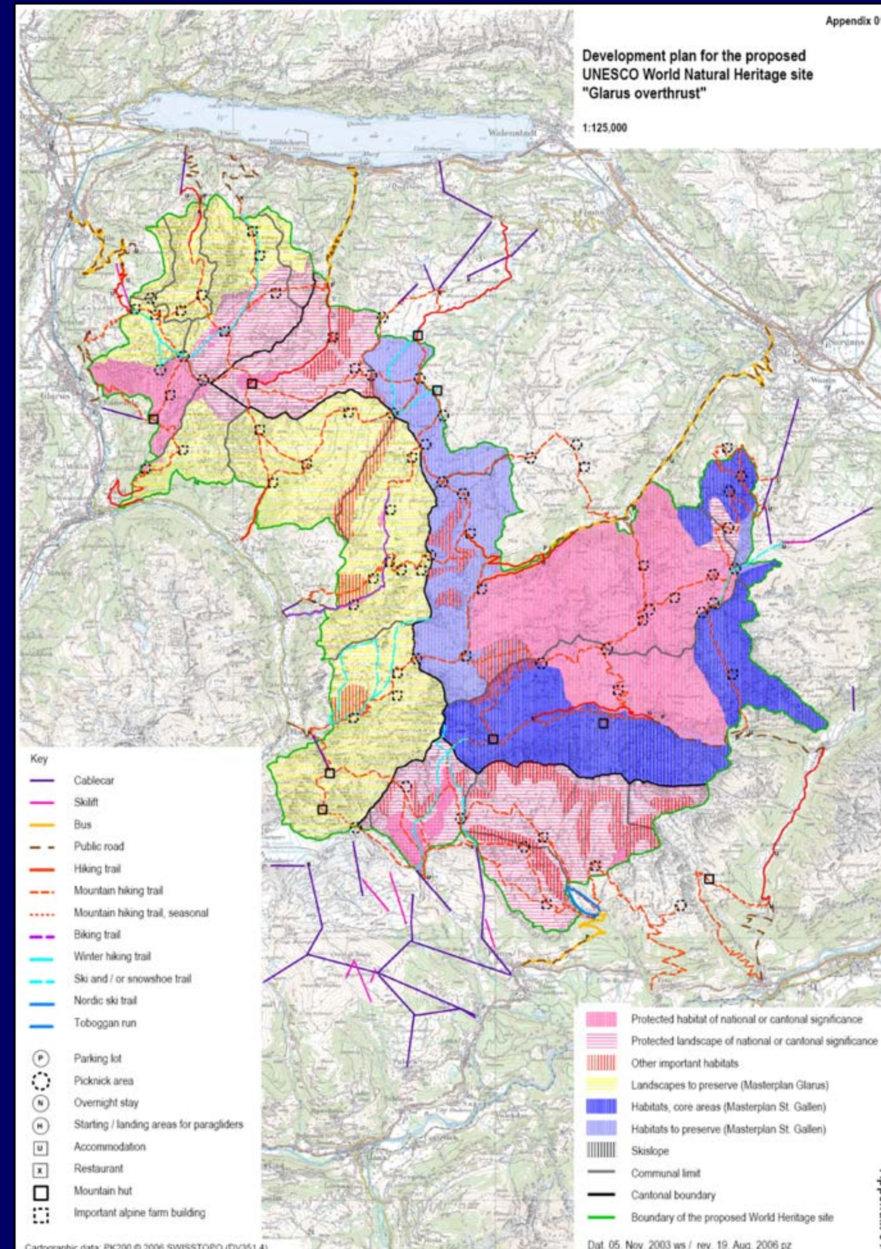
Forest management	Permissible
Biotope management and upkeep	Desirable
Hazard prevention	Permissible
Appropriate mountain farming use	Permissible
Mountain farming and forestry access roads	Permissible where required for appropriate mountain farming use and forest management
Hunting (except in game reserves)	Permissible
Fishing	Permissible
Gathering berries	Permissible
Gathering mushrooms	Permissible
Military use	Permissible at present levels
New military facilities	Not desirable
Extraction of materials	Not permissible
Terrain modifications	Not desirable
Collection of rock crystals	In accordance with communal regulations
Depositing of materials	Not permissible
Power generation	New plants are not desirable unless they are designed merely to enable cabins to meet their own energy needs
New above-ground high-voltage power lines	Not permissible
Above-ground pipelines	Not permissible

Tourist-related uses

Public information	Desirable
Notice boards	Desirable
Resting/picnic areas	In accordance with the Development Plan
Bivouac areas	In accordance with the Development Plan
Campsites	Not permissible
New hiking paths	In accordance with the Development Plan
Simple accommodation/catering facilities	In accordance with the Development Plan
New tourist transport facilities and buildings	Not permissible
Structures and equipment that do not have to be sited within the property for operational reasons	Not permissible (in accordance with Spatial Planning Law)
Construction zones	Not permissible
New tourist access roads	Not permissible
Vehicular traffic	Use of private cars on existing roads is not desirable
New parking facilities	Not desirable
Parking outside designated areas	Not desirable
Minibus and taxi services	For licensed operators in accordance with the Development Plan
Hiking	Permissible
Mountaineering/climbing	Permissible
Littering	Not permissible
Access for dogs under owners' control	Permissible
Winter hiking paths	In accordance with the Development Plan
Snowshoeing routes	In accordance with the Development Plan
Snowshoeing	In accordance with the Development Plan
Cross-country skiing	In accordance with the Development Plan
Tobogganing	In accordance with the Development Plan
Skiing and snowboarding	In accordance with the Development Plan
Off-piste skiing/off-piste snowboarding	Not desirable
Ski touring	In accordance with the Development Plan
Heli-skiing	Not permissible
Aircraft landing sites	Not permissible
Hang-gliding launching and landing areas	In accordance with the Development Plan
Mountain biking	In accordance with the Development Plan
Motorized water sports	Not permissible
Sporting events	In accordance with the Development Plan

Agreement on joint protection of the UNESCO World Heritage site "Glarus overthrust"





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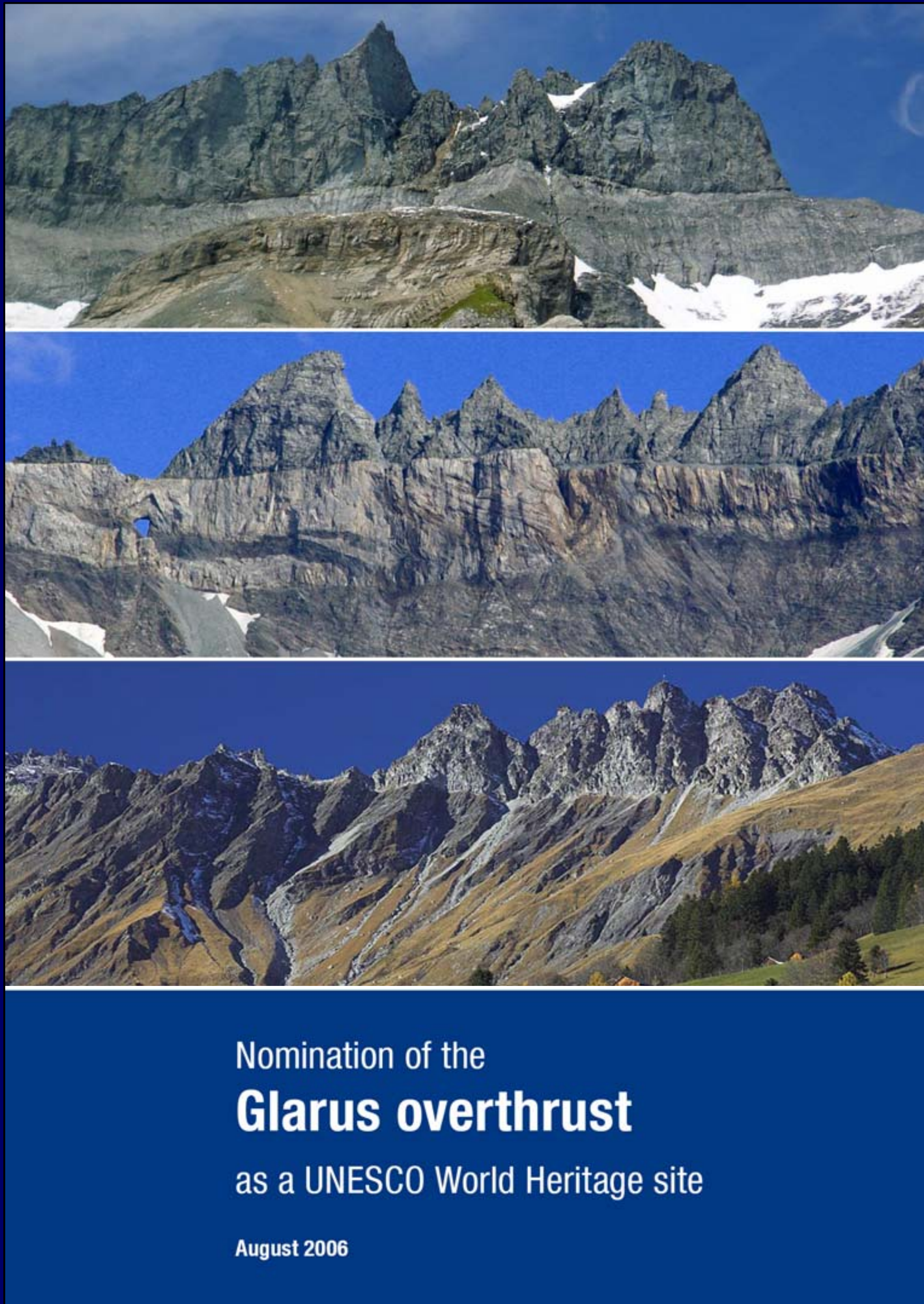
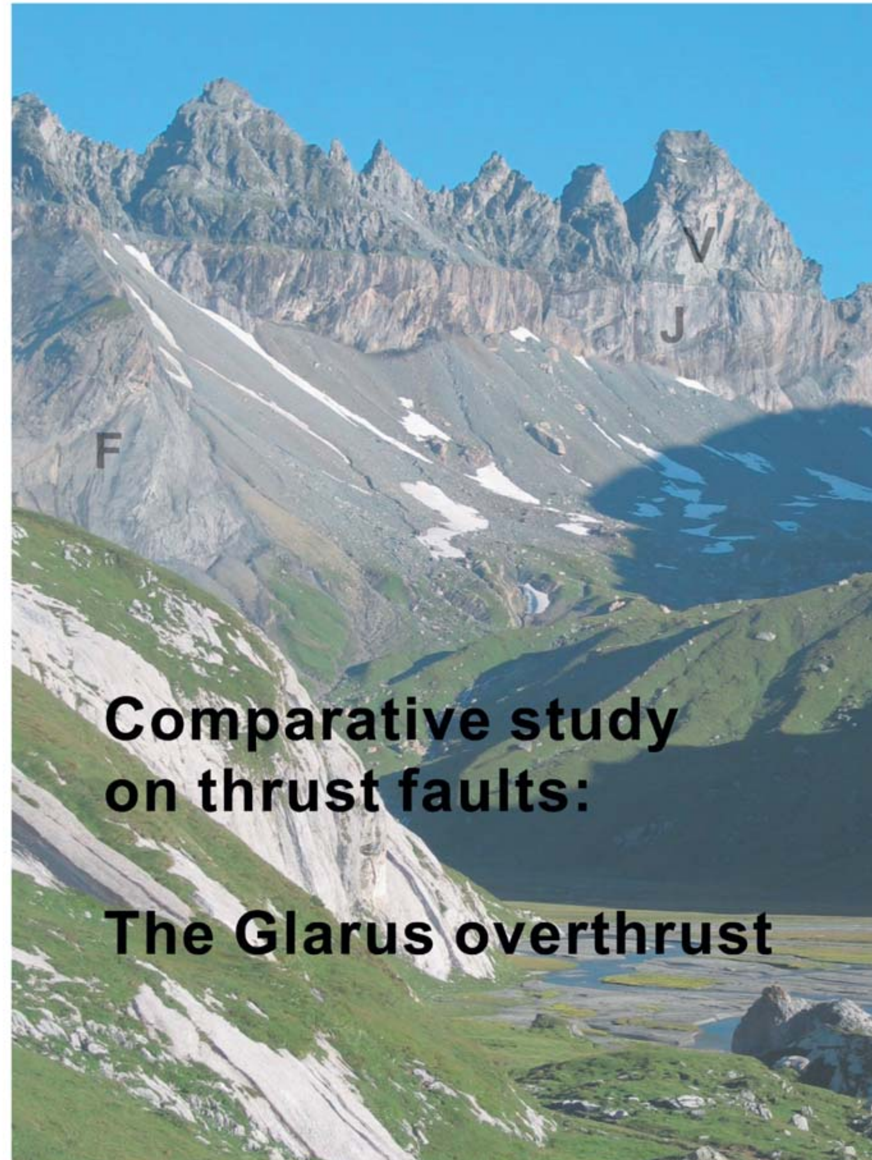
UNESCO World Heritage Candidate



Nomination of the Glarus overthrust as a UNESCO World Heritage site (August 2006)

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate



Comparative study on thrust faults:

The Glarus overthrust

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Management Plan for the proposed

UNESCO-World Heritage Site

Glarus Overthrust

IG UNESCO World Heritage Site Glarus Overthrust

Heiligkreuz/Mels, Switzerland, 31 August 2006

Swiss Tectonic Arena Sardona
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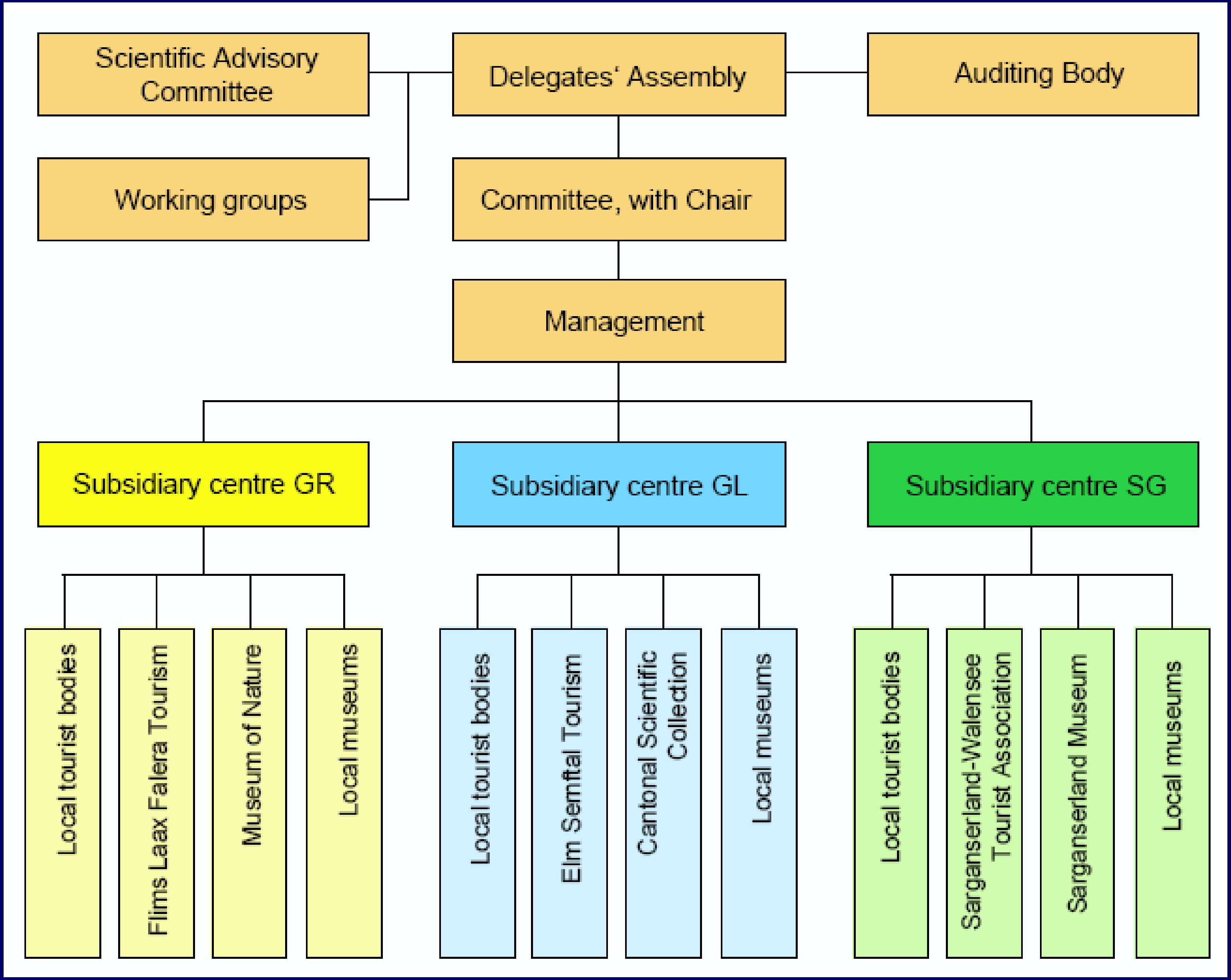


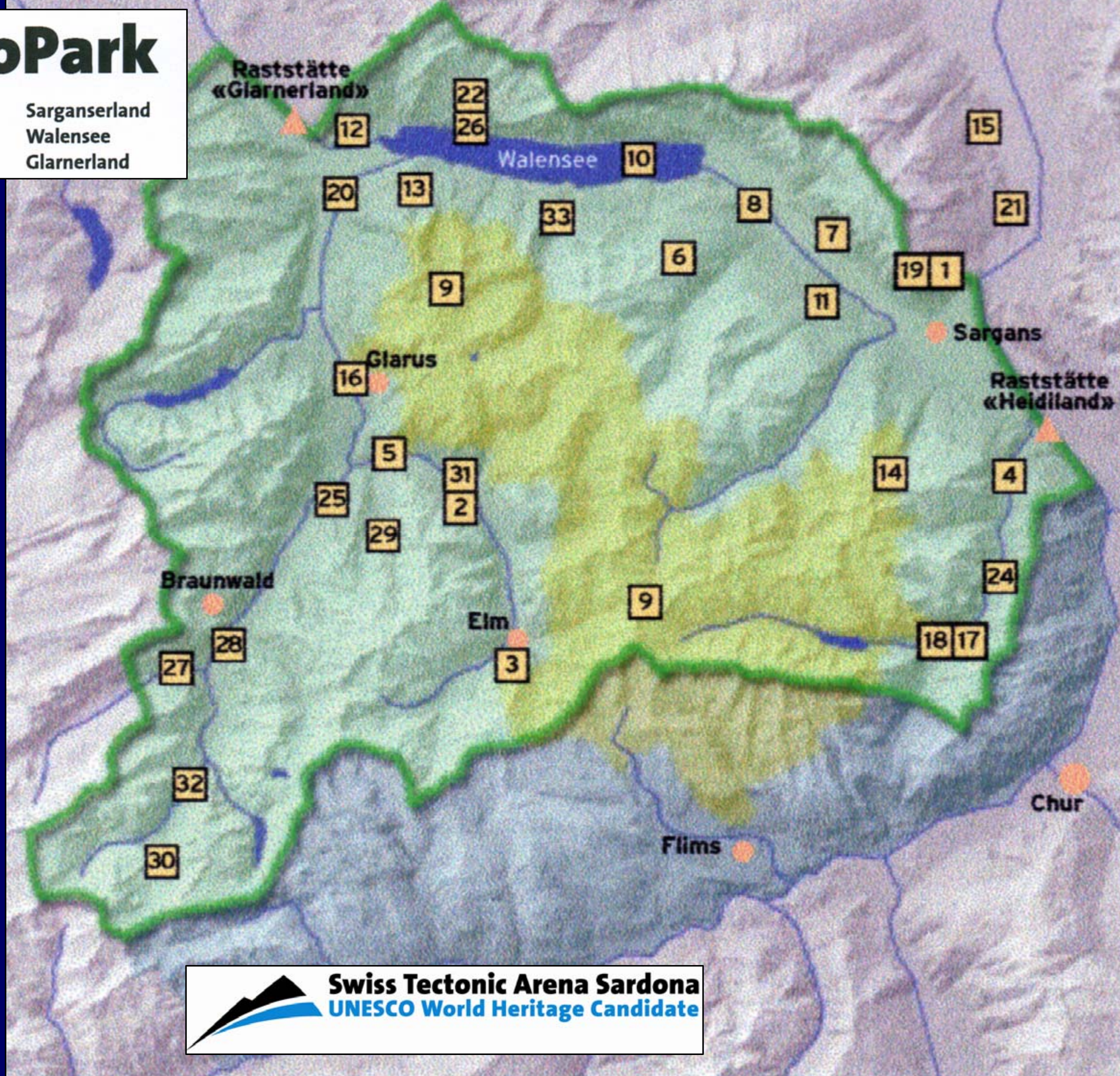
Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

Members of the Committee

- Chair
- A representative of the Contracting Parties from the canton of Glarus
- A representative of the Contracting Parties from the canton of Graubünden
- A representative of the Contracting Parties from the canton of St. Gallen
- A FOEN representative, with an advisory vote
- A representative of the three cantons concerned, with an advisory vote
- If possible an additional person, who may also be elected as Chair

GeoPark

Sarganserland
Walensee
Glarnerland



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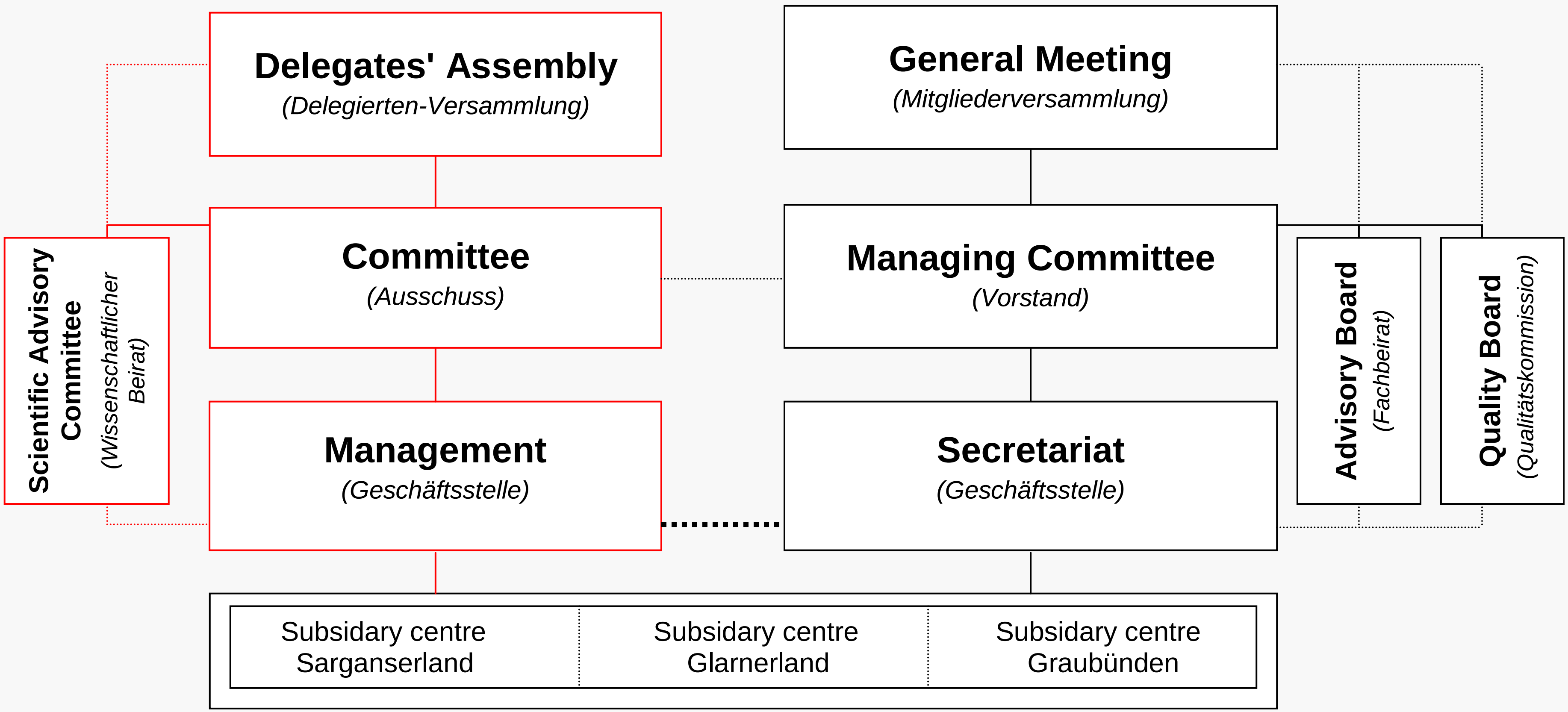
Organigram

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

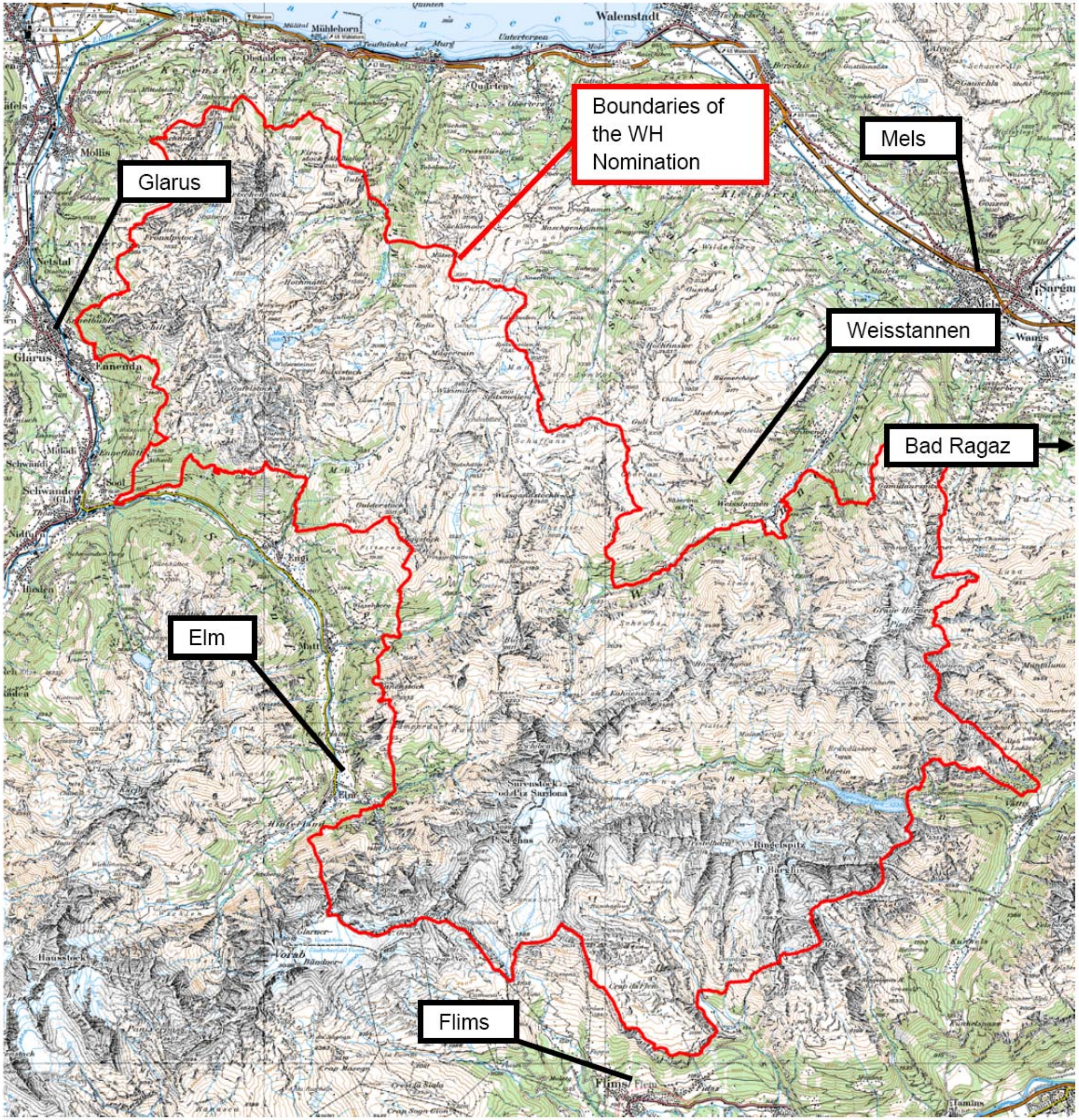
GeoPark
Sarganserland
Walensee
Glarnerland

UNESCO-WORLD NATURAL HERITAGE SITE GLARUS OVERTHRUST

SARGANSERLAND - WALENSEE - GLARNERLAND GEOPARK




KANDIDAT
UNESCO
WELTNATURERBE
GeoPark
Erdgeschichte erleben
GeoPark
GeoPark-Information
2004
GeoPark
Erdgeschichte erleben
Willkommen
www.geopark.ch



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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Department of the Environment,
Transport, Energy and Communications
Federal Office for the Environment FOEN

Thuesday, September 18th

Glarus side and discussion with representatives

Time	Activities	Information
7.42 a.m.	Departure from Gland	By train.
11.35 a.m.	Arrival at the train station in Glarus	Possibility to leave the package in the bus, walk to the restaurant.
11.45 a.m.	Welcome in the restaurant Glarnerhof in Glarus	Participants: M. Viviani-Schärer (Swiss UNESCO Commission), H. Dürst (Glarus canton), B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), F. Marti-Egli (WHC GO), D. Imper (WHC GO).
00.15 p.m.	Lunch in the restaurant Glarnerhof in Glarus	
1.30 p.m.	Introduction: geographical and structural overview	
2.00 p.m.	Travel to Elm	By bus
2.30 p.m.	Coffee break: with view of the Glarus overthrust and the Elm landside at the Hotel Elmer, walk in the village of Elm	Participants: Dr. J. Powell (IUCN), P.M. Rosabal (IUCN), M. Viviani-Schärer (Swiss UNESCO Commission, B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), A. Wernle (GeoPark guide), D. Imper (WHC GO).
3.15 p.m.	Travel to Lochsite	By bus.
3.30 p.m.	Visit of Lochsite: Glarus overthrust, geology and geohistory	
4.30 p.m.	Travel to Bad Ragaz	By bus.
5.30 p.m.	Check-in at the Hotel Hof, Bad Ragaz	Grand Hotels Bad Ragaz CH-7310 Bad Ragaz Telephone +41 (0)81 303 30 30 Fax +41 (0)81 303 30 33
6.30 p.m.	Travel to Bad Pfäfers (old thermal baths of Pfäfers)	By bus.
7.00 p.m.	Visit of the gorge of Tamina by the restaurant Altes Bad Pfäfers	
7.30 p.m.	Apéro and discussions with the representatives of cantons and communities involved in the nomination at the restaurant Altes Bad Pfäfers	E. Iten (Swiss Ambassador at UNESCO Paris), W. Geiger (vice-director FOEN), B. Walder (FOEN), C. Ossola (FOEN), J. Mürner (FOC), M. Viviani-Schärer (Swiss UNESCO Commission), RR W. Haag (St. Gallen canton), RR C. Lardi (Grisons canton), RR M. Dürs (Glarus canton), Prof. A. Pfiffner (Univ. Bern), F. Marti-Egli (WHC GO), D. Imper (WHC GO), other representatives.
8.00 p.m.	Dinner at the restaurant Altes Bad Pfäfers	
10.00 p.m.	Travel to Bad Ragaz, Overnight stay at the Hotel Hof, Bad Ragaz	

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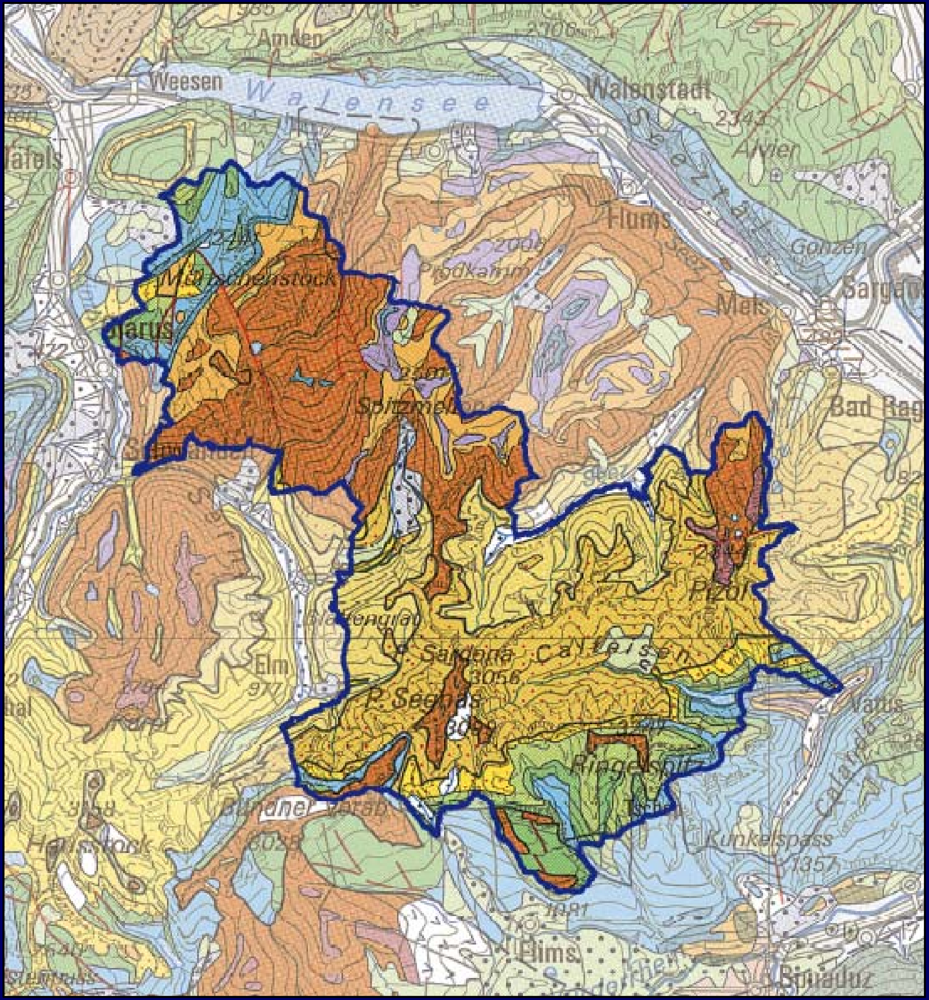
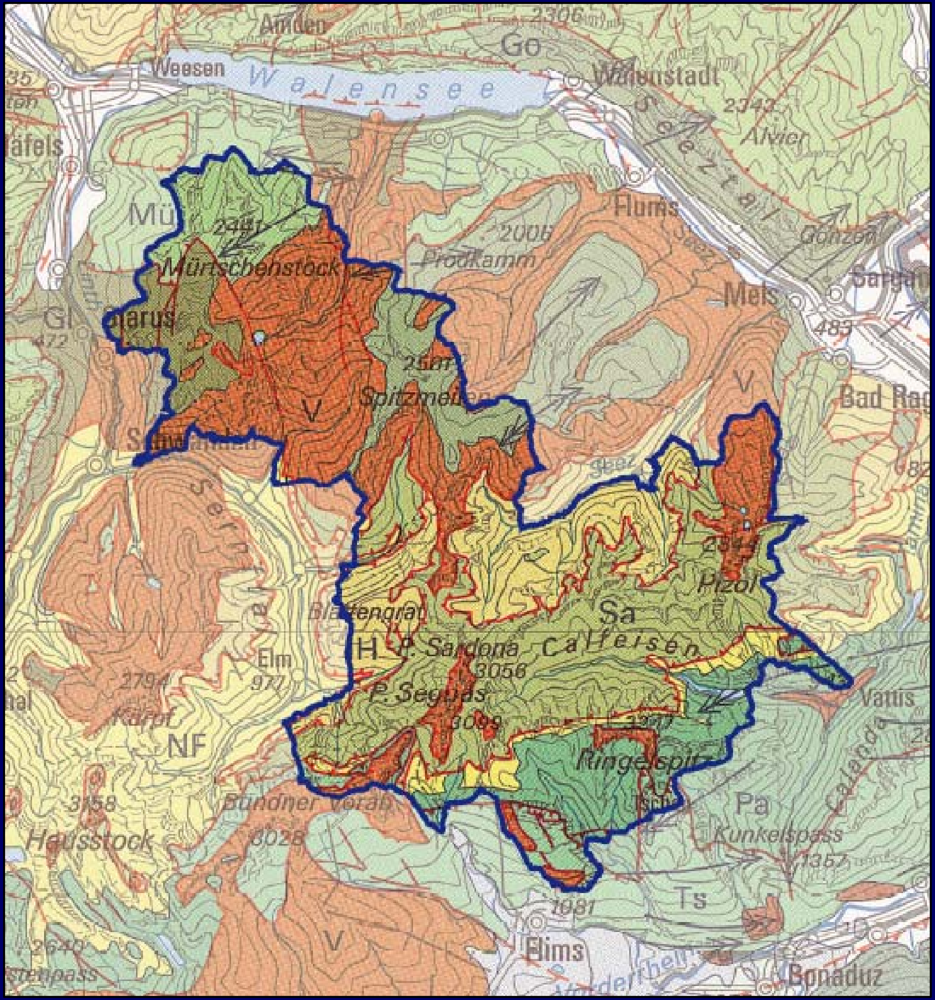
Geological and tectonic maps





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The Magic Line

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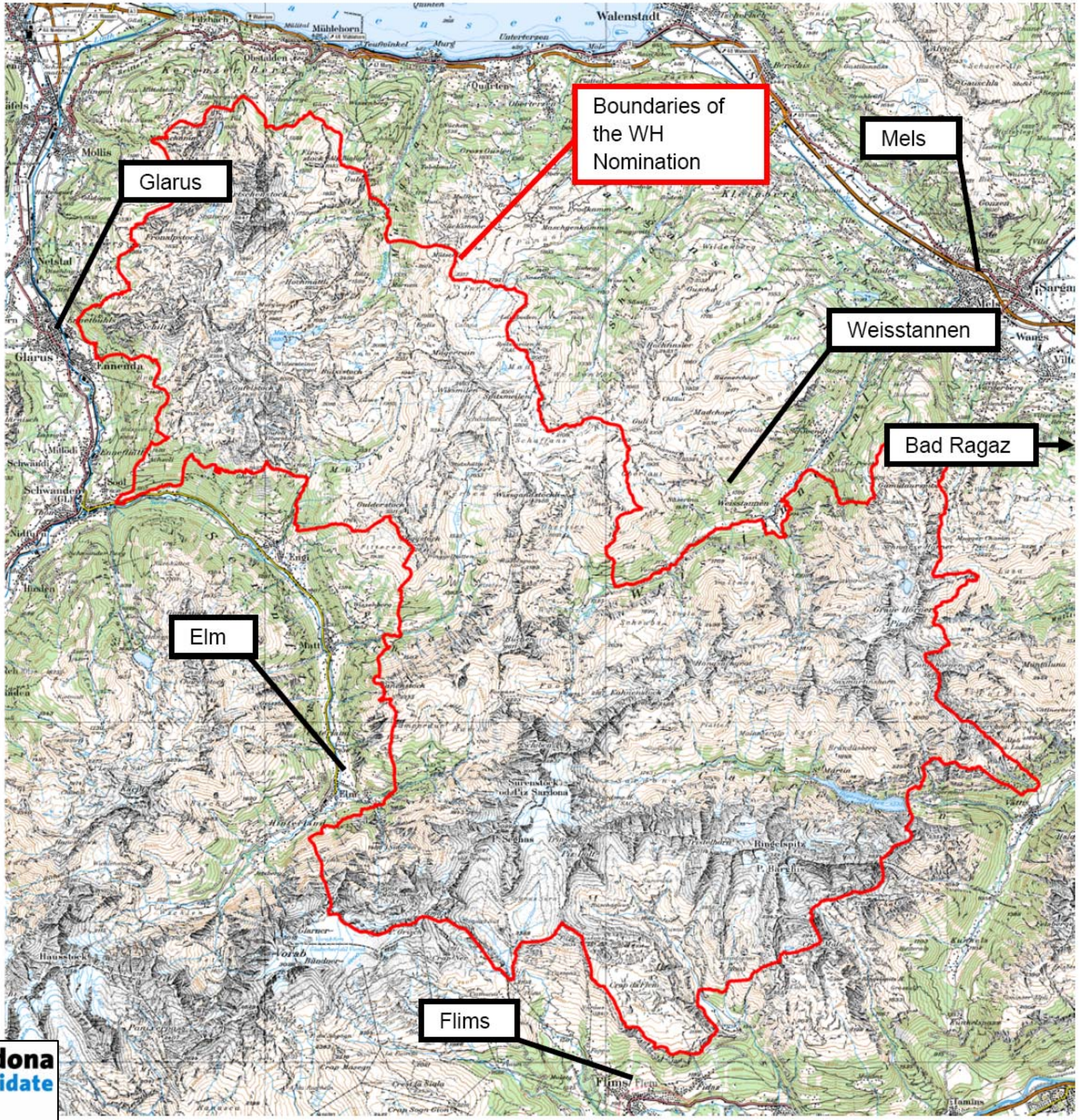

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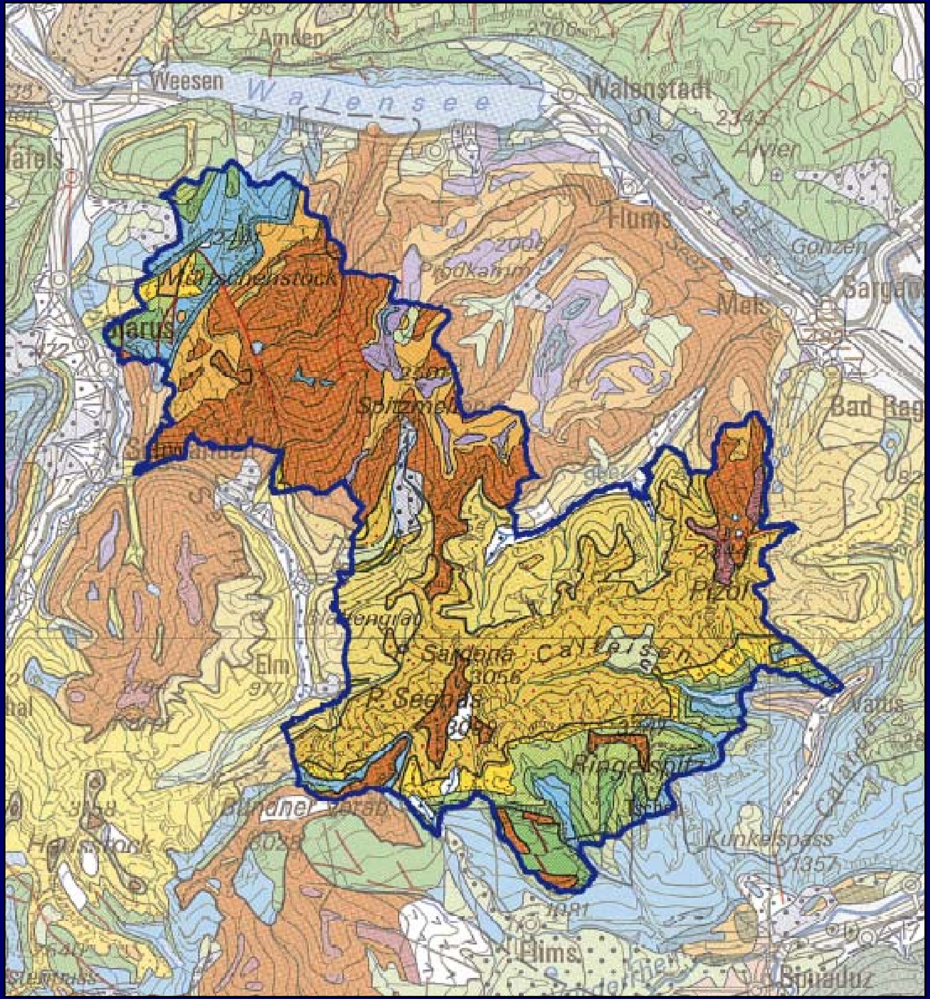
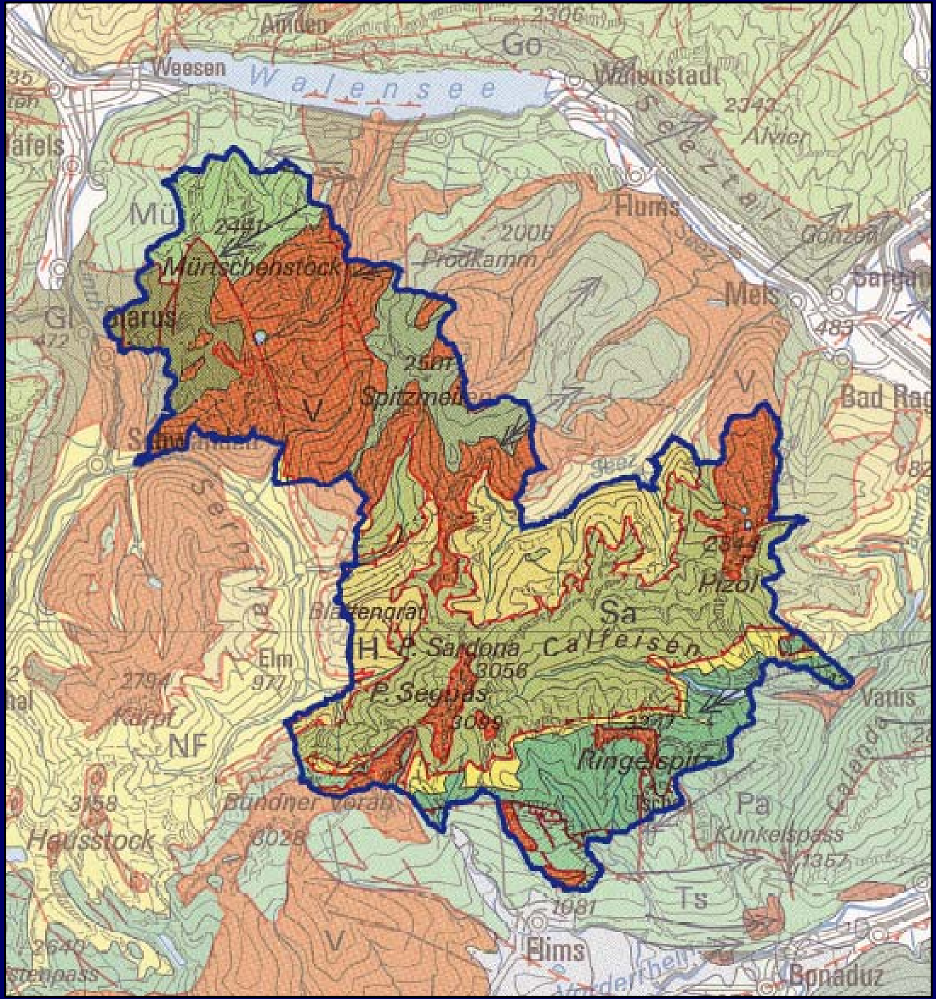
Geological and tectonic maps





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Swiss Confederation

Department of the Environment,
Transport, Energy and Communications
Federal Office for the Environment FOEN

Thuesday, September 18th

Glarus side and discussion with representatives

Time	Activities	Information
7.42 a.m.	Departure from Gland	By train.
11.35 a.m.	Arrival at the train station in Glarus	Possibility to leave the package in the bus, walk to the restaurant.
11.45 a.m.	Welcome in the restaurant Glarnerhof in Glarus	Participants: M. Viviani-Schärer (Swiss UNESCO Commission), H. Dürst (Glarus canton), B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), F. Marti-Egli (WHC GO), D. Imper (WHC GO).
00.15 p.m.	Lunch in the restaurant Glarnerhof in Glarus	
1.30 p.m.	Introduction: geographical and structural overview	
2.00 p.m.	Travel to Elm	By bus
2.30 p.m.	Coffee break: with view of the Glarus overthrust and the Elm landside at the Hotel Elmer, walk in the village of Elm	Participants: Dr. J. Powell (IUCN), P.M. Rosabal (IUCN), M. Viviani-Schärer (Swiss UNESCO Commission, B. Walder (FOEN), C. Ossola (FOEN), Dr. J. Marti (Glarus canton), A. Wernle (GeoPark guide), D. Imper (WHC GO).
3.15 p.m.	Travel to Lochsite	By bus.
3.30 p.m.	Visit of Lochsite: Glarus overthrust, geology and geohistory	
4.30 p.m.	Travel to Bad Ragaz	By bus.
5.30 p.m.	Check-in at the Hotel Hof, Bad Ragaz	Grand Hotels Bad Ragaz CH-7310 Bad Ragaz Telephone +41 (0)81 303 30 30 Fax +41 (0)81 303 30 33
6.30 p.m.	Travel to Bad Pfäfers (old thermal baths of Pfäfers)	By bus.
7.00 p.m.	Visit of the gorge of Tamina by the restaurant Altes Bad Pfäfers	
7.30 p.m.	Apéro and discussions with the representatives of cantons and communities involved in the nomination at the restaurant Altes Bad Pfäfers	E. Iten (Swiss Ambassador at UNESCO Paris), W. Geiger (vice-director FOEN), B. Walder (FOEN), C. Ossola (FOEN), J. Mürner (FOC), M. Viviani-Schärer (Swiss UNESCO Commission), RR W. Haag (St. Gallen canton), RR C. Lardi (Grisons canton), RR M. Dürs (Glarus canton), Prof. A. Pfiffner (Univ. Bern), F. Marti-Egli (WHC GO), D. Imper (WHC GO), other representatives.
8.00 p.m.	Dinner at the restaurant Altes Bad Pfäfers	
10.00 p.m.	Travel to Bad Ragaz, Overnight stay at the Hotel Hof, Bad Ragaz	

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The Taminaschlucht

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Altes Bad Pfäfers

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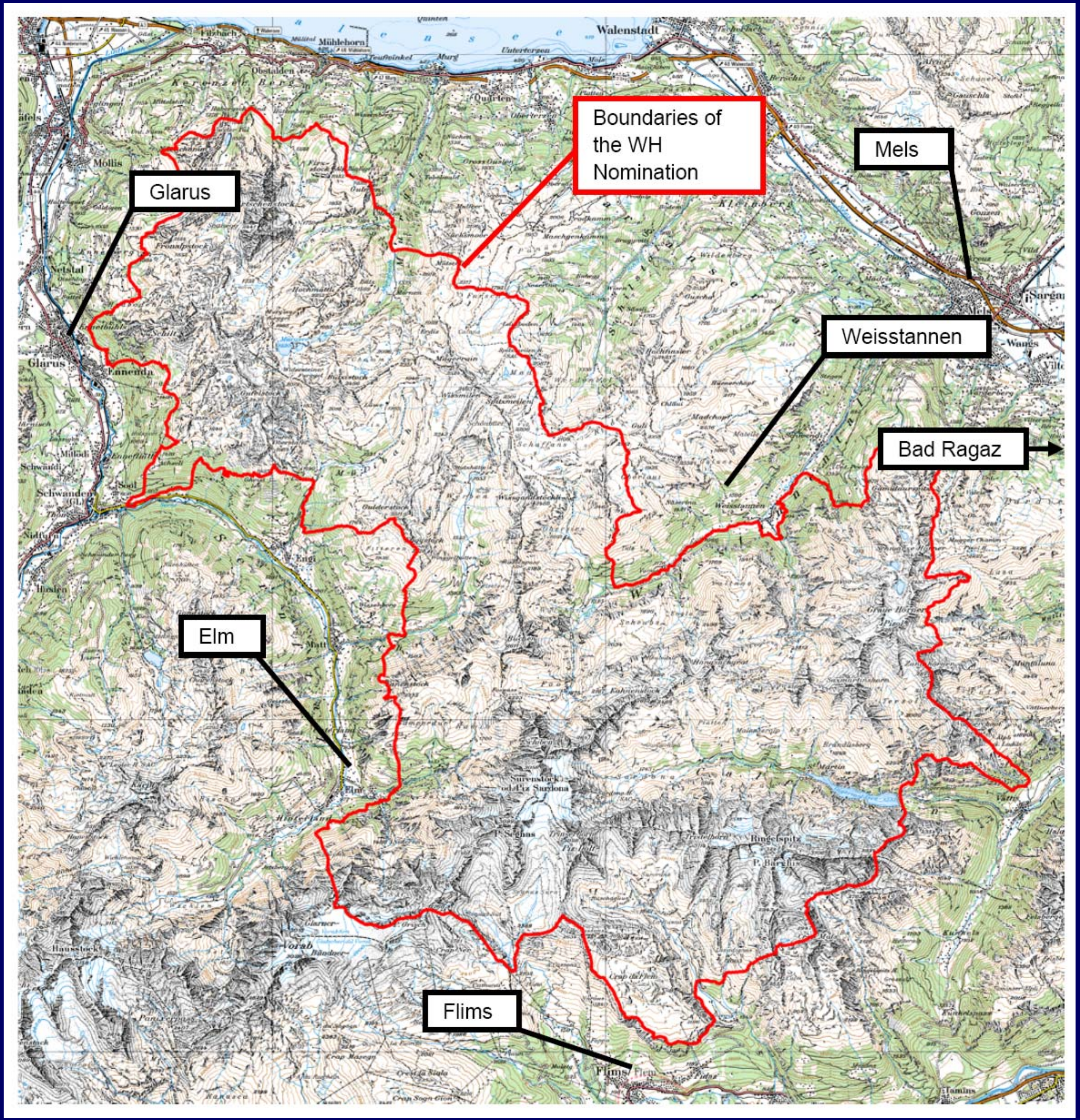

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Department of the Environment,
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Wednesday, September 19th,

Overview flight and walk on the Grison side, presentations and scientific discussion (in case of good weather)

Time	Activities	Information
7.45 a.m.	Travel to Flims	By bus.
8.15 a.m.	Flight – Overview from the air of the geological nature of the site	By helicopter. Participants : Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
9.15 a.m.	Walk: Cassonsgrat-Segnas	Walk: Cassonsgrat (2634 m osl.) - Plaun Segnas Sura (2376 m osl.) – La Siala (2459 m osl.) – Plaun Segnas Sut (2096 m osl.) – Camona da Segnas (2102 m osl.). March: 10 km, 2 hours, 500 m of altitude difference. Topics: Glarus overthrust, geomorphology, Flims landslide, alluvial site, fenland, mire landscape, tourism, integrity: federal inventories. Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO).
1.30 p.m.	Lunch at the restaurant Startgels	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), Dr. P. Baumgartner (Grisons canton), M. Gassmann (Flims commune), H. Cabalzar (Flims Laax Falera Tourism), A. Gisler (Flims Laax Falera Tourism).
3.00 p.m.	Travel to Flims	By bus.
3.30 p.m.	Travel to Bad Ragaz	
4.00 p.m.	Arrival in Bad Ragaz at the Hotel Hof	
5.00 p.m.	Travel to Mels	
5.30 p.m.	Presentations and discussion: Restaurant Waldheim, Mels	Participants: B. Walder (FOEN), C. Ossola (FOEN), Prof. A. Pfiffner (Univ. Bern), Dr. S. Hesske (Univ. Zürich), Prof. M. Maisch (Univ. Zürich), PD Dr. M. Rahn (Univ. Freiburg i.Br.), Dr. P. Fricker, Em. Prof B. Messerli, Prof. J. Mullis (Univ. Basel), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), D. Imper (WHC GO), other experts.
7.30 p.m.	Waldheim, Mels Dinner, Restaurant	
10.00 p.m.	Overnight stay at the Hotel Hof, Bad Ragaz	

If the weather conditions don't permit the flight Wednesday, it can take place Thursday.

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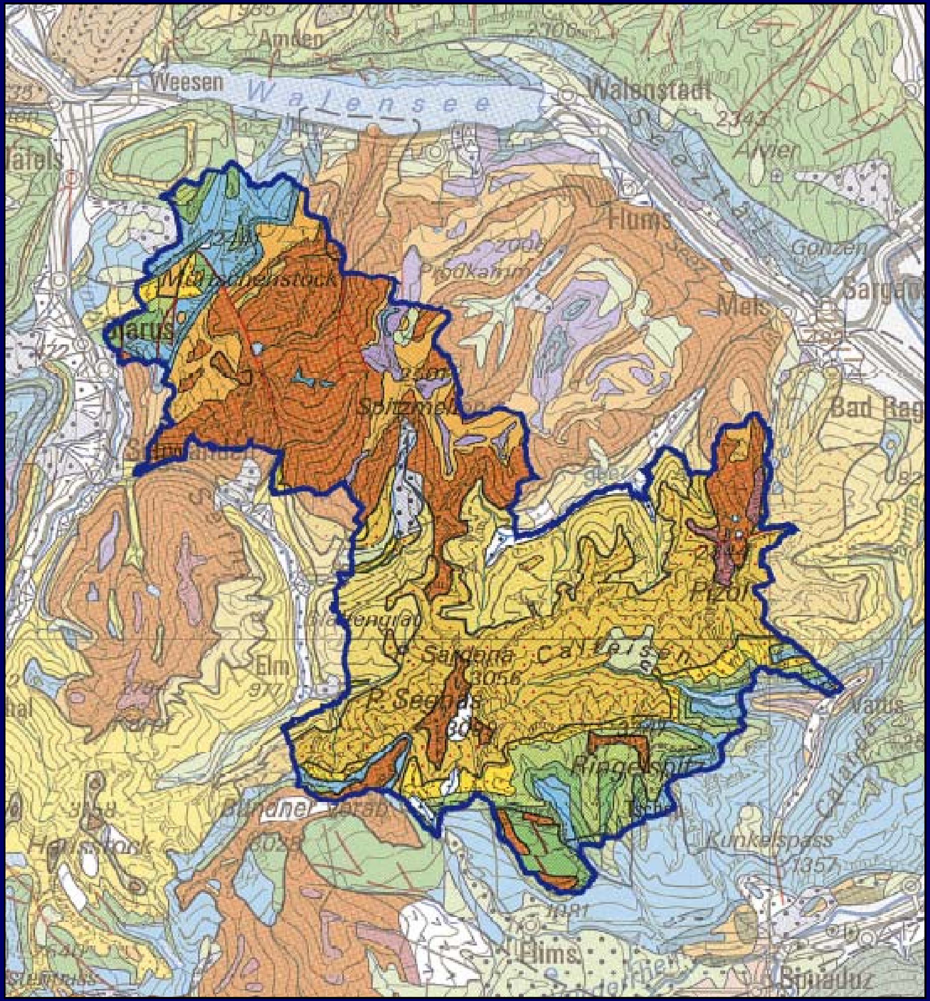
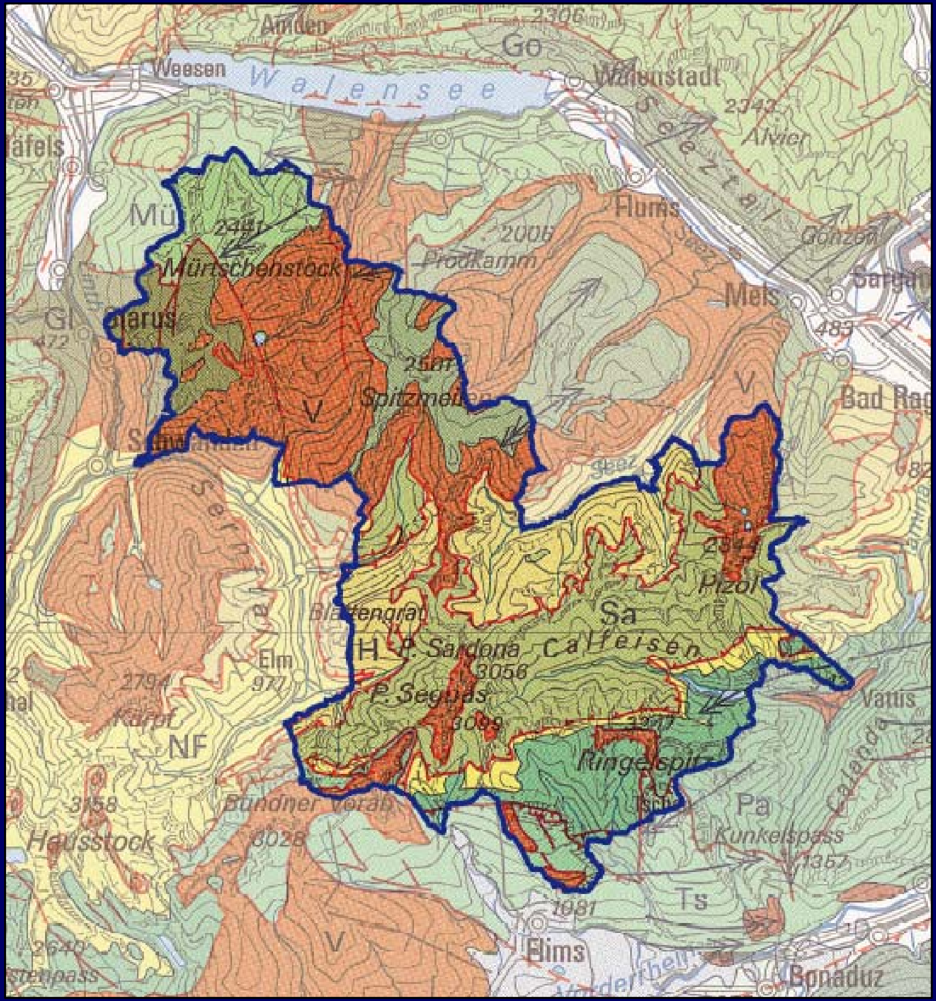
Geological and tectonic maps





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The Magic Line

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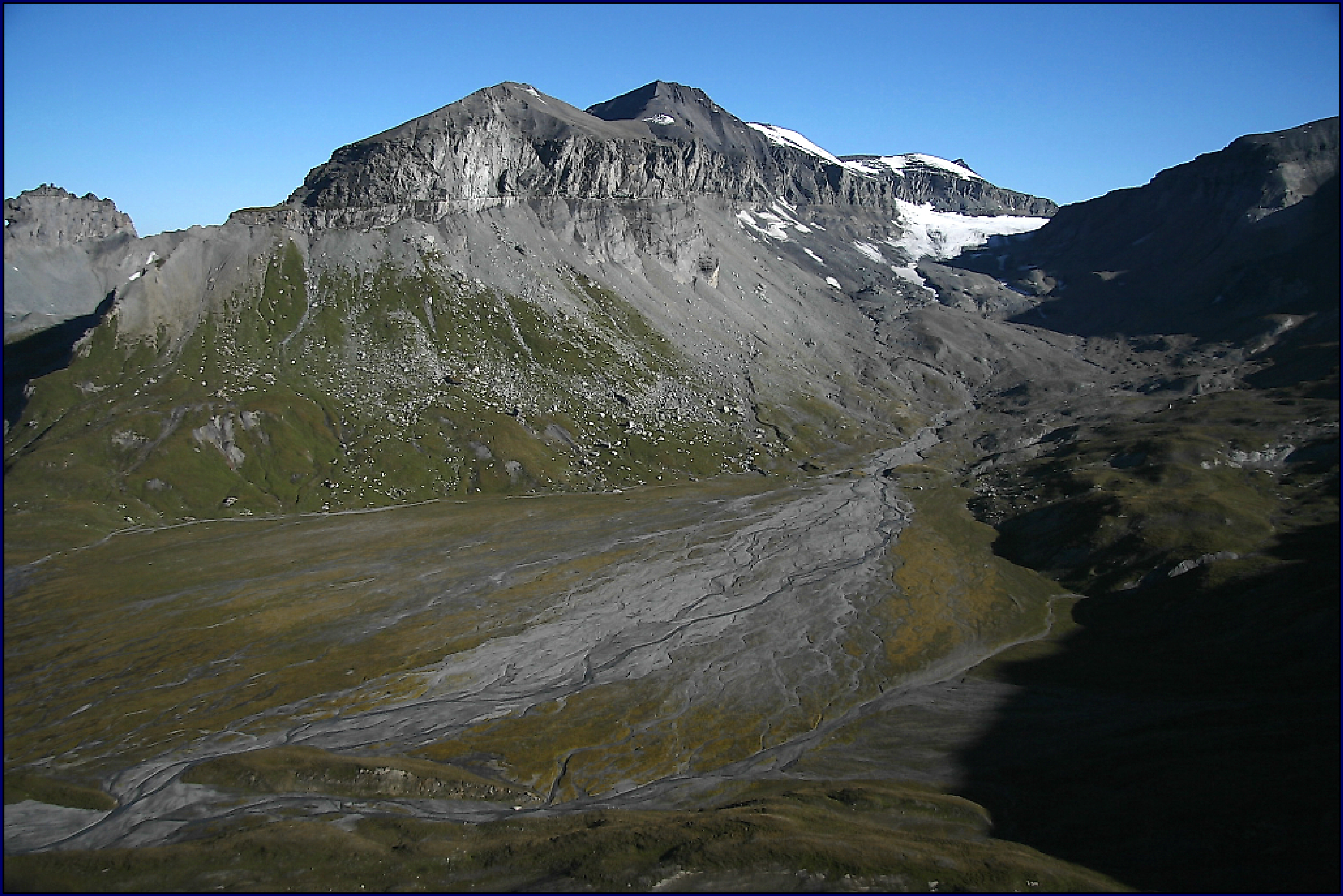

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Department of the Environment,
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Wednesday, September 19th,

film of the overthrust and walk on the Grison side, presentation and scientific discussion (in case of bad weather)

Time	Activities	Information
8.00 a.m.	Travel to Flims	By bus.
9.00 a.m.	Projection: Film of the Glarus overthrust	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), M. Gassmann (Flims commune).
9.15 a.m.	Geology of the Glarus overthrust	
9.45 a.m.	Travel to Cassonsgrat and coffee break	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO). By aerial passenger line.
11.00 a.m.	Walk: Cassonsgrat (2634 m osl.)	Short Walk on Cassonsgrat (2634 m osl.): Topics: Glarus overthrust, geomorphology, tourism. Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO).
0.00 p.m.	Travel to restaurant Startgels	
0.45 p.m.	Lunch, restaurant Startgels	
2.00 p.m.	Discussion: management plan tourism, restaurant Startgels	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), Dr. P. Baumgartner(Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), M. Gassmann (Flims commune), H. Cabalzar (Flims Laax Falera Tourism), A. Gisler (Flims Laax Falera Tourism).
3.00 p.m.	Travel to Flims	By bus.
3.30 p.m.	Travel to Bad Ragaz	
4.00 p.m.	Arrival in Bad Ragaz at the Hotel Hof	
5.00 p.m.	Travel to Mels	By bus.
5.30 p.m.	Presentations and discussion: Restaurant Waldheim, Mels	Participants: B. Walzer (FOEN), C. Ossola (FOEN), Prof. A. Pfiffner,(Univ. Bern), Dr. S. Hesske (Univ. Zürich), Prof. M. Maisch (Univ. Zürich), PD Dr. M. Rahn (Univ. Freiburg i.Br.), Dr. P. Fricker, Em. Prof B. Messerli, Prof. J. Mullis (Univ. Basel), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), D. Imper (WHC GO), other experts.
7.30 p.m.	Dinner, Restaurant Waldheim, Mels	
10.00 p.m.	Overnight stay at the Hotel Hof, Bad Ragaz	

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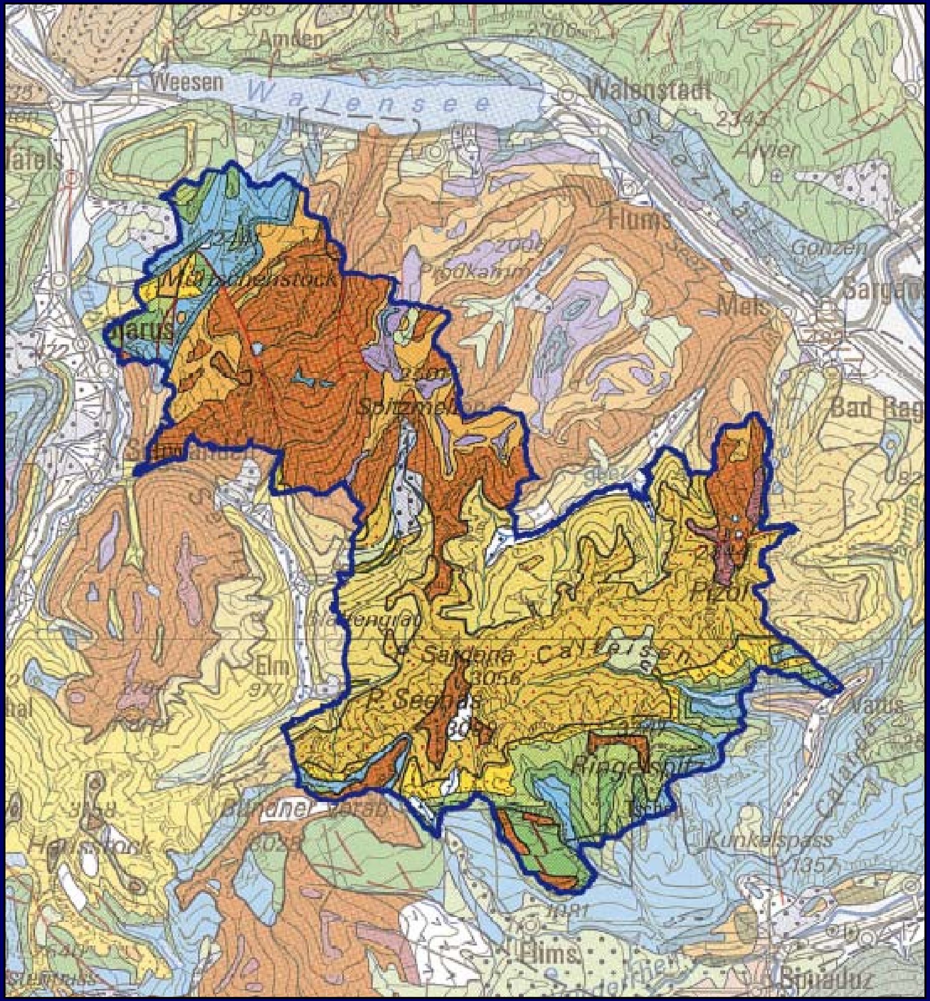
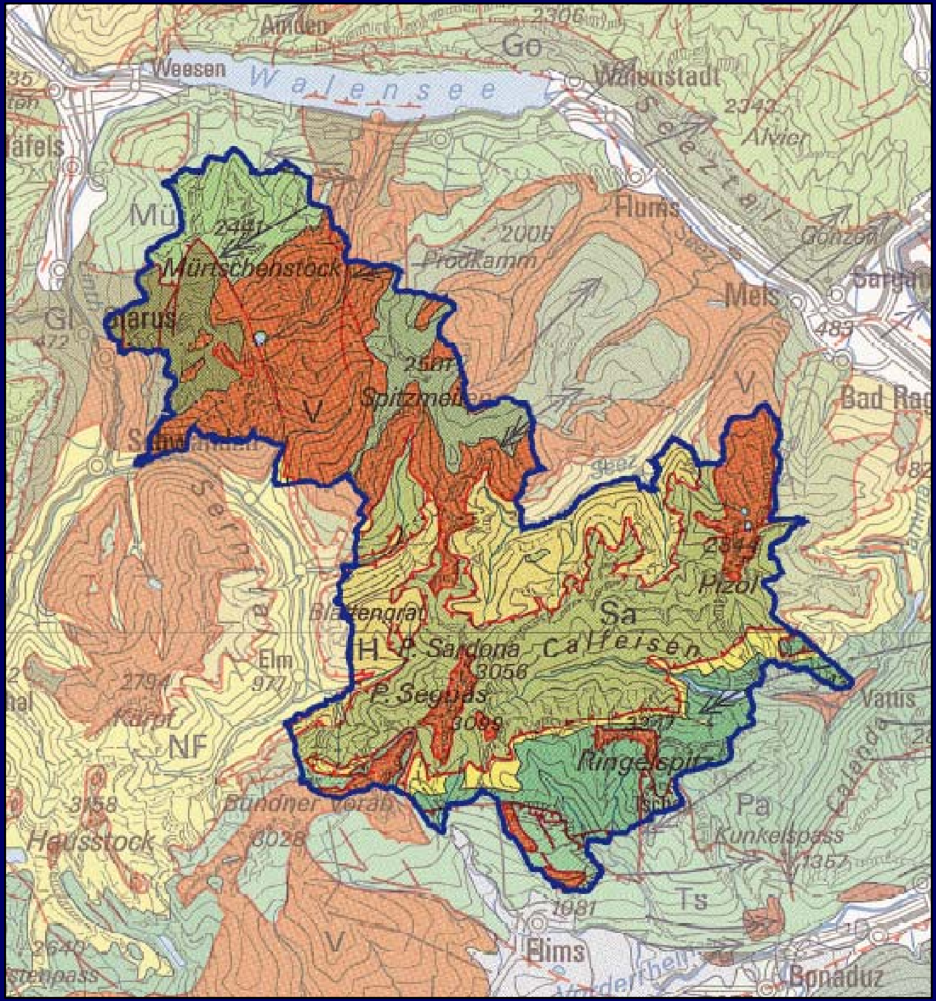
Geological and tectonic maps





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The Magic Line

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Wednesday, September 19th,

film of the overthrust and visit of the Natural museum in Chur, presentation and scientific discussion (in case of fog and snow)

Time	Activities	Information
8.00 a.m.	Travel to Flims	By bus.
9.00 a.m.	Film of the Glarus overthrust	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), M. Gassmann (Flims commune), Dr. P. Baumgartner (Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton).
9.15 a.m.	Geology of the Glarus overthrust	
9.45 a.m.	Coffee break	
10.15 a.m.	Discussion: management plan tourism	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), M. Gassmann (Flims commune), Dr. P. Baumgartner (Grisons canton), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), H. Cabalzar (Flims Laax Falera Tourism), A. Gisler (Flims Laax Falera Tourism).
11.15 a.m.	Travel to restaurant Startgels	
0.00 p.m.	Lunch	
1.30 p.m.	Travel to the museum of nature in Chur	By bus.
2.00 p.m.	Discussion: visitors center, science, education	Participants : B. Walder (FOEN), C. Ossola (FOEN), L. Filli (Grisons canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), M. Gassmann (Flims commune), Dr. J.P. Müller (Scientiflic Advisory Committee), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton).
3.30 p.m.	Travel to Bad Ragaz	By bus.
4.00 p.m.	Arrival in Bad Ragaz at the Hotel Hof	
5.00 p.m.	Travel to Mels	By bus.
5.30 p.m.	Presentations and discussion: Restaurant Waldheim, Mels	Participants: B. Walzer (FOEN), C. Ossola (FOEN), Prof. A. Pfiffner,(Univ. Bern), Dr. S. Hesske (Univ. Zürich), Prof. M. Maisch (Univ. Zürich), PD Dr. M. Rahn (Univ. Freiburg i.Br.), Dr. P. Fricker, Em. Prof B. Messerli, Prof. J. Mullis (Univ. Basel), Dr. J. Marti (Glarus canton), P. Zopfi (Glarus canton), D. Imper (WHC GO), other experts.
7.45 p.m.	Dinner	
10.00 p.m.	Travel to Bad Ragaz, Overnight stay at the Hotel Hof, Bad Ragaz	

Thursday, September 20th

Walk on the St. Gallen side, final discussion (in case of good weather conditions)

Time	Activities	Information
7.45 a.m.	Travel to Wangs	By bus.
8.00 a.m.	Travel to Pizol-Pizolhütte	By funicular
8.45 a.m.	Walk: Pizolhütte	Pizolhütte (2222 m osl.) – Wildseeluggen (2493 m osl.) – Pizolhütte. Walk: 2 hours. Topics: Glarus overthrust, glacio-geomorphology, mountain farming, tourism, federal game reserve "Graue Hörner" Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), G. Ackermann (St. Gallen canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
0.00 p.m.	Travel to Wangs (Wangs – Pizol)	
0.45 p.m.	Travel to Bad Ragaz	
1.00 p.m.	Lunch in Bad Ragaz, Hotel Hof	
2.30 p.m.	Final discussion, Hotel Hof	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), G. Ackermann (St. Gallen canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), L. Filli (Grisons canton), P. Zopfi (Glarus canton)
4.00 p.m.	Press conference	Participants : RR W. Haag (St. Gallen canton), NR S. Cathomas (Grison canton), B. Walder (FOEN), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO)
5.30 p.m.	Departure from Bad Ragaz to Gland	By train

Fig. 1 – Glarus overthrust: Pizol (2844 m o.s.l.) and Pizol glacier

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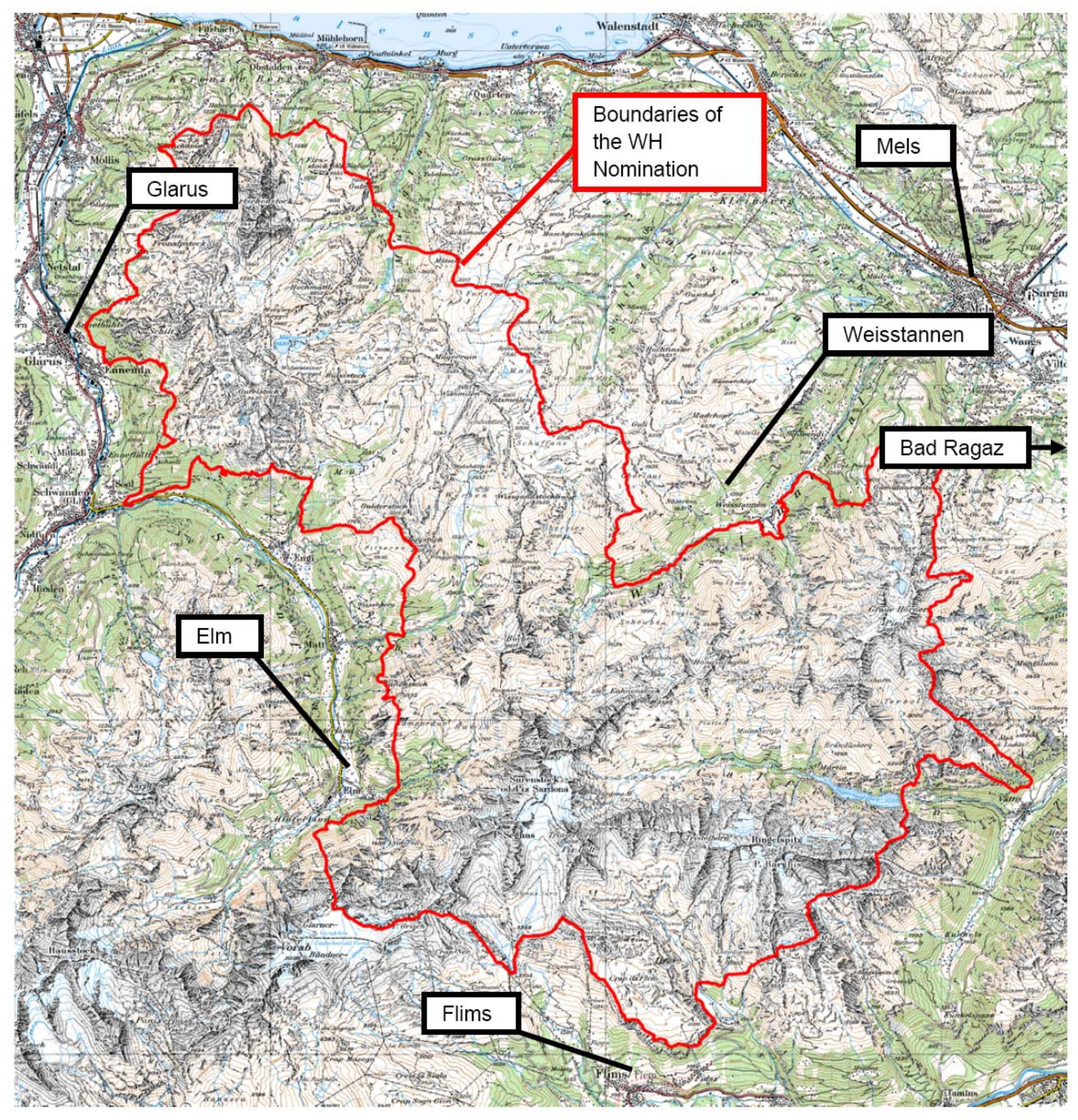

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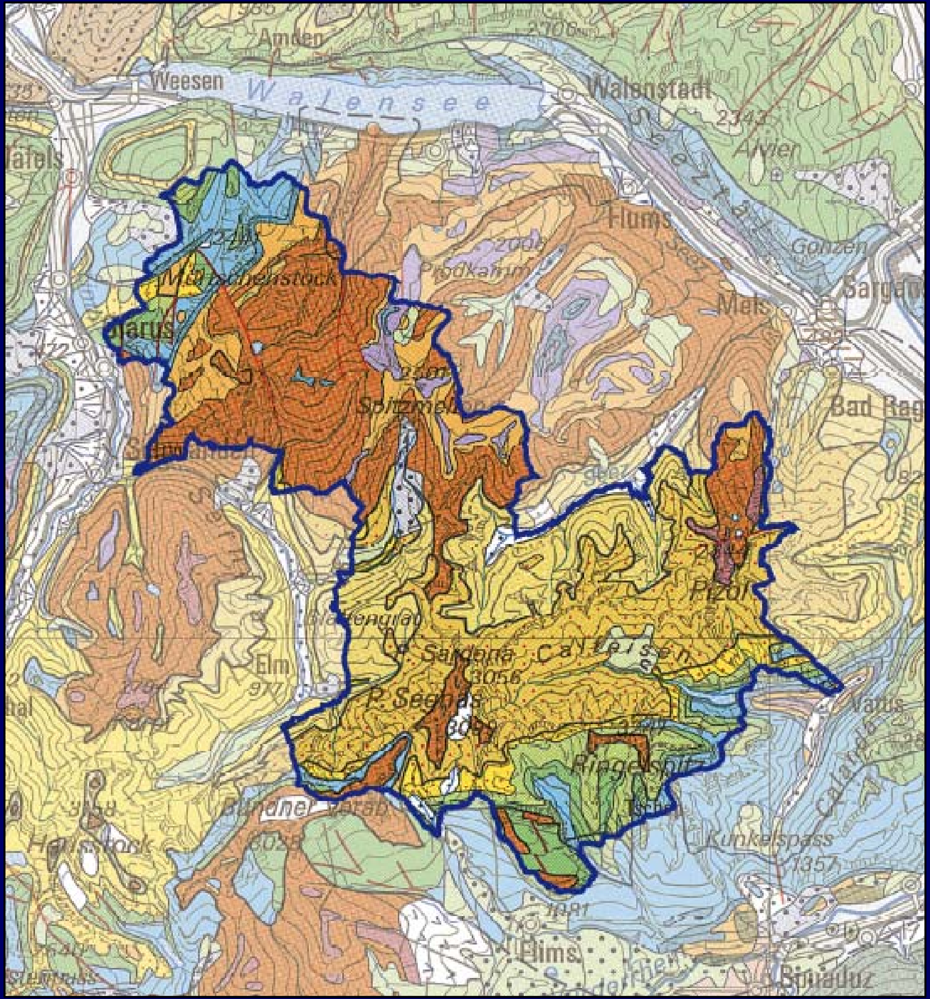
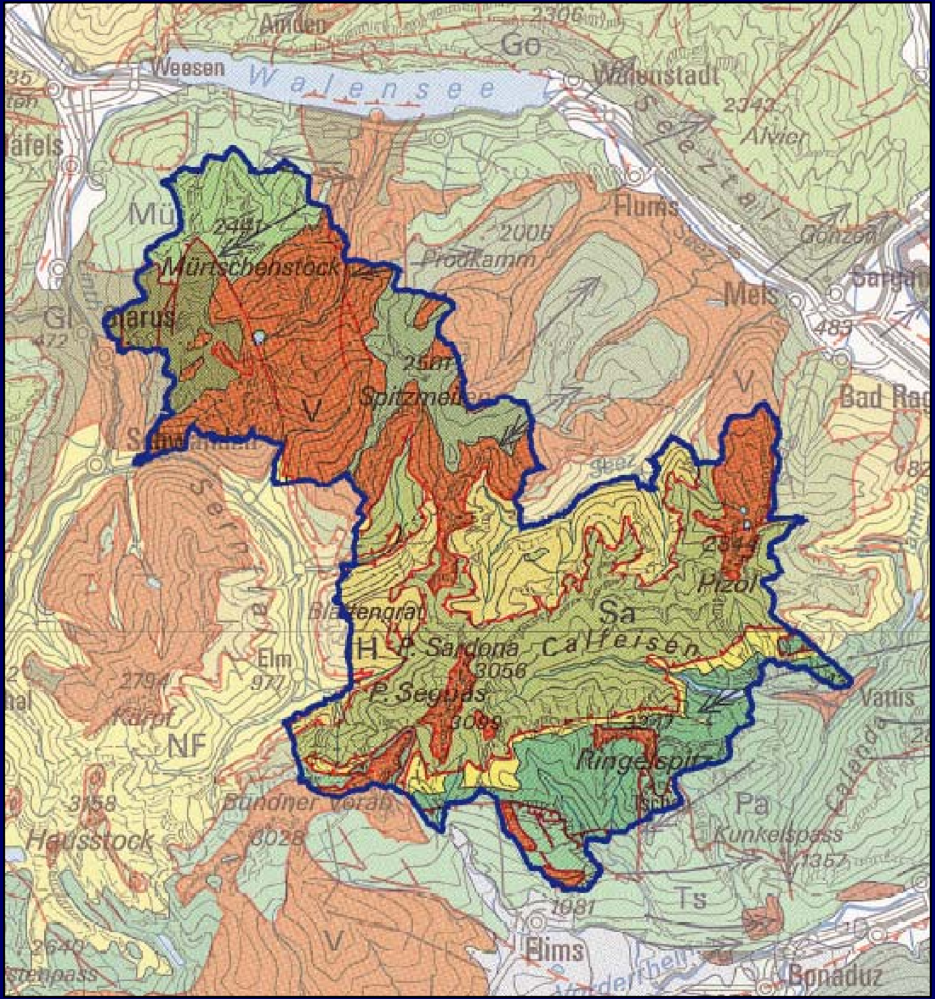
Geological and tectonic maps





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Department of the Environment,
Transport, Energy and Communications
Federal Office for the Environment FOEN

Thursday, September 20th

Travel on the St. Gallen side, federal game reserve and final discussion (in case of bad weather conditions)

Time	Activities	Information
8.00 a.m.	Travel to Alp Walabütz, in Weisstannen	By bus
8.45 a.m.	Alp Walabütz: presentation of the federal game reserve "Graue Hörner"	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), G. Ackermann (St. Gallen canton), V. Pavlovic (St. Gallen canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO).
9.45 a.m.	Coffee Break	
10.15 a.m.	Discussions: integrity and management	
00.00 p.m.	Travel to Bad Ragaz	By bus
1.00 p.m.	Lunch, Hotel Hof, Bad Ragaz	
2.30 p.m.	Final discussion, Hotel Hof, Bad Ragaz	Participants : B. Walder (FOEN), C. Ossola (FOEN), Dr. A. Brülisauer (St. Gallen canton), G. Ackermann (St. Gallen canton), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO), L. Filli (Grisons canton), P. Zopfi (Glarus canton).
4.00 p.m.	Press conference	Participants : RR W. Haag (St. Gallen canton), NR S. Cathomas (Grison canton), B. Walder (FOEN), Prof. A. Pfiffner (Univ. Bern), D. Imper (WHC GO).
5.30 p.m.	Departure from Bad Ragaz to Gland	By train

Fig. 2 – Glarus overthurst: east wall of Ringelspitz (3247 m ü. M.)

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Glück Auf!

GeoPark
Sarganserland
Walensee
Glarnerland

Swiss Tectonic Arena Sardona
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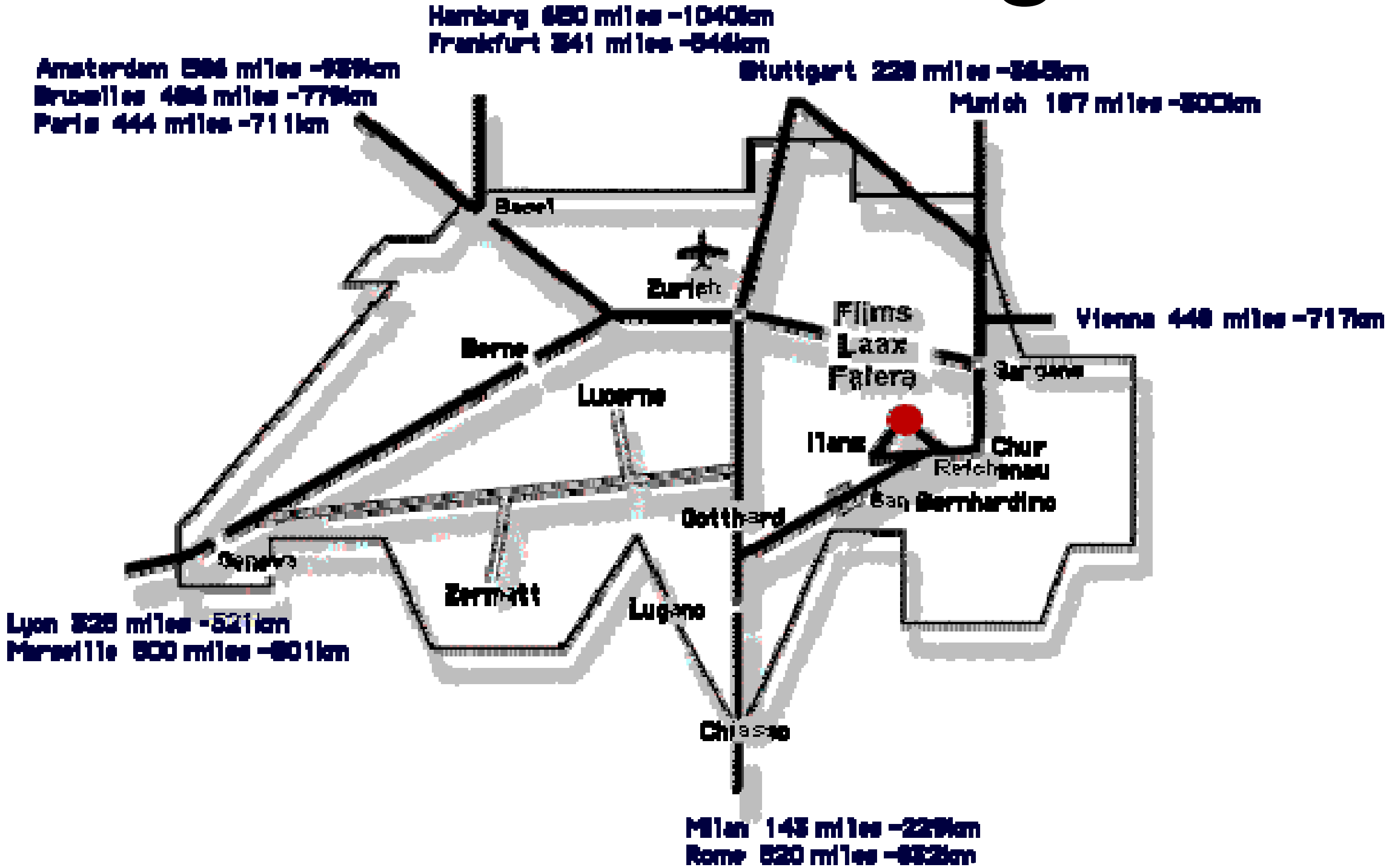
Welcome to Flims Laax Falera

Dr. James Powell

Pedro Manuel Rosabal

How to get There



Winter

LAAX
Flims Laax Falera

- 29 Transportation Systems
- 220 km Ski Slopes
- 100 km Hiking Trails
- 900‘000 Overnights

Summer

- 3 Bathing Lakes
- 4 Themed Trails
- 250 km marked HikingTrails
- 330 km Bike Trails
- 500‘000 Overnights



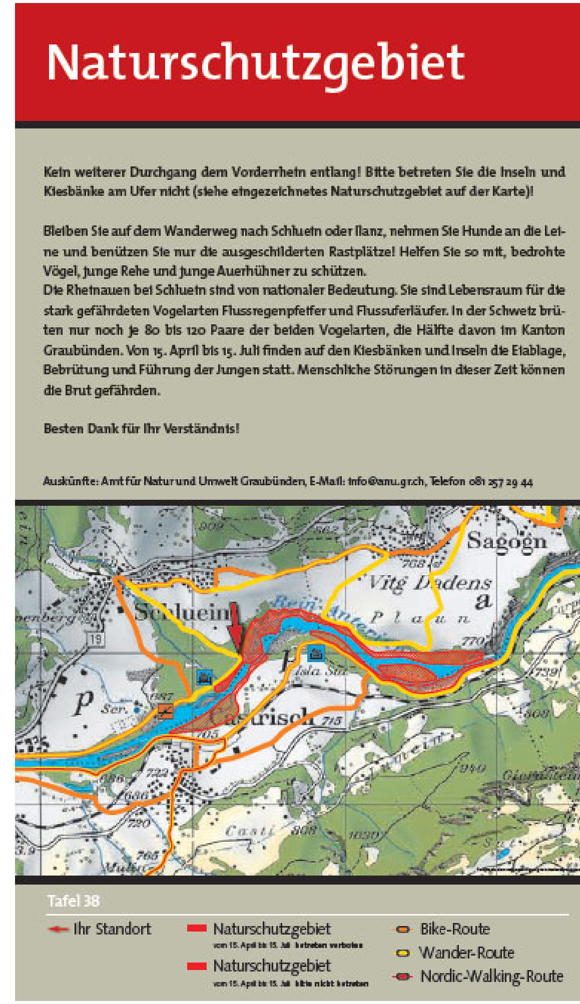
Target Groups Summer

Flims stands for

- Unique landscapes
- Summer freshness
- A place for aktive, healthy bon vivants

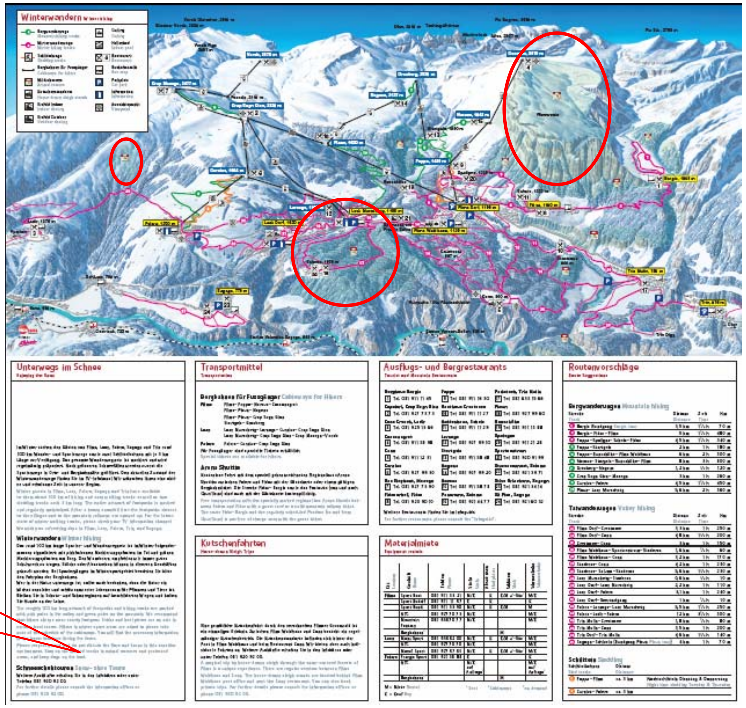
The way to success

- Protect and use of nature
  - Separation of protectet areas
  - Signposted, well maintained hiking trails



The way to success

- Inform and guide
  - Nature learning trail on Cassons
  - Include protected areas on Maps of the region



Please respect nature and do not disturb the flora and fauna in this sensitive environment. Stay on the marked tracks in animal reserves and protected areas, and keep dogs on the lead.

The way to success

- Rules instead of prohibition
  - Gentlemans Agreement

Expectations

- More Guests
- New target Groups
- International Reputation

Swiss Tectonic Arena Sardona
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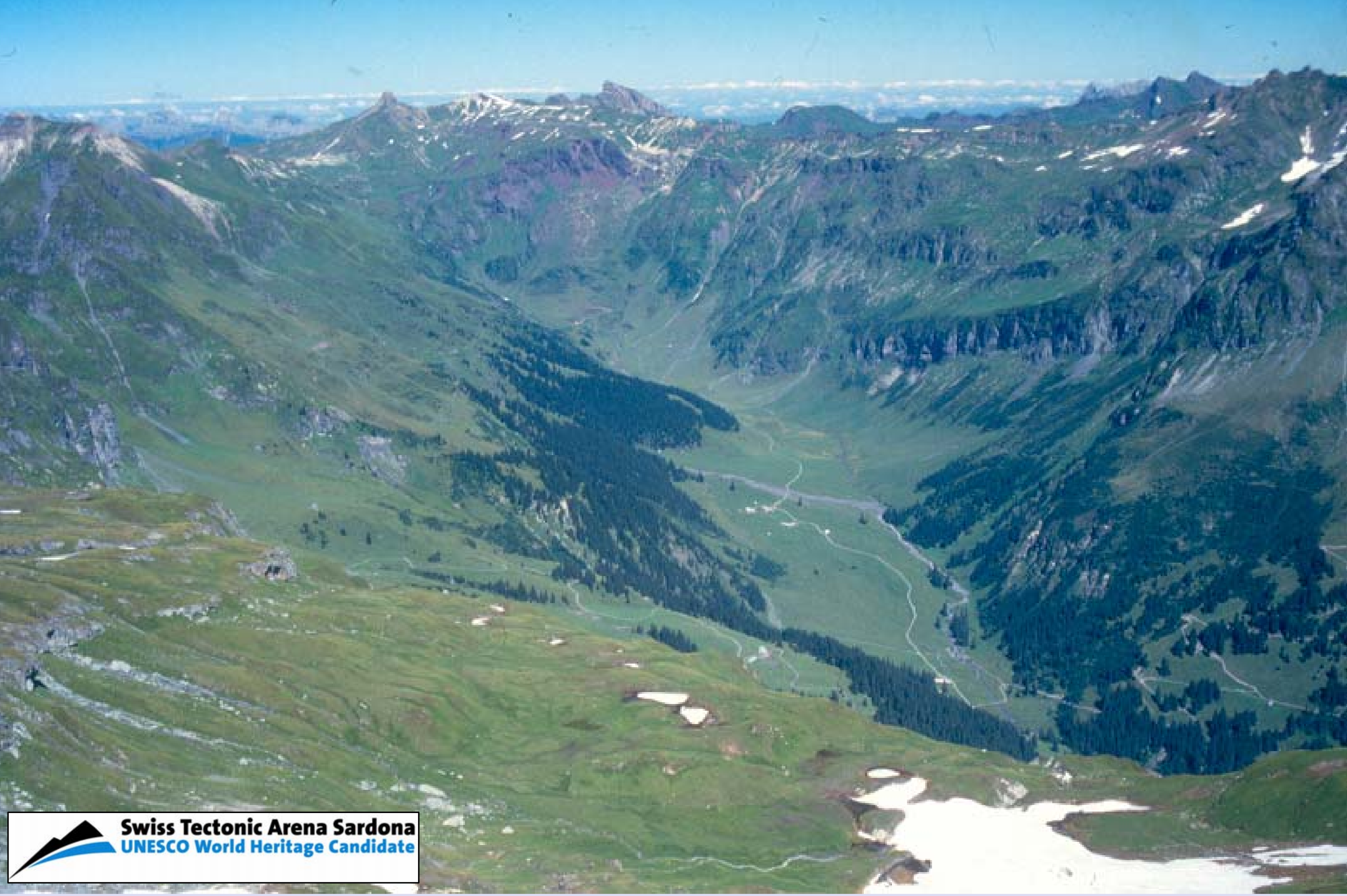
Expectations

The Oscar goes to

Glarner overthrust

Legal Basis of the conservation of the property – protection of nature and landscapes

Jakob Marti, Department for infrastructure and environment, Canton of Glarus



Glarus overthrust property 3 cantons, 19 communes

Responsibility

Swiss constitution Art. 78

Responsible for the protection of the nature (biotopes, species and landscapes) are the cantons (provinces)

The cantons are responsible for the protection of landscapes

Actors

federation:

- regulation
- sites of national importance/protection of species
- partial financing

cantons:

- implementation of cantonal and federal laws
- protection of sites of national and cantonal importance
- partial financing

communes

- implementation of cantonal and federal laws
- protection of sites of communal importance
- Implementation in land use planning/financing

landowners

- Land use according to protection rules
- can appeal against protection rules

Several actors contribute to the protection of the nature

Cooperation

Commune

Federation

Canton

The protection of nature and landscapes can only succeed in a teamwork

Presently protected areas

The nominated property comprises not only outstanding geological features but vast areas of already protected areas (landscapes, mires, alluvial zones, geotopes, dry meadows etc.) of national, cantonal and communal importance.

Biodiversity

These areas are inhabited by a rich and diverse flora and fauna
example: tree pipit
(dramatic decline in the lowlands of Middle Europe)


Tree pipit (Anthus trivialis)– inhabits species rich dry meadows

Procedure "Glarus overthrust"

communes:

- decision on protective rules and subsequent adaption of territorial plans
- decision on joint agreement

cantons:

- adaption of master plan
- approval of communal agreement
- Reservation of financing
- submission of site to the federal authorities

The initiative for the Glarus overthrust object came from interested individuals

bly of the commune Mollis

Conservation Aims

- conserve and manage the natural monument
- sites of geological importance, biotopes and the landscapes are to be conserved
- as far as consistent with the conservation it is accessible to visitors and available for sustainable use
- list of desirable / not permissible uses

Restrictions on land use

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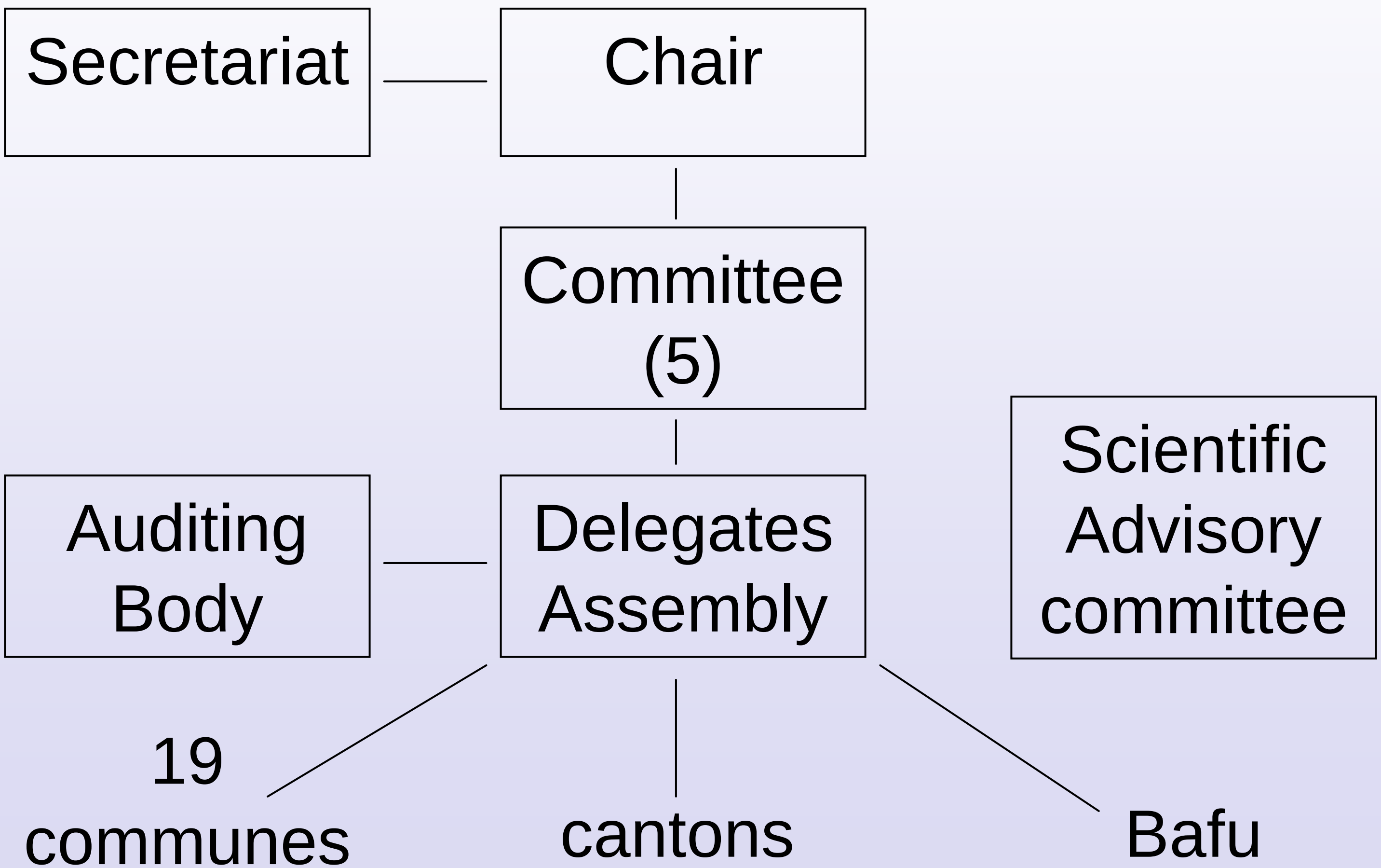
Forest management	allowed
Hunting	Allowed (except in game reserves)
Extraction of materials	Not allowed
New hydro-power plants	Not desirable
Hiking	allowed
New hiking paths	In accordance with development plan
Off-piste skiing	Not desirable
Construction zones	Not allowed
New tourist transport facilities	Not allowed

Ski touring along marked routes are allowed

Management Plan Organisation



Prof. Dr. Adrian Pfiffner

UNIVERSITÄT BERN

The Glarus Thrust -

Outstanding Universal Value and Comparative Study

September 19, 2007

Criteria for the Assessment of Outstanding Universal Value

77. The Committee considers a property as having outstanding universal value if the property meets one or more of the following criteria.

Nominated properties shall therefore :

(vii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

(viii) be outstanding examples representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;

Criterion (vii):

superlative natural phenomena

Older rocks on younger
Lubricant
Folds

or

areas of exceptional natural beauty and aesthetic importance

Landscape and exposure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Criterion (viii)

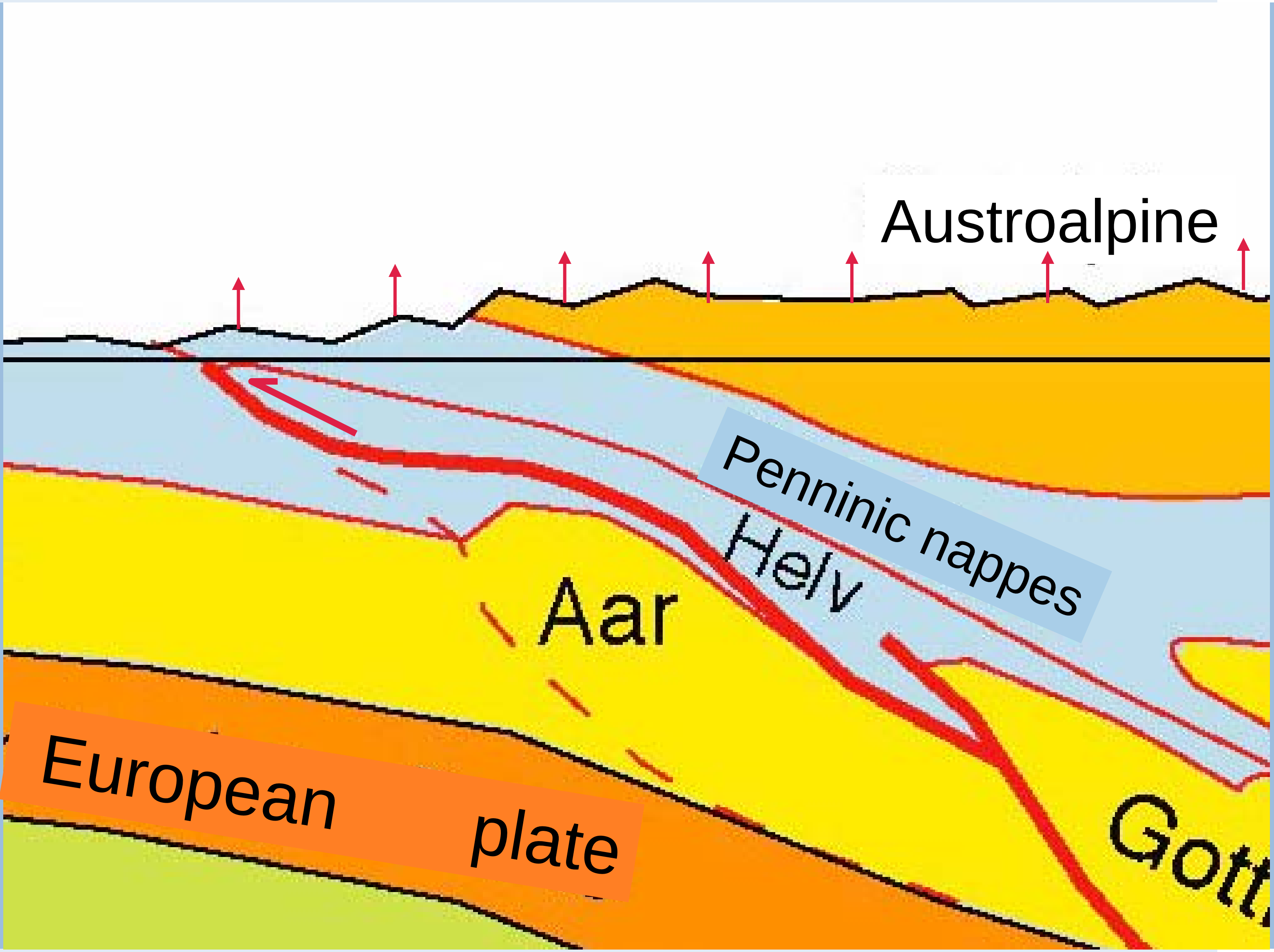
outstanding example representing

- major stages of Earth's history, — Alpine cycle

- significant on-going geological processes — Thrusting

in the development of landforms — Mountain Building

The Glarus thrust 20 myr ago



Comparative Study - apples & pears ??

An objective comparison needs **objective criteria !**

We chose the following criteria for a comparison:

- **Scientific Value**
- **Scenic Value**
- **Geomorphic Expression**
- **Educational Value**

The criteria were evaluated using **sub-criteria.**

These sub-criteria allowed an objective assessment of the various thrust faults in the various geological regions.

Which sub-criteria did we use ?

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Sub-criteria related to the **Scientific Value:**

(1) relation to plate motions

(2) mountain building processes

(3) magnitude of displacement along the thrust fault

(4) deformation of the rocks beneath and above the thrust fault

(5) deformation mechanisms observable along the thrust surface

Sub-criteria related to the **Scenic Value:**

(6) natural beauty of the thrust fault

(7) beauty and quality of the structures beneath and above the thrust fault

(8) three-dimensionality of exposure

Sub-criteria related to the **Geomorphic Expression:**

(9) geomorphic expression of the thrust fault in the landscape

(10) presence of spectacular and visually striking phenomena

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Sub-criteria related to the **Educational Value:**

(11) historic geological context of the object

(12) potential of the object to stimulate public awareness

We assembled a list of the most important thrust faults in mountain ranges worldwide.

28 thrust faults and regions from **all continents** were chosen.

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Each of the thrust fault and region was evaluated using all the 12 sub-criteria previously defined.

The evaluation answered the question whether or not the thrust fault fulfilled the specific sub-criterion.

We were three structural geologists who evaluated the thrust faults independently based on our experience and gathering the opinion of colleagues.

Prof. Adrian Pfiffner, University of Bern
Prof. Stefan Schmid, University of Basel
Prof. Martin Burkhard, †, University of Neuchâtel

Based on the number of sub-criteria fulfilled, the four criteria

- scientific value
- scenic value
- geomorphic expression
- educational value

were each given a mark:

1 = excellent, 2 = very good, 3 = good, 4 = fair

The sum of these four marks gave the ranking number of the thrust faults and regions.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Hauptabteilung für die Sicherheit der Kernanlagen HSK

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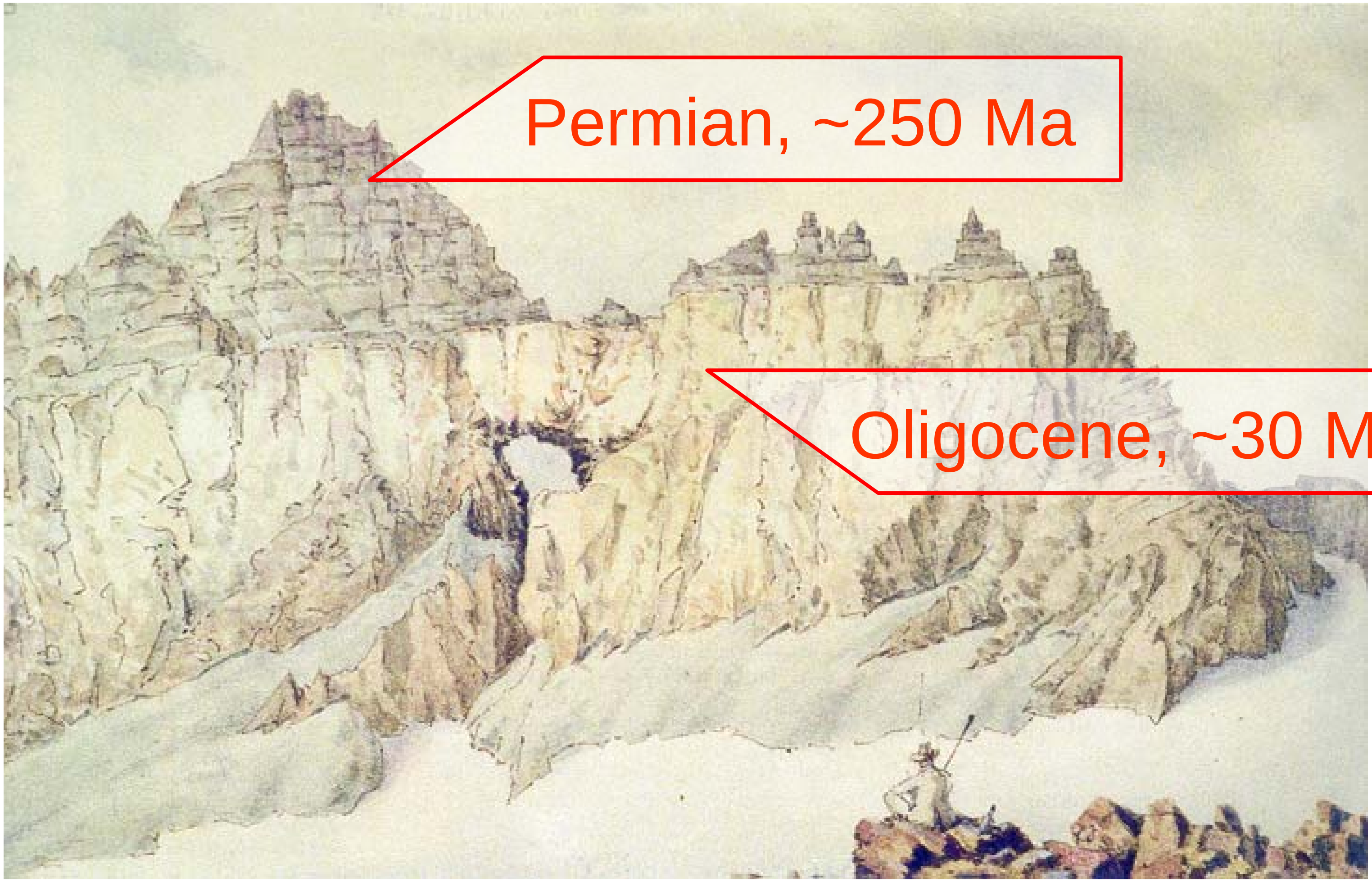
Glarus overthrust: A Magic Line through Earth Sciences (Scientific Value)

Meinert Rahn

The thrust line: a mystery of former times



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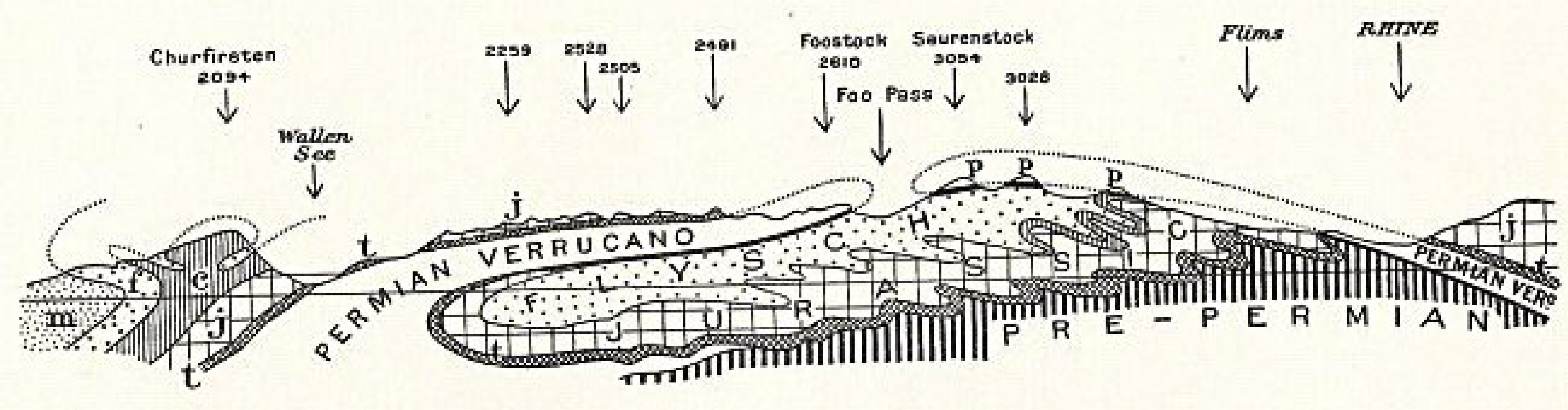
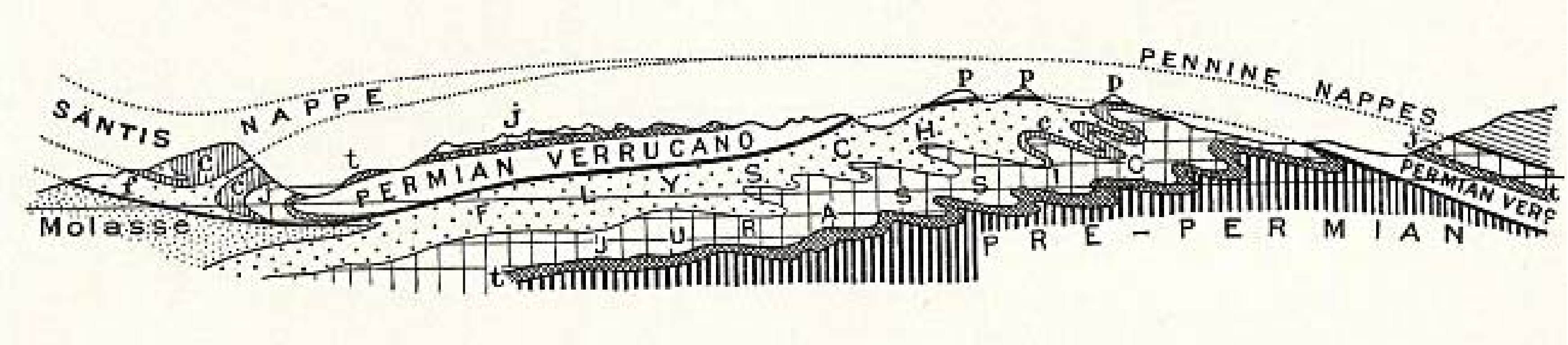
The solution is "thrusting"



Double-vergent fold of A. Escher and A. Heim (1870-1902)



(from Bailey 1935)

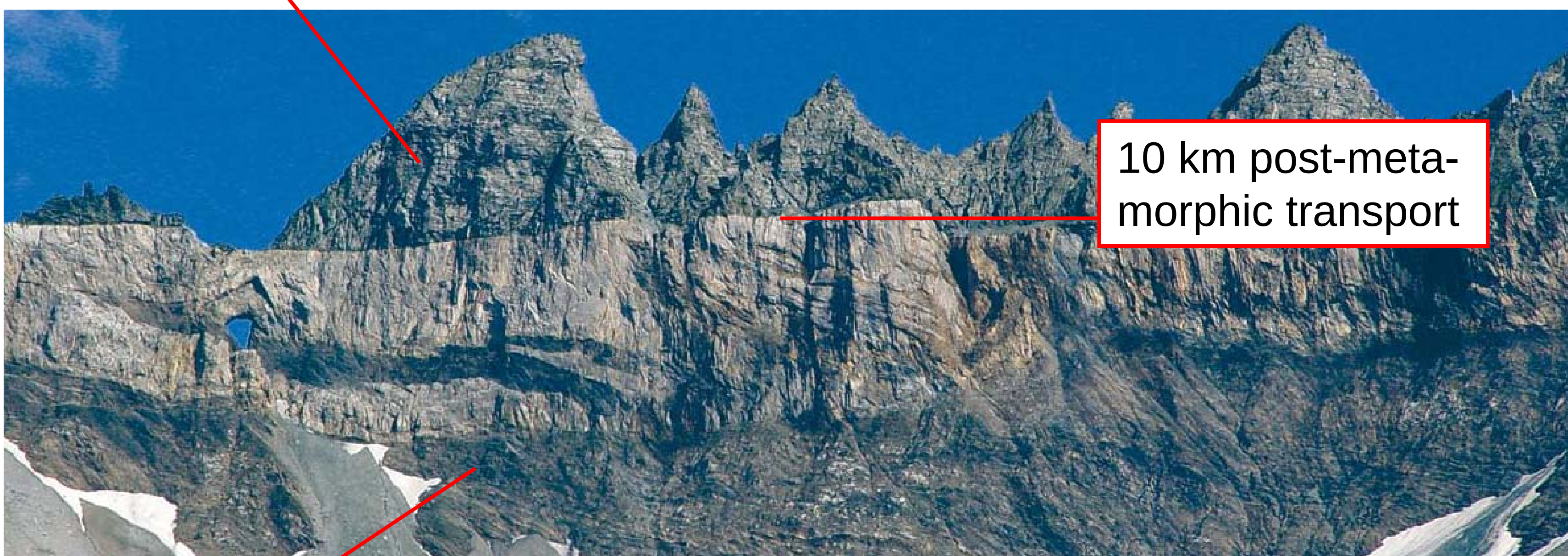
Thrust plane of M. Bertrand (1883) and E. Suess (1892)

The thrust line:
a source for scientific key papers

250 Ma

300° C

H_2O



30 Ma

250° C

CH_4

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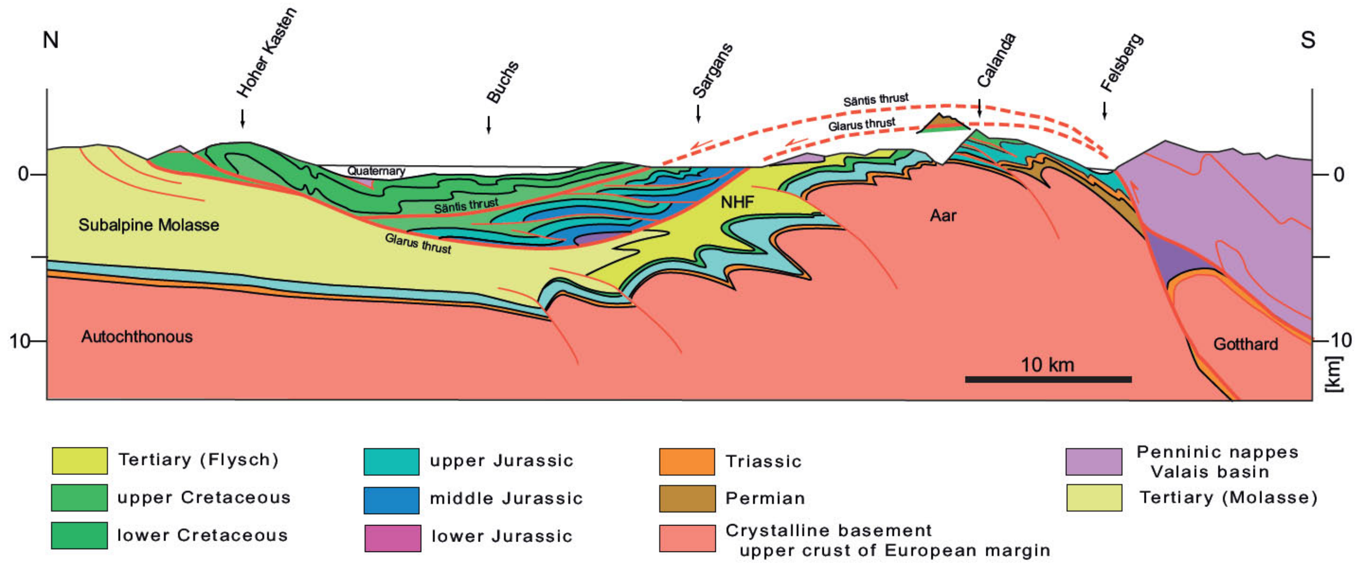
Rotation of the thrust plane in time



25 Ma, during metamorphism

10 Ma, during exhumation

today

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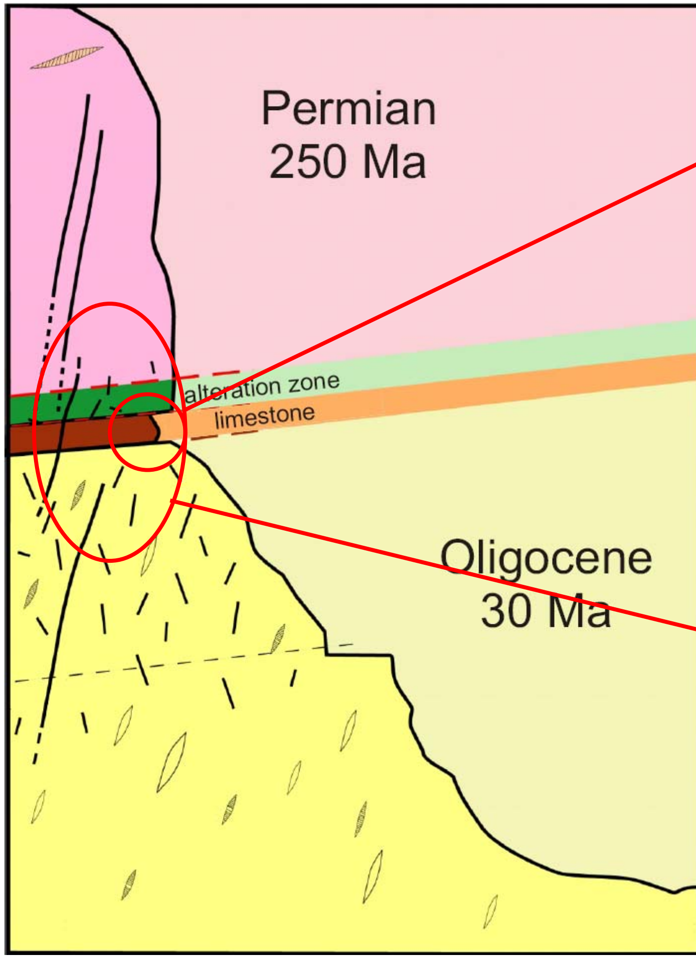
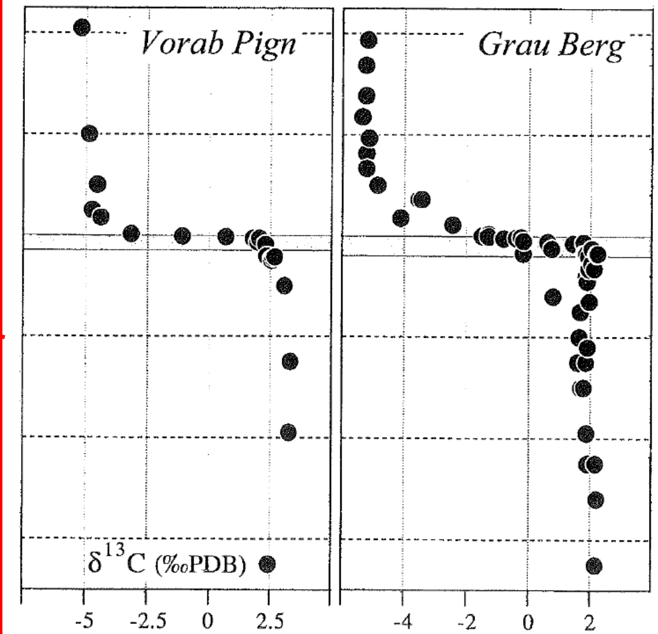
How works thrusting?

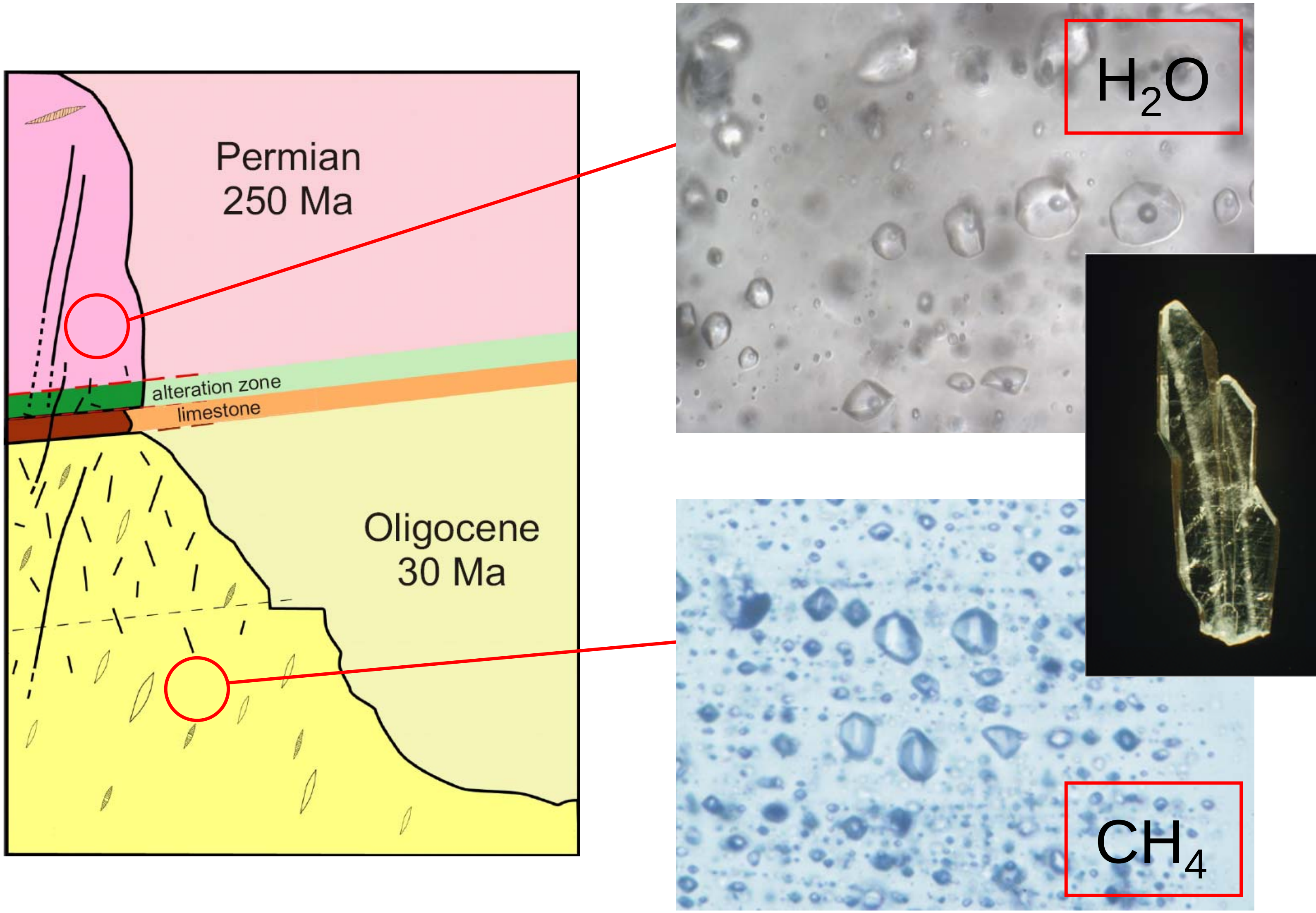


A. Pfiffner, S. Schmid: superplastic flow in limestone

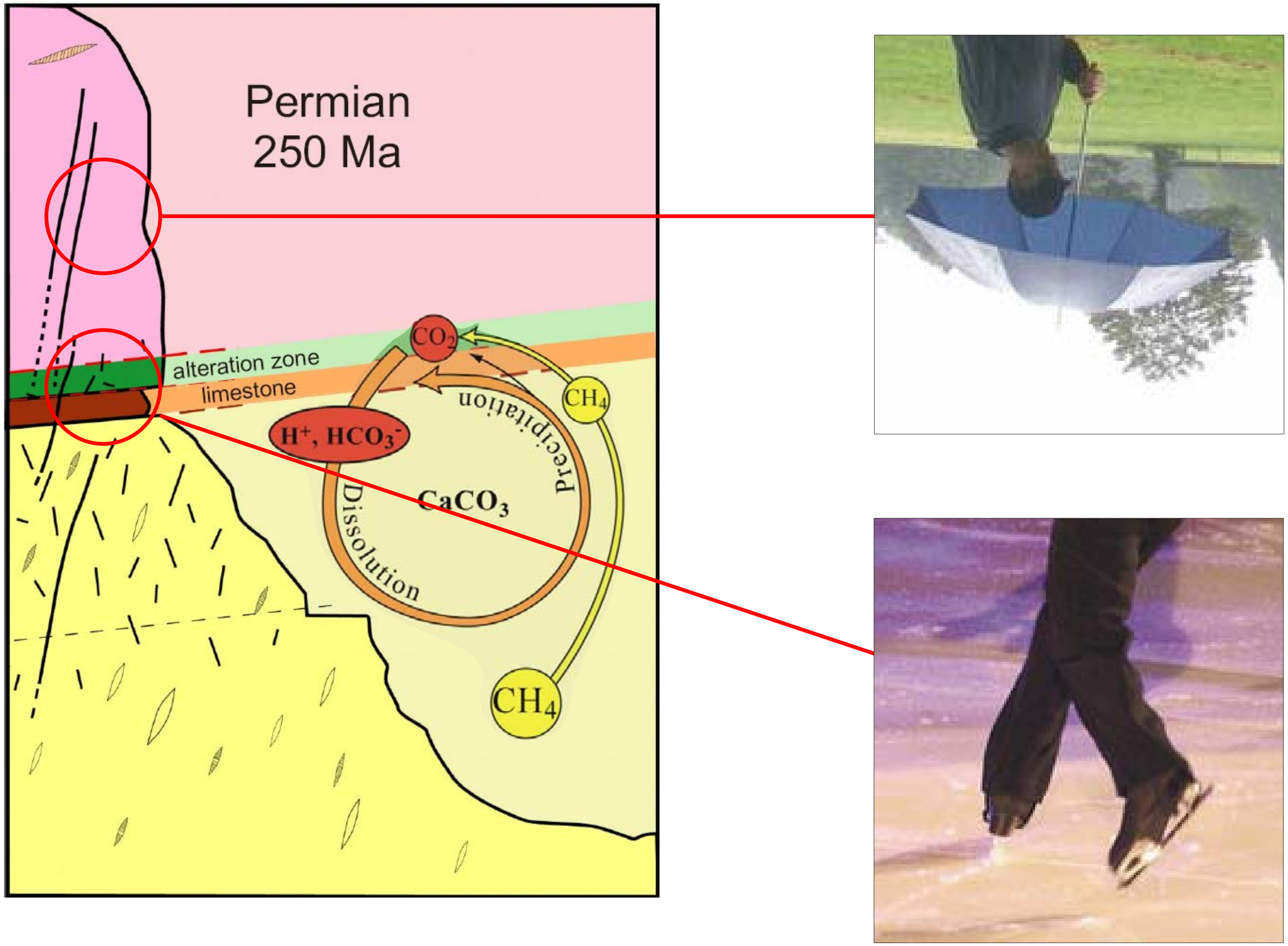
M. Burkhard, R. Abart et al.: Different isotope signatures across thrust plane:



The role of the fluid



Gliding on a "bed of overpressure"



Scientific conclusions

- Among many nicely exposed thrust planes, the Glarus overthrust is exceptional with respect to its quality of exposure, accessibility, and outstanding scientific clarity.

- The Glarus overthrust in the Swiss Tectonic Arena Sardona is the type locality of the geologic "nappe" concept and the reconnaissance of the importance of horizontal movements in geology.

- The Swiss Tectonic Arena Sardona is a unique example of discontinuous metamorphism at low grade.

- The Swiss Tectonic Arena Sardona has a well documented evolution and thus serves as a key tectonic element in the orogenic understanding of the European Alps.

- Latest research reveals how thrusting works along Glarus overthrust and again the Swiss Tectonic Arena Sardona serves as a leader in our fundamental understanding of geological processes.

Prof. Dr. Adrian Pfiffner

UNIVERSITÄT BERN

Outstanding Universal Value

and

Comparative Study:

Results

Outstanding Universal Value of Thrust Faults

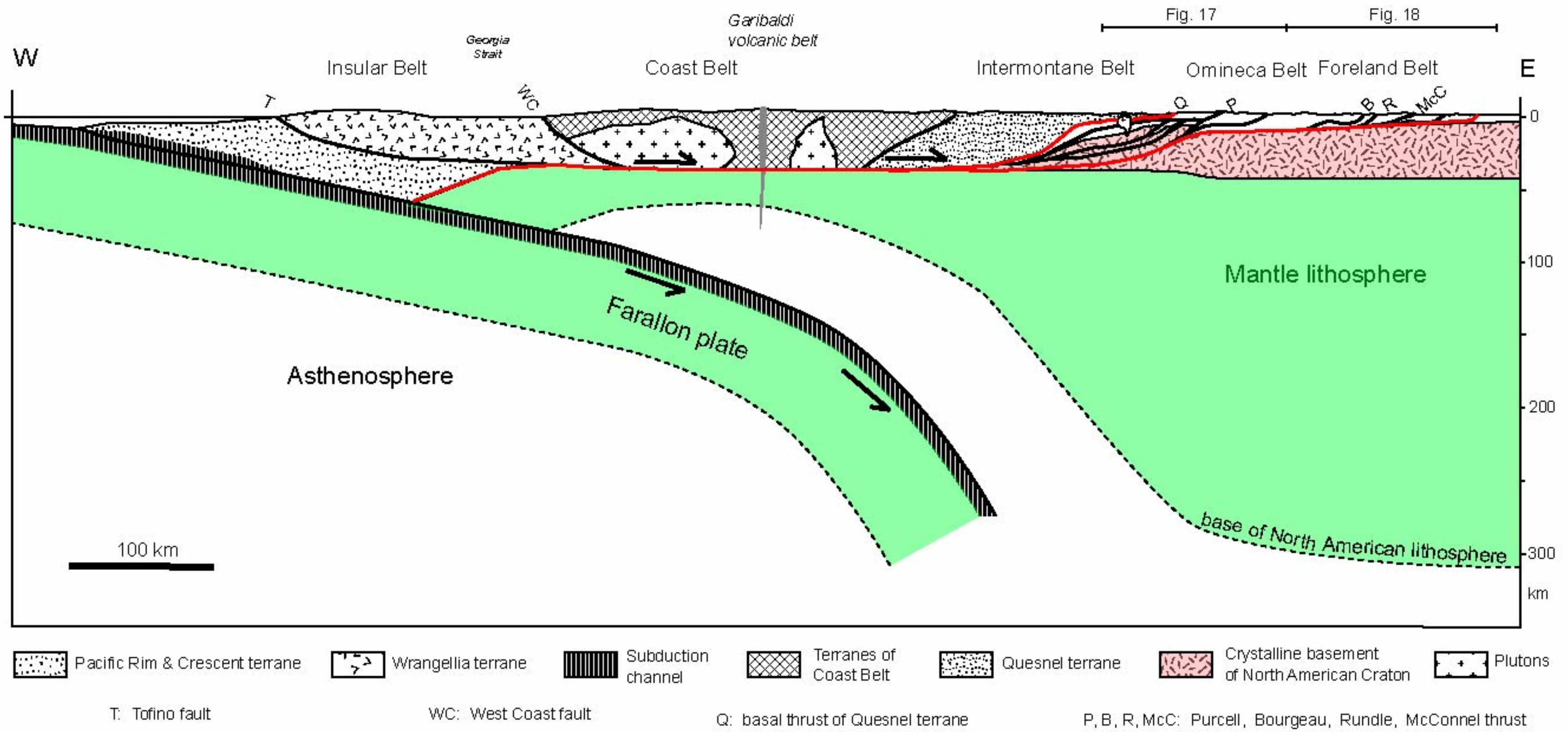
Thrust faults are faults in the Earth's crust where one rock unit is moved on top of another unit over distances of tens or hundreds of kilometers.

Thrust faults are a direct expression of the dynamics of convergent tectonic plates.

They are also directly responsible for the formation of mountain belts.

Their outstanding universal value is based on the direct relationship to plate tectonics and on the origin of mountain belts.

North American Cordillera



Based on the criteria

scientific value
scenic value
geomorphic expression
educational value

we arrived at the following ranking for the 28 thrust faults analyzed from all of the continents

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Mountain range	Thrust fault	Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking	
Western Alps / Provence	Roselend thrust	2	3	2	3	10	7	
	Digne thrust	3	3	1	2	9	6	
Swiss Alps	Glarus thrust	1	1	1	1	4	**1**	1
	Drusberg-S ntis thrust	2	1	2	3	8	5	
	Axen thrust	2	2	2	3	9	6	
	Wildhorn thrust	2	2	2	3	9	6	
	Morcles & Doldenhorn thrusts	2	3	3	3	11	8	
	Base Pr˘alpes M˘dianes	1	2	2	2	7	4	
	Matterhorn / Base Austroalpine	1	1	2	2	6	**3**	3
	R tikon / Base Austroalpine	1	1	3	3	8	5	
	Engadine / Base Austroalpine	1	2	3	3	9	6	
Eastern Alps / Austria	Inntal thrust	3	3	2	3	11	8	
	Hohe Tauern / Penn &Austroalpine	1	2	3	2	8	5	
Pyrenees	Gavarnie thrust	2	1	2	2	7	4	
Caledonides	Moine thrust / Scotland	1	1	2	1	5	**2**	2
	Jotun thrust / Bygdin, Norway	1	2	2	2	7	4	
Himalayas	Main Central thrust	1	2	3	3	9	6	
Atlas Mountains / Morocco	High Atlas & Anti-Atlas	3	3	3	3	12	9	
Naukluft Mountains	Namibia	3	3	3	3	12	9	
Andes	Western Cordillera Peru	2	1	2	3	8	5	
	Eastern Cordillera Peru	1	4	3	4	12	9	
	Subandine Zone Bolivia	2	2	3	3	10	7	
Rocky Mountains	Omineca Belt	1	3	3	2	9	6	
	Foreland Belt / Lewis thrust	1	1	2	2	6	**3**	3
	Livingstone thrust	2	1	1	2	6	**3**	3
Appalachians	Pine Mountain thrust	1	3	3	2	9	6	
Alice Springs / Australia	Arltunga nappe	1	3	3	3	10	7	
Southern Alps New Zealand	Southalpine fault	2	3	3	2	10	7	

Ranking:
1 = excellent
2 = very good
3 = good
4 = fair

The winners:

1 Glarus thrust in eastern Switzerland (sum of marks: 4)

2 Moine thrust in the Caledonides of Scotland (sum of marks: 5)

3 Three thrust faults ex-aequo (sum of marks: 6)
- Lewis thrust in the Foreland Belt (Rocky Mountains)
- Keystone thrust (Southern Rocky Mountains)
- Base of Austroalpine nappes in Matterhorn area

We had our evaluation checked by internationally recognized experts in the field: Prof. Jonas Kley, Germany
Prof. Steven Wojtal, U.S.A.

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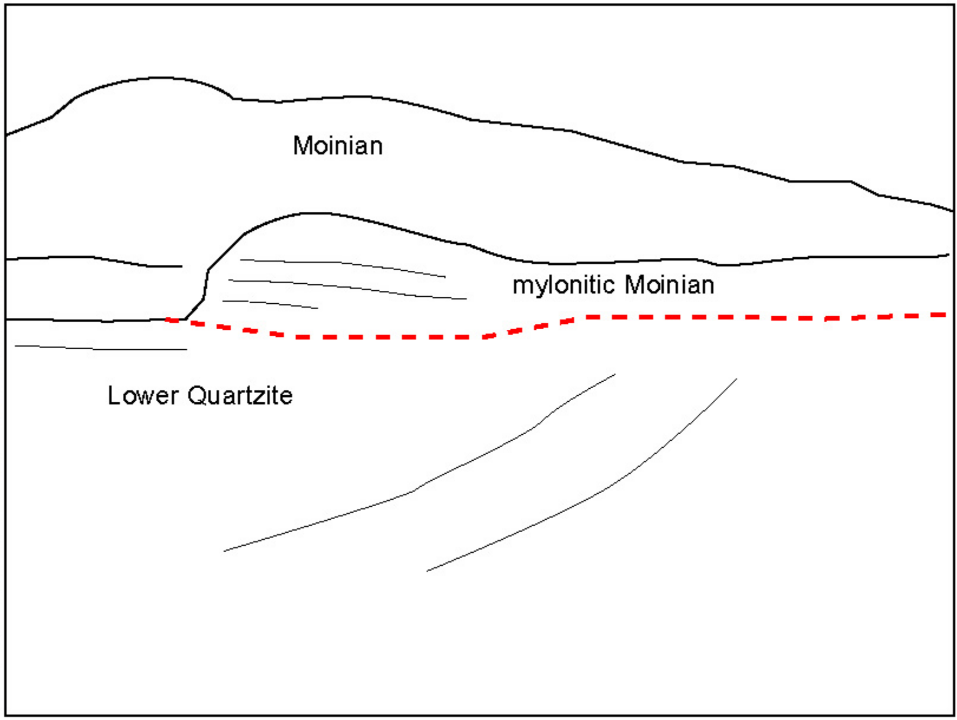
Glarus thrust in Pizol area

Glarus thrust at Grauberg and Tschingelhoren

Moine thrust at Loch Glencoul.



Crystalline basement rocks of the Moine thrust sheet overly Lower Quartzite and Lewisian basement rocks. The thrust contact is marked in the morphology as a flat surface.

Moine thrust at locality Knockan Crag. Crystalline basement rocks (Moinian) overly Paleozoic carbonates.

Photograph taken at the protected site showing a sharp thrust contact (shown as - - -).

Photograph taken some 2 km farther N. The thrust contact follows the river.

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Lewis thrust in the Rocky Mountains / Front Ranges, Canada

L

Lewis thrust (L)at Crowsnest Mountain, Alberta.
Devonian carbonates forming the Crowsnest Mountain overly Cretaceous sandstones (Photo by A. Pfiffner).

Keystone thrust west of Las Vegas, Nevada (Photo by K. Hamblin).

The Keystone thrust puts Paleozoic strata (dark) onto Jurassic sandstones (light).

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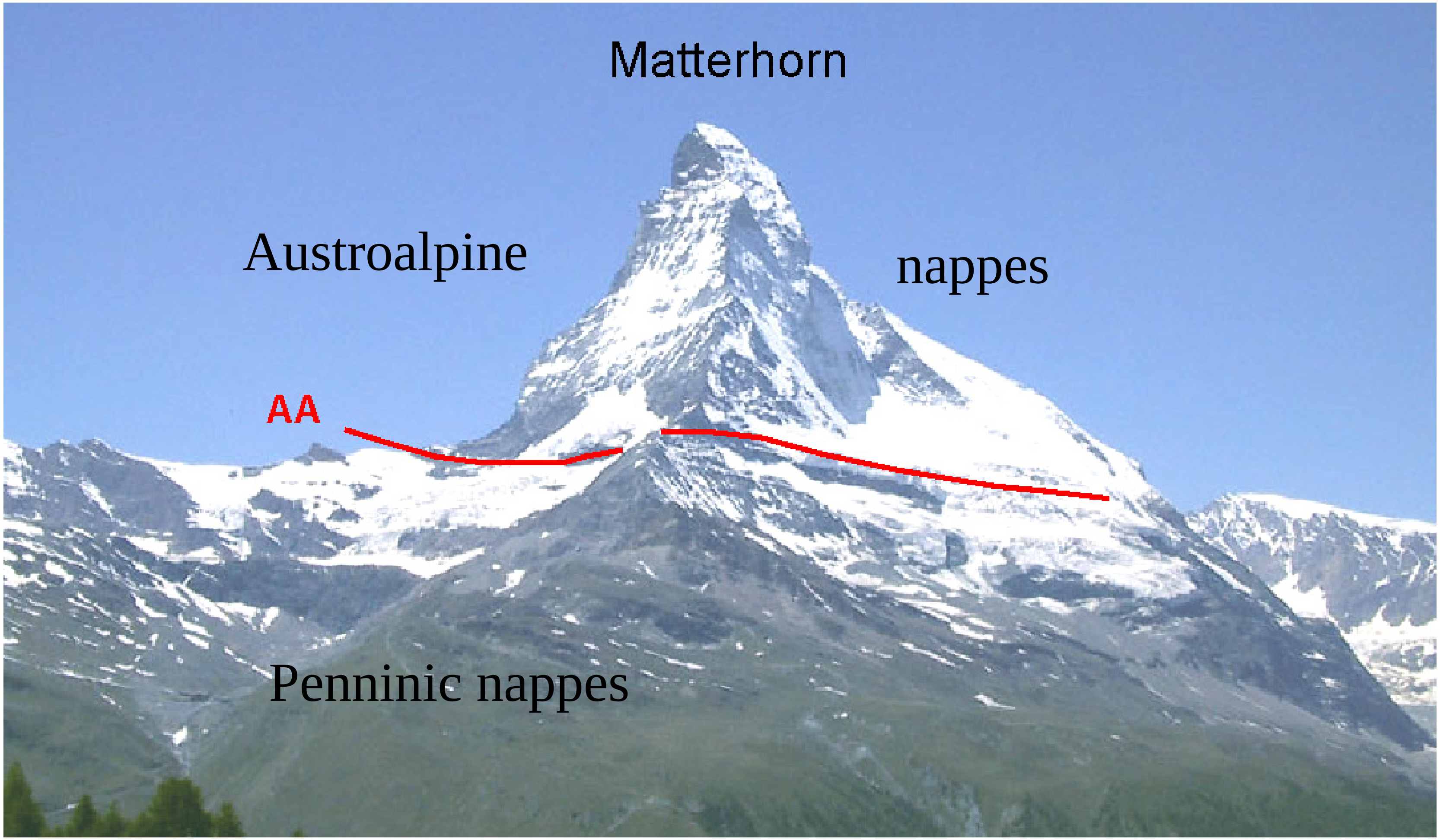
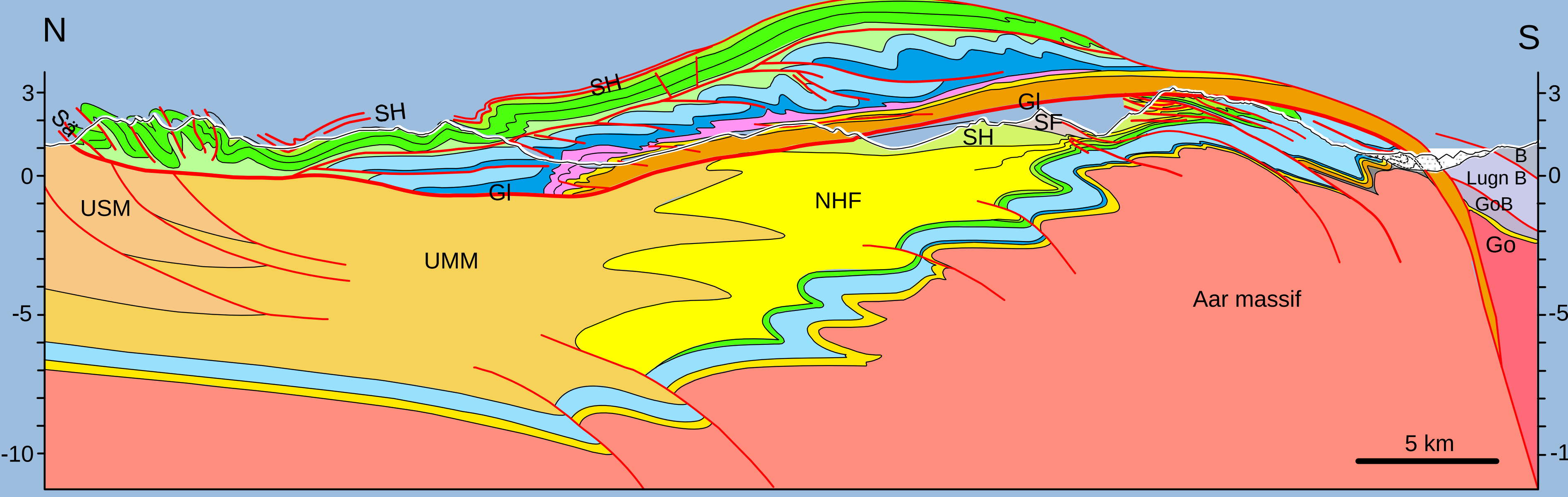


AA: basal thrust of Austroalpine nappes

Geological profile across the Helvetic zone of eastern Switzerland

drawn along km 735 of the Swiss national grid



Conclusions

We are convinced that

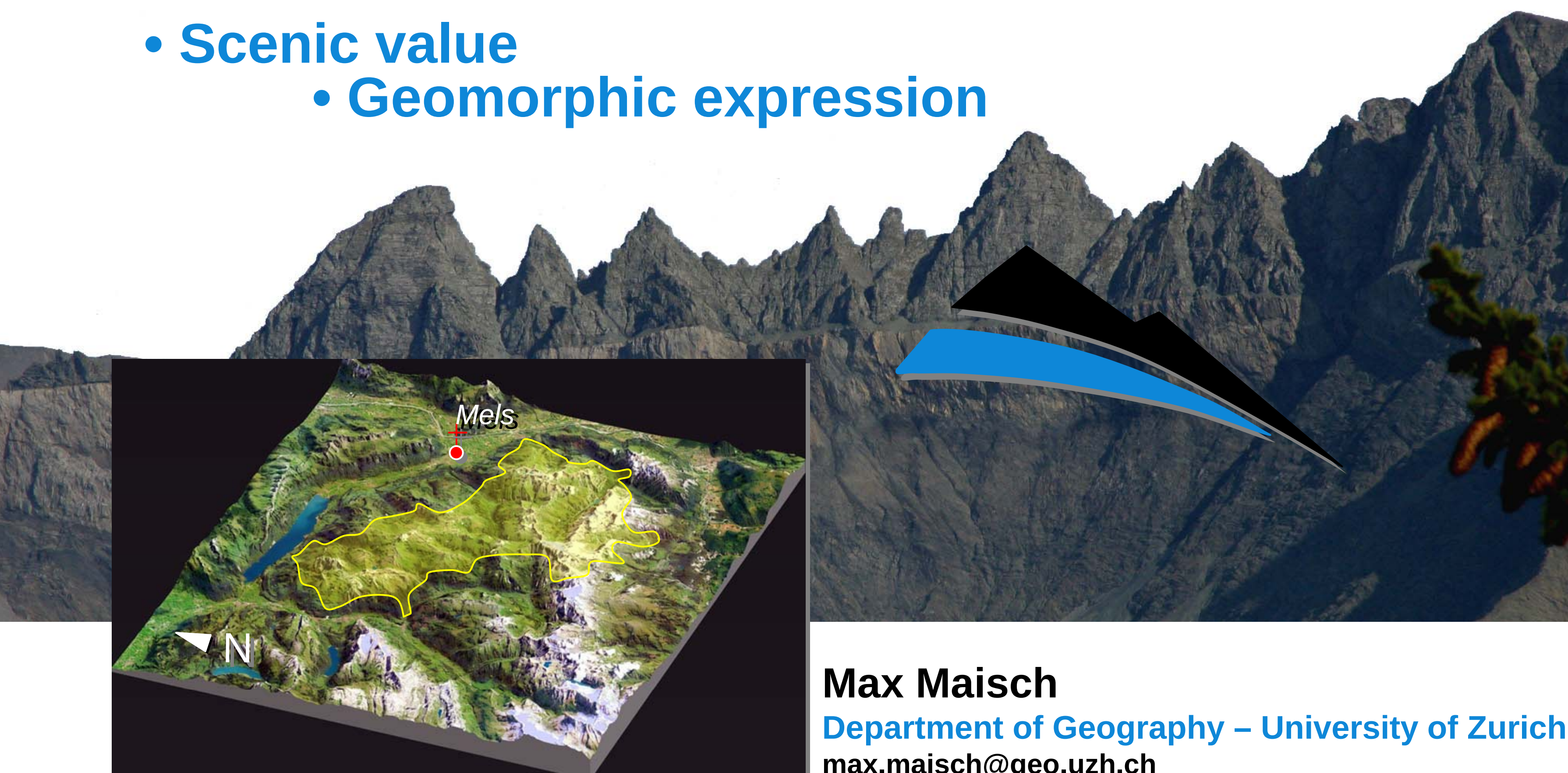
- *Thrust faults as such may be of Outstanding Universal Value*

We are moreover convinced that the Glarus thrust

- *is of Outstanding Universal Value*
- *ranks top amongst the best known spectacular thrust faults*
- *satisfies the criteria established by IUCN*
- *merits to be inscribed into the list of the World Heritage*

Swiss Tectonic Arena Sardona

- Scenic value
  - Geomorphic expression



Max Maisch
Department of Geography – University of Zurich
max.maisch@geo.uzh.ch

Swiss Tectonic Arena Sardona

- **Scenic value**
  - **Geomorphic expression**

(6) **natural beauty** of the thrust fault
(7) **beauty** and **quality** of the **structures** beneath and above the thrust fault
(8) **three-dimensionality** of exposure

(9) **geomorphic expression** of the thrust fault in the landscape
(10) presence of **spectacular** and **visually striking phenomena**

Swiss Tectonic Arena Sardona: from space to Earth...

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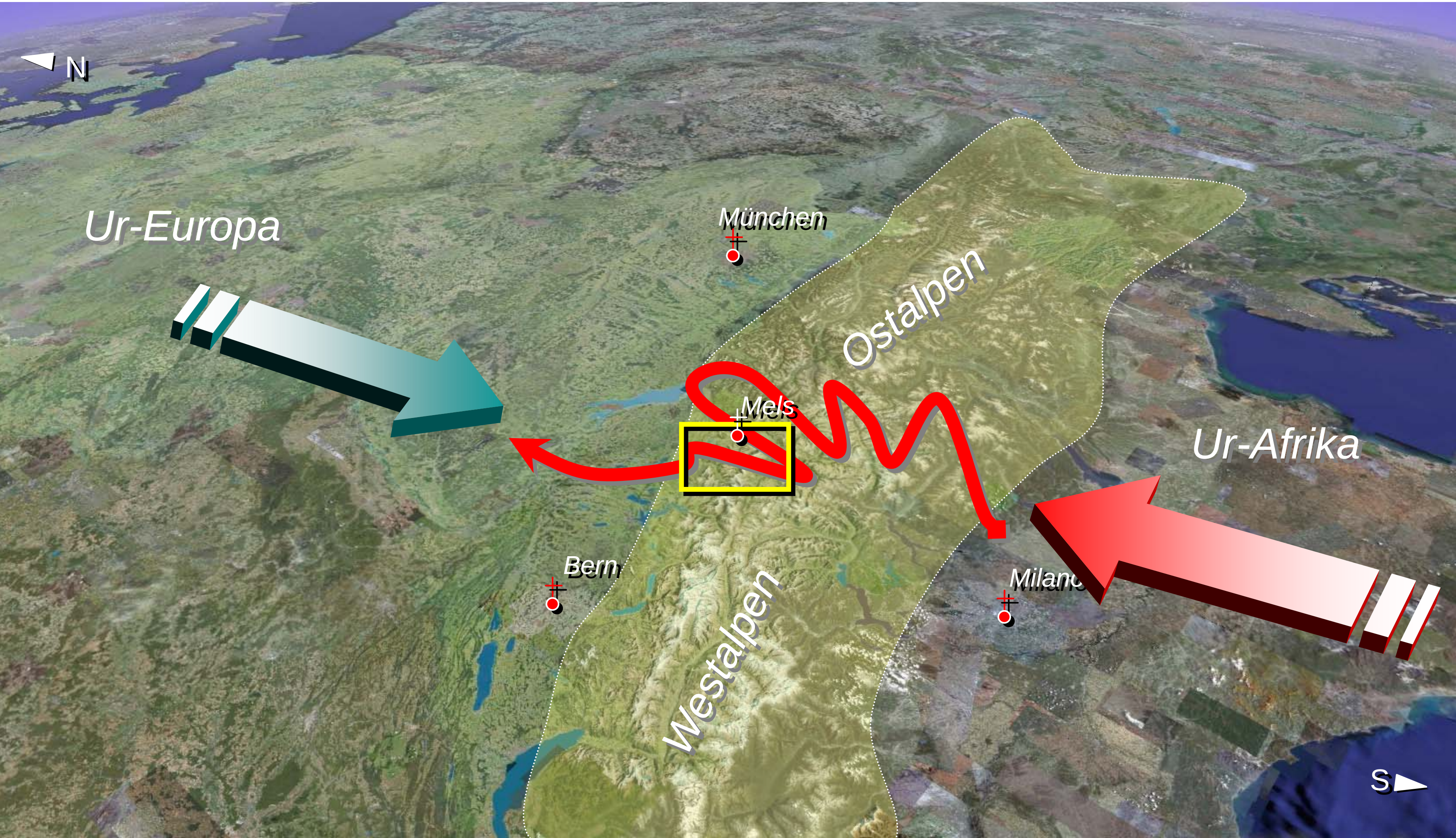

Swiss Tectonic Arena Sardona: topographic view

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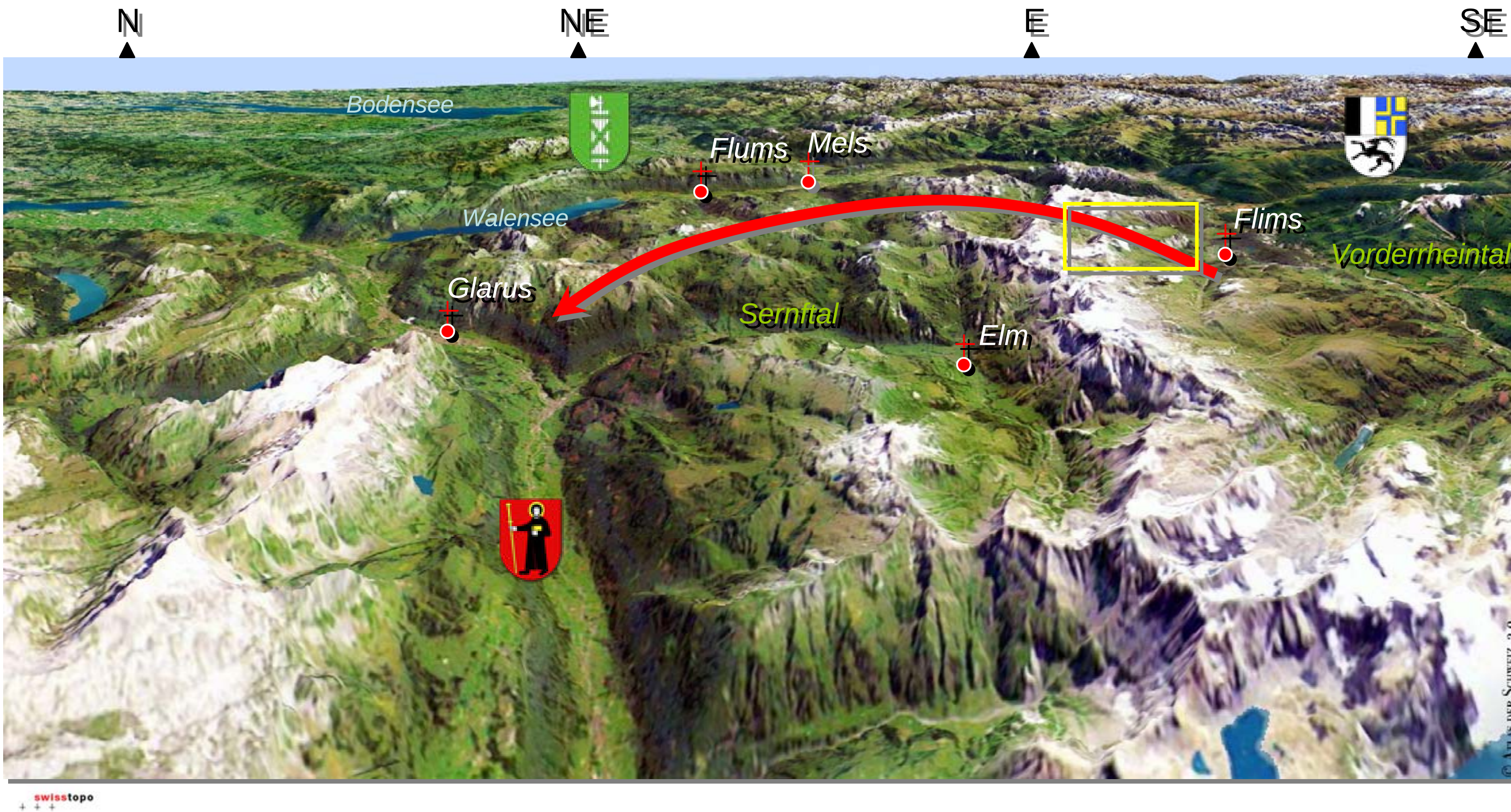
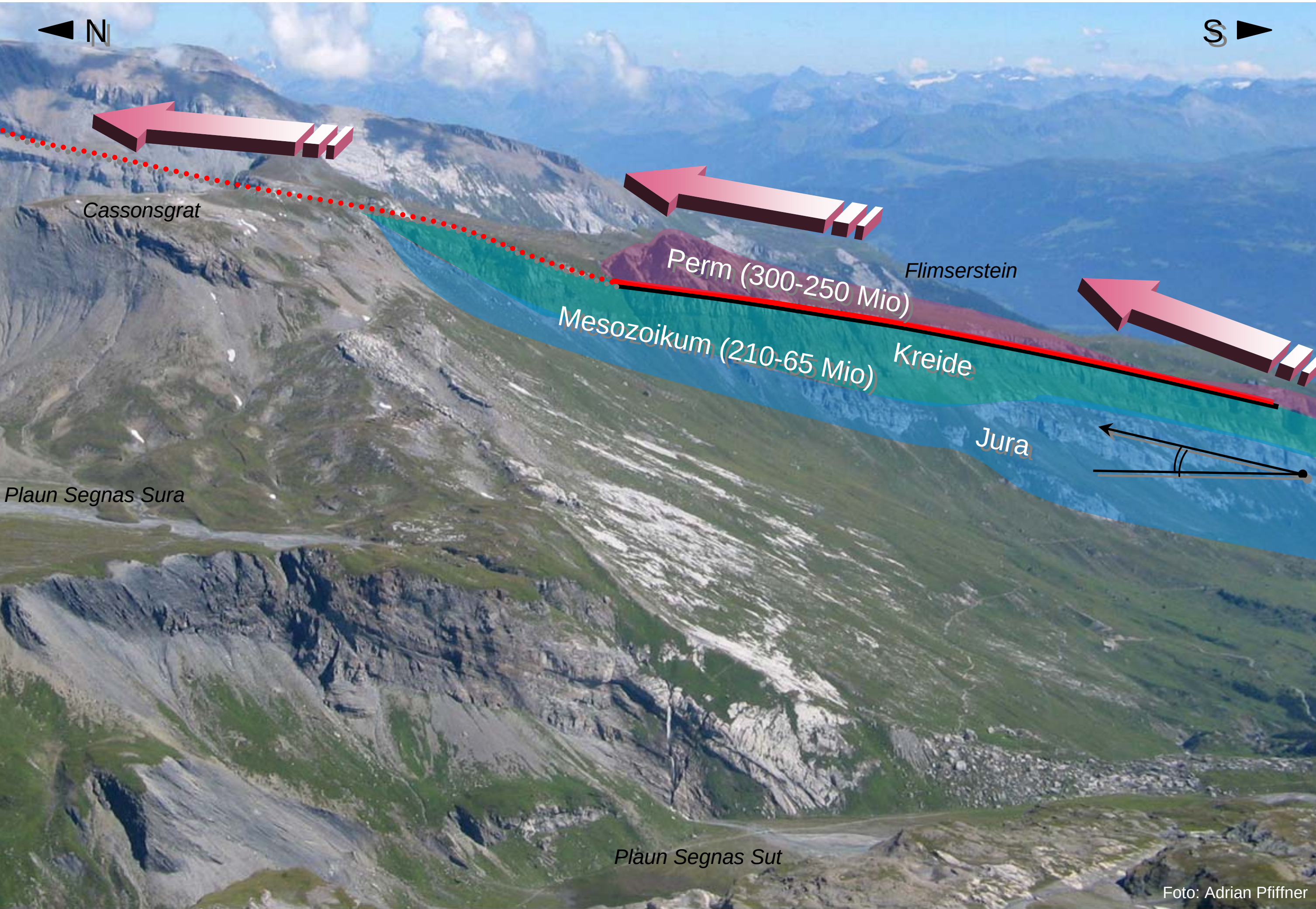


Glarus overthrust: the magic line



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Glarus overthrust

Swiss Tectonic Arena Sardona: topographic view

Swiss Tectonic Arena Sardona
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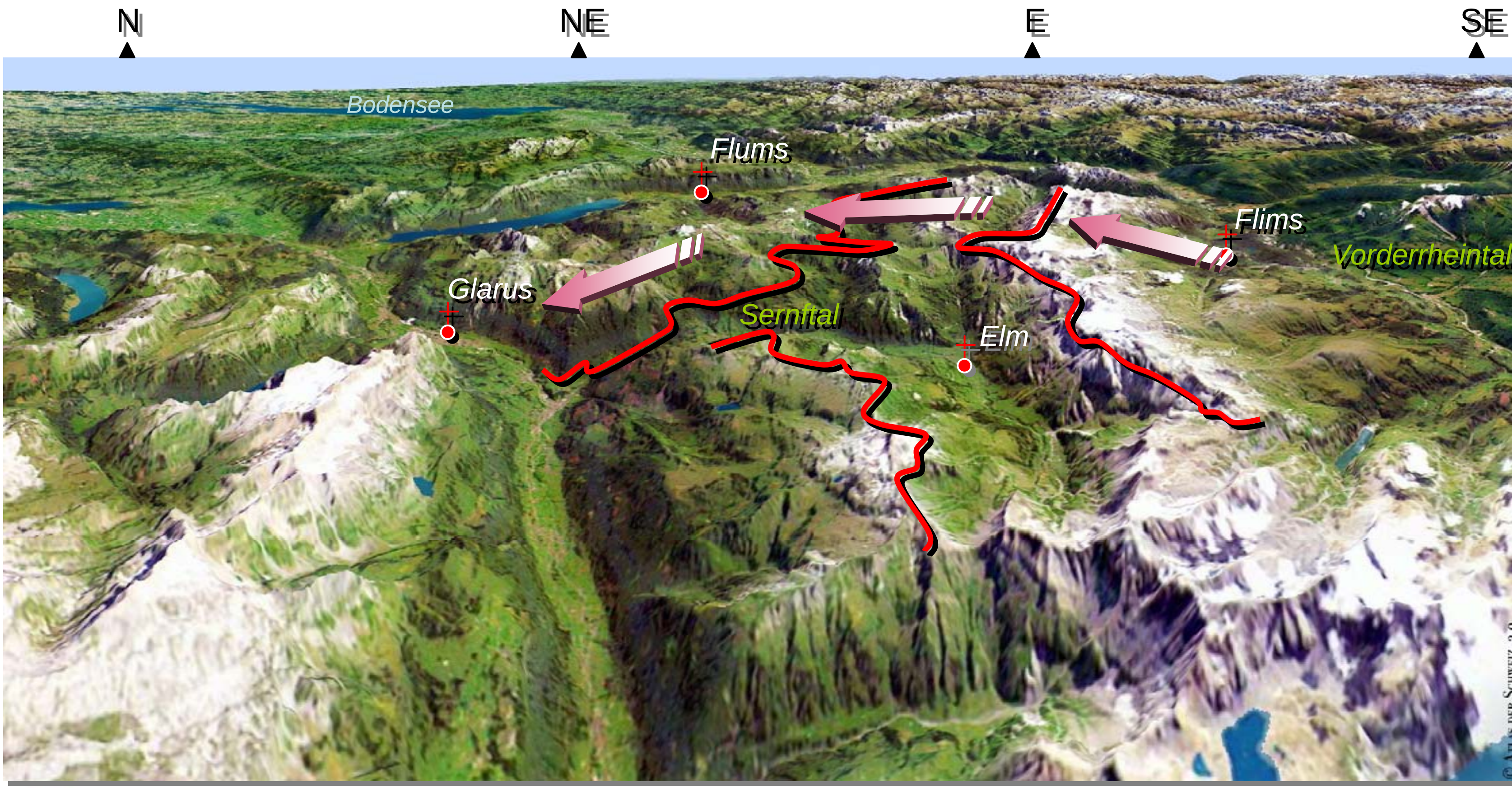

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Swiss Tectonic Arena Sardona: geologic overview

Swiss Tectonic Arena Sardona
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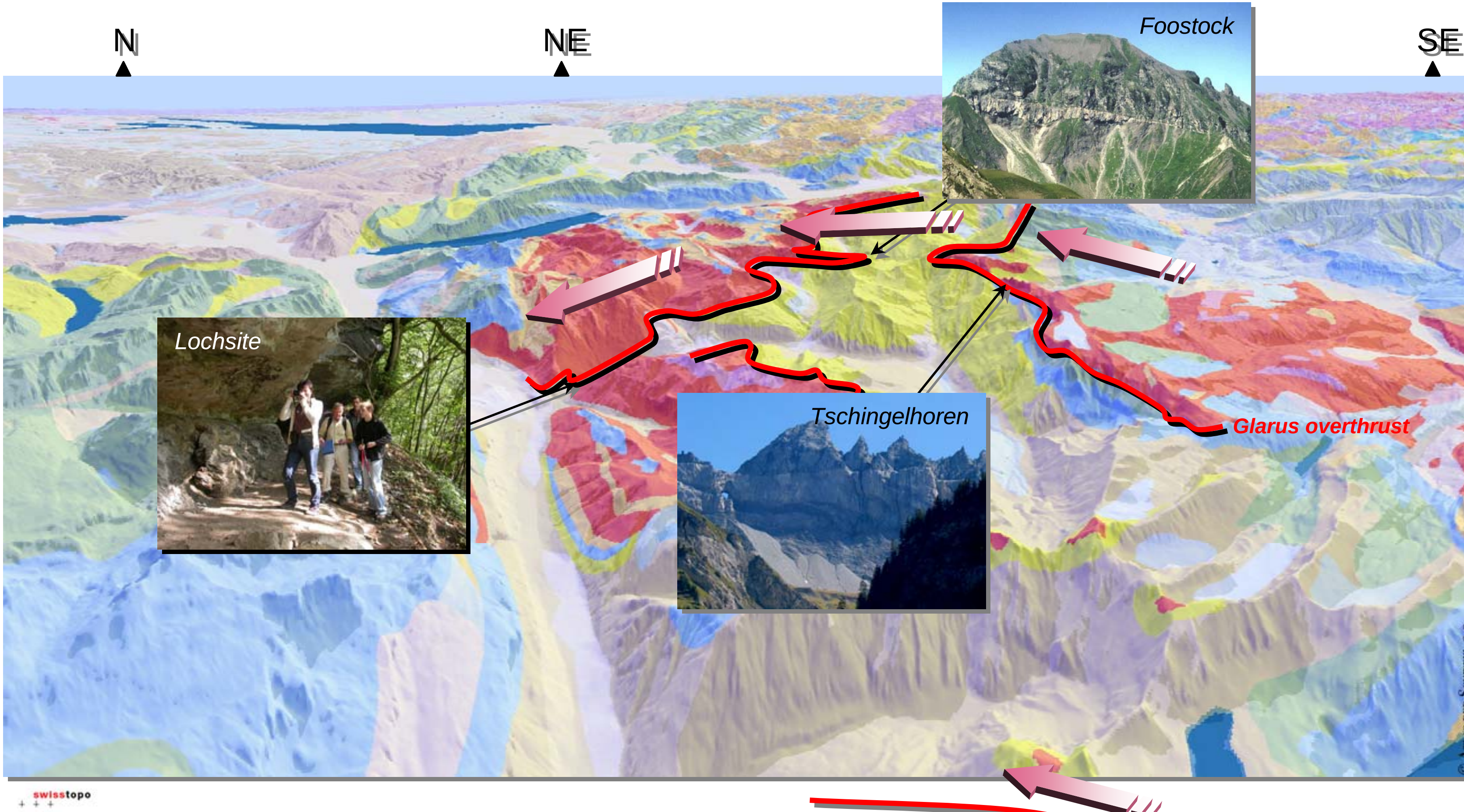

Tertiär (50 - 35 Mio)

Kreide (140 - 65 Mio)

Jura (210 - 140 Mio)

Perm (250 - 300 Mio)

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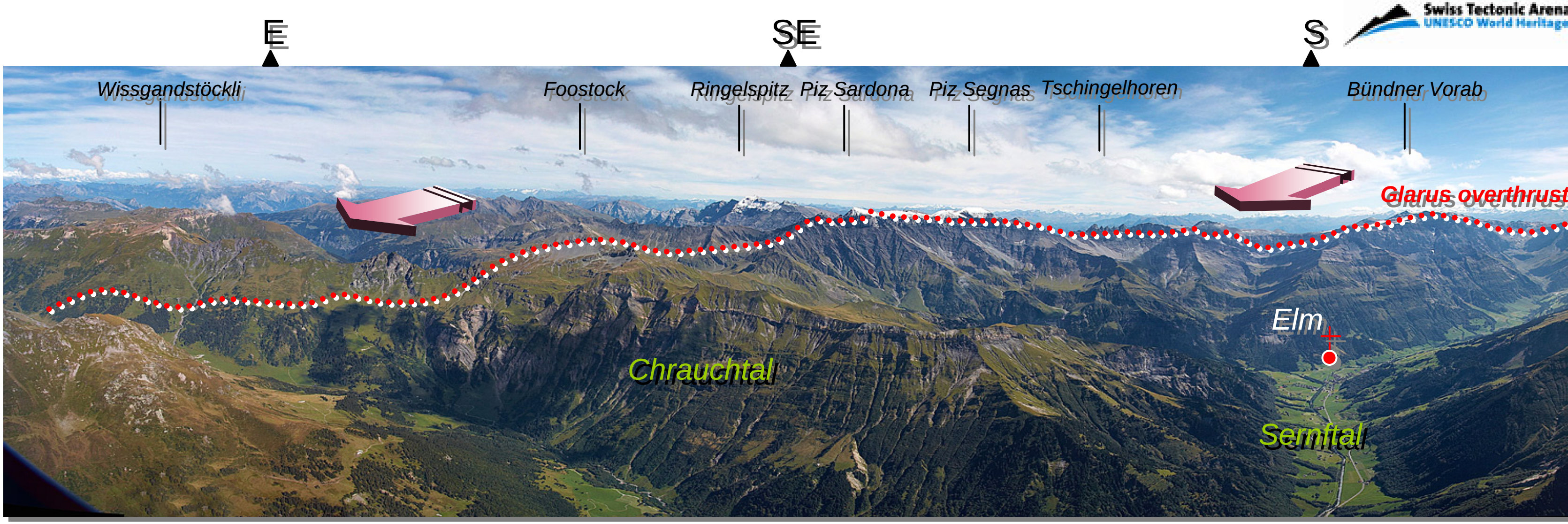

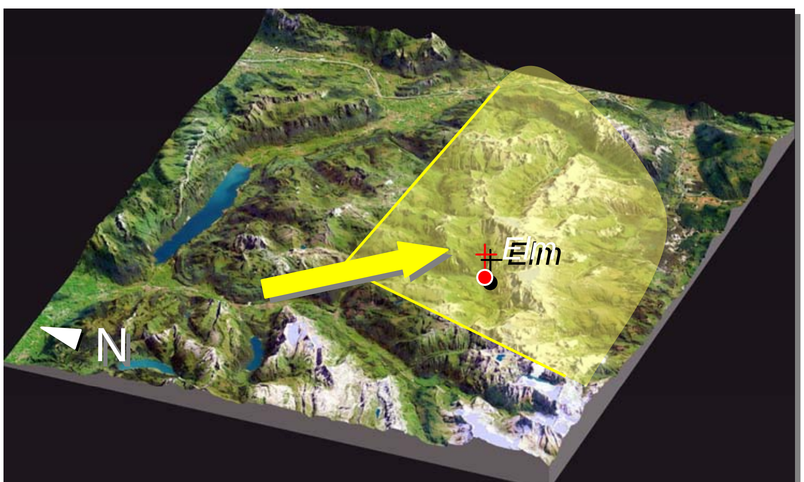

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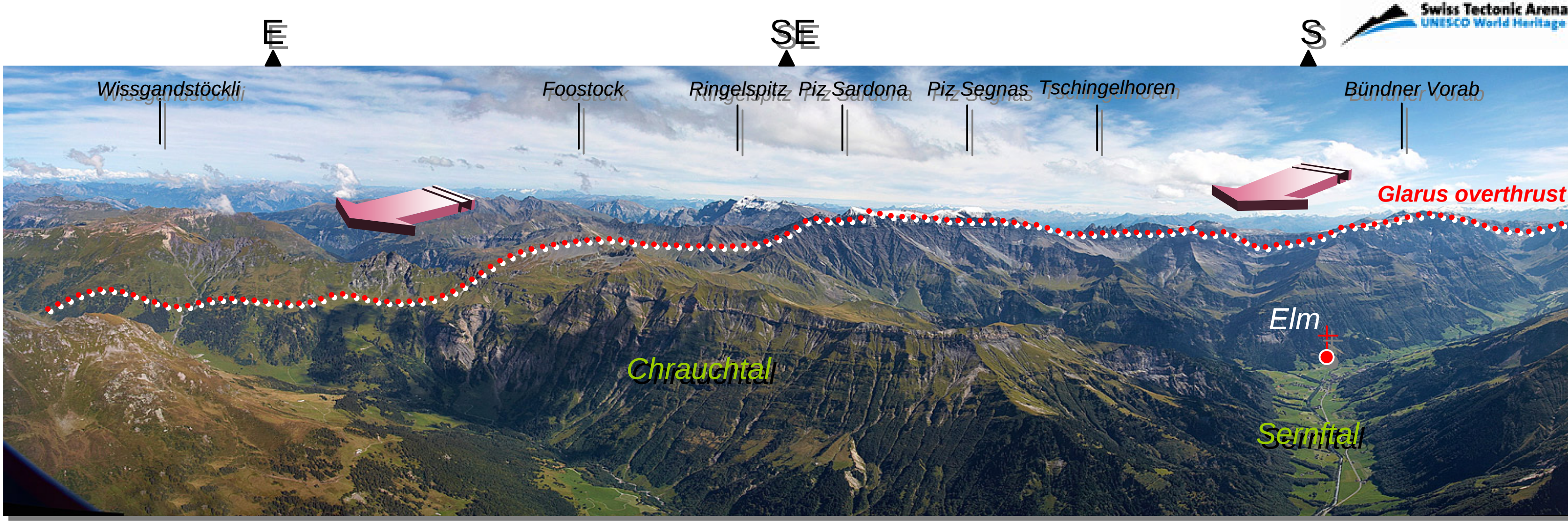

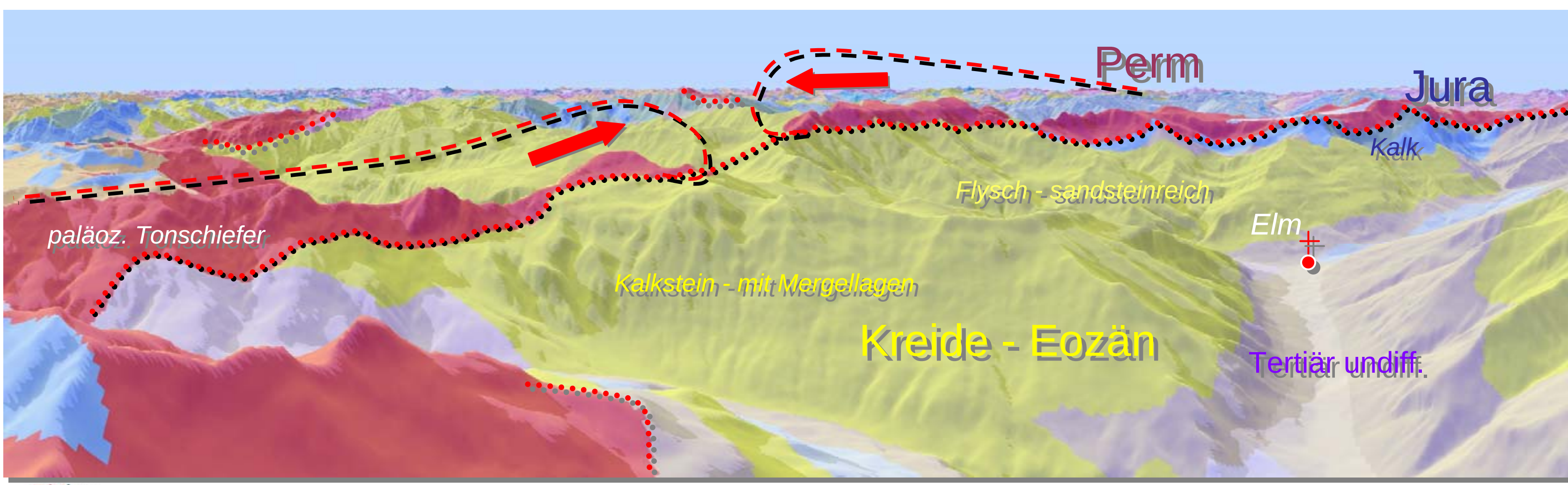

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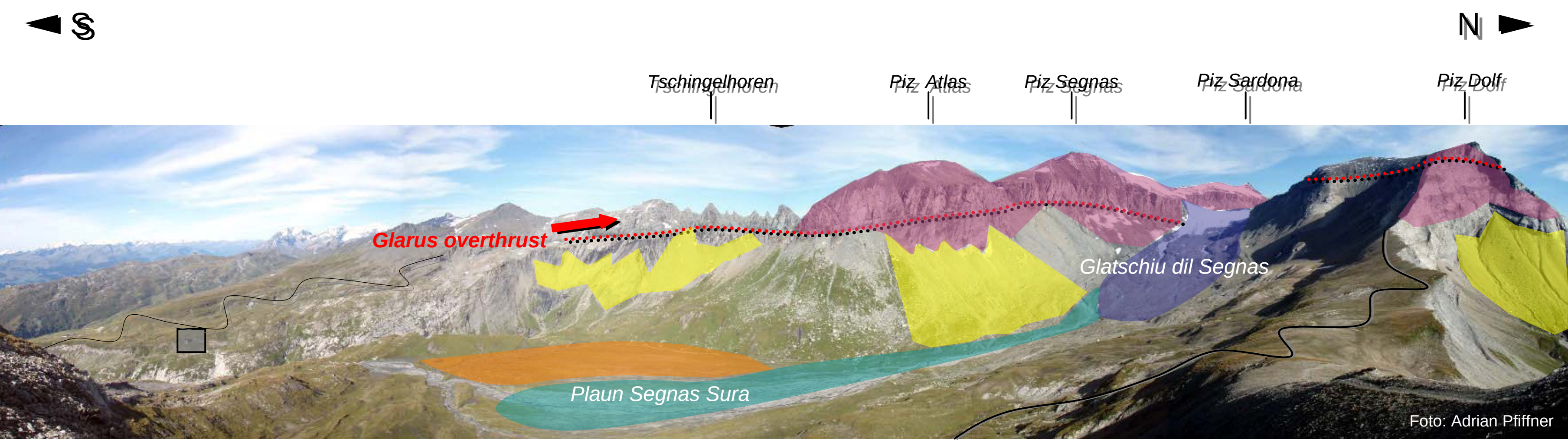
Swiss Tectonic Arena Sardona: sculpturing the landscape



Geomorphologic processes

• *glacial*	• *glaciers and snow*
• *periglacial*	• *permafrost, solifluction*
• *fluvial*	• *rivers, hydrology*
• *gravitational*	• *gravity*
• *organic*	• *vegetation, peat bogs*
• *anthropogenic*	• *homo sapiens... –> geologists !*

Swiss Tectonic Arena Sardona: sculpturing the landscape

Swiss Tectonic Arena Sardona
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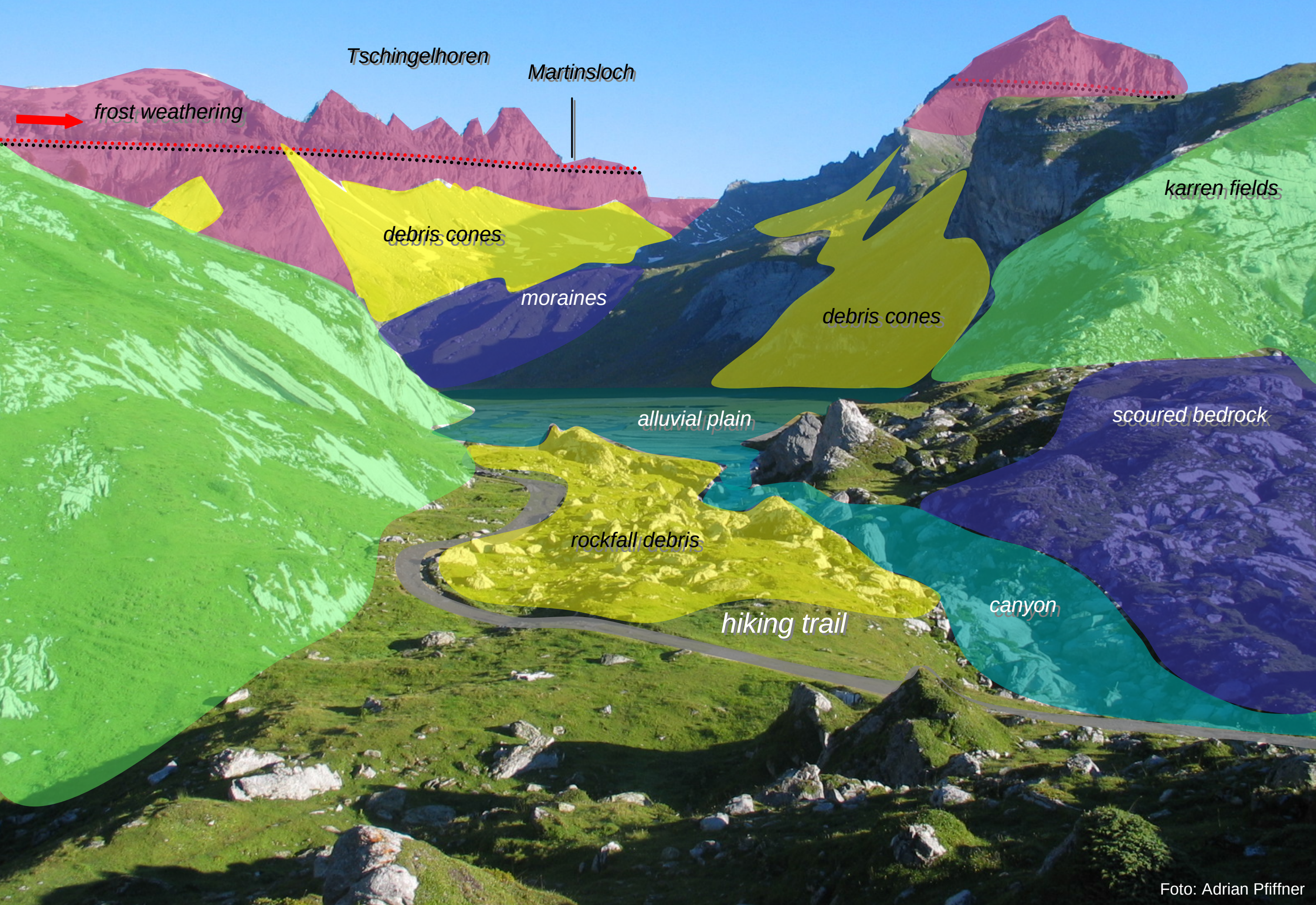
- glacial
- periglacial
- fluvial
- gravitational
- organic
- anthropogenic
- corrosive

Swiss Tectonic Arena Sardona: sculpturing the landscape

Swiss Tectonic Arena Sardona
UNESCO World Heritage Candidate

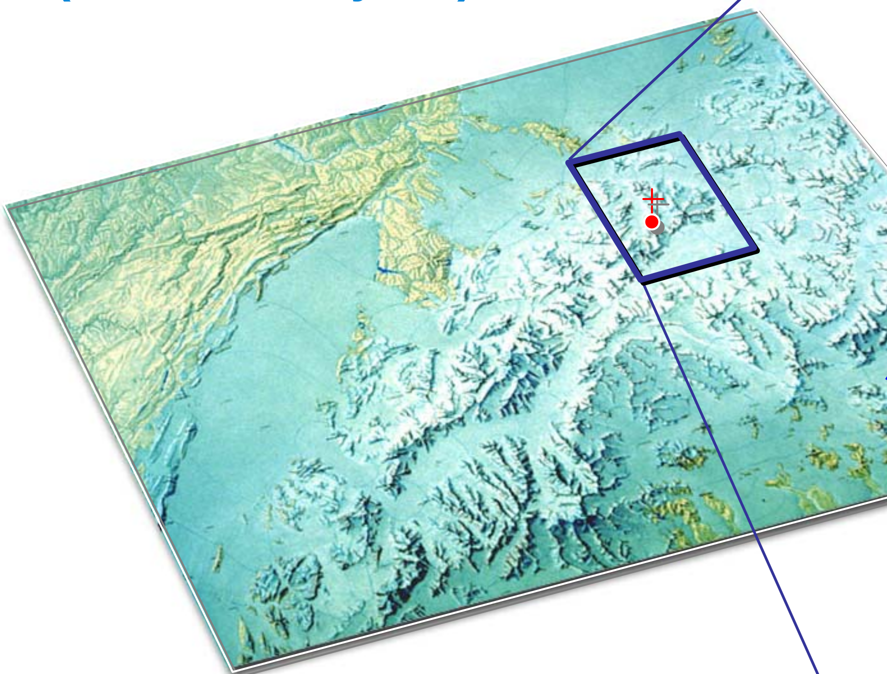


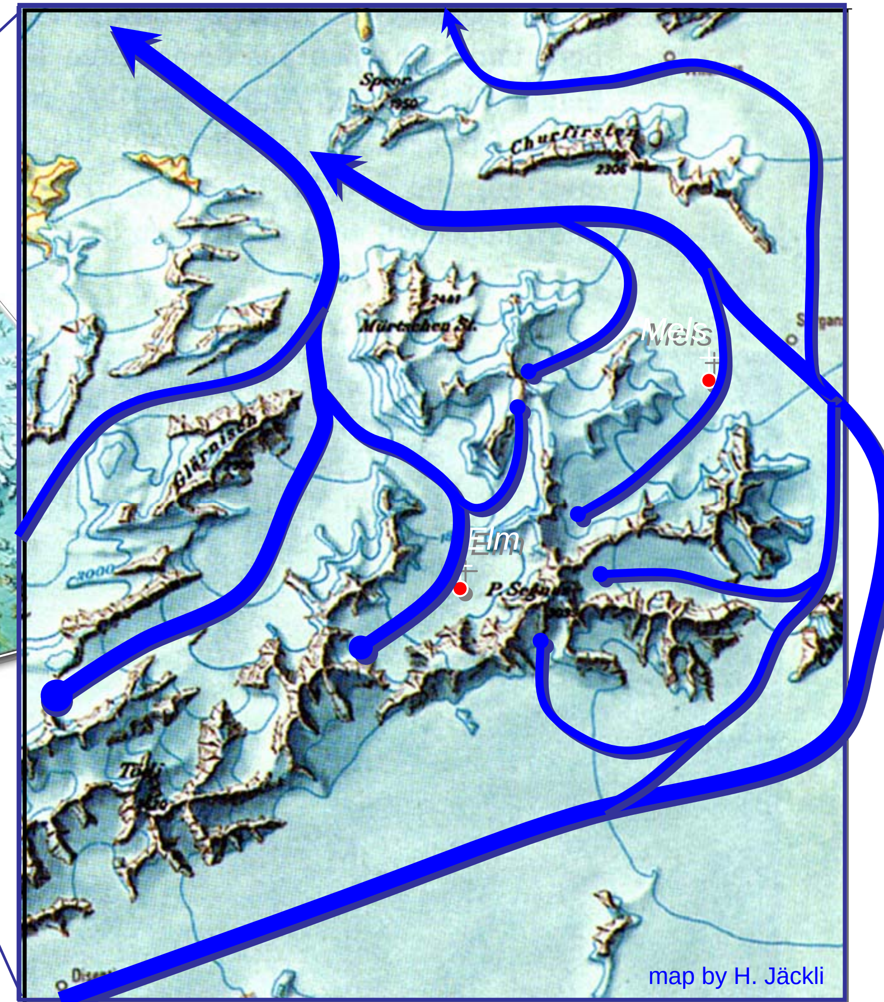
Glarus overthrust

- glacial
- periglacial
- fluvial
- gravitational
- organic
- anthropogenic
- corrosive

Swiss Tectonic Arena Sardona: pleniglacial landscape

The last glacial maximum
(LGM 25‘000 y BP)





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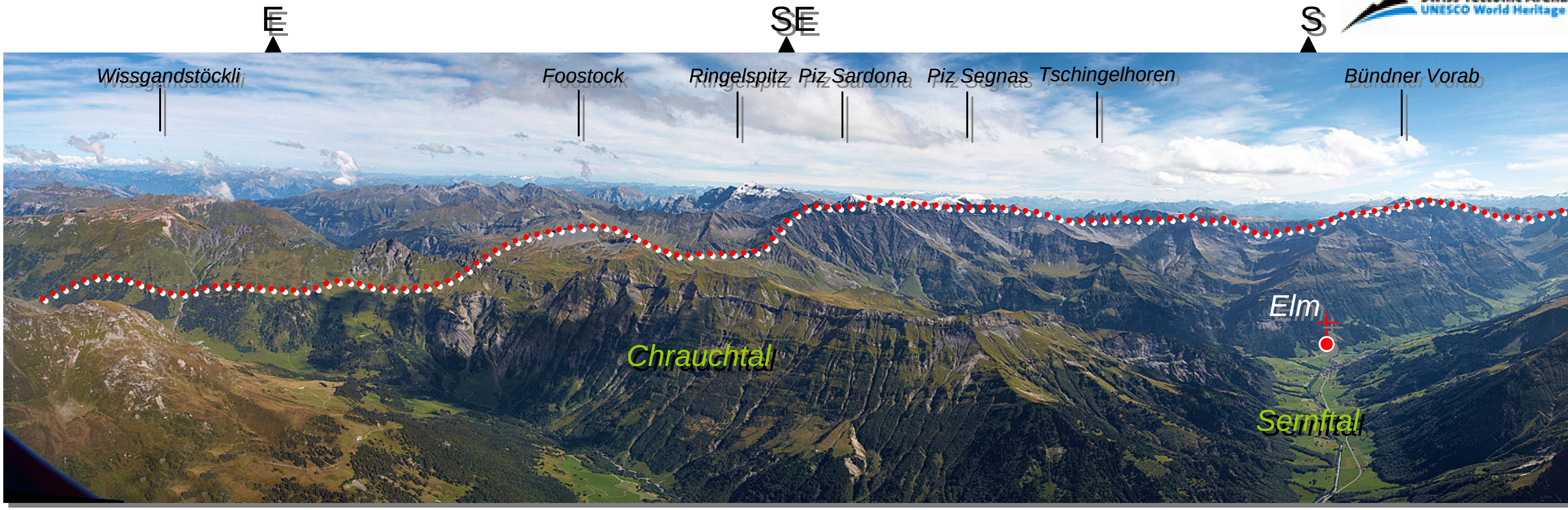

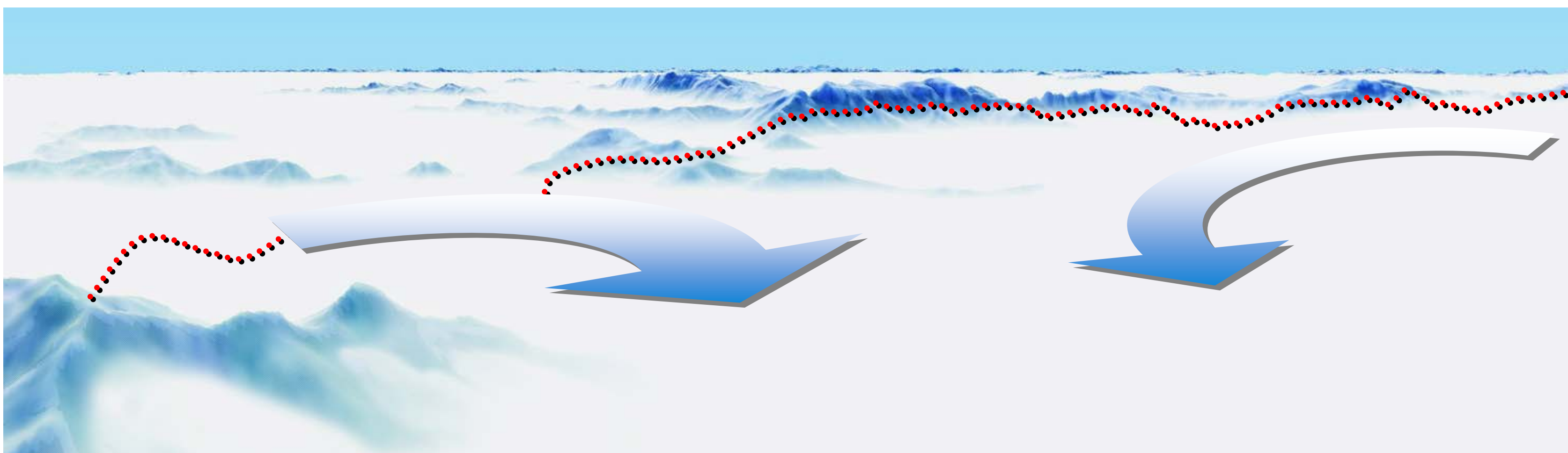

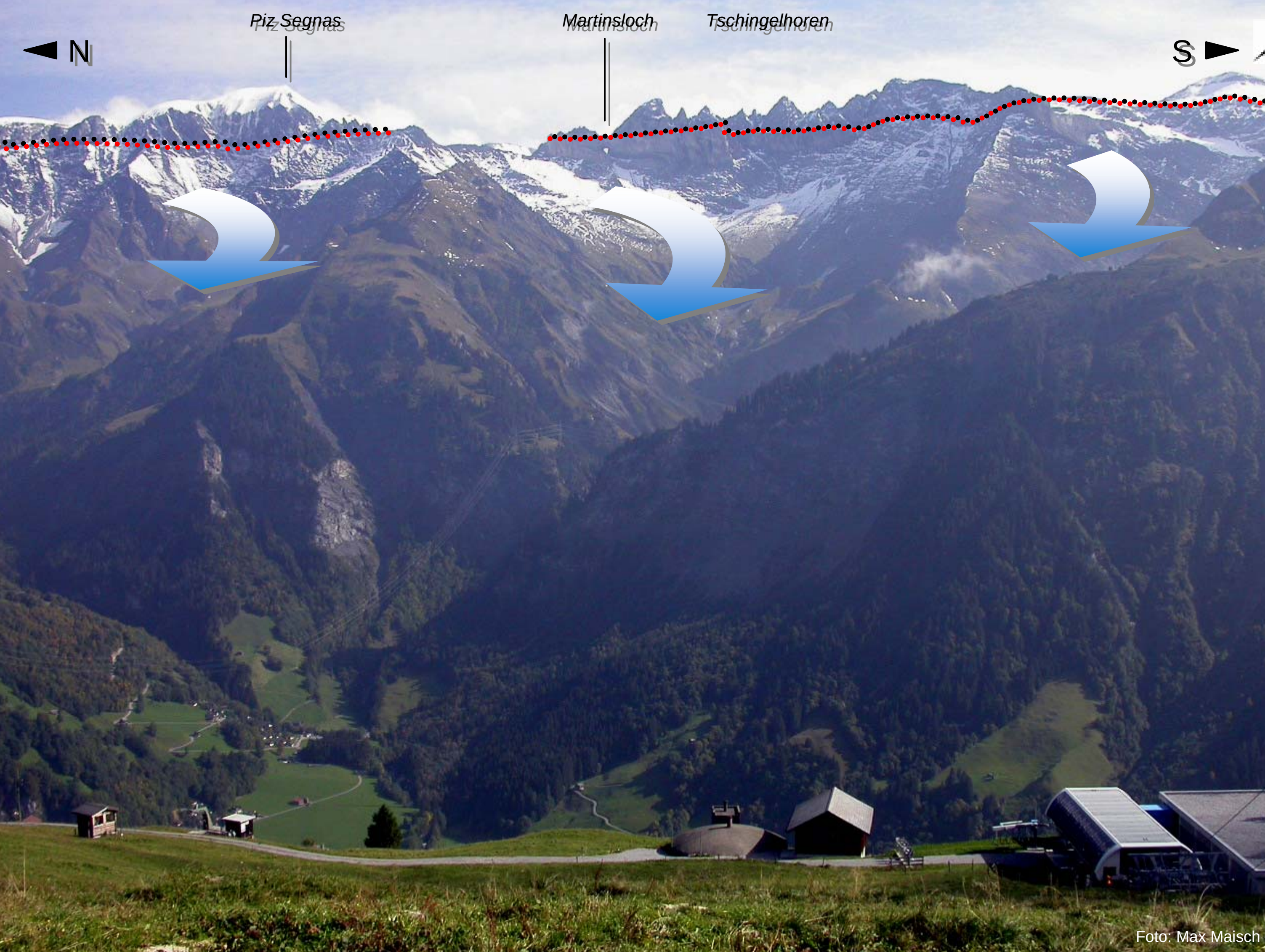

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Swiss Tectonic Arena Sardona: Verrucano erratics

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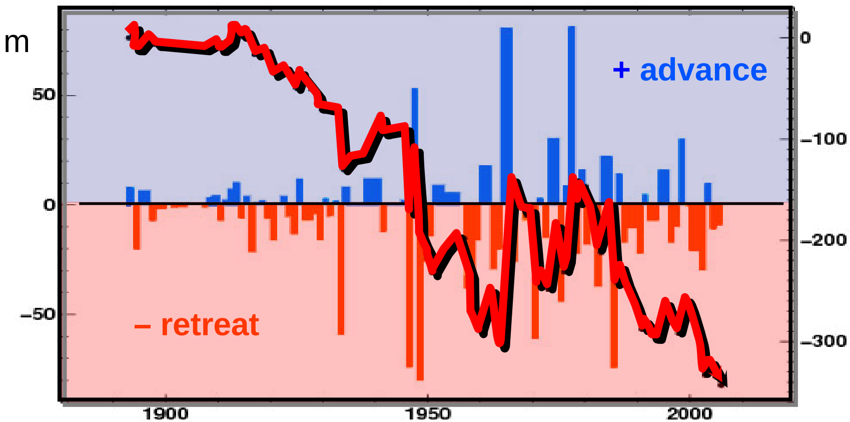
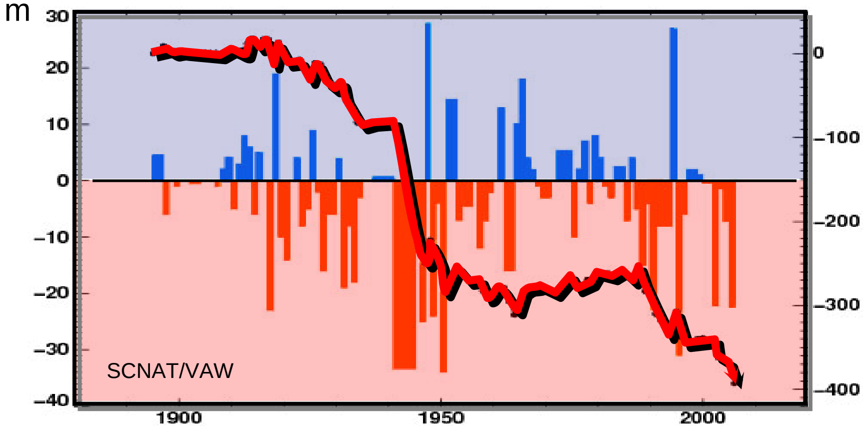
gravel pit Gossau ZH


Fotos: MM

Swiss Tectonic Arena Sardona: the signal of climate warming





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Sardonagletscher

Ranking of thrust faults

		Scientific value	Scenic value	Geomorphic expression	Educational value	sum of rankings	relative ranking
Western Alps / Provence	Roselend thrust	2	3	2	3	10	7
	Digne thrust	3	3		2	9	6
Swiss Alps	Glarus thrust	1			1	4	1
	Drusberg-Säntis thrust	2		2	3	8	5
	Axen thrust	2	2	2	3	9	6
	Wildhorn thrust	2	2	2	3	9	6
	Morcles & Doldenhorn thrusts	2	3	3	3	11	8
	Base Préalpes Médianes	1	2	2	2	7	4
	Matterhorn / Base Austroalpine	1		2	2	6	3
	Rätikon / Base Austroalpine	1		3	3	8	5
	Engadine / Base Austroalpine	1	2	3	3	9	6
Eastern Alps / Austria	Inntal thrust	3	3	2	3	11	8
	Hohe Tauern / Penn &Austroalpine	1	2	3	2	8	5
Pyrenees	Gavarnie thrust	2		2	2	7	4
Caledonides	Moine thrust / Scotland	1		2	1	5	2
	Jotun thrust / Bygdin, Norway	1	2	2	2	7	4
Himalayas	Main Central thrust	1	2	3	3	9	6
Atlas Mountains / Morocco	High Atlas & Anti-Atlas	3	3	3	3	12	9
Naukluft Mountains	Namibia	3	3	3	3	12	9
Andes	Western Cordillera Peru	2		2	3	8	5
	Eastern Cordillera Peru	1	4	3	4	12	9
	Subandine Zone Bolivia	2	2	3	3	10	7
Rocky Mountains	Omineca Belt	1	3	3	2	9	6
	Foreland Belt / Lewis thrust	1		2	2	6	3
	Livingstone thrust	2			2	6	3
Appalachians	Pine Mountain thrust	1	3	3	2	9	6
Alice Springs / Australia	Arltunga nappe	1	3	3	3	10	7
Southern Alps New Zealand	Southalpine fault	2	3	3	2	10	7

Swiss Tectonic Arena Sardona: the magic outdoor arena

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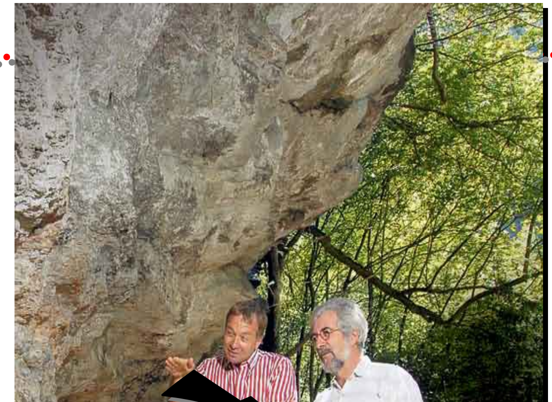
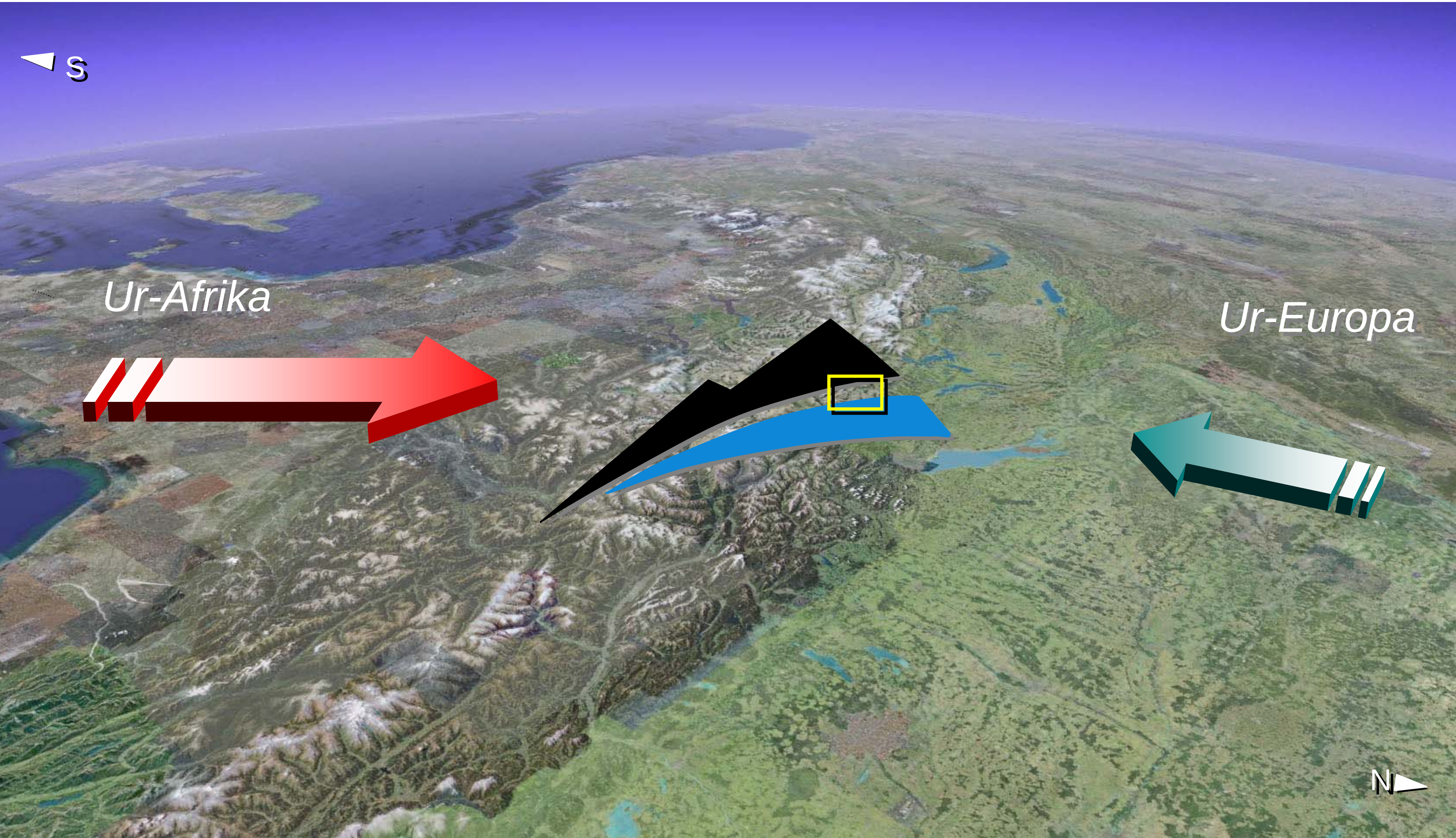
Scenic value + Geomorphic expression —> Nr. 1



Swiss Tectonic Arena Sardona: from Earth to space...



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Thank you !

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4th main criterion:

The Educational Value of the Glarus overthrust

IUCN Evaluation mission

September 19, 2007

Dr. Stefan Hesske,
Institute for Teacher Education, Section Geography
University of Zurich (Switzerland)

4th main criterion: The educational value

2 subcriteria:

- (11) **The historic geological context of the object**
- (12) **the potential of public awareness of the object**

11th subcriterion:

History of science

Hans Conrad Escher (1767-1823) described already 1807 the Glarus overthrust.

Tschingelhoren painted by H.C. Escher, 1812

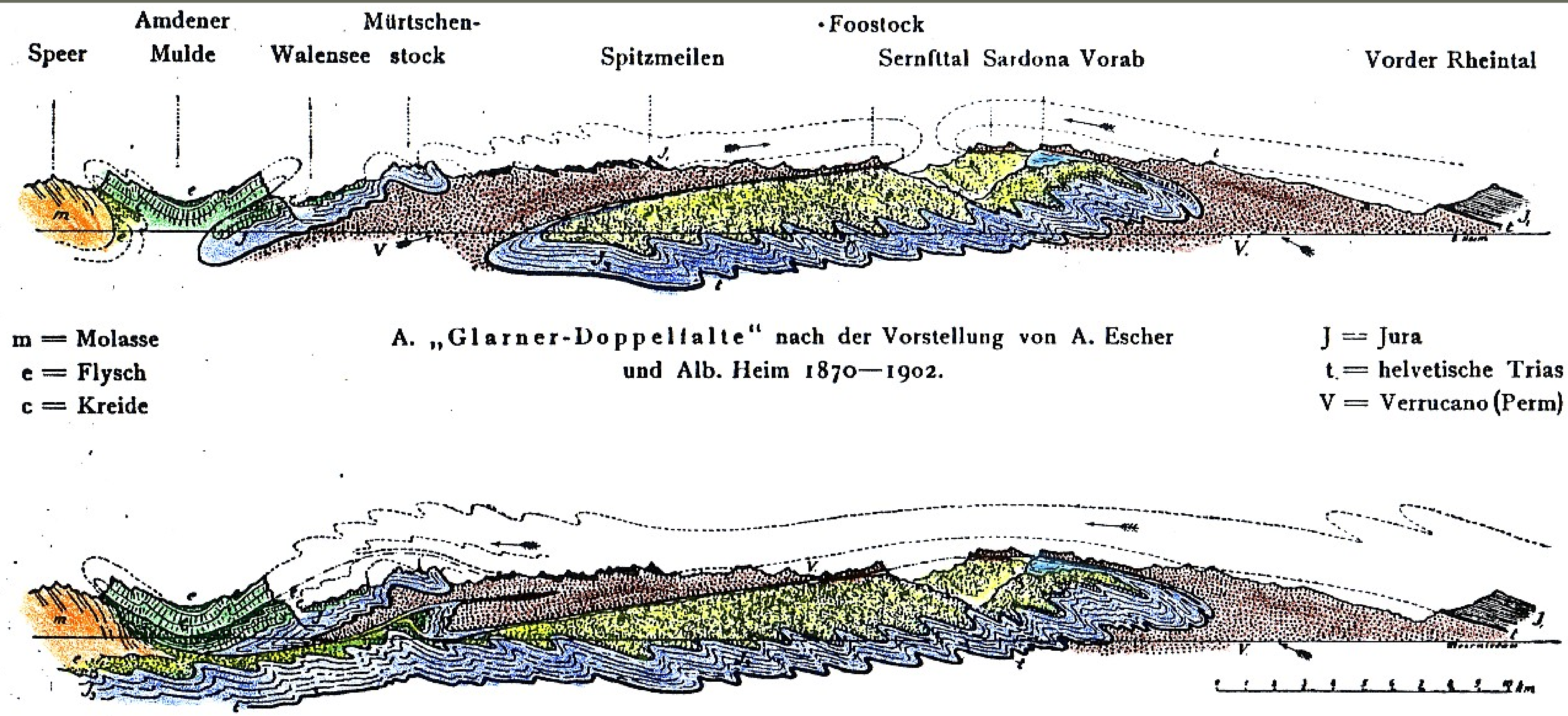
(11) The historic geological context

History of science:
The recognition of thrust faults

- Glarus overthrust (H.C. Escher 1807)
- Appalachians (Rogers & Rogers 1843)
- Moine thrust (Callaway, Lapworth 1883)
- Swiss Prealps (Schardt 1893)
- Scandinavia (Törnebohm 1896)

The famous controversy around the Glarus overthrust

after A. Escher & A. Heim (1870-1902)



A. „Glarner-Doppelfalte" nach der Vorstellung von A. Escher und Alb. Heim 1870—1902.

B. „Glarner-Deckfalten" nach der Vorstellung von M. Bertrand 1883 und E. Sueß 1892, angenommen von Alb. Heim 1903.

Fig. 5. Die Glarner-Deckfalten in schematischem Profil von N nach S nach älterer und neuerer Auffassung.

after Marcel Bertrand (1847-1907)

12th subcriterion:

The potential to stimulate public awareness

- accessibility of the site
- the policy of protection:
  - understanding for natural science and for mountain building
  - preservation for future generations

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Accessibility of the Glarus overthrust

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12th subcriterion:

Examples that meet subcriterion (12) include:

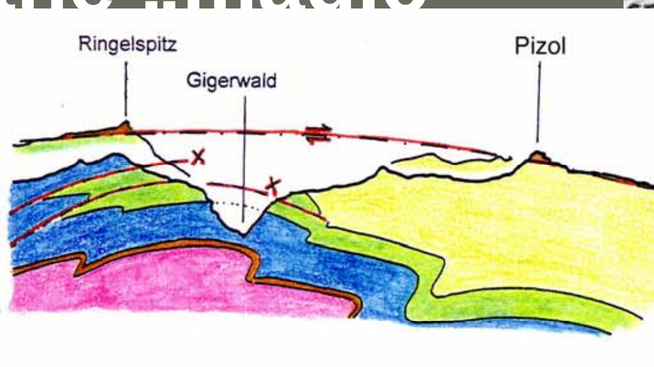
- Lewis thrust (Canada/USA)
- The Gavarnie thrust (France/Spain)
- Alpine Fault in Te Wahipounamu (New Zealand)
- the Glarus Overthrust (Switzerland)

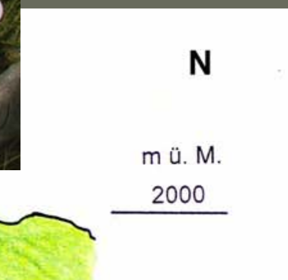
Exploring the „magic

Sargans/Wangs

Sandwich-Stratigraphy

Fürg



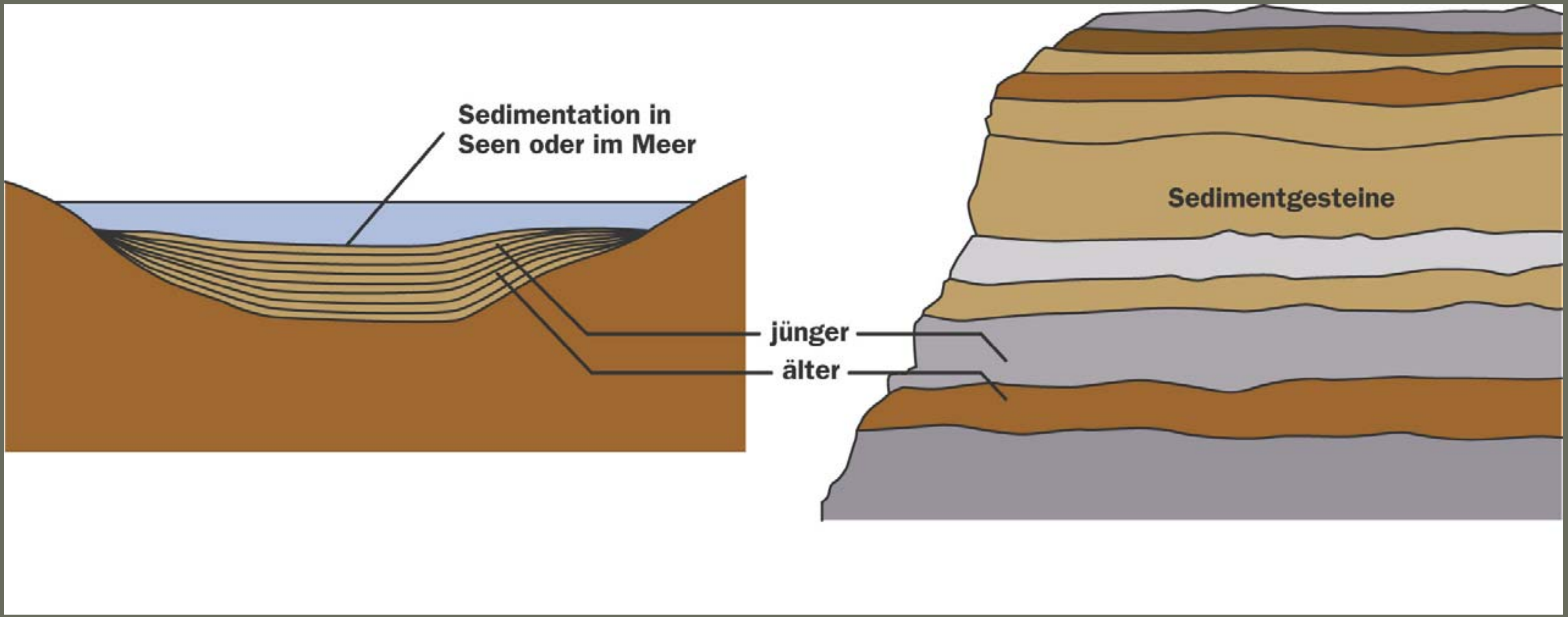


mountain building

Rock game

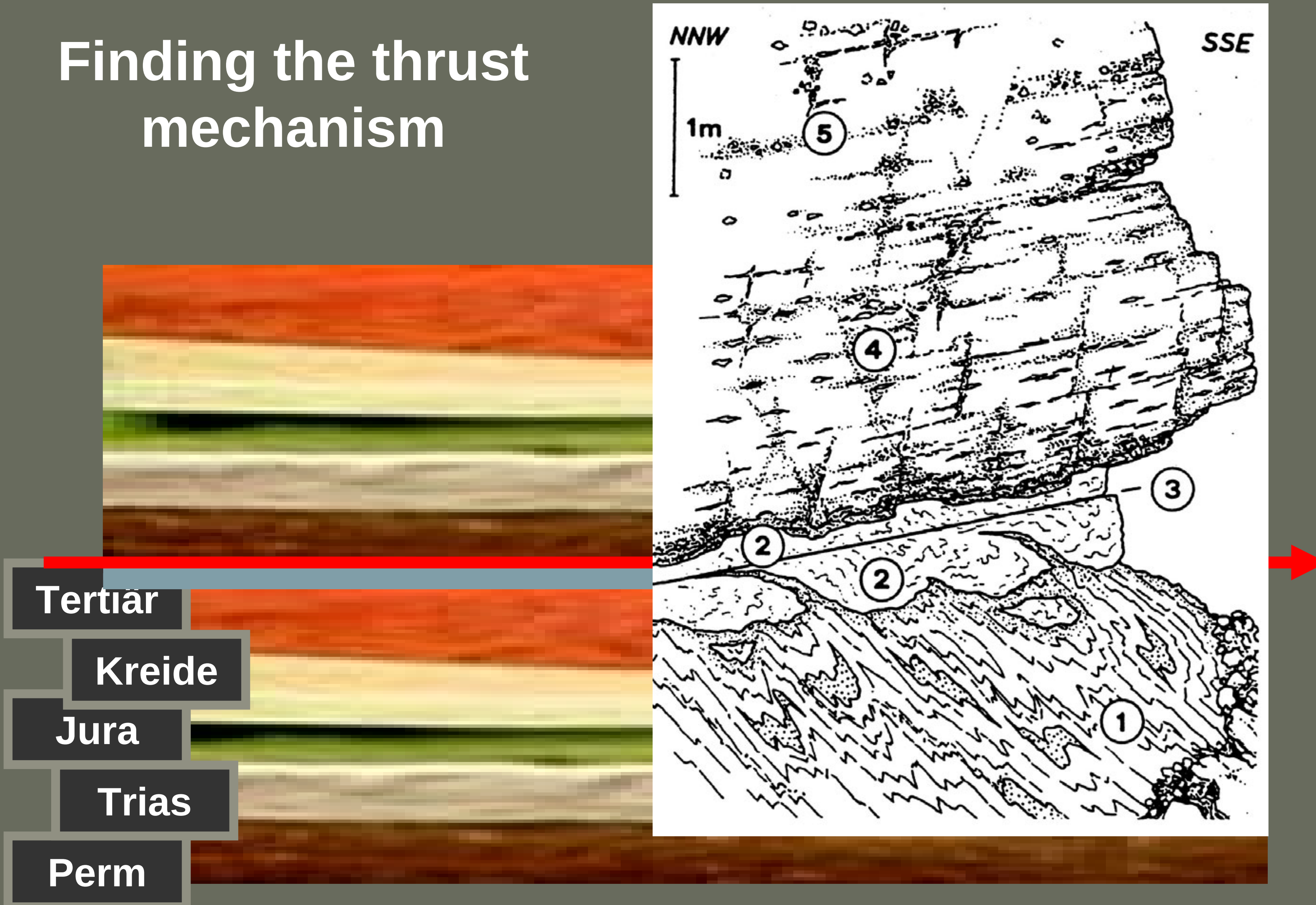
Gaffia

The main principle of stratigraphy

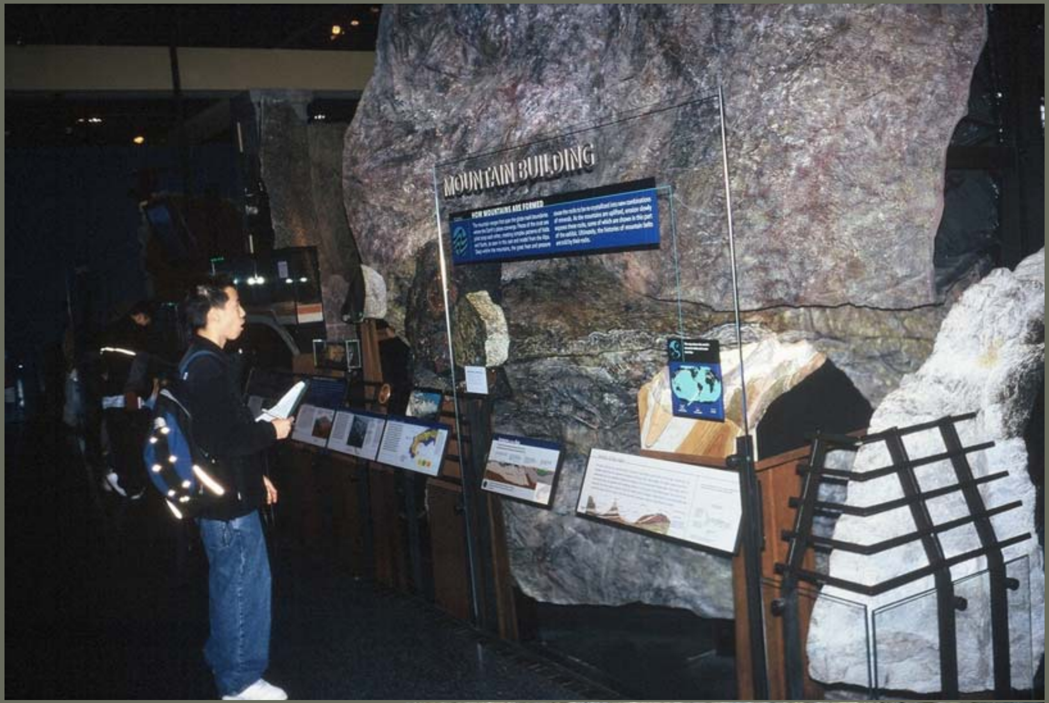


Understanding Stratigraphy

Finding the thrust mechanism



The Glarus overthrust („Lochsite“) in New York



American Museum of Natural History, New York, 1.10.2003

4th main criterion: The educational value

Conclusion:

- The Moine thrust,
- the basal thrust in the Swiss Prealps and
- **the Glarus overthrust**

really meet the 2 subcriteria for the educational value **unequivocally** and **simultaneously**.

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Thank you for your attention!

The „Magic Line“ in the „Swiss Tectonic Arena Sardona“

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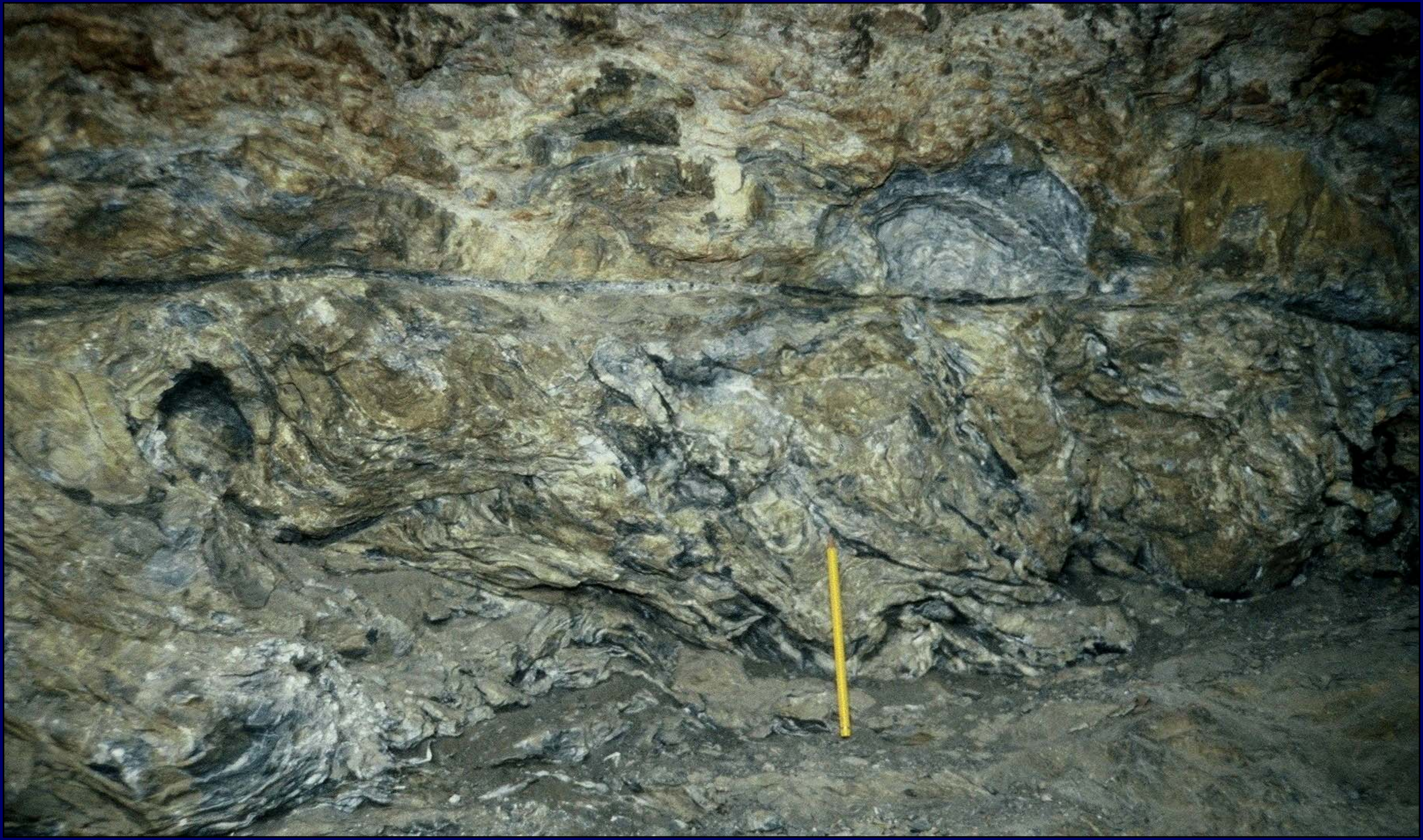
The Magic Line



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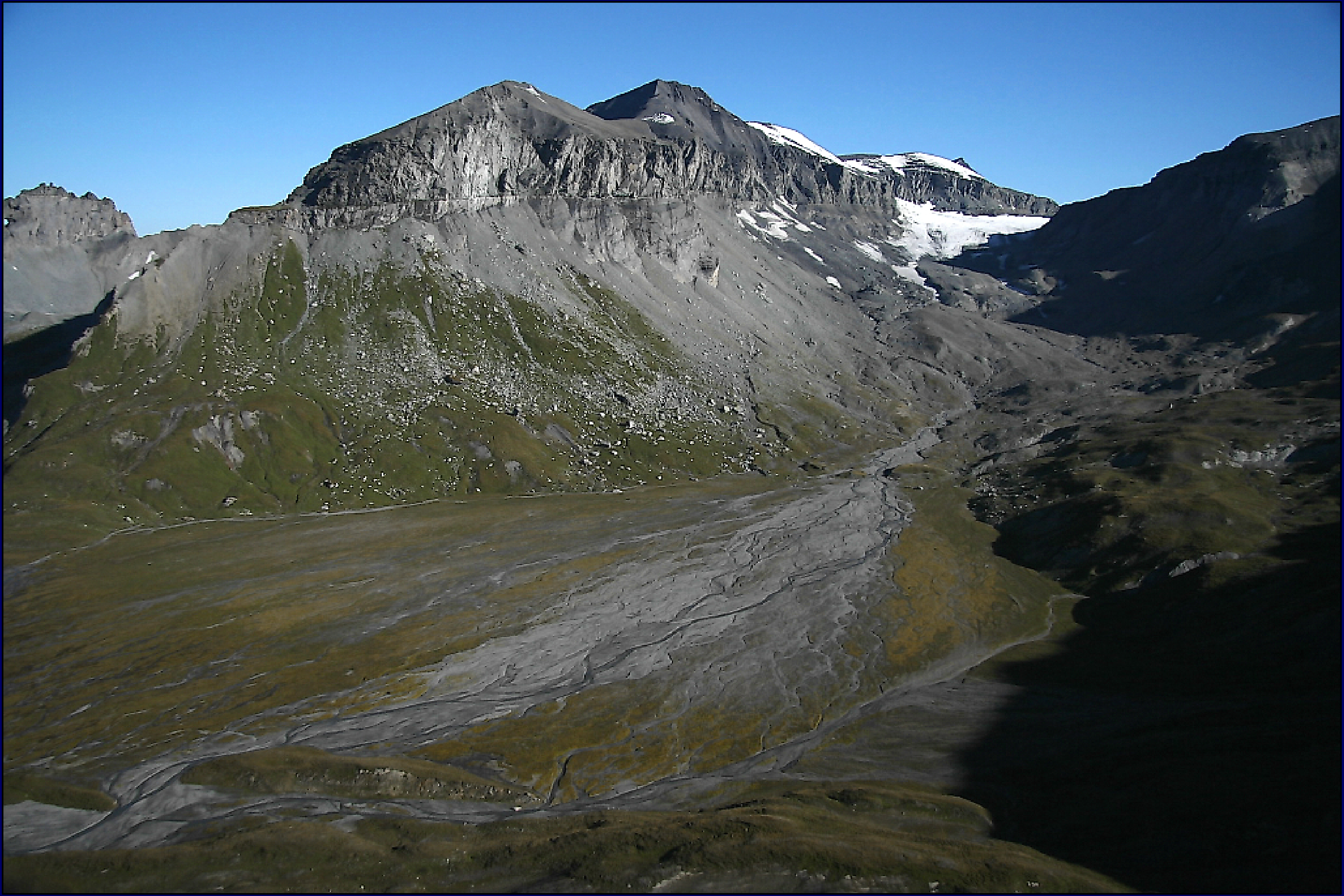

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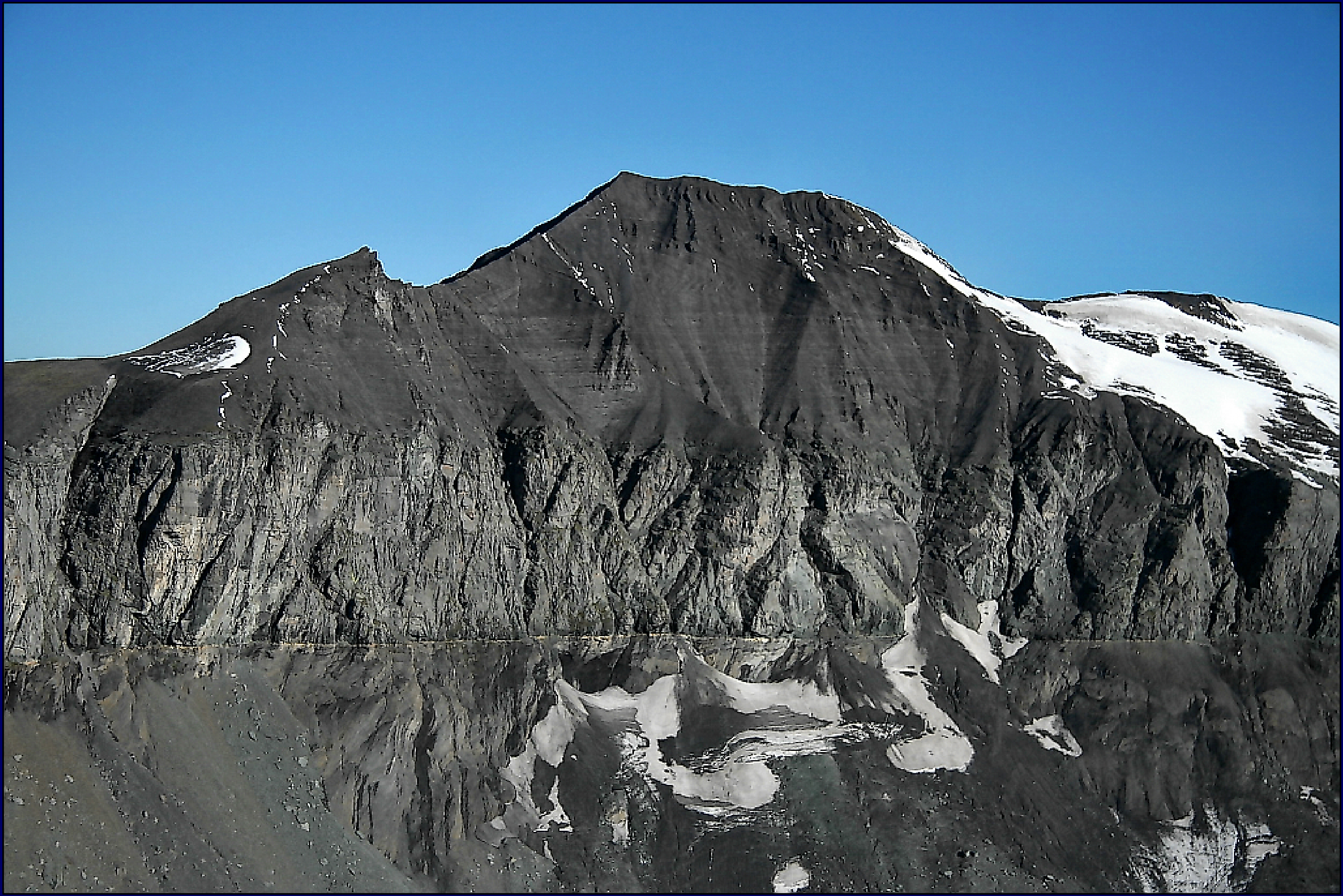

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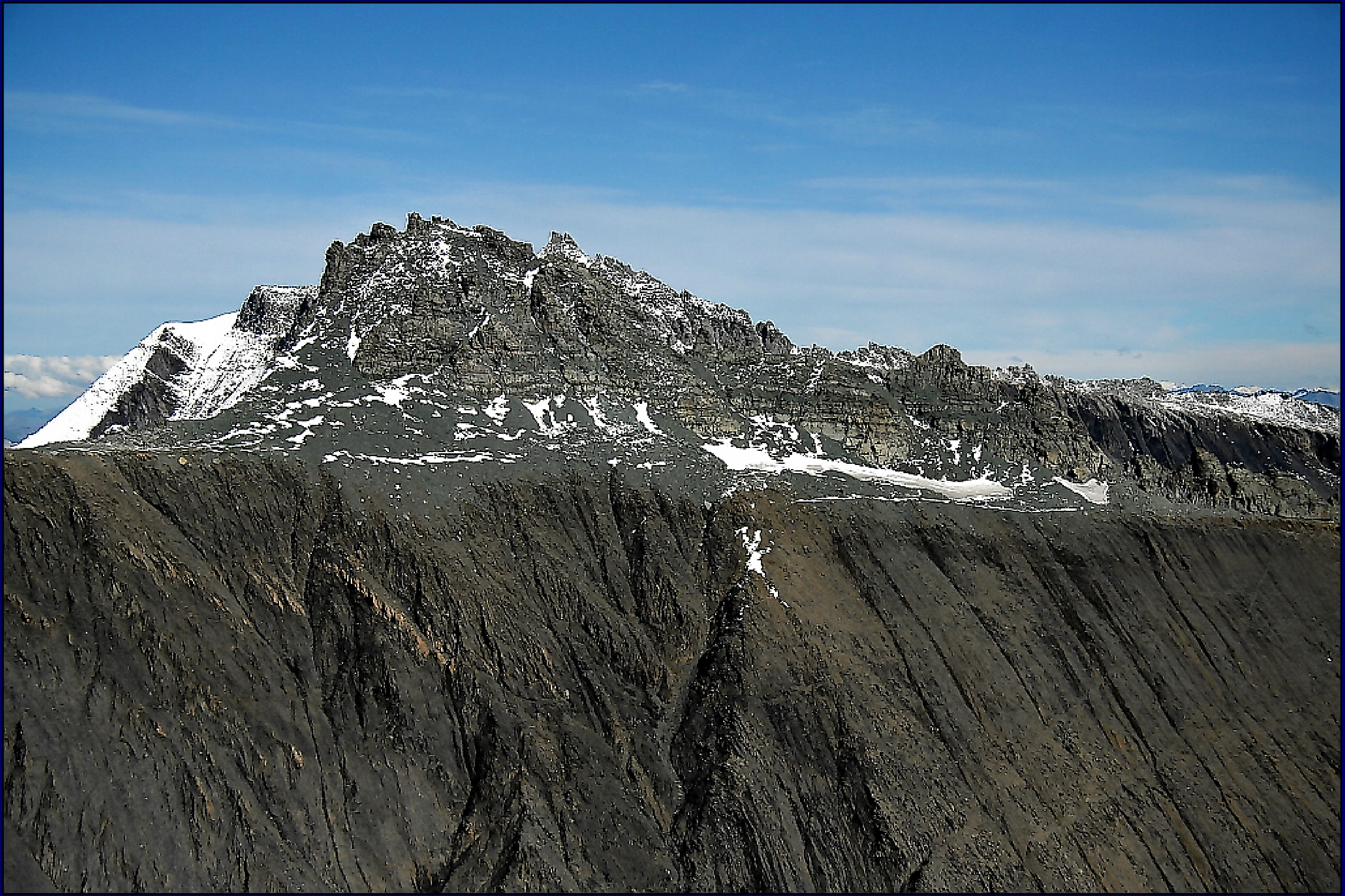

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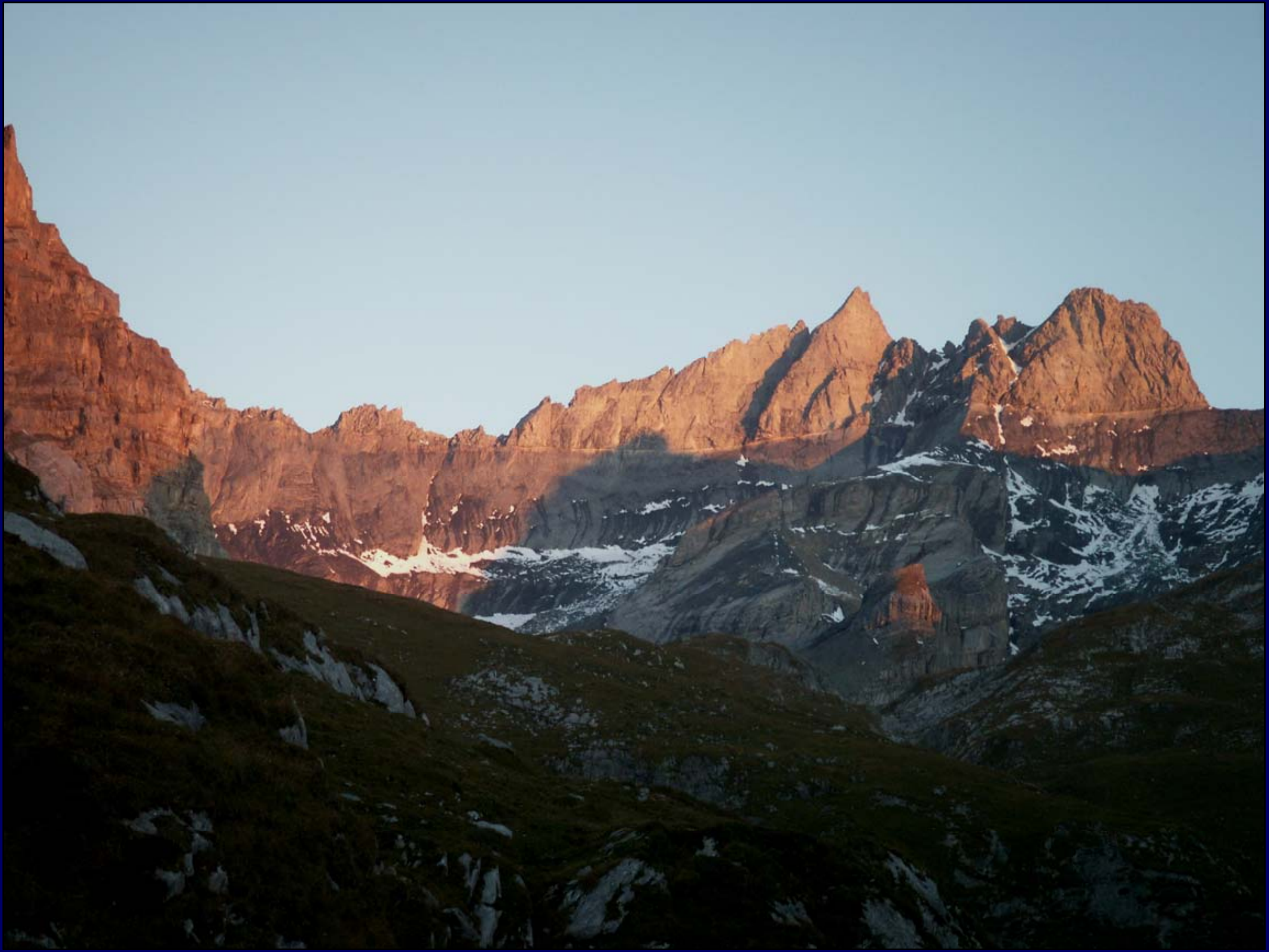

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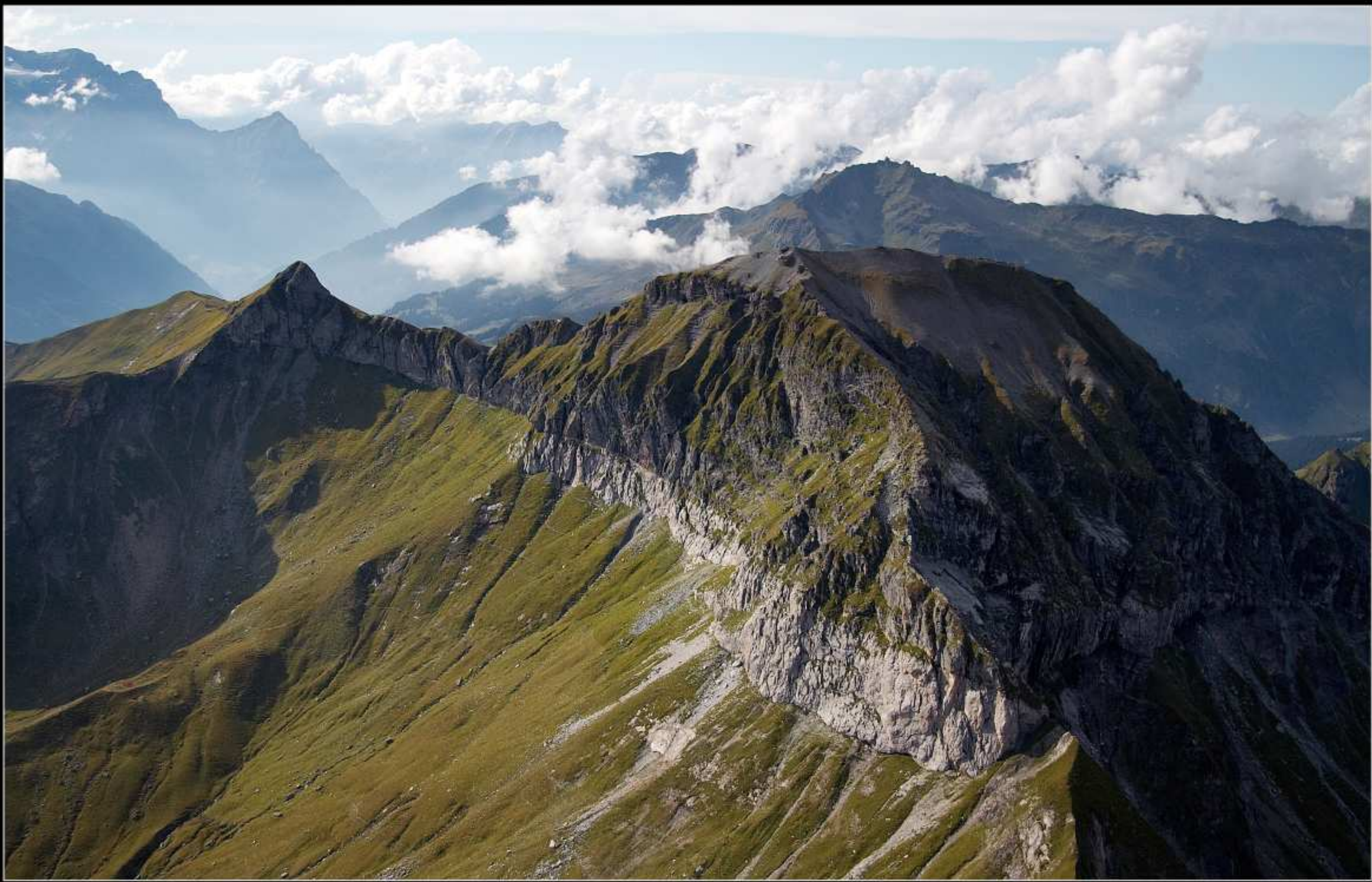

Foostock / Ruchen

Kandidat UNESCO Weltnaturerbe
Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Piz Sardona/Surenstock-Piz Segnas-Atlas

Kandidat UNESCO Weltnaturerbe
Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Tschingelhoren mit Martinsloch

Kandidat UNESCO Weltnaturerbe
Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Segnas Sut / Unterer Segnesboden

Kandidat UNESCO Weltnaturerbe
Glarner Hauptüberschiebung

Segnas Sura / Oberer Segnesboden

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Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Atlas-Piz Segnas-Piz Sardona/Surenstock

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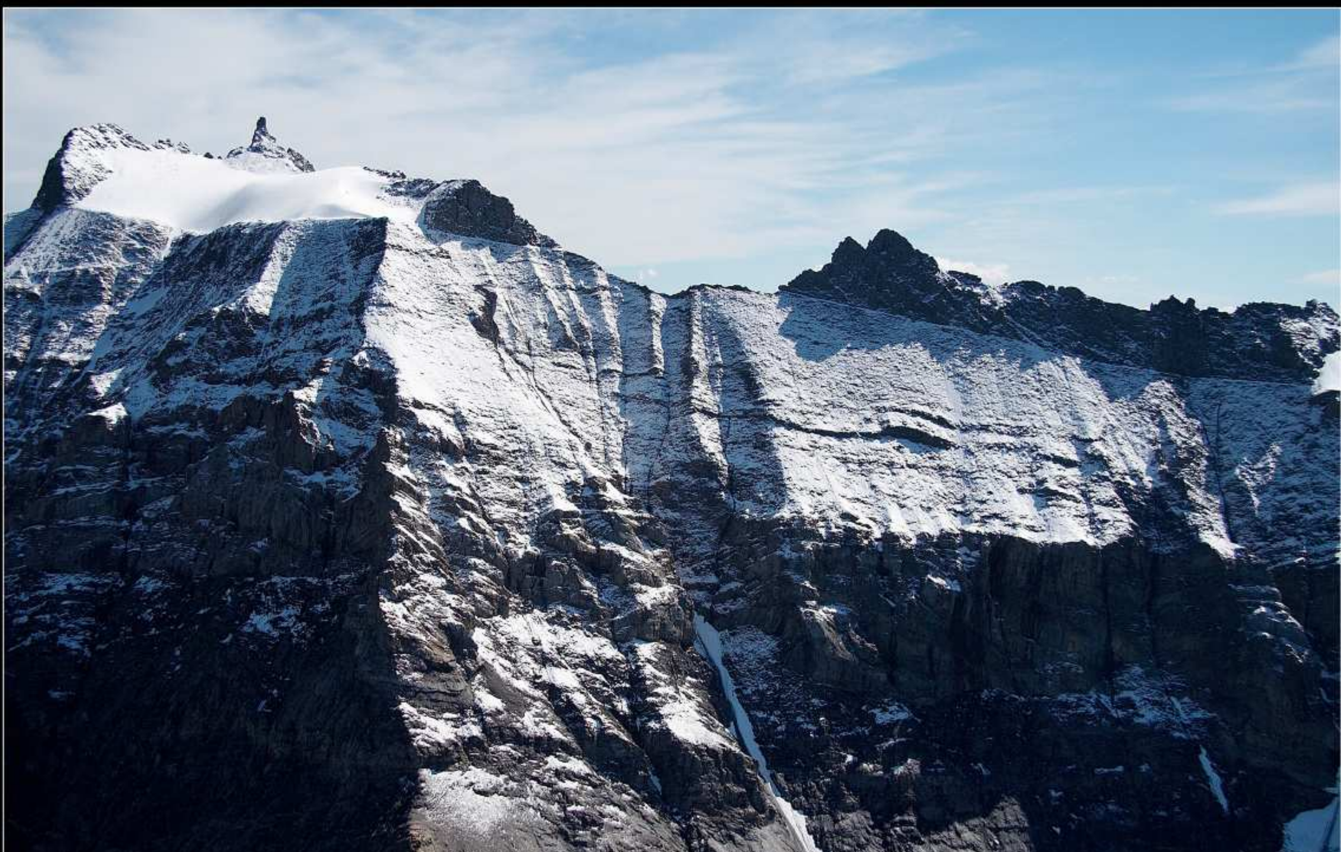
Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Ringelspitz / Piz Barghis



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Glarner Hauptüberschiebung

Aerial photography Ruedi Homberger

Pizolgebiet

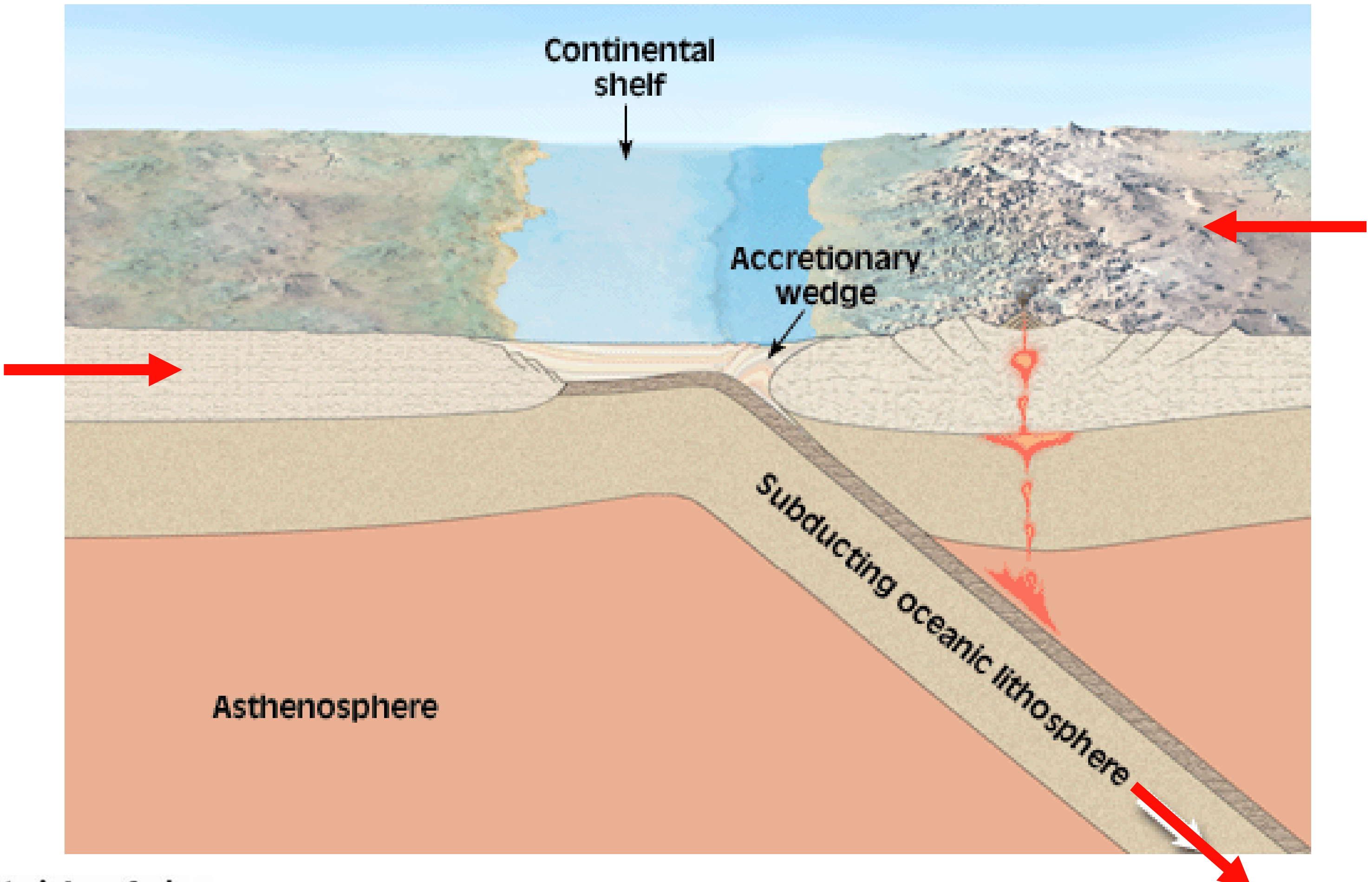
Kandidat UNESCO Weltnaturerbe
Glarner Hauptüberschiebung

Aerial photogrraphy Ruedi Homberger

Mountain Building in the Swiss Tectonic Arena Sardona

(Prof. A. Pfiffner)

Plate tectonics: convergence of two plates



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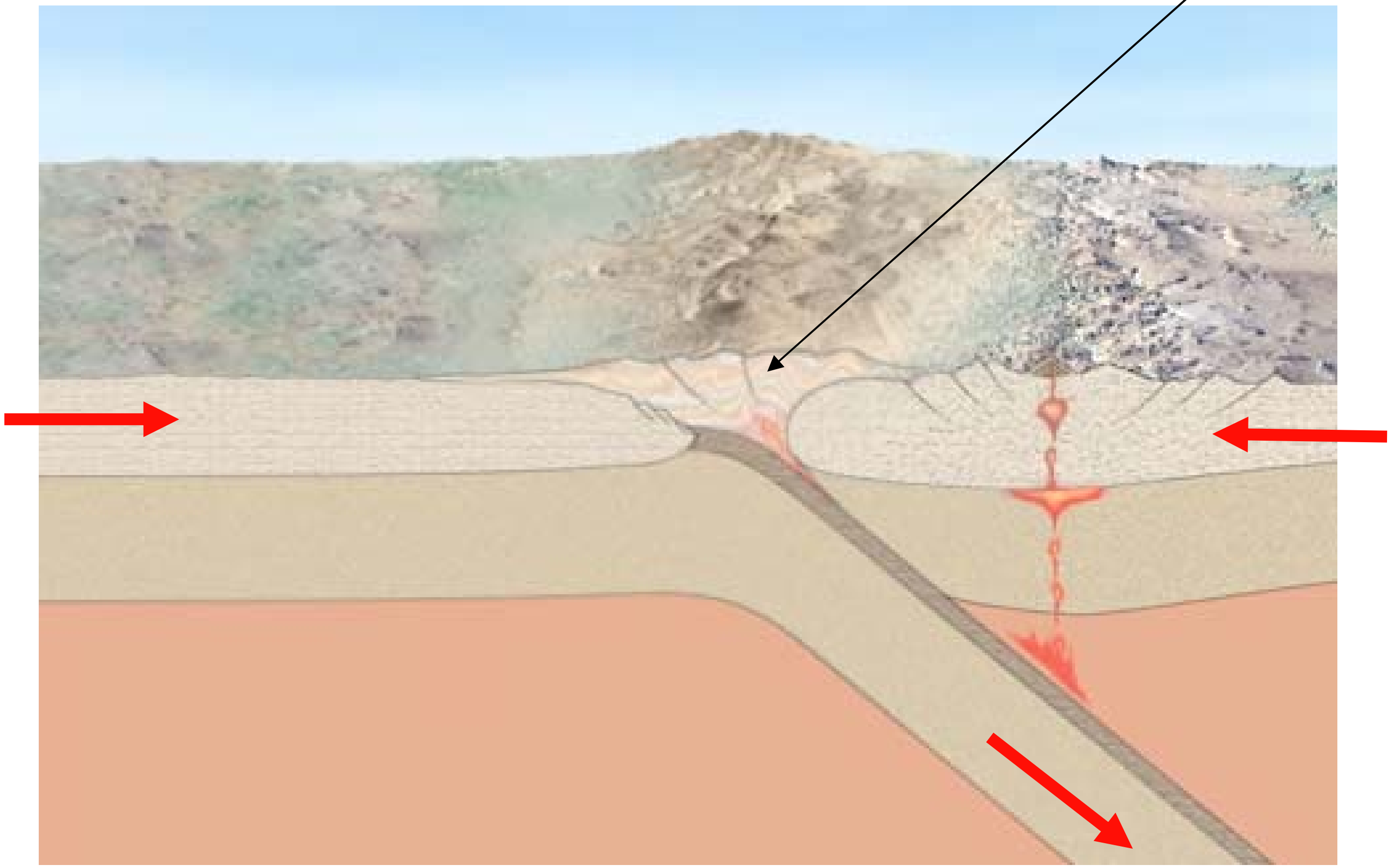
Two continents collide: plate margins are squeezed



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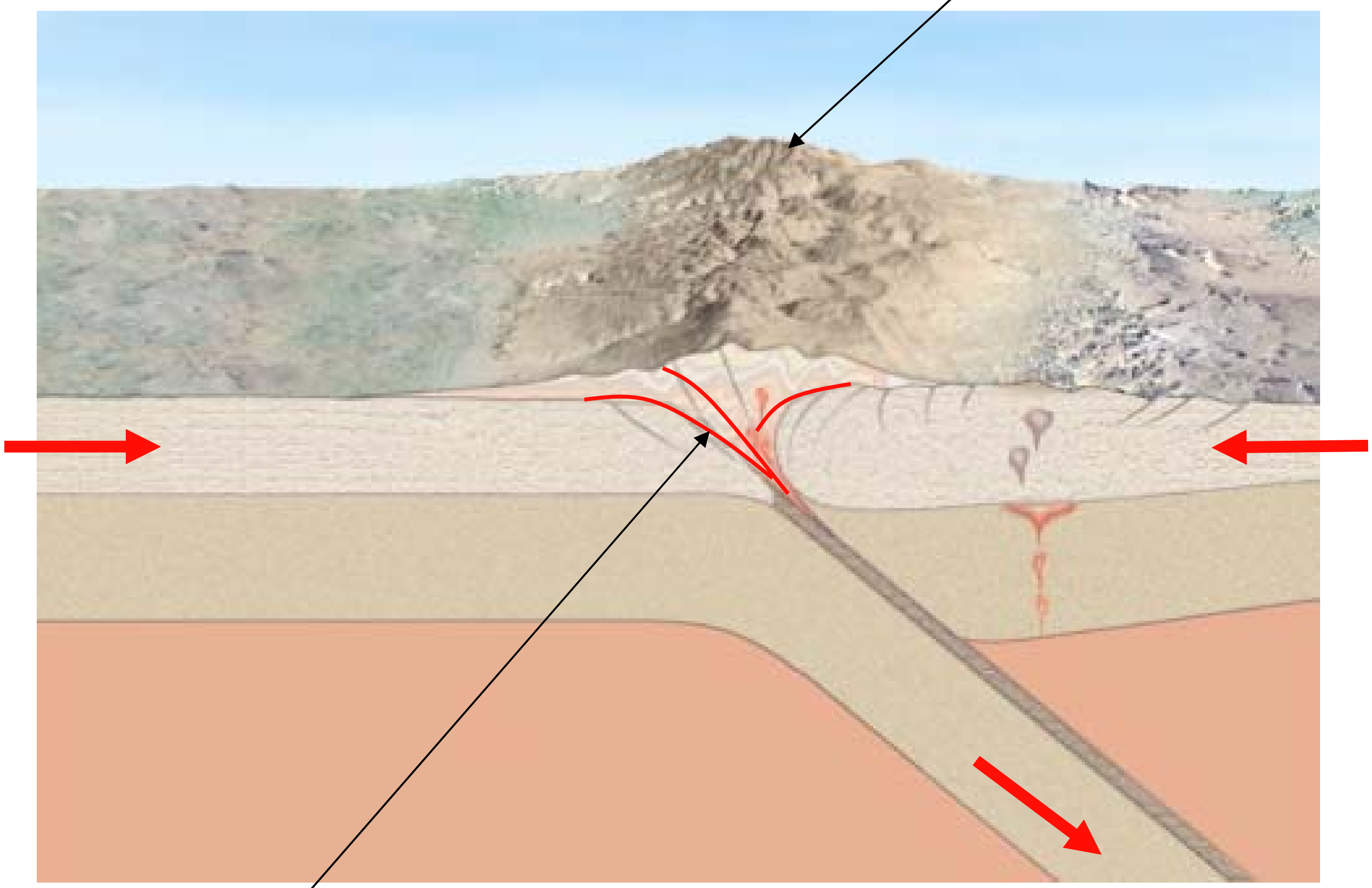
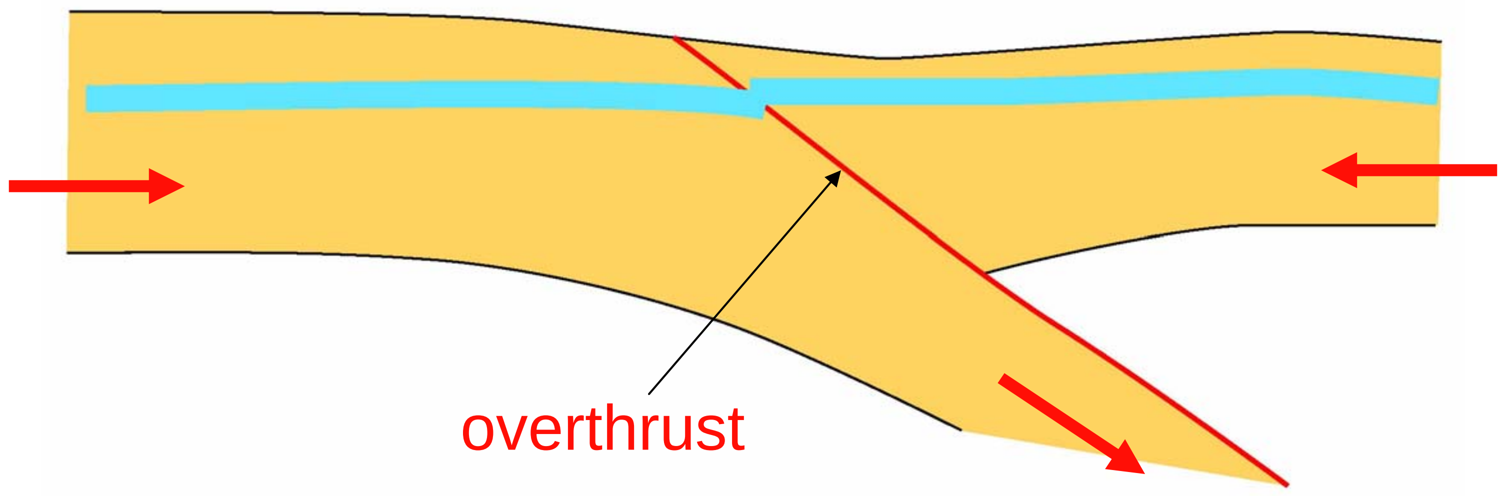
The squeezed margins form a mountain range



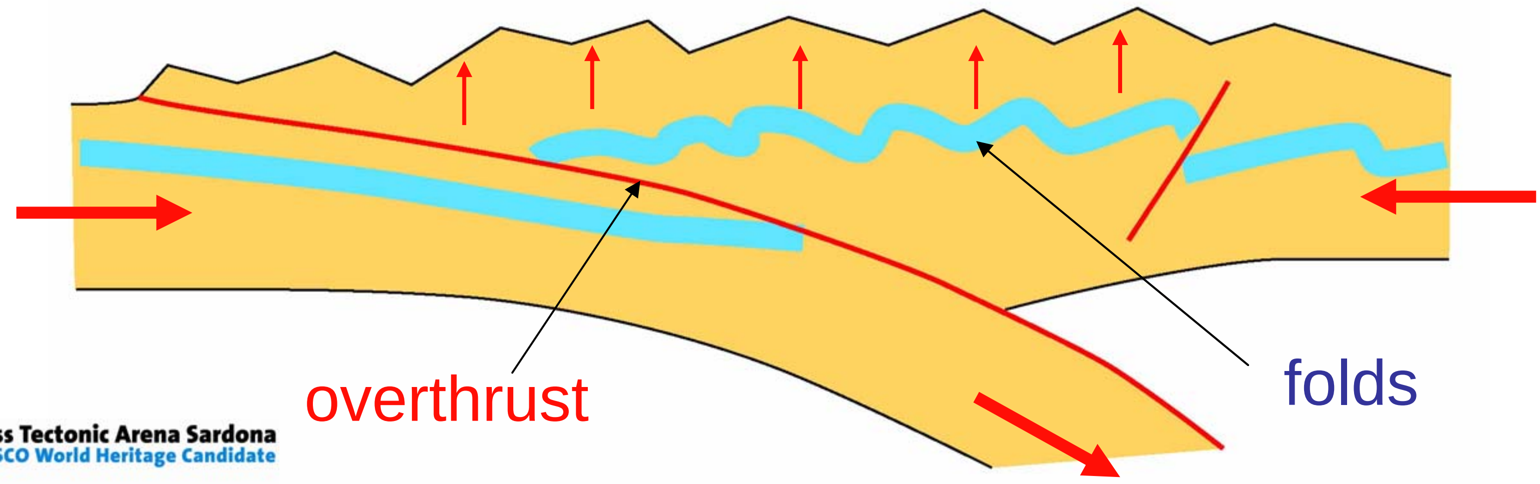
Thrust faults in the interior of the mountain range

Why is the Swiss Tectonic Arena Sardona so special ?

Initial stage of plate convergence



Squeezed plate margin thickens by overthrusting and folding



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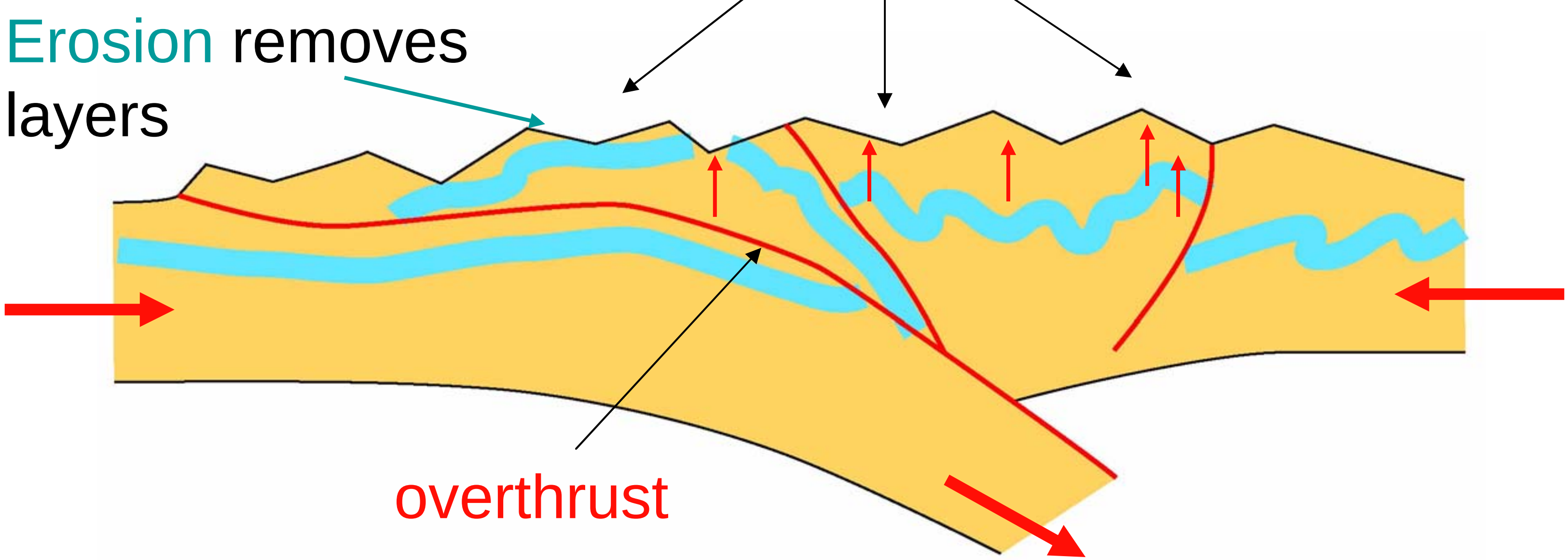
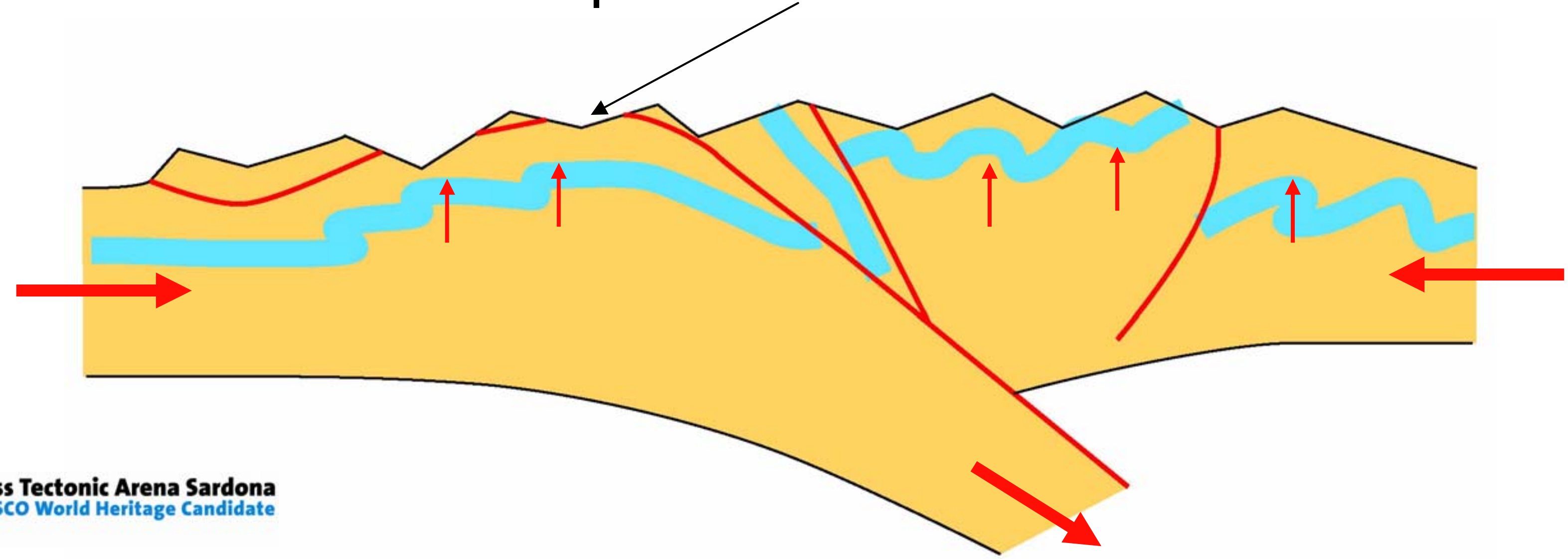
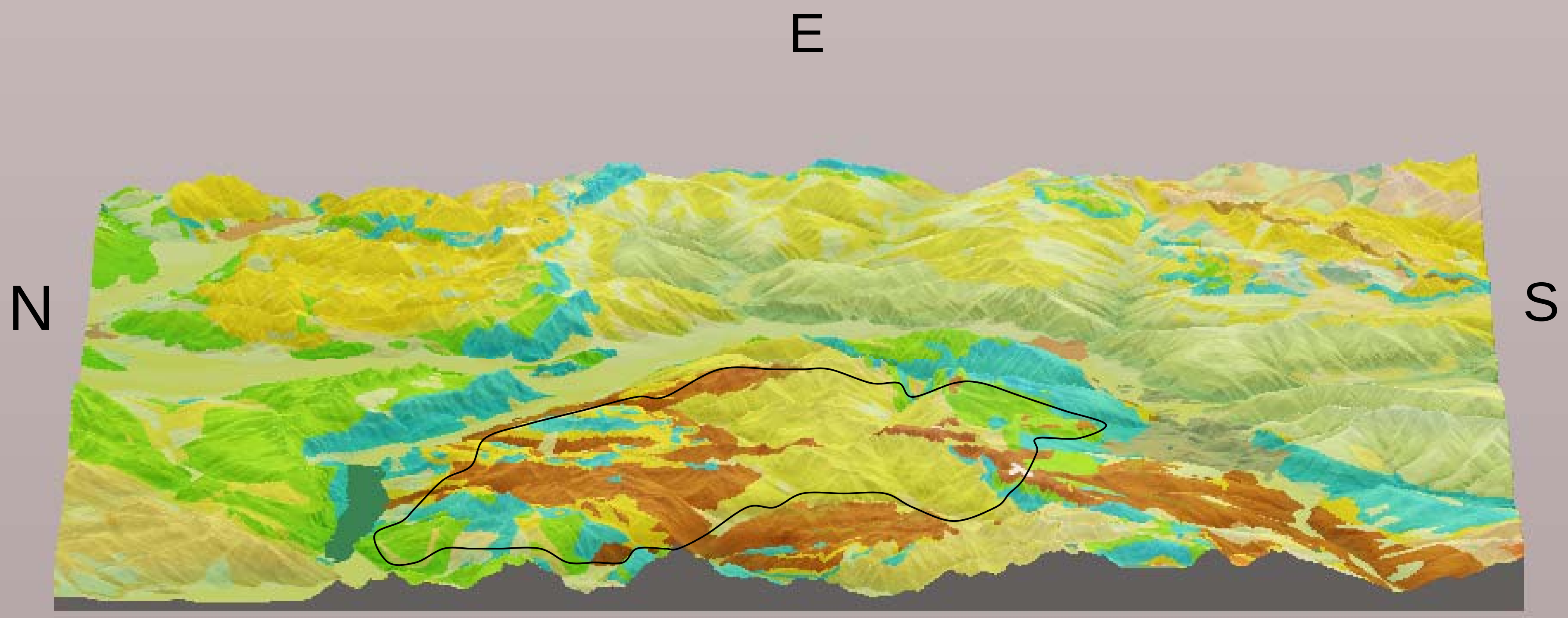
More squeezing: a mountain range is formed



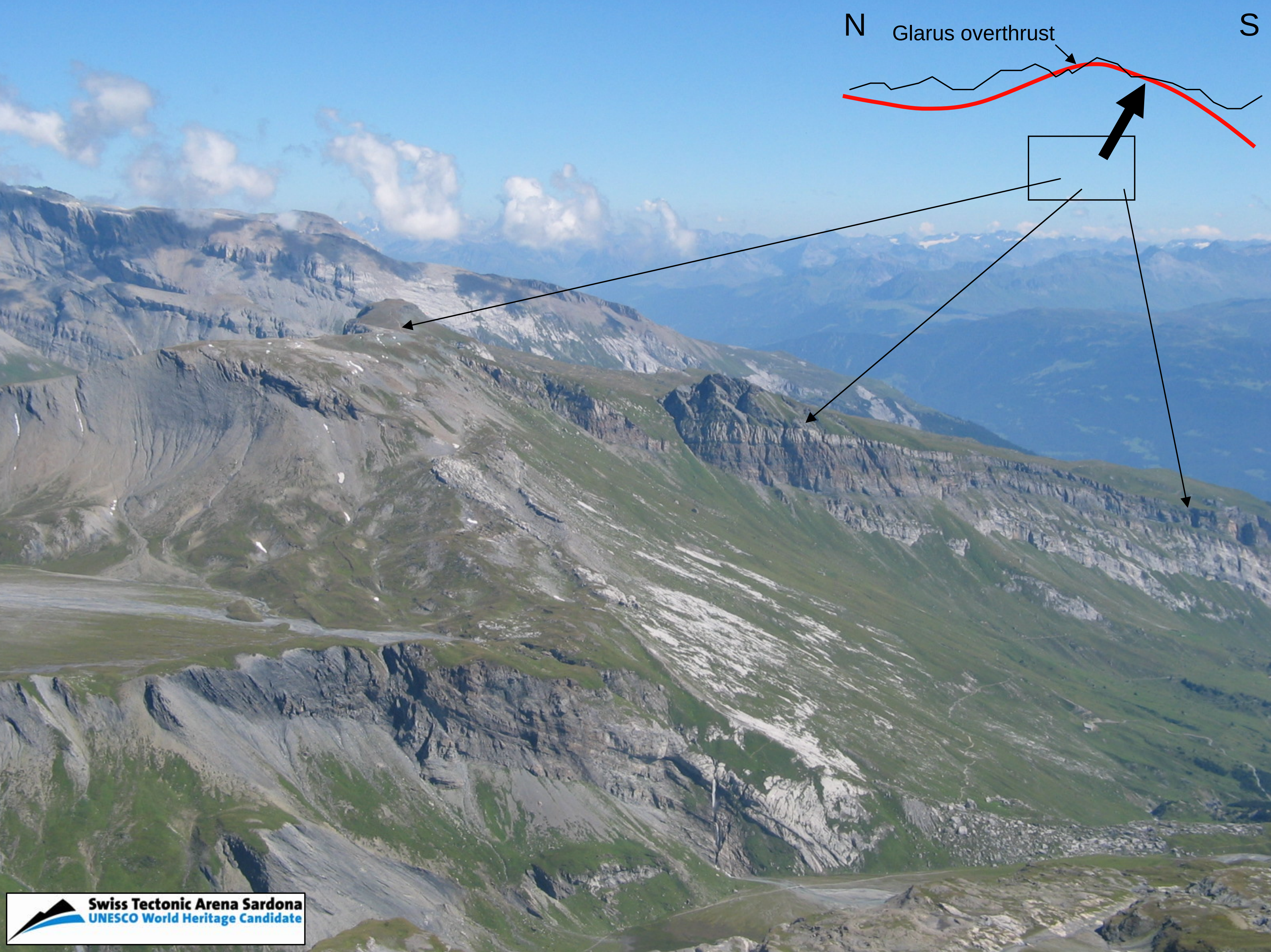
More erosion exposes overthrust at surface



Three-dimensional view of the Swiss Tectonic Arena Sardona



The Glarus overthrust puts Permian Verrucano (shown in brown) onto Tertiary Flysch (shown in yellow).


N
Glarus overthrust
S
Swiss Tectonic Arena Sardona
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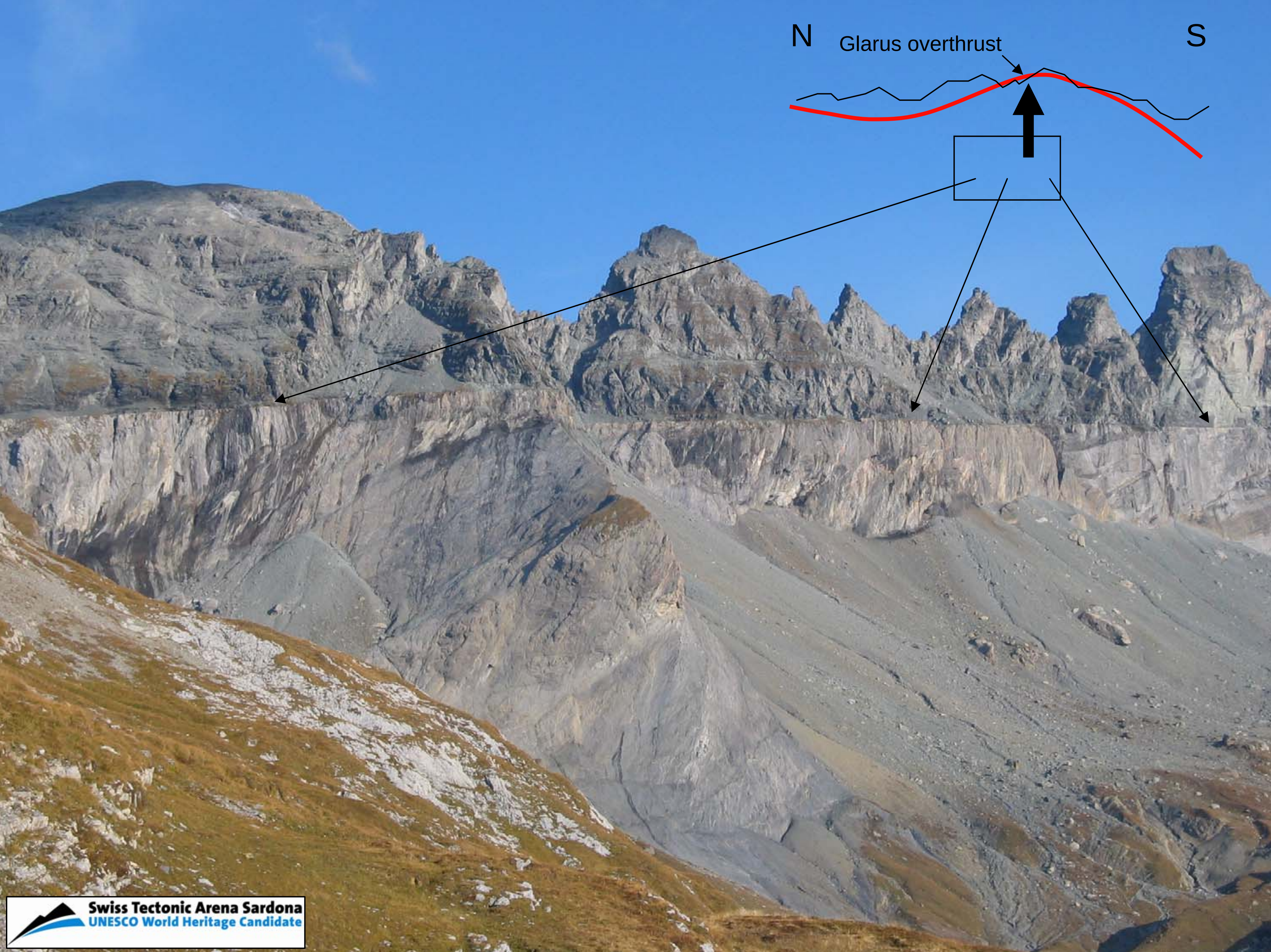
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Glarus overthrust
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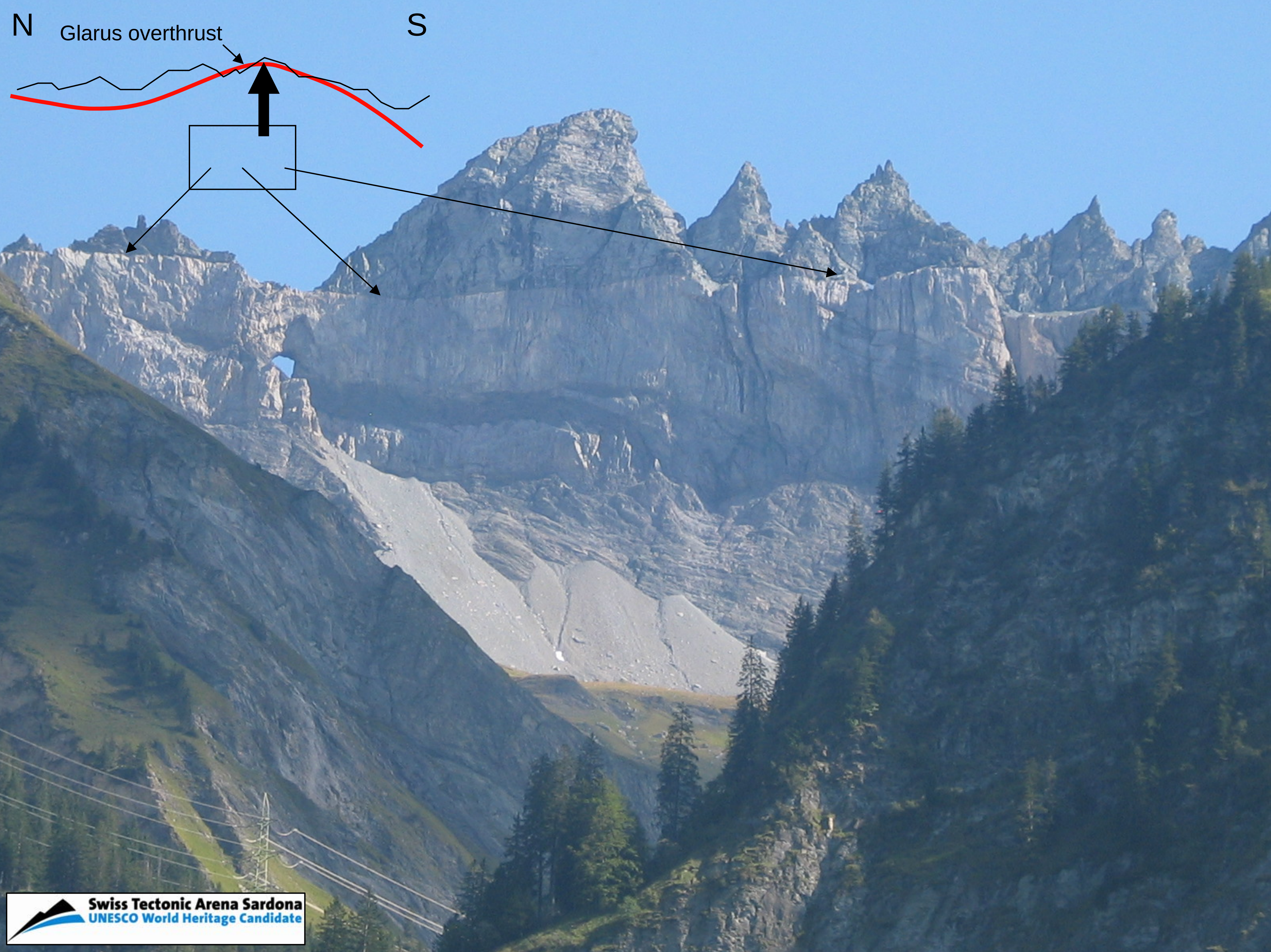
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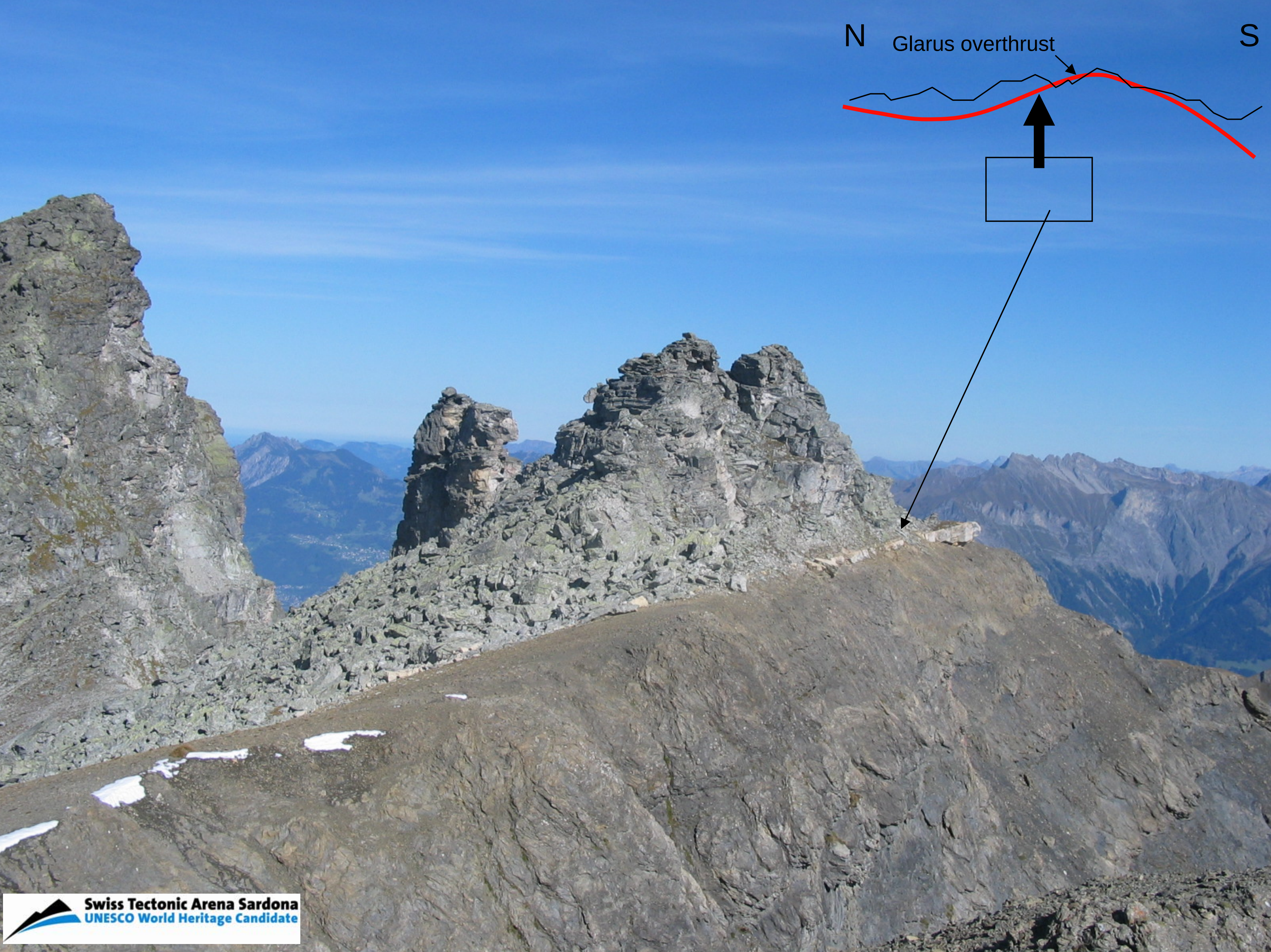
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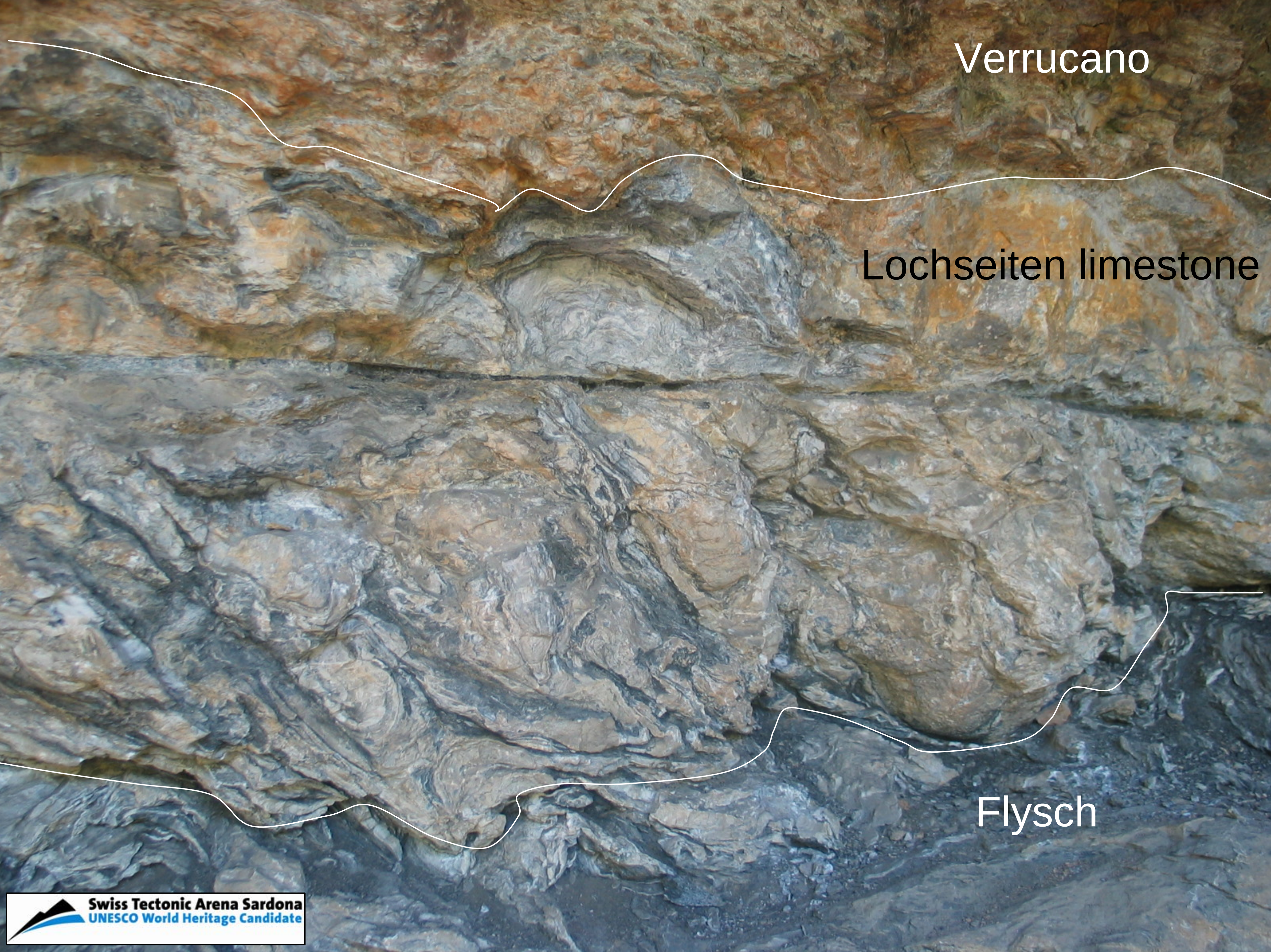
Verrucano
Lochseiten limestone
Flysch
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