



United Nations
Educational, Scientific and
Cultural Organization



International Geoscience
Programme
Austria

ÖAW

ÖSTERREICHISCHE
AKADEMIE DER
WISSENSCHAFTEN

AUSTRIAN CONTRIBUTIONS TO UNESCO'S INTERNATIONAL GEOSCIENCE PROGRAMME (IGCP)

Summary Report for 2015

*Austrian National Committee for Geo/Hydro Sciences
c/o Austrian Academy of Sciences
International Research Programmes
Dr. Ignaz Seipel-Platz 2
1010 Vienna
Austria
Tel: +43 1 51581 2771
Fax: +43 1 51581 1275
E-mail: quenter.koeck@oeaw.ac.at
WWW: <http://www.oeaw.ac.at>*

1. NATIONAL COMMITTEE ACTIVITIES AND FUNDING:

In 2011 the Austrian Academy of Sciences has started the reorganization of its international research programmes. IGCP is now part of the new research structure “Earth System Sciences (ESS)” and responsibilities of IGCP were overtaken by the new “National Committee for Geo/Hydro Sciences”. In 2015 one meeting of the Geo/Hydro-National Committee took place.

Personnel structure of the Austrian National Committee for Geo/Hydro Sciences:

Chair: Prof. Dr. Werner E. Piller, University of Graz, Institute for Earth Sciences (Geology and Palaeontology), Heinrichstrasse 26, A-8010 Graz, Austria. Phone: +43-316 380-5582, Fax: +43 316 380-9171; werner.piller@uni-graz.at;
http://erdwissenschaften.uni-graz.at/mitarbeiter/personal/homepages/piller/index_de.php
<http://palstrat.uni-graz.at/>

Vice Chair: Prof. Dr. Christoph Spötl, University of Innsbruck, Institute of Geology, Innrain 52, A-6020 Innsbruck, Austria. Phone: +43-512-507-5593, Fax: +43-512-507-2914;
christoph.spoetl@uibk.ac.at;
<http://quaternary.uibk.ac.at/People/Staff/Christoph-Spotl.aspx?type=info>

Secretary: Dr. Günter Köck, Austrian Academy of Sciences, International Research Programmes, Dr. Ignaz Seipel-Platz 2, A-1010 Vienna, Tel. ++43 1 51581-1271, Fax: ++43 1 51581-1275;
guenter.koeck@oeaw.ac.at; <http://www.oeaw.ac.at>

Members of the Austrian Academy of Sciences:

Prof. Dr. Werner Piller
Prof. Dr. Dieter Gutknecht
Prof. Dr. Christoph Spötl

The Ministry of Science, Research and Economy:
The Ministry of European and international Affairs:
Austrian Commission for UNESCO:
Austrian Geological Survey:
Austrian Universities:

Dr. Karolina Begusch-Pfefferkorn
Botschafter Mag. Stephan Vavrik
Secretary General Mag. Gabriele Eschig
Mag. Klaus Motschka
Prof. Dr. Georg Hoinkes
Prof. Dr. Ewald Brückl
Prof. Dr. Hermann Mauritsch
Prof. Dr. Steffen Birk
Prof. Dr. Günter Blöschl
Prof. Dr. Helmut Habersack
Prof. Dr. Susanne Muhar
Prof. Dr. Hans-Peter Nachtnebel

Natural History Museum Vienna:
Other governmental institutions:

Dr. Alexander Lukeneder
Dr. Robert Holnsteiner
Dr. Christine Jawecki
Dr. Reinhold Godina
Oberst Günter Wendner

In 2015 the funding for IGCP, provided by the Austrian Ministry for Science, Research and Economy, was

EURO 80.000,- = US\$ 87.114,-¹

¹ Exchange rate per 20/01/2016

This funding is entirely used for research projects.

2. CURRENT RESEARCH PROJECTS WITHIN THE FRAMEWORK OF IGCP:

In 2015 four research projects were carried out:

IGCP-557 Mantle xenoliths: a petrological, geochemical and spectroscopic investigation of mantle minerals and rocks

Project manager: C. HAUZENBERGER, University of Graz

A combination of petrological, geochemical, spectroscopic and microstructural methods will be used to obtain new information on the subcontinental lithospheric mantle. Our approach is to combine the information from “hydrous” nominally water free minerals with their trace element content, their *PT* evolution as well as deformation of natural samples in order to evaluate the significance of these processes in element mobility and transport in the upper mantle. Mantle xenoliths from different depths from the earth's mantle will be sampled and investigated: 1) xenoliths from kimberlites (South Africa: Kimberley area; Botswana: Letlhakane, Damtshaa, Jwaneng; Tanzania: Mwadui,) and 2) from alkaline basalts (Styrian Volcanic Arc, Austria, Slovenia). The different mantle xenolith origins were chosen because the first group represents mantle material beneath Archean cratons while the latter group includes samples from the mantle below the young Alpine orogen. The main topics of the project include:

(1) Characterization of mantle xenoliths from different mantle sources (*PT*, geochemistry, textural relationships and deformation); (2) Quantification of hydrogen and trace element concentrations in mantle minerals with special emphasis on textural constraints and origin of the xenoliths; (3) Establishing of 2D compositional maps, especially along cracks, grain boundaries, and inclusions; (4) Relationships of deformation mechanism, hydrogen and trace element concentrations in olivine and pyroxene; and (5) Comparison of obtained data with experimental results.

IGCP-572 Restoration of marine ecosystems following the Permian-Triassic mass extinction: Lessons for the present

Project managers: L. KRYSZYN, University of Vienna; M. HORACEK, Austrian Institute of Technology, Vienna

Many marine ecosystems are under threat at the present day. This is nothing new, as the marine realm has suffered major extinction and upheaval on numerous occasions over the geological past, the most serious of which occurred during the Permian-Triassic transition. Of the major factors supposed to have caused the Permian-Triassic biotic crisis, such as increased carbon dioxide concentrations, oceanic anoxia, hypercapnia (CO₂ poisoning) and rapid global warming, some are observed in the present day, and others may happen in the near future. The Permian-Triassic rock and fossil records may thus display a natural experiment in global-scale ecosystem collapse that, if properly deciphered, could provide an insight into the possible responses of modern marine ecosystems to present day climate and environmental change. This links into current global concerns and issues such as the “sustainable use of global biodiversity”, “biodiversity response to global warming” and “keeping our planet environmentally

sustainable". The proposal aims to investigate the recovery of marine ecosystems following the Permian/Triassic (P/Tr) mass extinction through analyses of the rock and fossil records of western and central Tethys localities.

The main task is the investigation of the Permian-Triassic Boundary (PTB) in detail in several sections in Iran (Shah Reza, Zagros Mountains, etc.) to get a high-resolution data record displaying the sequence of the recorded events. The Lower Triassic will be investigated for carbon isotope chemistry and conodont stratigraphy with high resolution across the Griesbachian-Dienerian (GDB), Dienerian-Smithian (DSB), Smithian-Spathian (SSB) and Spathian-Anisian (SAB) boundaries. This will result in a better understanding of the events that occurred and lead to the already observed changes across these boundaries (e.g., stratification/circulation (DSB, SSB)), faunal radiation (DSB, SSB, SAB). Investigations include carbon isotope, sulphur isotope of bulk sediment (carbonate and trace sulphate in carbonate respectively), oxygen isotope measurements of conodont apatite, sedimentology and macro- and micropaleontological stratigraphy.

We plan with this study to 1) better fit an already existing carbon isotope curve to the conodont and ammonite stratigraphy and thus be able to exactly correlate globally and regionally observed events, 2) to investigate the $\delta^{18}\text{O}$ development of the seawater at the PTB and in the Lower Triassic to obtain valuable information about salinity and temperature variations, 3) to produce a $\delta^{34}\text{S}$ curve for the Lower Triassic. 4) These geochemical and paleontological proxies will help us to elucidate the environmental changes across the PTB and in the Lower Triassic and can then be interpreted with respect to their influence on the biota.

IGCP-572 Sedimentological and geochemical analysis of microbialite structure in the aftermath of the Permian-Triassic mass extinction

Project manager: S. RICHOZ, Commission for the Palaeontological and Stratigraphical Research of Austria, Austrian Academy of Sciences, Vienna, c/o Institute of Earth Sciences (Geology and Palaeontology), University of Graz.

As the greatest mass extinction of Earth life, the Permian-Triassic (PTB) extinction resulted in dramatic elimination of >90% marine species and >70% land life. The giant carbonate platform present all around Pangea during the Permian suffered dramatically. The prolific upper Paleozoic skeletal carbonate factory was abruptly replaced by a nonskeletal carbonate factory. After the mass extinction, microbial communities recolonized the normal marine realm of the oceans margin in a great variety of forms and settings. The Early Triassic is characterized by a low diversity of skeletonized organisms and trace fossils and displays at least four main events of anomalous carbonate deposition in form of microbial communities (stromatolites, thrombolites and dendrolites) or microbial by-products (e.g. oolites or wrinkle structures). The recovery of metazoan reefs was largely delayed until Middle Triassic time. The aftermath of the end-Permian mass extinction not only witnesses a major crisis in carbonate systems but also experienced large-scale perturbations of the global carbon cycle as shown by the biggest variations of the Phanerozoic in carbon isotope records. These microbial deposits consequently developed under complex and changing environmental conditions.

Although the presence of PTB microbialites is well-known, a continuing problem is the precise determination of the conditions of growth, the processes leading to a non obligatory calcification and the phylogenetic affiliations of the microorganisms involved in microbialite formation. It is unclear if microbialite growth in the aftermath of the extinction was favoured by the absence of metazoan organisms or by peculiar environmental conditions. PTB microbialite sequences vary from place to place regionally, even locally, and variations are clear globally. Therefore, it is important to attempt to account for microbialite formation in detail, on a site-by-site, with a high resolution approach, to understand the chemical processes that operated in the shallow shelves waters.

Some preliminary tests of isotope analysis on the microbial microfacies have shown that in some cases the different components (filling micrite, filaments, biomicrite, etc.) can have a difference in $\delta^{13}\text{C}$ of up to 1‰, meanwhile other cases show no difference at all. A more systematic isotopic analysis of the different types of microbialite is clearly required to better understand the conditions of growth of each type of microbialite and to better assess the general water geochemistry in the aftermath of the PTB mass extinction. Biomarker (i.e. molecular fossil) determination is a new powerful method to constrain the organisms involved in microbialite formation. We want to take some samples to test this method on the Triassic microbialites. The ^{13}C -content of individual molecular fossils will be determined as well.

To reach these goals we want to work mainly on localities in Turkey, Oman and Iran: The Cürük Dag section in SW Turkey is a candidate for the most complex PTB microbialite sequence worldwide. It was already well studied sedimentologically and the preliminary isotopic tests were made on this section. A new sampling for geochemical analyses is however necessary. Some other sections in SW Turkey (Kopuk dag, Demirtas) require a complete study of their microbialitic structures. Shareeza and Zal section in Iran present beside a rich diversity in microbial structures, direct precipitation of calcite crystal and other peculiar mineralogy. Maqam and Ba'id sections in Oman display microbialite in a totally other paleoecological position than the ones before (on a large platform in Turkey and on a proximal ramp in Iran). Maqam's stromatolites are situated on a platform slope whereas the microbialite of the Ba'id section are deposited on a isolated small carbonate atoll-like platform. The sedimentological, isotopic and biogeochemical comparisons of different type of microbial structure (Stromatolite, dendrolite, thrombolite, etc.) in different paleoenvironmental settings should allow us to better understand the conditions of growth of the triassic post-extinction microbialite and to assess water chemistry changes on shallow shelves in the aftermath of a major mass extinction.

IGCP-609 Climate-environmental deteriorations during greenhouse phases: Causes and consequences of short-term Cretaceous sea-level changes

Project manager: M. WAGREICH, University of Vienna

See also: <http://www.univie.ac.at/igcp609/>

IGCP-609, a 5 year UNESCO-IUGS project, investigates sea-level changes during extreme greenhouse climates. The recent rise in sea-level in response to increasing levels of atmospheric greenhouse gases and the associated global warming is a primary concern for society. Evidence from Earth's history indicate that ancient sea-level changes occurred at rates an order of magnitude higher than that observed at present. To predict future sea-levels we need a better understanding of the record of past sea-level change. In contrast to glacial eustasy controlled mainly by waxing and waning of continental ice sheets, shorttime sea-level changes during major greenhouse episodes of the earth history are known but still poorly understood. The global versus regional correlation and extend, their causes, and consequences of these sea-level changes are strongly debated.

IGCP609 addresses correlation, causes and consequences of significant short-term, i.e. kyr to 100s of kyr, sea-level changes during the last major greenhouse episode of earth history, the Cretaceous (145 Ma – 66 Ma). The long-term sea-level record, i.e. 1st to 2nd order cycles occurring over millions to tens of millions of years, is controlled by the internal dynamic history of the Earth. The changing rates of ocean crust production led first to long-term sea-level rise, high stands, and then decline during Cretaceous times. However, superposed shorter-term, 3rd to 4th order (kyr to 100s of kyr), sea level changes are recorded in Cretaceous sedimentary sequences. The mechanisms for these are highly controversial and include brief glacial episodes, storage and release of groundwater, regional tectonism and mantle-induced processes. Recent refinements of the geological time scale using new radiometric dates and numerical calibration of bio-zonations, carbon and strontium isotope curves, paleomagnetic reversals, and astronomically calibrated time scales have made major advances for the Cretaceous.

Major international efforts such as EARTHTIME, EARTHTIME-EU and GTSnext programs are improving the Cretaceous time scale to yield a resolution comparable to that of the Neogene. It is now for the first time possible to correlate and date short-term Cretaceous sea-level records with a resolution appropriate for their detailed analysis.

This project will investigate Cretaceous sea-level cycles in detail in order to differentiate and quantify both short- and long-term records within the new high-resolution absolute time scale based on orbital cyclicity. The time interval for study begins with the first major oceanic anoxic event (OAE 1a) and terminates at the end of the Cretaceous. It includes the time of super-greenhouse conditions, the major oceanic anoxic events, the Cretaceous Thermal Maximum and the subsequent cooling to ordinary greenhouse conditions.

The first major goal is to correlate high-resolution sea-level records from globally distributed sedimentary archives to the new, high-resolution absolute time scale, using sea-water isotope curves and orbital (405, 100 kyr eccentricity) cycles. This will resolve the question whether the observed short-term sea-level changes are regional (tectonic) or global (eustatic) and determine their possible relation to climate cycles.

The second goal will be the calculation of rates of sea-level change during the Cretaceous greenhouse episode. Rates of geologically short-term sea-level change on a warm Earth will help to better evaluate recent global change and to assess the role of feedback mechanisms, i.e. thermal expansion/contraction of seawater, subsidence due to loading by water, changing vegetation of the Earth System.

The third goal will be to investigate the relation of sea-level highs and lows to ocean anoxia and oxidation events, represented by black shales and oceanic red beds, and to evaluate the evidence for ephemeral glacial episodes or other climate events. Multi-record and multi-proxy studies will provide a high-resolution scenario for entire sea-level cycles and allow development of quantitative models for sea-level changes in greenhouse episodes.

3. SELECTED IGCP-RELATED PUBLICATIONS

Baud A. & Richoz S. (2015): *An Early Triassic (Smithian) Sponge – microbial build-up in the Oman Mountains*. 12th International Symposium on Fossil Cnidaria and Porifera. 5th-15th February, Muscat, Oman.

Baud A., Friesenbichler E., Krystyn L., Sahakyan L. & Richoz S. (2015): *Proterozoic-Like/type Basal Triassic Microbial Build-Ups of Unusual Height in Armenia*. Goldschmidt2015, 16-21 August 2015, Prague, Czech Republic.

Carmichael, S. K., Waters, J. A., Batchelor, C. J., Coleman, D. M., Suttner, T. J., Kido, E., Moore, L. M. & Chadimová, L. (2015, online first). Climate instability and tipping points in the Late Devonian: Detection of the Hangenberg Event in an open oceanic island arc in the Central Asian Orogenic Belt. - Gondwana Research. <http://dx.doi.org/10.1016/j.gr.2015.02.009>

M. O. Clarkson, S. A. Kasemann, R. A. Wood, T. M. Lenton, S. J. Daines, S. Richoz, F. Ohnemueller, A. Meixner, S. W. Poulton, E. T. Tipper (2015). Ocean acidification and the Permo-Triassic mass extinction. *Science* 348 (6231), 229-231

Wagreich, M., Dinares-Turell, J., Wolfring, E. (2015). A reference section for the Santonian-Campanian boundary: The Postalm section. *Geophysical Research Abstracts* 17, EGU2015.8542, EGU General Assembly 2015,

4. GEOPARKS

The National Committee decided to take the responsibilities for the Geopark Program in Austria. This decision is supported by the Austrian UNESCO Commission and by the Austrian Ministry of Science and Research. In November 2015 the meeting of the Austrian Geoparks Forum took place at the Austrian Academy of Sciences in Vienna.

CURRENT STATUS OF AUSTRIAN GEOPARKS

Approved by the Global Geoparks Network:

- *Carnic Alps* (approved 2012):

The Geopark Carnic Alps is situated in the south of Austria and borders Italy. It includes two west-east orientated mountain ranges of 140 kilometers length, the Carnic Alps and the Gailtal Alps. They are separated from each other by the Lesach Valley and its eastern continuation the Gailtal Valley. In total the Geopark covers an area of approx. 830 km² and is inhabited by 19.600 people.

The Carnic Alps represent one of the very few places in the world in which an almost continuous sequence of Ordovician to end-Permian age has been preserved. In the Gailtal Alps the largest plant fossils of Austria, the petrified trees of Laas, have been preserved.

On more than 80 Geosites, along 5 Geotrails and in the visitor center in Dellach the geological heritage of the region can be explored.

Link: <http://www.geopark-karnische-alpen.at/>

- *Nature Park Steirische Eisenwurzten* (approved 2002):

The Nature Park Eisenwurzten, located in the Austrian province of Styria, is part of the Northern Calcareous Alps. Geotourism has a long tradition in the area. As early as 1892 the Kraus Cave of Gams, one of the most splendid gypsum-bearing caves of Europe and the first one in the world with electric light, was opened to the public. In recent times, the adventure of experiencing 250 million years of Alpine history has given new impulses to tourism in the region, which has suffered from extreme depopulation in the past decades.

Scientists have been aware of the magnificent geology of the region since the early 19th century. It might be mentioned that one geological time interval (about 235 to 230 million years ago) of the Triassic period has been named the Anisian stage after a section of rocks close to the Enns River, which was called Anisius fluvius in Roman times. These comprise two permanent exhibitions: the museum of the Second Vienna Water Supply Line, which benefits from karstic springs in the area, and the GeoCentre of Gams, which provides an overview of the regional geology.

In November 2015 the Global Geoparks Bureau has reconfirmed Eisenwurzten Global Geopark's continuing membership of the Global Geoparks Network for a further four-year period.

Link: <http://www.geoline.at/>

- *Karawanken-Karavanke* (approved 2013):

This trans-boundary geopark connected and divided by the mountain range with the same name includes several Austrian and Slovenian municipalities. The Geopark is located between two Alpine mountains that exceed 2,000 metres: the Peca and the Košuta. It is marked by the rich, geological variety between the Alps and Dinarides. The area covers 977 km² and is inhabited by approx.

50.400 people. The Geopark area includes thirteen municipalities (8 in Austria, 5 in Slovenia): Feistritz ob Bleiburg/Bistrica nad Pliberkom, Črna na Koroškem, Dravograd, Gallizien, Globasnitz/Globasnica, Mežica, Bleiburg/Pliberk, Prevalje, Ravne na Koroškem, Zell/Sele, Neuhaus/Suha, Bad Eisenkappel/Železna Kapla, Sittersdorf/Žitara vas.

Link: <http://www.geopark.si>

- *Ore of the Alps* (approved 2014):

The Geopark „Ore of the Alps“ in the district of Pongau near Salzburg is mainly situated in the Graywacke Zone (Palaeozoic clastic rocks rich in mineral deposits) of Austria. The northern fringe of the Geopark belongs to the Northern Calcareous Alps, the southern one to the Central Alps. The most important rocks of the three geological units are slates, graywackes, phyllites, limestones and dolomites. These rocks are often covered by quaternary sediments (till, silt, gravel) of the Salzach glacier. The morphological inventory is manifold. Carbonate cliffs, waterfalls, gorges, springs, rock falls, earth pillars, terraces, cirque lakes, roche moutonnées etc. are detectable. But most important for the Geopark are the ore deposits. Copper ore, but also iron and gold forms the basis of former mining, which starts at prehistoric time. The history of copper began in the Bronze Age at the “Arthur-Stollen” (Arthurs mine). Today mining is history – but the memory of this long-lasting mining tradition in the core of the Geopark is still alive in public mines, mineral museums and traces in the nature. However it comes hand in hand with the responsibility, to secure the former mining activities as a common heritage of man for the future. Furthermore, this region is famous for the skiing area “Hochkönigs-Winterreich”, the annual ski jumping competition in Bischofshofen at epiphany and the wonderful recreation area of the “sun-terrace” of St. Veit / Goldegg, where in ancient times miners were busy, to prospect minerals. The Geopark offers a diversity of GEO, nature, culture, wellness, culinary and adventure.

Link: <http://en.geopark-erzderalpen.at/>