International Geosciences Programme - IGCP

2018 Annual Report

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Report drafted by Dr Özlem Adiyaman - 2019

1. Introduction

Developing an advanced understanding of the Earth's fundamental processes and resources is essential to reaching UN sustainable development goals.

UNESCO is the only United Nations organization with a mandate to support research and capacity in Earth Sciences and the International Geoscience and Geoparks Programme is our flagship.

The International Geoscience and Geoparks Programme (IGGP) consists of two pillars:

1. International Geoscience Programme (IGCP), since 1972, has harnessed the intellectual capacity of a worldwide network of geoscientists to lay the foundation for our planet's future, focusing on responsible and environmental resource extraction, natural hazard resiliency and preparedness, and adaptability in the era of a changing climate.

2. UNESCO Global Geoparks (UGGp) are laboratories for sustainable development which promote the recognition and management of Earth heritage, and the sustainability of local communities. As of December 2018, there are 140 UNESCO Global Geoparks within 38 Member States, covering a total area of 250,000 km^2.

UNESCO's International Geoscience and Geoparks Programme (IGGP) is implemented through these two activities: the International Geoscience Programme, a co-operative venture with the International Union of Geological Sciences (IUGS), and the UNESCO Global Geoparks. They coordinate their work through a shared UNESCO Secretariat and joint coordination meetings of their respective bureaux which convene as necessary. The chairpersons of the two respective Councils co-chair the IGGP (Annex 9).

In the framework of the International Geoscience and Geoparks Programme (IGGP), this report is drafted by UNESCO IGGP Secretariat for the 4th Open Session of the International Geoscience Programme (IGCP) Council and the presentation of the new UNESCO Global Geoparks applicants which will take place at UNESCO HQ from 9.30 a.m. to 12.30 p.m. on Thursday 21 February 2019.

This report summarizes:

- UNESCO IGCP Secretariat 2018 activities,
- The results, scientific achievements and the project meeting activities of 27 IGCP projects annual reports submitted as of 31 December 2018,
- Details of 21 new IGCP project proposals received as of 15 October 2018 for the evaluation of the IGCP Scientific Board in February 2019.

UNESCO Global Geoparks 4th Council meeting report is published separately and is available on UNESCO's website.

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2. Definition of IGCP

The International Geoscience Programme (IGCP) serves as a knowledge hub of UNESCO to facilitate international scientific cooperation in the geosciences. The IGCP mission includes promoting sustainable use of natural resources, advancing new initiatives related to geo-diversity and geo-heritage and geohazards risk mitigation.

Since 1972, the International Geoscience Programme (IGCP) has partnered with the International Union of Geological Sciences (IUGS) to bring together thousands of Earth scientists from around the world and allowed them to benefit from the cooperative spirit generated under the umbrella of UNESCO.

The IGCP promotes collaborative projects with a special emphasis on the benefit to society, capacity-building, and the advancement and sharing of knowledge between scientists with an emphasis on North-South and South-South cooperation. IGCP operates by providing seed funding grants donated by UNESCO, IUGS and extra-budgetary sources. IGCP projects primarily deal with geosciences on global issues within its five themes:

- Earth Resources,
- Global Change,
- Geohazards,
- Hydrogeology and
- Geodynamics.

Each project has an average lifespan of five years and its progress is assessed annually through a rigorous peer review process conducted by the IGCP Council following the evaluation reports from members of the Scientific Board during the first half of February.

The Scientific Board and IGCP Council are also responsible for evaluating new project proposals. The Scientific Board consists of about 50 specialists responsible for the technical reviews and it works electronically only. Board members are appointed as specialists in their given field for each of the five IGCP themes, with preferably an overlap in the Earth sciences fields, and reflects a worldwide geographic distribution.

The IGCP Council consists of six members, a chairperson and five experts, one for each IGCP theme and they meet annually at UNESCO Headquarters.

As the IGCP has a limited budget, IGCP support is specially allocated to supporting scientists from developing countries.

3. UNESCO IGCP Secretariat 2018 activities

In 2018, UNESCO IGCP Secretariat focused on below listed main activities.

1. Organization of the annual statutory meeting of the IGCP Council from 19 to 21 February 2018, and the funding of 26 IGCP project meetings in 16 countries,
2. Project partnership agreement with the Jeju Province Development Corporation (JPDC) of the Republic of Korea to support IGCP projects,
3. Management of the open call for the replacement of three new IGCP Council members and ten scientific board members,
4. Participation in the International Conferences to disseminate the achievements of the IGCP, organization of IGCP project presentation meeting to the representatives of UNESCO delegations,
5. Collaboration with National Commissions for UNESCO and IGCP National Committees, organization of joint meetings,
6. Launch of 2018 IGCP New Project Proposal open call and upon the receipt of 21 new proposals the management of their evaluation along with the active projects annual reports.

3.1 International Geoscience Programme Council Session 19-21 February 2018

UNESCO IGCP secretariat is responsible for the organization and financial support of the annual statutory meeting of the IGCP Council which assess new IGCP project proposals and annual reports of existing projects plus agreed fund allocation to each project. In 2018, IGCP Council meeting was organized with the participation of five Council members using UNESCO HQ Paris facilities between 19 and 21 February 2018. Unfortunately, Geodynamics Theme Council Member, Dr Nellie Mutemeri (Zimbabwe), was not able to participate in the 3rd IGCP Council meeting due to unexpected health problems.

Following the completion of the closed IGCP council session, the Council presented their recommendations to the members of IGCP, National Commissions for UNESCO, IGCP National Committees and Permanent Delegations to UNESCO on 21 February 2018. Total number 70 representatives participated in this meeting and were informed about IGCP 2017 activities and the decisions of the closed IGCP Council session.

In March 2018, UNESCO IGCP secretariat finalised the council meeting minutes and decisions which were published on UNESCO website. The minutes of the 3rd Council session and IGCP 2017 annual report were also circulated to the IUGS, Member States and Associate Member States of UNESCO by IGCP secretariat.

Following the funding allocation for 2018 IGCP projects by the Council, UNESCO IGCP Secretariat, in collaboration with the IUGS Treasurer and General Secretary of the IUGS, financially supported 22 IGCP projects related workshops and capability building activities in 2018, the details of these activities are listed in Annex 11 of this report. IGCP projects leaders are responsible of providing the details of their annual meeting plans, agenda and objectives to the IGCP Secretariat ahead of their workshops. IGCP UNESCO Secretariat evaluates and approves these activities and following UNESCO's validation, IUGS treasurer is responsible for the funds transfer for these project meetings.

3.2. Project partnership agreement with the Jeju Province Development Corporation (JPDC) of the Republic of Korea to support active IGCP projects

In 2017, UNESCO IGCP secretariat focused on the resource mobilization activities to extend the portfolio of IGCP projects. As a result, on 20 February 2018, UNESCO and the Jeju Province Development Corporation (JPDC) of the Republic of Korea signed a project partnership agreement entitled "Geoscience for Society: JPDC supporting the International Geoscience and Geoparks programme" through which the JPDC will contribute 100,000 USD to support IGCP projects and UNESCO Global Geoparks over the next five years. The partnership agreement ceremony was organized by the IGCP Secretariat at UNESCO HQ on 16 April 2018. The Permanent Delegation of the Republic of Korea to UNESCO and the National Commission representatives, JPDC CEO and senior management team signed an overarching agreement in the field of Natural Sciences for the protection and sustainable management of the Earth's geological resources and geological heritage with the Assistant Director-General for Natural Sciences of UNESCO.

3.3. Management of the open call for the replacement of three new IGCP Council members and ten Scientific Board members

3.3.1 IGCP Council

According to the Statutes of the International Geoscience and Geopark Programme (IGGP) and the Operational Guidelines for the International Geoscience Programme (IGCP) approved by the 38th General Conference, the IGCP Council shall be composed of six ordinary members, appointed by mutual agreement by the Director-General of UNESCO and the President of the International Union of Geological Sciences (IUGS). Initial six members of the Council were appointed by the Director-General of UNESCO in December 2016 indicating those whose initial term shall expire after two years. To renew the membership of the three Council members in 2018, on 31 December 2017, the IGCP Secretariat opened a call using the channels of the IUGS, the IGCP National Committees and the National Commissions for UNESCO to reach potential new members. The IGCP Council members shall consist of high-level experts who are actively engaged in scientific research related to the objectives of the IGCP.

By the 12 March 2018 deadline, the IGCP Secretariat had received 106 applications from 36 member states, of which 62 applications from 33 member states were qualified to be IGCP council members for the three currently open positions, including 20 applications from qualified female candidates (from 14 Member States).

Keeping in mind the priority gender in UNESCO and ensuring a good geographical distribution of the Council members, while making sure we will still have highly qualified members, the below listed international experts were approved by Prof Qiuming Cheng, President of IUGS, and nominated by the Director-General of UNESCO, Ms Audrey Azoulay.

They started their activities in October 2018.

- Mr Sobhi Nasir (Jordan/Canada): Earth Resources
- Mrs Weijian Zhou (China): Global Change

- Mr Carlos Vargas Jimenez (Colombia): Geohazards

UNESCO and IUGS would like to thank Mr Guy Narbonne (Chairperson, Canada), Ms Maria-Julia Orgeira (Global Change Theme Council Member, Argentina) and Mr Alik Ismail-Zadeh (Geohazards Theme Council Member, Azerbaijan) for their efforts to promote and support IGCP as outgoing IGCP council members since their initial appointments in 2016.

3.3.2 IGCP Scientific Board

The IGCP Council shall be assisted in its scientific duties by a Scientific Board established for this purpose jointly by UNESCO and IUGS on the recommendation of the IGCP Council. All Scientific Board members are appointed for a term of four years and are eligible for an appointment of a second term as determined by the IGCP Council.

In 2018, due to the completion of their initial terms, five scientific board members left the IGCP Scientific Board and following the decision of the Council to extend the board membership, ten new members were appointed following the nominations of the IGCP Council members. IGCP Secretariat thanks to experts, listed below, for their services and contributions to the IGCP.

- Mr Reimar Seltmann (UK)
- Ms Anne-Sylvie André-Mayer (France)
- Ms Suzanne Paradis (Canada)
- Mr Carlos Jaramillo (Colombia)
- Ms Mary Anderson (USA)
- Mr Brian Menounos (Canada)
- Mr Stephenson Randell (UK)
- Mr Robert Wright (USA)
- Mr Jafar Omrani (Iran)

IGCP Secretariat also welcomes the experts to IGCP Scientific Board listed below:

- Ms Claudia Alicia Marsicano (Argentina)
- Mr Yirgu Gezahegn (Ethiopia)
- Ms Irasema Alcántara Ayala (Mexico)
- Mr Mohsen Ghafory-Ashtiany (Iran)
- Mr José Ignacio Valenzuela Rios (Spain)
- Mr Frank Schwartz (USA)
- Mr Alfred Muzuka (Tanzania)
- Ms Liliana Castro (Argentina)
- Mr Carles Canet-Miquel (Mexico)
- Ms Baatar Munkhtsengel (Mongolia)

Ms Maria Julia Orgeira from Argentina (2016-2018 Council Member for the Global Change Theme) and Mr Guy Narbonne from Canada (2016-2018 Council Chairperson) kindly agreed to continue to serve for the Scientific Board for two years to support new Council Members during the early years of their terms.

IGCP Scientific Board consists of **53** experts from **41** Member States (Annex 10).

3.4. UNESCO IGCP Secretariat Participation in the International Conferences to disseminate the achievements of the IGCP

In 2018, Dr Ozlem Adiyaman from UNESCO IGCP Secretariat presented IGCP's objectives and achievements during the International Conferences listed below:

- **European Geosciences Union General (EGU) Assembly 2018** was organized in Vienna, Austria from 7 to 13 April 2018 with the participation of 15,075 scientists from 106 participating countries, of which 53% were under the age of 35 years. UNESCO IGCP Secretariat and our IGCP partner, the International Union of Geological Sciences (IUGS) and the Commission for the Geological Map of the World (CGMW) jointly hired a booth to present the IGCP programme during the EGU 2018 Assembly in Vienna and received inquiries from young scientists about the IGCP.
- **Resources for future generations (RFG) 2018**, the Premier International Conference on Energy, Minerals, Water and the Earth, was organized in Vancouver, Canada, from 16 to 22 June 2018. This major international conference examined the critical natural resources on which humanity depends, from minerals and water to energy. It attracted around 2,000 attendees and was organized by the IUGS (International Union of Geological Sciences). UNESCO IGCP Secretariat was invited by our IGCP partner, IUGS, to present the programme during this conference. Dr Adiyaman made oral presentations about the IGCP and participated several sessions of keynote speeches and seminars related to the UNESCO Earth sciences section, and met several industry and academic partners who are interested collaborating with the IGCP in the future.
- **The 8th International Conference on UNESCO Global Geoparks** was organized in Adamello Brenta UNESCO Global Geopark in Italy from 10 to 15 September 2018. The UNESCO IGCP Secretariat presented the work of the International Geoscience Programme and invited UNESCO Global Geoparks members to participate in this programme. This conference helped to disseminate the success of the IGCP to the representatives from the 140 UNESCO Global Geoparks programmes.
- **The 10th Jeju Water World Forum** was organized from 9 to 13 October 2018, in Jeju Island, the Republic of Korea by the Jeju Province Development Corporation (JPDC). In February 2018, UNESCO's International Geoscience and Geoparks Programme (IGGP) welcomed a new partner, the Jeju Province Development Corporation (JPDC) of the Republic of Korea. JPDC invited Dr Ozlem Adiyaman from IGCP Secretariat to participate in the 10th Jeju Water World Forum. As part of our aim to further promote the work of the IGGP, particularly, the work of the Hydrogeology Theme of the IGCP and UNESCO Global Geoparks, the Natural Sciences Sector of UNESCO agreed to attend the annual event to give an update of the cooperation between IGGP and the JPDC as part of the project partnership agreement signed in February 2018. During the opening ceremony of the forum, Dr Adiyaman provided a keynote lecture about the IGGP to 450 participants of the forum. This forum was an excellent opportunity to extend the outreach of the IGGP to the representatives of the Asia Pacific region.

- **Organization of IGCP 636 project presentation meeting at UNESCO HQ to the representatives of UNESCO Permanent Delegations.** The growing interest in renewable energies is an attractive opportunity for the next generation geoscientists to help fulfil clean energy needs globally and this is reflected in IGCP 636: *Characterization and Sustainable Exploitation of Geothermal Resources*. Four projects leaders travelled to France to participate in the European Geothermal Workshop in Strasbourg where the IGCP 636 team presented their scientific achievements. IGCP funds partly support the participation of the scientists to this important international event. On 5 October 2018, IGCP Secretariat organized an information meeting for the UNESCO Permanent Delegations of Colombia, Chile, Canada, France, Belgium, Iceland, Sweden, the Republic of Madagascar. IGCP 636, young scientist project leaders presented their work and achievements to the representatives of their delegations and discussed about their international collaboration under the UNESCO/IGCP umbrella.

3.5 Collaboration National Commissions for UNESCO and IGCP National Committees

National Commissions for UNESCO

UNESCO is the only UN Agency to have a global network of national cooperating bodies known as National Commissions for UNESCO. National Commissions make part of the overall constitutional architecture of the Organization.

Set up by their respective governments in accordance with the Article VII of the UNESCO Constitution, the National Commissions operate, on a permanent basis, for the purpose of associating their governmental and non-governmental bodies in education, sciences, culture and communication with the work of the Organization.

Presently, there are 199 National Commissions for UNESCO across the world. They constitute a truly global family with an authoritative network of stakeholders, partners and experts and offer a comparative advantage to the Organization within the United Nations system. This network plays a significant role in the liaison with partners, the coordination of activities, and the promotion of UNESCO's visibility at the country level.

IGCP National Committees

The IGCP National Committees are non-profit organizations that represent IGCP in a particular country. The committees act as agencies of consultation, liaison, mobilization, and coordination with national partners, including the civil society. They also make substantial contributions in the advancement of UNESCO's objectives and in project implementation.

The major aim of a National Committee is the organization and coordination of the IGCP-related outreach in the country and to sustain linkages of the national geological institutions and individuals with the international scientific community, and notably the IGCP. To this end, the IGCP Secretariat is in regular contact with the IGCP National Committees and invites the Committees' Chairpersons to the annual IGCP Council meeting, which is usually held in February.

IGCP National Committee:

- endorses new IGCP project proposals coming from the country's geoscientific community before they are sent to the IGCP Secretariat;
- proposes candidates for the IGCP Scientific Board;
- stimulates the participation of their country's geoscientists in new IGCP projects and enables them to share the ongoing, internationally relevant geoscience research.

The running of the IGCP National Committees is usually backed up by national funding. IGCP National Committees are, for example, established by and hosted at a variety of governmental and non-governmental organizations, such as National Academies, Universities and Institutions, Geological Surveys, Geological Societies, Ministries, industry and/or other professional bodies.

There are currently 44 IGCP National Committees for UNESCO across the world.

UNESCO IGCP Secretariat identified that in some countries the National Commissions for UNESCO and IGCP National Committees are not connected and not always aware of each other's work. Another issue that has also been recognized is that not all UNESCO Member States have an IGCP National Committee.

In 2018, IGCP Secretariat started a new initiative to:

- Connect National Commissions for UNESCO with IGCP National Committees,
- To increase the outreach of the IGCP National Committees to all UNESCO Member States.

To realize above points, IGCP Secretariat organized several meetings/workshops in Paris, Ankara and London between these two UNESCO bodies to better connect them and will continue this activity in 2019.

3.6 IGCP 2018 New Project Proposal Call

UNESCO IGCP Secretariat launched the open project proposal submission call for new IGCP projects early 2018 by using UNESCO website, contacting IGCP networks, social media sites as well as the communications channels of our IGCP partner organization IUGS.

IGCP Projects must focus, inter alia, on producing high-quality science of international importance and societal relevance, enabling interdisciplinary cooperation, and promoting international participation, including scientists from developing countries.

Project proposals may be submitted by individuals or groups to the IGCP Secretariat accompanied by a letter of endorsement from one of the project leader's IGCP National Committees.

The deadline for project proposals was on 15 October 2018 and the IGCP secretariat received 21 new project proposals, which is a substantial increase from previous years (there were 13 proposals received in 2017 and seven proposals received in 2016). We believe that

this considerable increase in IGCP project proposals is due to the extensive outreach and communication activities led by the IGCP Secretariat in 2017 and 2018 by participating to the international conferences and forums.

In 2018, the IGCP Secretariat established a new process to screen and review the content of new proposals by completing a checklist approved by the IGCP Council. Following the initial content verification the Secretariat distributed 21 new project proposals (Figure 1) to the IGCP Scientific Board members as of 15 November along with completed checklists which facilitated the work of Scientific Board members. These proposals will be evaluated by the Council from 18 to 20 February 2019 during the 4th IGCP Council session.

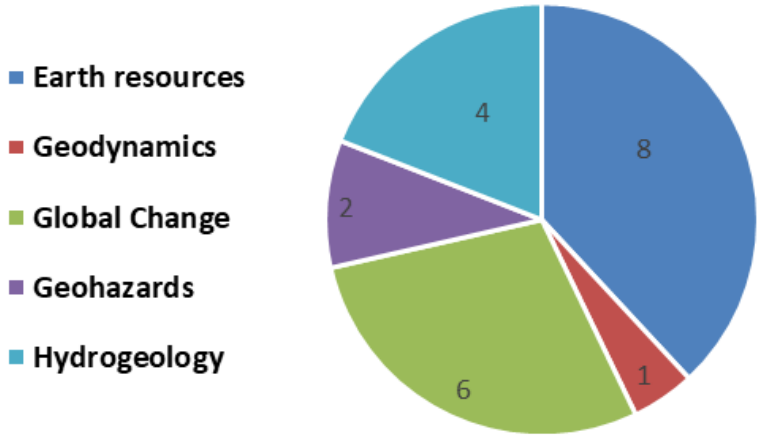


Figure 1: 2018 New IGCP project proposals distribution by theme.

A total of **108** project leaders from **49** member states jointly submitted **21** new IGCP project proposals which are requesting funding from 2019 (Figure 2).

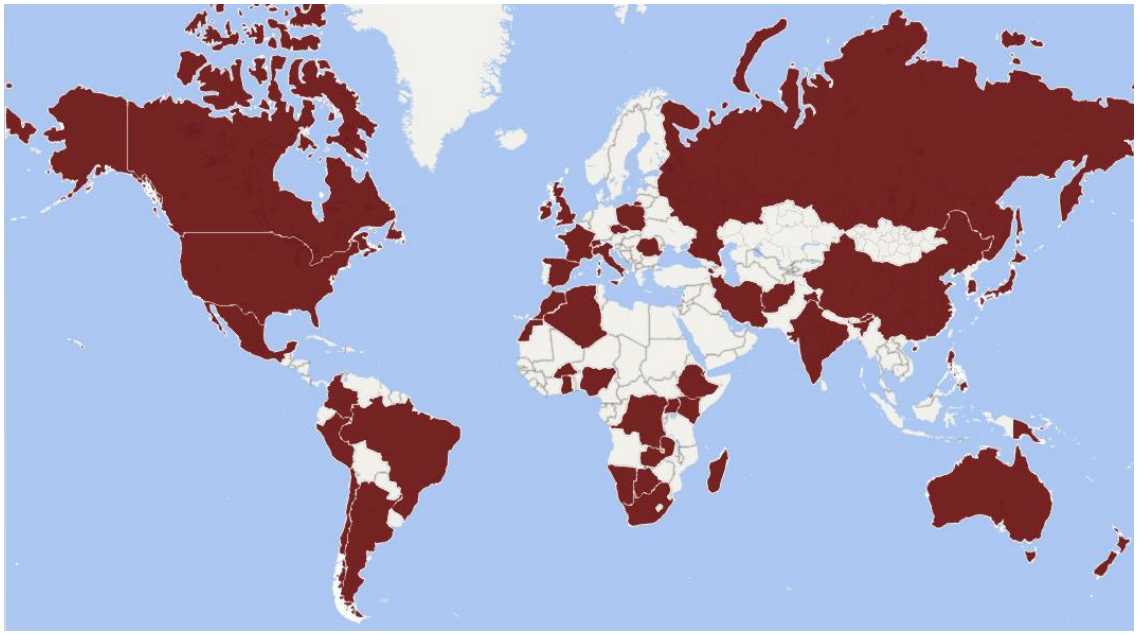


Figure 2: 2018 New IGCP Project Proposals distribution by Project Leader countries.

4. IGCP Projects 2018 Annual Reports Summary

The Council of the International Geoscience Programme (IGCP) met in February 2018 to select new projects that will be supported by UNESCO and the International Union of Geological Sciences (IUGS), the Democratic Republic of China as well as the Jeju Province Development Corporation Supporting (JPDC) from the Republic of Korea during 2018.

IGCP council members reviewed **13** new projects proposals and the **21** active IGCP projects which had an outreach to **111** countries in 2017.

The IGCP Council decided to continue funding sixteen ongoing projects and to nominate seven new IGCP projects. Four projects were eligible to keep their IGCP status during 2018 without receiving funding. Following the decisions taken during the 3rd IGCP Council Meeting in 2018, **27** IGCP projects were active and **22** IGCP projects received financial support (Figure 3).

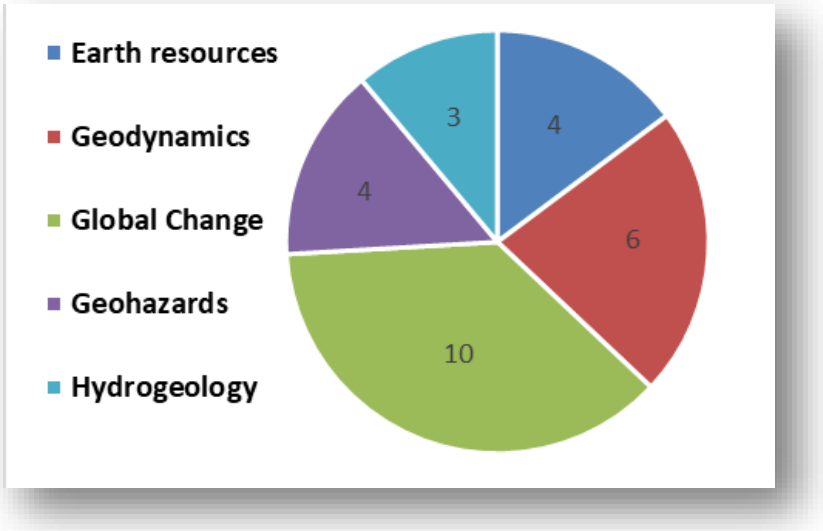


Figure 3: Distribution of 27 active IGCP projects by theme in 2018.

This report summarizes the results of all **27** IGCP projects which submitted their annual reports as of 31 January 2018.

4.1. International Collaborations

In 2018, the scientists from **105** countries participated in the delivery of these **27** active IGCP projects (Figure 4).

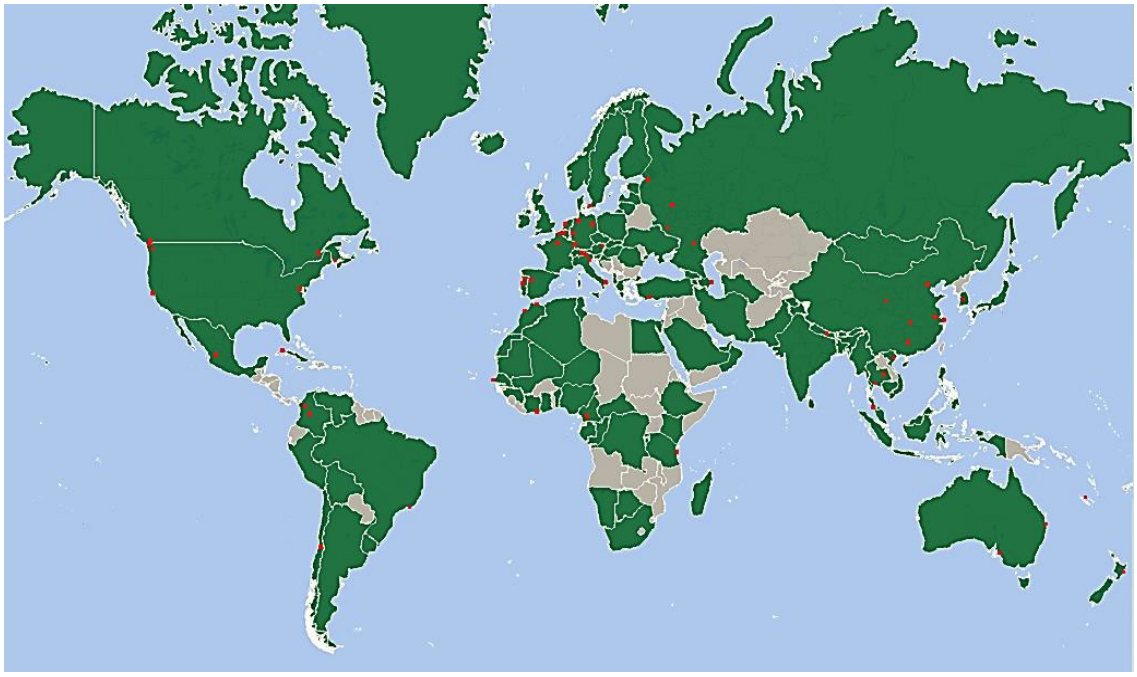


Figure 4: World map showing IGCP projects participating member states (in green) in 2018 and IGCP meetings sites (in red).

In 2018, Latin American and Caribbean participation and Arab State participation both increased, however African country participation decreased from 30 member states to 28. Figure 5 displays the number of countries in each region that are active in the 27 IGCP projects in 2018, and Figure 6 displays the number of member states involved in each project.

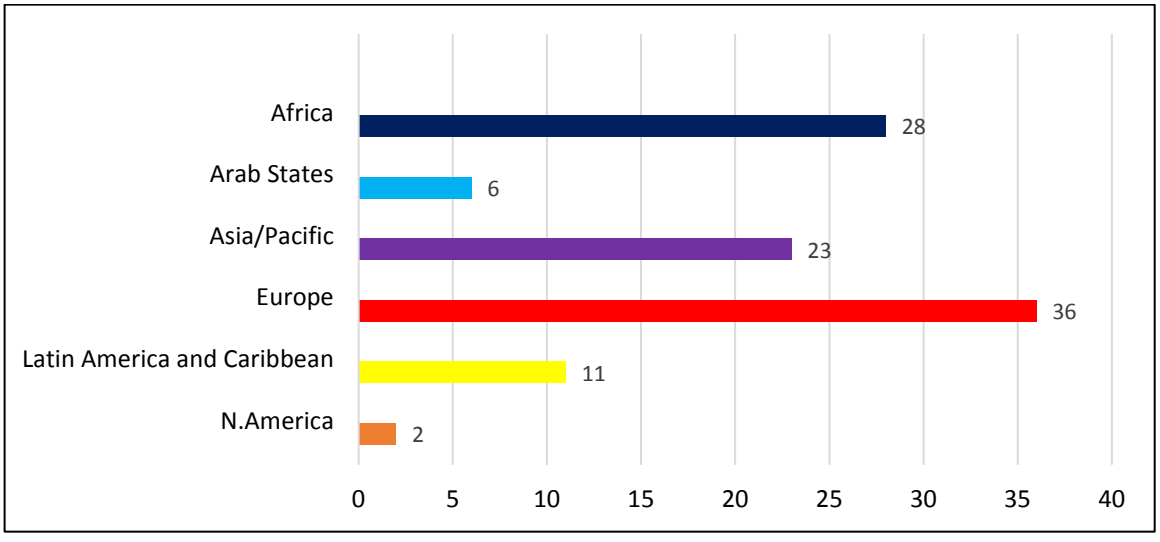


Figure 5. Number of participating Member States by region.

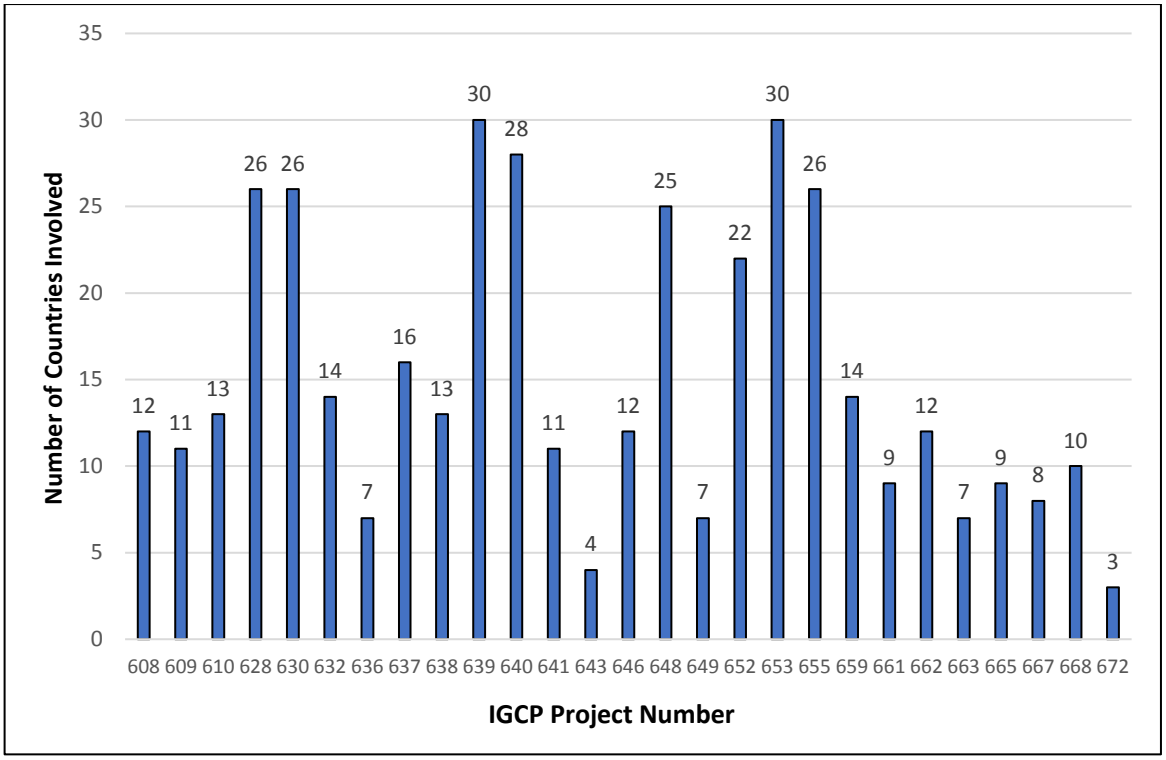


Figure 6. Number of Countries Involved in Each IGCP Project in 2018.

4.2. IGCP Project Leadership

In 2018 a total number of **160** IGCP Project Leaders came from **57** different countries (Figures 7 & 8).

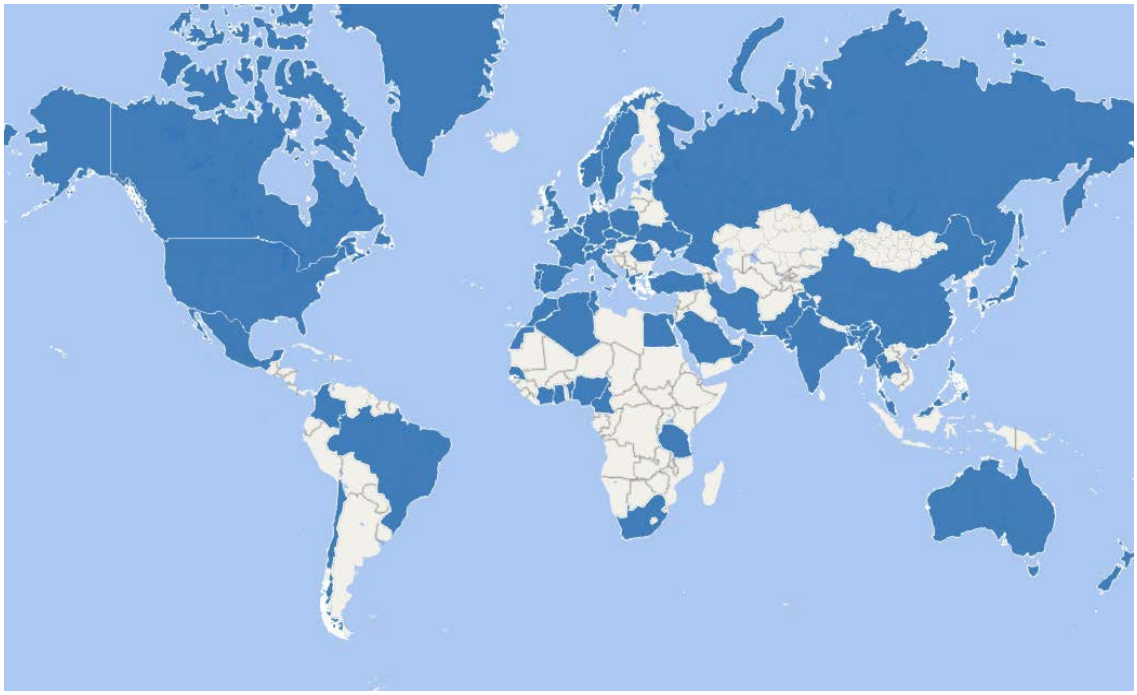


Figure 7: IGCP 2018 Project Leader Countries

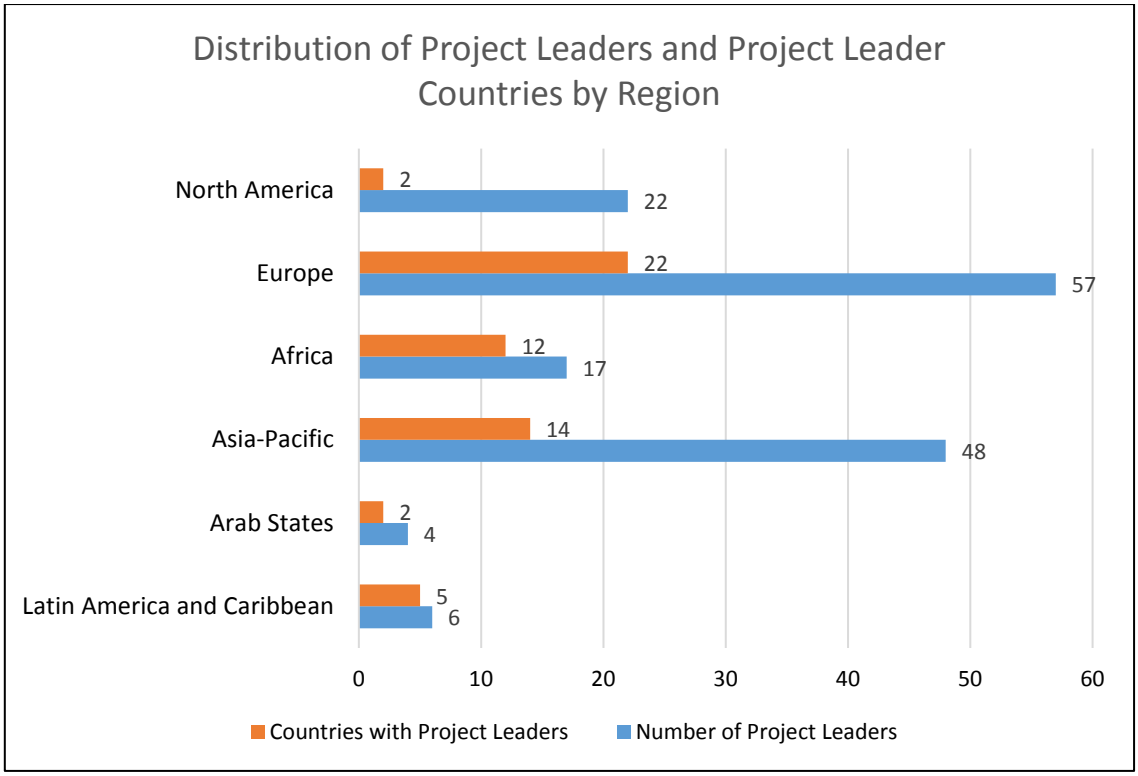


Figure 8: Distribution of Project Leaders and Project Leader countries by region

Each IGCP project is led by several project leaders from different countries, for example IGCP 630 project was led by 14 project leaders from 9 countries and IGCP 637 had 13 project leaders came from 12 different countries (Figure 9).

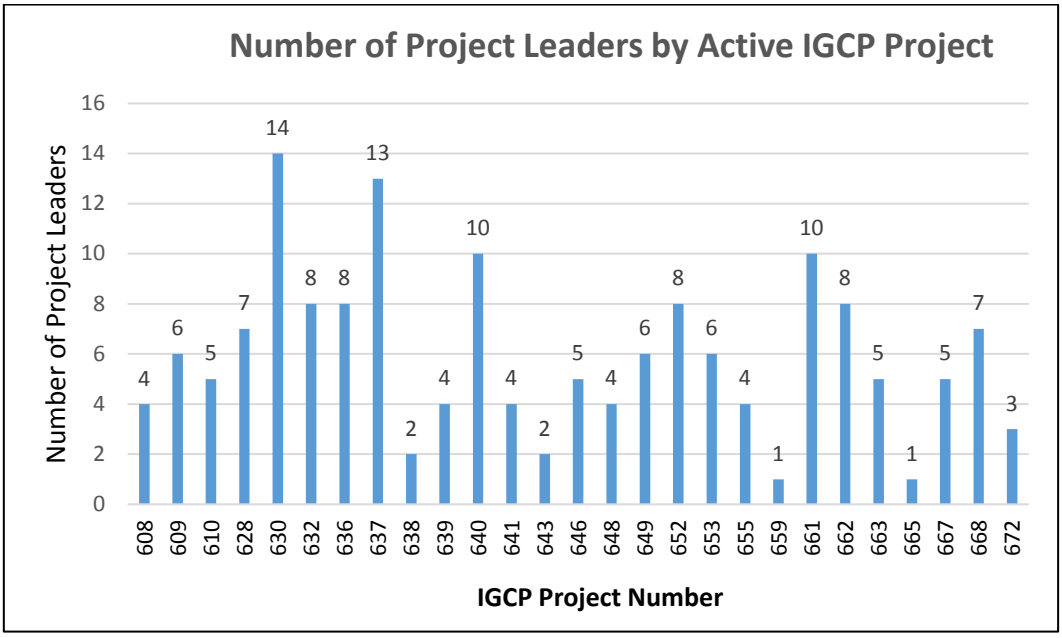


Figure 9: Number of Project Leaders in each IGCP project.

4.3. IGCP Project Participant Demographics

According to the project annual reports, a total of **160** project leaders brought together **4485** project participants to deliver the objectives of the **27** active IGCP projects that received financial supports from IUGS and UNESCO. Of all the project participants, **56%** are young scientists (<35 years old) and **65%** of all participating scientists come from developing nations.

The overall analysis of the 2018 annual reports confirms the trend observed during last four years which shows that IGCP project outreach and diversity have increased continuously over these years. Gender equality is one of UNESCO's priority areas, and the IGCP projects show very promising results, with women comprising of a total of **32%** of all participating scientists in 2018 (Figure 10).

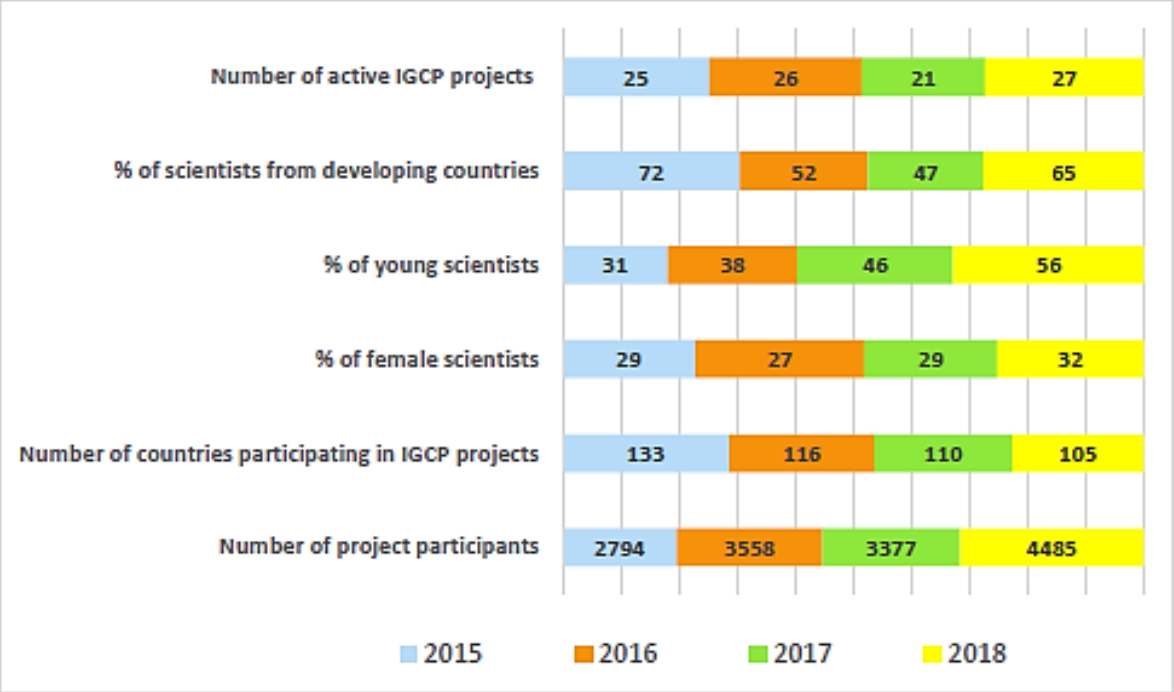


Figure 10: Comparison of IGCP projects participants between 2015 and 2018.

Additionally, the 2018 annual reports indicate that **27%** of the 160 project leaders are women. Women also make up **32%** of the 2924 participants from developing countries. These percentages increase in the young scientists group, where out of 2506 young scientists, **34%** are young women (Figure 11).

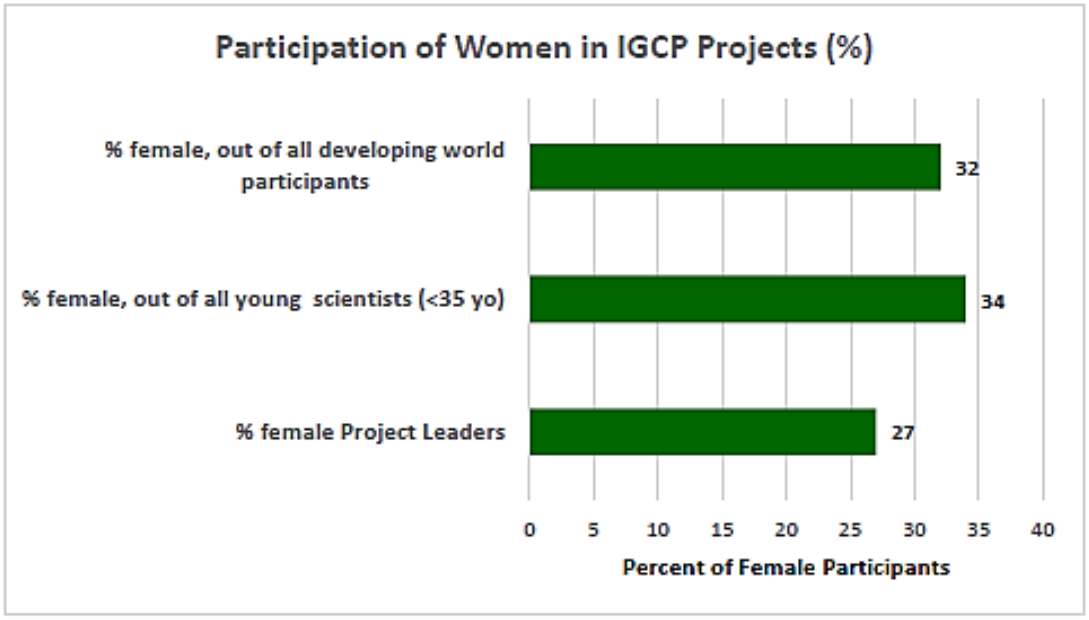


Figure 11: Percent of women involved in 2018 projects (in percentages).

4.4. Project Meetings

In 2018, a total number of **67** IGCP project meetings took place in **33** countries (Figure 4). Of these, a total of **26** IGCP project meetings, taking place in **16** countries, were financially supported by the IGCP programme funds. Annex 11 shows the details of 26 IGCP project meetings funded jointly by the IUGS and UNESCO.

5. IGCP Council member biographies and 2018 IGCP Themes highlights

As stated previously, the IGCP Council, supported by the Scientific Board (Annex 10), is responsible for evaluating project proposals according to the IGCP Guidelines, as well as for the quality assessment of projects that are in progress.

The IGCP Council is composed of six members, all of which are high-level experts. The IGCP Council consists of a Chairperson and five theme group leaders who manage and represent the collective reviews and process of evaluating projects within their appointed theme. Once a year, the IGCP Council assisted by the Scientific Board assess the progress of about half a dozen existing projects as provided in their annual reports and also critique several new project proposals for the future funding. They have assembled at UNESCO Headquarters on the occasion of the IGCP 3rd Council meeting from 19 to 21 February 2018.

During the IGCP Council 2018 session, the IGCP Council Chairperson was Dr Guy Narbonne (Canada), a Professor and Research Chair in the Department of Geological Sciences and Geological Engineering at Queen's University in Canada. He has been a member of the IGCP Scientific Board since 2008, and previously served as Theme Leader for Global Change: for four years (2013-2016) before beginning his role as Chair of IGCP in 2016. Dr Narbonne's research centres on the early evolution of complex multicellular

life 1000-500 million years ago (Neoproterozoic–Cambrian) and the inter-relationship between this biotic evolution and coeval changes in the world's oceans and atmosphere.

Due to the completion of his two years term and the renewal of the IGCP Council members, the IGCP Council members voted that Dr Brigitte Vlaswinkel will be acting chairperson for the evaluation of IGCP 2018 projects and new proposals for the preparation of the 4th IGCP Council meeting which will be held from 18 to 21 February 2019.

Dr Brigitte Vlaswinkel obtained her PhD in Marine Geology and Geophysics at University of Miami, USA, in 2007. She presently works as Head of Research at a young, clean-tech company Oceans of Energy, which specializes in floating renewables and ocean energy. Besides this, Dr Vlaswinkel is the Environmental Impact Lead at The Ocean Cleanup.

5.1. Earth Resources: Sustaining our Society

Knowledge on natural resources, including minerals, hydrocarbons, geothermal energy, and water, and their management is the frontline of the struggle for more sustainable and equitable development. The environmentally responsible exploitation of these resources is a challenge for geoscience research. The progress of technological development is equally bound to this premise. Annex 1 details the 2018 highlights of the IGCP Earth Resources Theme drafted by Prof. Sobhi Nasir (Jordan/Canada) who replaced the position left by Dr Brigitte Vlaswinkel (Netherlands). Dr Vlaswinkel represented the Earth Resources Theme during 2017 and 2018 IGCP Council meetings.

Professor Sobhi Nasir graduated in Mineralogy/Petrology at Wurzburg University, Germany (1986). Prof. Nasir joined the Sultan Qaboos University in Oman in 2004 as a Head of Department and now he is the Director of Earth Sciences Research Centre and the UNESCO Chair for Ophiolite Studies as well as an Adjunct Professor at Western University, Canada.

5.2. Global Change and the Evolution of Life: Evidence from the Geological Record

Changes in the Earth's climate and of life on Earth are preserved in the geologic record. Ice and dust records, terrestrial and ocean sediments, and sequences of fossil plant and animal assemblages all tell the story of our Planet, which holds important lessons about present-day environmental challenges and the ways to mitigate and manage environmental damage. Annex 2 details the 2018 highlights of the IGCP Global Change Theme drafted by Prof. Weijian Zhou (China) who replaced the position left by Dr María Julia Orgeira (Argentina) who represented the IGCP Global Change theme during 2017 and 2018 IGCP Council meetings but left the council due to the termination of her initial two years term.

Dr Weijian Zhou was graduated from Guizhou University, (1976) and a PhD in Geology from North-West University, China (1992-1995). Currently, she is the Director and Professor of the Xi'an Accelerator Mass Spectrometry (AMS) Centre, the Director of the academic board of State Key Laboratory of Loess and Quaternary Geology, CAS (Chinese Academy of Sciences).

5.3. Geohazards: Mitigating the Risks

Geohazards include earthquakes, volcanic activity, landslides, tsunamis, floods, meteorite impacts and the health hazards of geologic materials. Geohazards can range from local events such as a debris slide or coastal erosion to events that threaten humankind (e.g., supervolcano eruption or meteorite impact). Earth scientists undertake research to better understand such hazards and contribute to risk reduction. Annex 3 details the 2017 highlights of the IGCP Geohazards Theme prepared by Dr Carlos Vargas Jimenez (Colombia) who replaced the position left by Dr Alik Ismail-Zadeh (Azerbaijan) who represented the Geohazards Theme during the IGCP Council meetings in 2017 and 2018 but left the Council due to the end of his initial two years term.

Dr Carlos Alberto Vargas J. is Professor in the Department of Geosciences of the Universidad Nacional de Colombia at Bogota. He is the Director of the Geophysics Research Group, and Director of the Seismological Network of this institution. Prof Vargas obtained his PhD in Geophysics from the Technical University of Catalonia (UPC), Barcelona, Spain in 2003.

5.4. Hydrogeology: Geoscience of the Water Cycle

Life on Earth depends on water and its sustainable use is crucial for continued human existence. Earth's water resources include surface/ground water, ocean water, and ice. The study of Earth's water involves understanding and managing both surface and ground water systems, including sources, contamination, vulnerability and history of water systems. Annex 4 details the 2018 highlights of the IGCP Hydrogeology Theme summarized by Dr Yongje Kim who is the IGCP Council Member representing Hydrogeology Theme and the rapporteur of the IGCP Council.

Dr Yongje Kim is a principal researcher in the Groundwater and Eco Hydrogeology Research Center of the Geologic Environment Division at the Korea Institute of Geoscience and Mineral Resources (KIGAM). He received his PhD in Geology (Environmental Hydrogeochemistry) at Texas A&M University, USA in 1995.

5.5. Geodynamic: Control our Environment

Our habitable environment at the Earth's surface is linked and controlled by processes occurring deep within the Earth. Earth scientists use, inter alia, geophysical techniques to study deep Earth processes ranging from changes in the Earth's magnetic field to plate tectonics to understand better the Earth as a dynamic planet. Those processes are also relevant to natural resource exploration, distribution and management of groundwater resources and the study and mitigation of natural hazards such as earthquakes. Annex 5 details the 2018 highlights of the IGCP Geodynamics Theme drafted by Dr Nellie Mutemeri who is the IGCP Council member for the Geodynamic Theme.

Dr Nellie Mutemeri is an Associate Professor in the School of Mining Engineering at the University of Witwatersrand in South Africa. She also runs a boutique consulting firm MutConsult which specializes in mining, energy and climate change. Dr Mutemeri's other areas of research interest in geology include geochemistry and ore genesis of Archaean gold deposits in the greenstone belts of Southern Africa and fluid inclusion studies.

6. IGCP 2018 Financial Summary

In 2018, the total IGCP budget was 149,327 USD (Annex 6). 22 IGCP projects received grants and the average support per project was around 6,800 USD of seed funding per project. In 2018, 22 IGCP projects were co-sponsored by UNESCO, IUGS ($60k), the People's Republic of China ($20k) and the JPDC ($40k) of the Republic of Korea.

7. Conclusions

The Council of the International Geoscience Programme (IGCP) held its 3rd Session in February 2018 and evaluated the progress of **21** existing projects as provided in their annual reports and also assessed **13** new project proposals that requested new funding.

During 2018, 27 IGCP projects were active across the following geological themes: Global Change and the Evolution of Life, Earth Resources, Geohazards, Hydrogeology and the Geodynamic Control of our Environment.

In 2018, UNESCO worked closely with the International Union for Geological Sciences (IUGS) to mobilize global cooperation in the Earth Sciences through the International Geoscience Programme (IGCP). IUGS's financial contribution to IGCP helped the continuity of this programme, with a heritage of over 45 years, providing a platform for scientists from across the world to push the frontiers of knowledge forward through concrete scientific research projects. IGCP was presented during the EGU 2018 Assembly in Vienna and RFG 2018 in Vancouver in collaboration with the IUGS.

In 2018, UNESCO's International Geoscience and Geoparks Programme (IGGP) welcomed a new partner, the Jeju Province Development Corporation (JPDC) of the Republic of Korea, this new partnership enabled IGCP to provide higher seed funds than previous years.

In 2018, the People's Republic of China continued their supports to the IGCP. The People's Republic of China provides annually $20k to the IGCP since 2009 and this contribution is very important for the outreach of the IGCP.

Three new IGCP Council members and ten new Scientific Board members were successfully appointed in 2018 and smoothly secured the continuity of the scientific evaluation of the programme.

IGCP Secretariat actively presented the success of the programme during the International Conferences, these outreach activities increased the visibility of the IGCP and resulted the submission of higher number of new IGCP project proposals.

In 2018, 160 project leaders collaborated with at least 4485 project participants to deliver the objectives of 27 active IGCP projects. A total of 26 IGCP project meetings (Annex 11) have successfully been organized by building bridges between disciplines and between scientists from 105 Member States, with aims of stimulating cutting-edge research and sharing scientific knowledge for the benefit of all.

IGCP projects published over 300 scientific papers, contributed scientific research regarding several UN SDGs (Annexes 1-5).

In 2018, the UNESCO IGCP Secretariat worked closely with the IUGS Secretariat and treasurer to provide regular updates about the progress of 27 IGCP projects and their meetings to the IUGS Secretariat and the wider Earth Science Community via the dedicated IGCP website.

Annexes

Annex 1: 2018 Summary of IGCP Earth Resources Theme

1) IGCP 636: Characterization and Sustainable Exploitation of Geothermal Resources

Duration: 3 years (2016-2018)

Aims: The general objective of this project is to investigate innovative field methodologies and modelling techniques to facilitate the decision-making process related to geothermal resources management, and to evaluate public awareness and acceptance of these systems which can further impact the management of these resources. This innovative approach supports the development of new models for geothermal systems. The project successfully managed to generate substantial funding for research, infrastructure and mobility for the whole consortium. The project established a widespread cooperation between universities and research institutions from four continents. This background provides a unique opportunity to complete comparative studies with a similar approach on different types of geothermal systems. The project obtained many excellent achievements, including fieldwork and data collections, meetings, involvement of graduate students, and development of further research studies.

Related UN SDGs: This project addresses the main objectives of IGCP, UNESCO and IUGS. It contributes to *Goal 4: to ensure inclusive and quality education for all and promote lifelong learning*, as one of the specific project objectives is to support young scientists and students from developing countries; for that reason 67% of the scientists involved are under 35 years old. The project also contributes to *Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all* and *Goal 13: Take urgent action to combat climate change and its impacts* as some of the project objectives are to develop new and more effective methods to exploit geothermal resources, which, unlike fossil fuels, do not involve any form of combustion. This means geothermal power systems give off significantly fewer amounts of carbon emissions and thereby help offset climate change.

Countries involved, approximate number of total 2018 participants: Forty-eight participants from nine countries were actively participating in this last year: Colombia, Chile, France, Belgium, Canada, Iceland, Sweden, Madagascar, Italy. Of all the participants, 40% are female, 60% are male, and 67% are under 35 years old.

Scientific activities (meetings, workshops, training sessions): In 2018, six abstracts written by IGCP636 researchers were accepted to be presented at the EGW workshop. Ten researchers attended this event. One researcher attended the GRC annual meeting in Reno, Nevada, USA, in October 2018. The Antioquia Geothermal day, on 12 April 2018, took place across three main countries: Colombia, Chile, Italy. The celebration was organized at the Universidad de Medellin (UdeM) with around 100 participants. The Geothermal and Hydrogeological Day, on 13 November 2018, involved participants from Colombia, Italy and Canada. The IGCP636 Annual Meeting 2018 was organized on 3-12 October 2018: involving participants from Canada, Chile, France, Belgium, Colombia, and many more, and took place at the European Geothermal Workshop in Strasbourg. The RENAG 2018 in Bogotá, Colombia took place from 11 to 15 December 2018, with around

50-100 participants from Colombia, Italy, Iceland, Mexico, and El Salvador. A short-course was organized by the Chilean chapter of the International Association of Hydrogeologists (IAH) with Professor L. Daniele. The course was titled, "Characterization and modeling of groundwater flow, transport, and deformation in fractured geological media." Finally, several undergraduate and graduate students participated and trained in Iceland, Canada, Colombia and Belgium.

Scientific achievements/ results (papers, new findings, new models, new data, new maps etc.): In its final year, the project obtained many excellent achievements, including fieldwork and data collections, meetings, graduate students involvement and the development of further research projects. In 2018, the results of the project were published in several peer-reviewed journals; 7 papers, one chapter in book, 5 submitted papers and 13 conferences papers. The team has established more collaboration with the UNESCO IGCP.

Societal/educational results/highlights (media coverage, science education, cultural activities)**:** Public outreach included radio interview to J. Raymond: inauguration of the LOG, Radio Canada, in 28 November 2018. Several moments of the IGCP636 Annual Meeting were recorded and shared through the Facebook page and website. An additional video about research conducted on geothermal resources will be produced at UdeM in 2018. The project can be followed on Facebook Public outreach, and includes a survey on the public perception of geothermal resource exploitation, which was available on the website until recently.

2) IGCP 637: Heritage Stone Designation

Duration: 5 years (2015-2019)

Aims: The scientific objectives of the project are to protect global heritage stone sites by certification, to increase professional and social awareness of the natural stone and cultural heritage, and to enhance international cooperation for the research and documentation on the global natural stone sites. The project aims to include more heritage stone sites from emerging countries where professional and social awareness are limited in order to preserve geological and cultural heritage.

Related UN SDGs: The project contributes to *Goal 4: Ensure inclusive and quality education for all and promote lifelong learning*, as one of the specific project objectives is to support young scientists and students from developing countries.

Countries involved, approximate number of total 2018 participants: Sixteen countries and 49 participants are actively involved in the project this year: seven from developing countries and 41 from developed countries (Argentina, Australia, Brazil, Colombia, Germany, India, Italy, Malta, Morocco, Norway, Portugal, Romania, Slovenia, Spain, Sweden and USA). 49% are female scientists, 51% male scientists and 25% are young scientists under 35 years old.

Scientific activities (meetings, workshops, training sessions): Two well attended major meetings were organized in 2018. The project held a congress and workshop in 2018, which are Global Stone Congress, from 24 April to 2 May with 170 participants from 12 countries, and one Workshop on Heritage Stones, from 2 to 4 October 2018, with 49 participants from 16 countries. Early career researchers were involved with the I Workshop on Heritage Stones as a part of the organizing committee.

Scientific achievements/ results (papers, new findings, new models, new data, new maps etc.): The main achievement of the project in the year of 2018 was to designate seven new global heritage stones, which are Maltese Globigerina Limestone in Malta, Jacobsville Sandstone in USA, Lede Stone in Belgium, Welsh Slate in Wales, Piedra Mar del Plata in Argentina, Kolmarden Serpentine in Sweden, and Lioz Limestone in Portugal. The IUGS Executive Committee also approved a poster design for ratified Heritage Stone Resources, which can be used by government agencies or local communities as well as for educational purposes to increase social awareness. The project's major meeting was the Global Stone Congress of 2018 and major scientific results were summarized in the Proceedings of the Global Stone Congress 2018. The First Workshop on Heritage Stones was held in Salamanca. The first book of the Book Series *Natural Stone and World Heritage*, edited by CRC Press (Taylor and Francis) was published. Several articles have been generated for other peer-reviewed technical journals and also local papers. A great deal of promotional events took place in relation with the First Workshop on Heritage Stones (attached to the celebration of 800 anniversary of University foundation).

Societal/educational results/highlights (media coverage, science education, cultural activities)**:** Many media reports were published in local papers and over the web and social media during the I Workshop on Heritage Stones (attached to the celebration of 800 anniversary of the University of Salamanca foundation, URLs are given in the annual report).

3) IGCP 638: Paleoproterozoic Birimian Geology for Sustainable Development

Duration: 5 years (2016-2020)

Aims: This project aims to improve knowledge of the relationship between gold-bearing mineralizations and the geodynamic evolution of the old Birimian formations from 2300-2000 million years ago in the West African Craton so that more targeted prospecting and exploitation can take place. A second aim is to determine the types of pollutants used in 'gold washing' and their impact on public health by carrying out a hydro-geochemical study.

Related UN SDGs: This project addresses the scientific objectives of IGCP, UNESCO and IUGS. It contributes to *Goal 6: Ensure access to water and sanitation for all* as it tries to evaluate the effects of the traditional exploitation of gold on water quality and the availability of the water resources to manage public health risks. The project also contributes to *Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all*, and *Goal 12: Ensure sustainable consumption and production patterns* as it tries to find new gold discoveries in West Africa and exploit them sustainably,

creating jobs in the mining sector and thereby contributing to the economic and social development of the states.

Countries involved, approximate number of total 2018 participants: Fourteen countries and 160 participants are actively involved in the project this year: 11 African countries (Algeria; Côte d'Ivoire; Gabon; Ghana; Guinea; Morocco; Mali; Mauritania; Niger; Senegal, South Africa) and three developed countries (Australia, Belgium, France). Of all participants, 22.5% are female scientists, 77.5% are male scientists, and 66.25% are young scientists under the age of 35.

Scientific activities (meetings, workshops, and training sessions): The project organized the 3rd annual meeting in Abidjan, Ivory Coast, 15-20 October 2018. Five plenary keynotes related to the sets of themes are allowed to reinforce the capacity of the participants regarding education, training in the Precambrian geodynamics and the related questions with water and environment for public health within the mining activity zones. The conferences were followed by a four-day fieldtrip on Paleoproterozoic Formations of the Comoe basin and Toumodi-Fetekro Belt of Ivorian Man-Leo ridge, from 17 to 20 October 2018. The investigators published a field trip guide book and abstracts book of the 3rd conferences.

Scientific achievements/ results (papers, new findings, new models, new data, new maps etc.): In 2018, the IGCP638 invited the WAXI group to join its 3rd conference, which offered an excellent occasion to present and discuss the last results obtained in geology of the WAC. This meeting created links for collaboration between geologists of various branches of earth sciences with an ambitious common objective: to better understand the geology of the WAC for an efficient and sustainable exploitation of its mining resources. A special volume has been published in Journal of African Earth Sciences in December 2018.

Societal/educational results/highlights (media coverage, science education, cultural activities)**:** Some results of works were released by the online press and websites of different institutions, universities, task groups, associations and non-governmental organization (NGO). A press event was also made with some national TV channels.

Annex 2: 2018 Summary of IGCP Global Change Theme

Projects are listed following Geologic Time (from Cenozoic to Paleozoic)

1) IGCP 639: Sea Level Changes from Minutes to Millennia

Duration: 5 years (2016-2020)

Aim: The aim of the project is to 1) study records of past coastal sea-level changes, 2) provide a platform for the development of integrated records of sea-level change and coastal hazards obtained from instrumental, historical, archaeological, and geological records, and 3) promote the understanding of the impacts of human interactions, coastal dynamics and vulnerability at different timescales.

Achievements: This project published 28 papers in 2018, some of which appeared in high impact journals such as Nature Communications, Proceedings of the National Academy of Sciences, and Quaternary Science Reviews. A second newsletter was completed and is expected to be published in January, 2019. A meeting report on the Oman conference and workshop was published in EPISODES. By hosting the 2018 annual meeting in Italy, the project had the chance to develop new working relationships with colleagues in northern Africa. Three sessions related to sea level, extreme waves, and coastal geomorphology at the EGU conference and one at AGU meeting were organized, as well as a two day training workshop.

2) IGCP 610: From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary

Duration: 5 years (2013-2017 + OET)

Aim: The aim of the project is to study the paleo-environmental changes in the Caspian-Black Sea-Mediterranean Corridor, to develop a model for the processes of Caspian-Mediterranean Corridor formation and Paratethys Sea-Lake degradation, to study geological characteristics of Quaternary stratotype as well as key archaeological and paleontological sites in this area, and to establish a theoretical foundation for understanding the human response to global climate change in the early days.

Achievements: Research related to stratigraphy, geochronology and paleogeography and some other topics have been carried out in several areas including the regions of Caspian Sea, Eastern Manych Valley, the Sea of Azov, the Black Sea, the Mediterranean and the Ponto-Caspian. For this project, a total of 9 meetings and symposia were held, including a field trip organized in 2018 for about 120 people from 11-12 countries. The project and training activities, which included a summer school programme, provided opportunities for students and young researchers to gain direct contacts between western and eastern countries. The project also promoted a multidisciplinary approach in paleo-environmental studies that encourages students in geology and geography to take

archaeological courses and vice versa. A total of 22 scientific papers were published in peer-reviewed journals.

3) IGCP 608: Asia-Pacific Cretaceous Ecosystems

Duration: 5 Years (2013-2017 + OET)

Aim: The aim of the project is to delineate the Cretaceous ecosystems and how they responded to the paleo-environmental changes that affected the South-East Asian and adjacent Western Pacific region.

Achievements: This 2018 project has integrated the current knowledge of Cretaceous land, ocean, biosphere and ecosystems in each participating country. This research will improve our understanding the Cretaceous paleo-environments and the paleo-ecosystems in Asia. Their work also provided information for local Geoparks and dinosaur museums. There were four symposiums, two conferences/congresses and one field excursion organized. The project also involved PhD, MSc, and Bachelor programmes, with which several students earned their PhD and MSc degrees. The Geoconvergence Center at Chonnam National University (Gwangju, South Korea) for Geo-tourism and Geo-education of Mudeungsan Area National Geopark was established, and the Geopark consisting of the Cretaceous volcanic rocks and fossil sites was approved as UNESCO Global Geopark on 20 May 2018. Additionally, there were several public lectures for adults and children on these topics. They published a scientific book consisting of 108 papers in peer-reviewed, international journals and 25 papers in domestic journals. Among these publications were the proceedings volume of the first and second meetings of our project, which has been published as a virtual issue.

4) IGCP 609: Cretaceous Sea-Level Changes

Duration: 5 Years (2013-2017 + OET)

Aim: The aim of this project is to study the correlation, causes and consequences of significant sea-level changes during Earth's last major greenhouse episode: the Cretaceous period.

Achievements: In the past year, this project planned its final proceedings volume at the Geological Society of London, Special Publications Book Series (GSL SP): Cretaceous Climate Events and Short-Term Sea-Level Changes. No other project meetings or educational and training activities were organized, except for the invitation of project participants to submit manuscripts to the final proceedings volume at GSL SP. Sixteen scientific papers were published in peer-reviewed journals.

5) IGCP 632: Continental Crises of the Jurassic

Duration: 5 Years (2014-2018)

Aim: This project specifically focuses on the interactions between the Earth's major events and the global climate, and the correlations between the evolution of ancient lacustrine ecosystems and the marine realm during the Jurassic Period, starting with the mass extinction event that occurred 202 million years ago, just prior to the Triassic-Jurassic boundary, through the Toarcian anoxic event 183 million years ago and finally covering the Jurassic-Cretaceous boundary at 145 million years ago.

Achievements: They published 32 papers in academic journals, conference proceedings, Research Gate, and some informal publications. The new results promoted our understanding of the Mesozoic climate, ecosystems, mass extinction events and atmospheric composition. A field excursion in North Island, New Zealand was organized and a Triassic-Jurassic boundary sequence preserved within deep marine sediments was investigated. The project website has been a highly-visible and widely utilized hub for the continental Jurassic research community and the project's social activities.

6) IGCP 655: Toarcian Oceanic Anoxic Event: Impact on Marine Carbon Cycle and Ecosystems

Duration: 3 years (2017-2019)

Aim: This project aims to 1) reveal how marine ecosystems are affected by the carbon cycle perturbation and the global warming through productivity, water stagnation and oxygen depleted conditions, 2) elucidate the causes triggering this environmental change and to 3) clarify the initial phases of the biotic crisis and the factors controlling biotic recovery in different trophic levels from various habitats and climate zones.

Achievements: In the second year of this project, we improved our understanding of the T-OAE in approaches and topics of sedimentology and stratigraphy, incidence of T-OAE on marine communities, and geochemistry, environmental conditions and paleoclimatology. Twenty-seven papers in total were published, 25 in international journals. The 2nd International Workshop on the T-OAE and a special session in the 26e Réunion des Sciences de la Terre (Société Géologique de France) were held. Additionally, an educational seminar and a short training course were organized.

7) IGCP 630: Permian-Triassic Climatic and Environmental Extremes

Duration: 5 Years (2014-2018)

Aim: This project aims to investigate the climatic and environmental extremes and ecosystem response during the Permian-Triassic mass extinction and its aftermath through analyses of the worldwide rock and fossil records.

Achievements: One special issue, "Permian and Triassic World", which included 15 papers, was published in Journal of Earth Sciences. A total of 285 papers (including 30 papers in press) were published in SCI-cited journals in 2018. These papers contained

new findings deepening our understanding of the Permian-Triassic events and biotic responses. The project's Annual Meeting, Post-Meeting Field Excursions, Closing Meeting, and Annual Field Excursion were organized. The meetings attracted a high number of scientists from many countries. Short courses in China were organized in order to train young researchers and postgraduate students in climate and ecosystem modelling.

8) IGCP 652: Reading Geologic Time in Paleozoic Sedimentary Rocks

Duration: 5 years (2017-2021)

Aim: The project intends to improve the Paleozoic timescale in order to unravel the history of the Paleozoic Earth system and study the environmental evolution during the Paleozoic era with a focus on the Ordovician to Devonian periods (485 – 359 million years).

Achievements: The project enhanced the resolution of the geological time scale for the Homerian (Silurian), Pragian and Emsian-Eifelian (Devonian). Furthermore, they also improved the understanding of various major events, with a focus on the Ordovician-Silurian boundary, the Mulde (Silurian) event and the Kacak (Devonian) event. Some papers were published on these findings, and a high-resolution database was developed. The project meetings were held in Canada, Belgium, China, and the USA. This allowed the project leaders to reach a vast community and to develop the networking capacity of the project. A workshop with teaching/exercises on cyclostratigraphy and spectral analysis was organized. Two popular science articles were shared in the google drive, and a popular science article related to biodiversity and climate change in the history of the earth was published in Natur-Forschung- Museum. Additionally, a popular science video about the field campaign has been released. Four blog notes were published to share the information of the project. The project was reported on 3 radio interview, a TV Show "Science Soop" on the National TV of Lithuania on the theme of Geology and global events. Six press releases, mostly concerning the papers on Nature Communications and Scientific reports, were disseminated. A total of 17 newspaper articles related to the outcomes of the project were published.

9) IGCP 653: The onset of the Great Ordovician Biodiversification Event

Duration: 4 Years (2017-2020)

Aim: The project focuses on the understanding of the onset of the Ordovician radiation, and attempts to answer the question: what was the Ordovician biodiversification event and what triggered it?

Achievements: A major achievement of 2018 is the first publication of a special issue (Lethaia) including papers on the terminology of the Great Ordovician Biodiversification Event (GOBE), which is now recognized as the sum of individual events, including several Biotic Immigration Events (BIME). New results show that the terrestrial ecosystems also

developed rapidly during the Ordovician. A total of 92 papers acknowledging IGCP653 were published.

10) IGCP 668: Equatorial Gondwanan History and Early Palaeozoic Evolutionary Dynamic

Duration: 5 Years (2018-2022)

Aim: The connection between the global biodiversification and extinction and the Cambrian-Ordovician transition has been poorly understood. A block formed by the intense felsic magmatism in equatorial Gondwana could potentially provide high geochronologic resolution for the Cambrian and Ordovician events based on its intrusive and extrusive rocks and thus give opportunity to determine whether episodes of regional extinction correlate with peaks in magmatic activity and whether such regional patterns could be global phenomenon. The project will also provide international coordination in updating taxonomy by integrating the disparate data across equatorial Gondwana in the context of the long history of stratigraphic research in the South and Southeast Asia. Accordingly, a further aim of this project will be to input a wide range of information from stratigraphic logs from equatorial Gondwana into a single Constrained Optimization database, obtaining a unified geochronology.

Achievements: Progress made in this year includes understanding of the relationship between the Himalayan and Indian sectors of core Gondwana and of the geological history of the ancient block, “Sibumasu”, and examining the changes of reef builders during this transition. This project also had some other achievements: the precise biostratigraphic link found between the Sibumasu sections on Koh Tarutao with those in Australia and North China, plus several U/Pb dates for ashes samples. There was also a conference held in Bangkok, Thailand with more than 150 participants, and a fieldtrip to Koh Tarutao. Additionally, graphic artists have produced educational materials associated with the project. Finally, 4 papers were published in international journals.

Annex 3: 2018 Summary of IGCP Geohazards Theme

1) IGCP 640: Significance of Modern and Ancient Subaqueous Slope Landslides (S4LIDE)

Duration: 5 Years (2015-2019)

Aims: Submarine landslides pose a risk to coastal communities and offshore infrastructure. However, our lack of understanding of the causal mechanisms and timing of submarine landslides has hampered progress in the prediction effort, which is essential to implement appropriate mitigation measures. This project seeks to create an international and multidisciplinary platform allowing geoscientists from academia and industry to sustain a dialogue conducive to the integration of findings from different fields into a more cohesive understanding of submarine landslides.

Related UN SDGs: This project contributes to the following sub-goals of the UN SDGs: *Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture* 2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. *Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable* 11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Countries involved: Representatives of 30 countries collaborate in this IGCP project: Australia, Austria, Belgium, Brazil, Canada, Colombia, China, Czech Republic, Egypt, France, Germany, India, Ireland, Israel, Italy, Japan, Republic of South Korea, Russia, Netherlands, New Zealand, New Caledonia, Nigeria, Norway, Peru, Spain, Switzerland, Thailand, United Kingdom, USA, and Venezuela. About 250 people are involved in the project.

Scientific activities (meetings, workshops, and training sessions): One main scientific meeting and two sessions in 2018 have been organized in Victoria and Quebec (Canada).

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): The Geological Society of London Special Publication (SP477) "Subaqueous Mass Movements and Their Consequences: Assessing Geohazards, Environmental Implications and Economic Significance of Subaqueous Landslides" that was published during 2018 and edited by Lintern et al. was a product of a bi-annual conference in Victoria, Canada. **Thirty-nine (39)** peer-reviewed contributions are part of this special volume (link). The most relevant contribution in 2018 for the project is the Clare et al. (2018) open access paper that is part of this special volume (link to paper). Sixty-three (63) papers, in

addition to the GSL volume, related to the S4SLIDE project were published during 2018. All these research endeavors received funding from a multitude of sources. S4SLIDE funding is not enough to sustain the science and publication cost associated with these papers; however, the S4SLIDE network and the events that are sponsored by this group facilitate the dissemination of knowledge linked to this topic and it also supports the networking necessary to encourage collaboration among researchers from different countries and technical backgrounds. A complete list of publications is included as part of this report.

Two Episodes reports were also published so far with activity updates: the Activity Report for (2015-2016) (link) and the Activity Report for (2016-2017) (link). A third Episodes activity report has been submitted to the journal and is under "review" at the moment (link). Another significant achievement was the successful completion of an international scientific logging and drilling experiment to investigate slow creeping submarine landslide (the Tuaheni Landslide Complex (TLC) by the Integrated Ocean Discovery Program (IODP) Expedition 372 (Pecher et al., 2018). Several IGCP-640 project members participated in this research endeavor that collected samples and in situ data from submarine landslide and gas-hydrate processes, now to be analyzed in several ongoing internationally-coordinated research projects.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** Scientists working on the IGCP project 640 "Significance of Modern and Ancient Subaqueous Slope Landslides (S4LIDE)" consider that the remains of landslide masses lie on the bed of many lakes (for example, Lake Tekapo). They conduct the research by collecting data and analyzing them using mathematical and numerical models to find out what sort of tsunamis could occur in the event of a major landslide. In these cases, the resulting tsunami could endanger local residents, tourists, and the surrounding infrastructure. The observation and modelling has helped scientists to see how big the landslides have been in the past, and make forecasts on what can happen in the future. The S4LIDE project participants disseminate the gained scientific knowledge on landslides and tsunamis via scientific meetings, workshops and training courses co-sponsored by the UNESCO-IUGS International Geoscience Program.

The IGCP project URL: https://sites.google.com/a/utexas.edu/s4slide/

2) IGCP 641: Deformation and Fissuring Caused by the Exploitation of Subsurface Fluids (M3EF3)

Duration: 4 years (2015-2018)

Aims: Ground response to subsurface fluid extraction in terms of land subsidence is one of the classical issues in geosciences, bearing wide implications from a societal point of view, e.g. increasing flood risks, damaging buildings and infrastructures, reducing water availability, etc. M3EF3 project aims to: (i) map the distribution of ground failure caused by subsurface fluid extraction at the world scale, with strong emphasis given to Africa where there are very few reports of systematic studies on subsidence and related processes; (ii)

characterize the major features of the detected fissure systems and identify the factors that interact for their occurrence; (iii) appropriately integrate geo-mechanical analyses, effective and economic monitoring methodologies, and modeling techniques to investigate the generation/propagation of earth fissure and fault activation; (iv) understand the process of ground failure by focusing on a few sites (in Mexico, China, Arizona); (v) develop a procedure of risk assessment for determining the most probable conditions (from both the geological point of view and also in terms of human activities) of ground failure; (vi) identify effective management and mitigation strategies that have been used to reduce this geologic risk; (vii) promote the integration between scientists from different disciplines and experts from developed/developing countries; and (viii) disseminate the M3EF3 outcomes through workshops, a project website, guidelines for laboratory, monitoring, and modelling investigations, risk analyses applied to ground failure, and non-technical fact sheets for policy makers and citizens.

Related UN SDGs: This project contributes to *Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable*. Namely, "11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations"

Countries involved: Representatives of 16 countries collaborate within this project: Australia, Canada, Colombia, China, Germany, Iran, Italy, Mexico, Pakistan, Philippines, Poland, Spain, Republic of China, The Netherlands, United Kingdom, and USA. Currently there are 68 people involved in the project.

Scientific activities (meetings, workshops, training sessions): A symposium and workshop in China, and two sessions in international meetings (San Francisco and Washington) were co- organized by leaders of this project.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): Project reports 12 peer-review articles published along 2018, as well as 21 presentations in international meetings. In addition, the project was focused mainly in two aspects:

Mechanisms: The main three/four mechanisms responsible for ground rupture development in subsiding basins have been defined. The paper entitled "A parametric numerical analysis of factors controlling ground ruptures due to groundwater pumping" by Frigo et al. has been recently submitted to Hydrogeology Journal. Appropriate material has been added in the project website. A large laboratory experiment has been developed at the Key Lab of Earth Fissures Geological Disaster, Ministry of Land and Resources (Geological Survey of Jiangsu Province) to test the mechanisms.

Modelling: Three-dimensional geomechanical model and Finite Element/Interface Element modelling approaches have been developed and applied to Queretaro, Mexico, and Wuxi, China, respectively. The approaches have been published in Engineering Geology and Water Resources Research.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** It is reported a short course about "Numerical modelling of groundwater flow and land subsidence", by P. Teatini, EAGE Student Chapter, Universidad Juarez Autonoma de Tabasco, Mexico, 25 September 2018.

The IGCP project URL: http://www.igcp641.org

3) IGCP 659: Seismic Risk Assessment in Africa (SEISMOSHAF)

Duration: 5 years (2018-2021)

Project Aims: The SEISMOSHAF aims to build upon the previously funded IGCP-601 project, new information and datasets to improve the seismotectonic map of Africa. The SEISMOSHAF project will include GPS monitoring, modelling of crustal stresses, InSAR data and field investigations of relevant structures with the aim to understand the links between the earthquake generation on active faults and the crustal deformation and to mitigate seismic risks in the African continent. In addition, it aims identifying the best pilot sites for a future early warning network of seismometers, and to build man-power in the field of seismic hazard assessment and risk management.

Related UN SDGs: This project contributes to the following sub-goals of the UN SDGs:
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture 2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable 11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Countries involved: Ethiopia, South Africa, Kenya, Cameroun, Morocco, Tunisia, Algeria, Tanzania, DR Congo, Botswana, Belgium, France, Egypt, Ghana.

Scientific activities (meetings, workshops, training sessions): Two international conferences were organized in collaboration with the IASPEI (2nd General Assembly of the African Seismological Commission - AfSC, 23 – 26 April 2018, Al Hoceima, Morocco), and the GMES program (Conference on the East African Rift System - EARS, 8-10 October 2018, Dar Es Salaam, Tanzania).

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): No peer-review publications were reported due, as 2018 was the first year of the project. However, 14 presentations were displayed during the EARS conference. In

addition, the working group established a program of actions towards the regional seismotectonics and seismic hazard assessment in Africa. Each seismotectonic province is preparing a database and a discussion is ongoing on the use of the deterministic and/or probabilistic methodologies as adapted to intraplate and interplate seismotectonic domains. Beside the seismicity catalogue (historical and instrumental), specific local projects are prepared for the inventory of earthquake faulting, gathering of GPS data and related results, and selection of test sites for the hazard and risk assessment.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** It is reported a training in Seismotectonics developed on 26 April 2018 (during the 2nd AfSC) supervised by Mustapha Meghraoui (IPG Strasbourg), Vunganai Midzi (CGS, Pretoria), and Ahmed Ksentini (Sfax University). See the attached list of participants in annex.

The IGCP project URL: http://www.unesco.org/new/en/natural-sciences/environment/earth- sciences/international-geoscience-programme/igcp-projects/geohazards/project-659/

4) IGCP 672: Himalayan Glaciers and Risks to Local Communities

Duration: 5 years (2018-2022)

Project Aims: 1) Mapping glaciers and lake extents using semi-automated remote sensing methods; 2) Using object-oriented and photogrammetric technology on freely available satellite images for detecting surface features on glaciers and estimating glacial hazards.

Related UN SDGs: This project contributes to the following sub-goals of the UN SDGs: *Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture*. 2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. *Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable*. 11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disaster, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Countries involved: India, Nepal, and Bhutan.

Scientific activities (meetings, workshops, training sessions): A meeting is reported, which was developed on 8 June 2018 in Thimhu, Bhutan. Seven project members and students from 3 countries (Nepal, Bhutan and India) were present.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.) Since this first year focused on capacity building, no publication was produced yet.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:**
It is reported two training activities:
1) 3-4 June 2018: Two-day training on remote sensing and GIS techniques for geoscience applications, co- funded with the 'Contribution to High Asia Runoff from Snow and Ice (CHARIS) project funded at USAID; and
2) 1-5 Nov 2018: 5-day Training on glacier hazard mapping using GIS and remote sensing (5-days hands-on).

The IGCP project URL: http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/international- geoscience-programme/igcp-projects/geohazards/project-672/

And https://wordpress.aber.ac.uk/discover-glaciers-IGCP672/

Annex 4: 2018 Summary of IGCP Hydrogeology Theme

1) IGCP 643: Water Resources in Wet Tropics and West-Central Africa (3WCA)

Duration: 5 Years (2015-2019)

Project Aims: The 3WCA project, associated with different laboratories from west-central Africa and France, studies hydrological/hydrogeological variability in relation with climate and land use changes. The primary objectives are to build a strong background in international collaboration, in particular, to provide 1) support for exchange students, 2) support for the mobility of teachers, 3) financing of laboratory materials, and 4) support for setting up the new research project. Three countries in Africa (Benin, Ivory Coast, Niger) and France worked on this project.

Related UN SDGs: *Goal 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*. Targets 4.3, 4.7, and 4; and *Goal 6 Ensure availability and sustainable management of water and sanitation for all*.

Countries involved: in the project (17 participants): Benin, Cameroon, Ivory Coast, France, Niger.

Scientific activities and achievements: A training workshop was held, titled, "Hydrological and hydrogeological modeling and peri-urban water quality." This project mostly focused on the "Lagune Aghien" research carried out within the framework of the LMI PICASS'EAU, which associates various laboratories of West Africa and France.

2) IGCP 661: Structure, Substance Cycle, and Environment Sustainability of the Critical Zone in Karst Systems

Duration: 5 Years (2017-2021)

Project Aims: The *critical zone* refers to the key sections of interaction between different spheres of the earth's surfaces, including the lithosphere, pedosphere, biosphere, hydrosphere, and atmosphere. This is essentially the space between the tree-tops and the aquifers in the earth's soils. Traditional weathering of the crust is a major component of the critical zone. This project mainly focuses on scientific issues involving the structure, evolution, and cycle of the carbon- water-calcium process (karst systems), the functions of the critical zone, and the sustainable utilization of its resources and surrounding environments. The main objectives of this project are to 1) significantly enhance the research on critical zone science in the karst systems, and 2) to promote international cooperation and technology-sharing on karst environment protection, education and training.

Related UN SDGs: *Goal 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.* Targets 4.3 and 4.7.

Countries involved: in the project (38 participants): China, USA, Slovenia, Thailand, Iran, Cambodia, Vietnam, Egypt, Romania, Myanmar.

Scientific activities: A special session in RFG2018 was held on 19 June 2018 in Vancouver, Canada, with about 40 scientists in attendance from more than 8 countries. A special session in 45th IAH Congress was held on 11 September 2018 in Daejeon, Korea, involving 30 project scientists from more than 6 countries. The IRCK 10th International Training Course took place from 13 to 19 June 2018 in Nanning, Xiangxi, Guilin China. During this course, the China- ASEAN forum and the Second International Symposium of Xiangxi Geopark on the karst systems took place. At this event, there were nearly 130 scientists in attendance from 16 countries. Finally, with the support of the International Research Center on Karst Dynamics and Global Change, an international training course on the karst ecology, geology and landscape was organized in order to promote the capacity of young karst geologists from Vietnam, Egypt, Iran, Slovenia, and thirteen other countries.

Scientific achievements: Scientists determined that the different forms of Calcite and HCO3 cycling were within various types of the karst critical zone. The project promoted the development of the monitoring network of the shallow karst critical zone, where new monitoring sites were established in tropical, sub-tropical and temperate climatic zones. The monitoring systems in China have been spread to Slovenia, Thailand, and Iran, with some other countries conducting comparative studies as well.

Additionally, an application of standards has been completed, and the ISO attributed "TC319" as the number of this new technical committee. The IGCP661 project leader Jiang Zhongcheng was elected as the chairman of ISO/TC319. This achievement is the result of the global karst geologists' joint efforts and collaboration. Additionally, a 1:10,000,000 karst distribution map of the world has been published.

3) IGCP 663: Impact, Mechanism, Monitoring of Land Subsidence in Coastal Cities (IM2LSC)

Duration: 4 Years (2018-2021)

Project Aims: Land subsidence is a global geohazard that not only reduces the flood control capacity in urban areas, but also brings security risk and damage to buildings, roads, bridges, rail transits, underground lines, etc. The impact of land subsidence is especially obvious in coastal cities and areas in proximity to shorelines, such as Shanghai, China and Jakarta, Indonesia. The primary objectives of IM2LSC are to study the impacts of human activities and sea-level rise, and understand the hydro-mechanisms and monitoring methods of land subsidence in coastal cities. The project is a platform for the service of society, including information which is relevant to urban planning and construction, underground management, flood prevention, and other infrastructures in coastal cities that can be vulnerable to land subsidence. The project findings can provide important information for policymakers and public organizations in mitigating land subsidence.

Related UN SDGs: *Goal 3 Take urgent action to combat climate change and its impacts*. Targets 13.3, 13.B; and *Goal 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.* Targets 4.3 and 4.7.

Countries involved in the project (94 participants): China, Italy, the Netherlands, Indonesia, Mexico, USA, Thailand

Scientific activities: The annual meeting of IGCP 663 took place on 2 November 2018, in Shanghai, China, with nearly 70 project members in attendance from China, Italy, the Netherlands, Indonesia, and Thailand. In the same week, the annual meeting of UNESCO, LaSII, took place from 4 to 7 November 2018, in Shanghai. Also, a workshop on "Land Subsidence and Eustacy" was organized by the Board of the Engineers of the Province of Venice, which took place in Venice on the 8 May 2018. Similar themes were also discussed at the Dutch National Conference on Land Subsidence, “Veenomeen,” which took place on the 22 November 2018, in Zaandam, the Netherlands.

Scientific achievements: The structural differences of the reclamation soil and its underlying natural sedimentary soil in Shanghai were studied on the micro scale (applying SEM, XRD, PLM and MIP). A high-resolution, long-term analysis of data depicted a new image of the land subsidence pattern along the Venice coastland, and revealed a very high heterogeneity of the ground dynamics both at the local and the regional scales. Short-term, man-induced displacements have been revealed to be affecting the historical center of Venice. About 25% of the city experienced movements due to anthropogenic causes in 2018. In the Netherlands, subsidence of peat due to the lowering of present-day phreatic groundwater levels was quantitatively evaluated by using a 3D geological subsurface voxel-model, modelled phreatic groundwater levels (calculated lowering: 0.25 and 0.5 m) in the Netherlands. Also in the Netherlands, a National Ground Motion Map and underlying dataset has been released (https://bodemdalingskaart.nl/). During our work in the Mekong Delta, Vietnam, a method has been developed to determine the relationship between land-use history, derived from a new optical remote sensing-based, 20-year time series of land use, and current InSAR-derived land subsidence rates.

Annex 5: 2018 Summary of IGCP Geodynamics Theme

1) IGCP 648: Supercontinent Cycles and Global Geodynamics

Duration: 5 years (2015-2019)

Aims: To shed light on the occurrence and evolution of supercontinents through time, and the underlying geodynamic processes, and also examine how the supercontinent cycles interacted with the deep mantle to produce episodic and unevenly distributed Earth resources.

Related UN SDG: *Goal 17 - Partnerships to achieve the Goal;* because of the large number of people from different countries involved, the project contributes towards global partnership for sustainable development.

Countries involved, approximate number of total 2018 participants: There are 265 scientists involved in the project. Of these 31% female scientists and 32% are young scientists, under the age of 35 years. The developing countries involved in the project constitute 33% of the total.

Scientific activities (meetings, workshops, training sessions): In 2018, the main event was the Field Symposium in South China with 90 participants. The project also held sessions at EGU, Resources for Future Generations 2018, and Nordic Geological Winter Meeting.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): This project has made good progress in generating new geological and palaeomagnetic data to support to constraining supercontinent cycles and related dynamic processes. The project achieved the following in the preceding year: 1) Over 120 peer-reviewed publications (including in reputable journals such as Nature, Nature Geoscience, and Geology), 2) Good evidence to support that there was a significant pause in geologic activity at 2.3 Ga, possibly related to the initiation of the supercontinent cycle, 3) New evidence for the Laurentia-Australia connection in the supercontinent Nuna.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** There were also some capacity building activities were carried out by members in different parts of the world. The Project made a combined 124 peer-reviewed publications reporting new geological and palaeomagnetic findings that help to constrain supercontinent cycles and related dynamic processes. The project has been pro- active in reporting results as regular media releases, popular science articles, and in community outreach programs. International TV and radio news have also reported the results.

2) IGCP 649: Diamond and Recycled Mantle

Duration: 5 years (2015-2019)

Aims: The main aim is to investigate the peridotite and chromitite formations belonging to classic ophiolite belts around the globe already documented the existence of diamond occurrence in the mantle.

Related UN SDG: *Goal 4 – Quality education*. Cutting-edge research including use of sophisticated analytical method is an important aspect of this project.

Countries involved, approximate number of total 2017 participants: A total of 70 scientists from 21 countries participate in this project. Of these 15 are female and 34 are young scientists.

Scientific activities (meetings, workshops, training sessions). In 2018 there was a meeting held in Brisbane (Australia) with 70 participants from 5 countries. There was a field trip in New Caledonia with 60 participants to look at the ophiolite area in the Pacific.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): Research has included systematic sampling of peridotites and chromitites in different ophiolites with a wide range in ages, geochemical affinities and tectonic settings of formation, in order to document the extent of diamond occurrence in the mantle. The project has generated new ideas on the petrology of ophiolitic peridotites, on the different settings in which ophiolites evolve and are emplaced, and on the origin of UHP minerals, like micro-diamonds ophiolitic rocks. Finally, it opens the question about the existence of UHP-minerals in ophiolites, which are not related to subduction. Many publications in peer-reviewed journals have been produced; but some of the titles were presented written in Chinese characters so could not be read. An abstract volume of Acta Geologica Sinnica with was published for the IGCP 649 Annual Meeting held in Brisbane (included abstracts of papers presented). A meeting report was accepted by Episodes.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** The project website is very well developed and appears to be updated with relevant and useful information. It serves well the needs of the project to publicise its activities. Economic benefits may be expected from the improved scientific understanding of the formation of chromitites which may provide new ideas for exploration for chrome.

3) IGCP 662: Orogenic Architecture and Crustal Growth from accretion to Collision

Duration: 4 years (2018-2022)

Aims: The aim of the project is to understand the differences between accretionary and collisional orogens by exploring differences in crustal composition, architecture and dynamics, and to evaluate their implications to metallogenesis.

Related UN SDG: *Goal 17 - Partnerships to achieve the Goal;* the topic of the project is global and there are 19 participating countries, which provides a great platform for future research.

Countries involved, approximate number of total 2018 participants: Of the 144 scientists involved 48 are female and 52 are young researchers, and 121 are from developing countries.

Scientific activities (meetings, workshops, training sessions): The project reported several scientific findings from the southern Central Asian Orogenic Belt, concerning the role of ridge subduction and slab windows, the role of East Asian blocks within Pangea, the characteristics of Phanerozoic granitoids, and Nd-Hf isotope evidence for juvenile sources for granitoids. The conference meeting was organized on 21 September 2018 in the Chinese Academy of Geological Sciences (CAGS), Beijing.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): A total of12 peer-reviewed journals related to the IGCP were published, showing their scientific knowledge contribution to the research in the Asian Orogenic Belt.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** The project has a website with information of its first conference, a linked field trip and all the completed reference publications. It serves as a platform for communication between IGCP 662 leaders and participants. The post-conference training workshops were conducted on 23 September 2018 in the Institute of Geology, CAGS, Beijing. The Geochronology presented by specialists as Alfred Kroner from Germany and Yusheng Wan from Beijing SHRIMP Center and others from Canada and Australia. More than 70 young researchers and students took part in these training courses.

4) IGCP 667: World Map of the Orogens

Duration: 3 years (2018-2020)

Aims: Compiling a digital World Map of the Orogens using a Generic Mountain Range whose characteristics could be applied to the majority of the orogens in the world. This map will provide a good basis for future research.

Related UN SDG: *Goal 17 - Partnerships to achieve the Goal.* This project is valuable in that it allow collaborative contributions from representatives of the scientific community in many different countries.

Countries involved, approximate number of total 2018 participants: This project has participants from China, Malaysia, Iran, Russia, Venezuela, Germany, Turkey, and France.

Scientific activities (meetings, workshops, training sessions): The first annual workshop was held in Paris in December 2018; 25 representatives from 8 countries attended. Further meetings are planned including a session at EGU in 2019 and 35 IGC in New Delhi in 2020.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.): Two young scientists from Malaysia and Hong Kong have participated in the project; they synthesised some of the data which resulted in two draft papers on the subject of orogeny reactivation.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)**:** The project is working on a tool where basic cross- sections can be represented by wire frame and users would be able to construct their own geological sections; even though it is in the early stages, the tool already works on simple multi- layered surfaces. Plans are underway to disseminate the results of the project through the Web.

Annex 6: Active IGCP Projects in 2018, 22 projects received funds from UNESCO, IUGS, JPDC and PR China

N°	Projects	Theme	Duration	IUGS	UNESCO
608	Asia-Pacific Cretaceous Ecosystems	Global Change	OET		
609	Cretaceous Sea-Level Changes	Global Change	OET		
610	From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary	Global Change	OET		
628	The Gondwana Map Project	Geodynamic	OET		
630	Permian-Triassic Climatic and Environmental Extremes and biotic responses	Global Change	2014-2018		9,000
632	Continental Crisis of the Jurassic	Global Change	2014-2018		6,000
636-Y	Characterization and sustainable exploitation of geothermal resources	Earth Resources	2016-2018	8,000	
637	Heritage stone designation	Earth Resources	2015-2019	6,000	
638	Paleoproterozoic Birimian geology for sustainable development	Earth Resources	2016-2020		4,500
639	Sea Level Changes from minutes to millenia	Global Change	2016-2020	8,000	
640	Significance of Modern and Ancient Submarine Slope and Landslides	Geohazards	2015-2019		9,000
641	Deformation and fissuring caused by exploitation of subsurface fluids	Geohazards	2015-2018		4,500
643	Water Resources in Wet Tropics of West-Central Africa	Hydrogeology	2015-2019		4,000
646	Dynamic interaction in tropical Africa	Geodynamic	2015-2018		6,000
648	Supercontinent Cycles an Global Geodynamics	Geodynamic	2015-2019		8,000
649	Diamonds and Recycled Mantle	Geodynamic	2015-2019		4,500
652	Reading Geologic Time	Global Change	2017-2021	6,000	
653	The onset of the Great Ordovician Biodiversification Event	Global Change	2016-2020	6,000	
655	Toarcian Oceanic Anoxic Event	Global Change	2017-2019		6,000
659 New	Seismic Risk Assessement in Africa	Geohazards	2018-2021		9,000
661	The Critical Zone in Karst Systems	Hydrogeology	2017-2021	2,000	
662 New	Orogenic architecture and crustal growth from accretion to collision	Geodynamic	2018-2022	6,000	
663 New	Land subsidence in coastal cities	Hydrogeology	2018-2021	4,500	
665 New	Sustainable use of black soil critical zone	Earth Resources	2018-2022	0	0
667 New	World Map of the Orogens	Geodynamic	2018-2020	4,500	
668 New	Equatorial Gondwana history and Early Palaeozoic Evolutionary Dynamics	Global Change	2018-2022		9,000
672 New	Himalayan glaciers and risks to local communities	Geohazards	2018-2022	9,000	
	TOTAL			**60,000**	**79,500**

UNESCO (including JPDC and China contributions) for IGCP 2018 Projects	**79,500.00**
UNESCO: Support for 2018 IGCP Board	**9,827.00**
Total UNESCO Support	**89,327.00**
Total IUGS Support	**60,000.00**
TOTAL	**149,327.00**

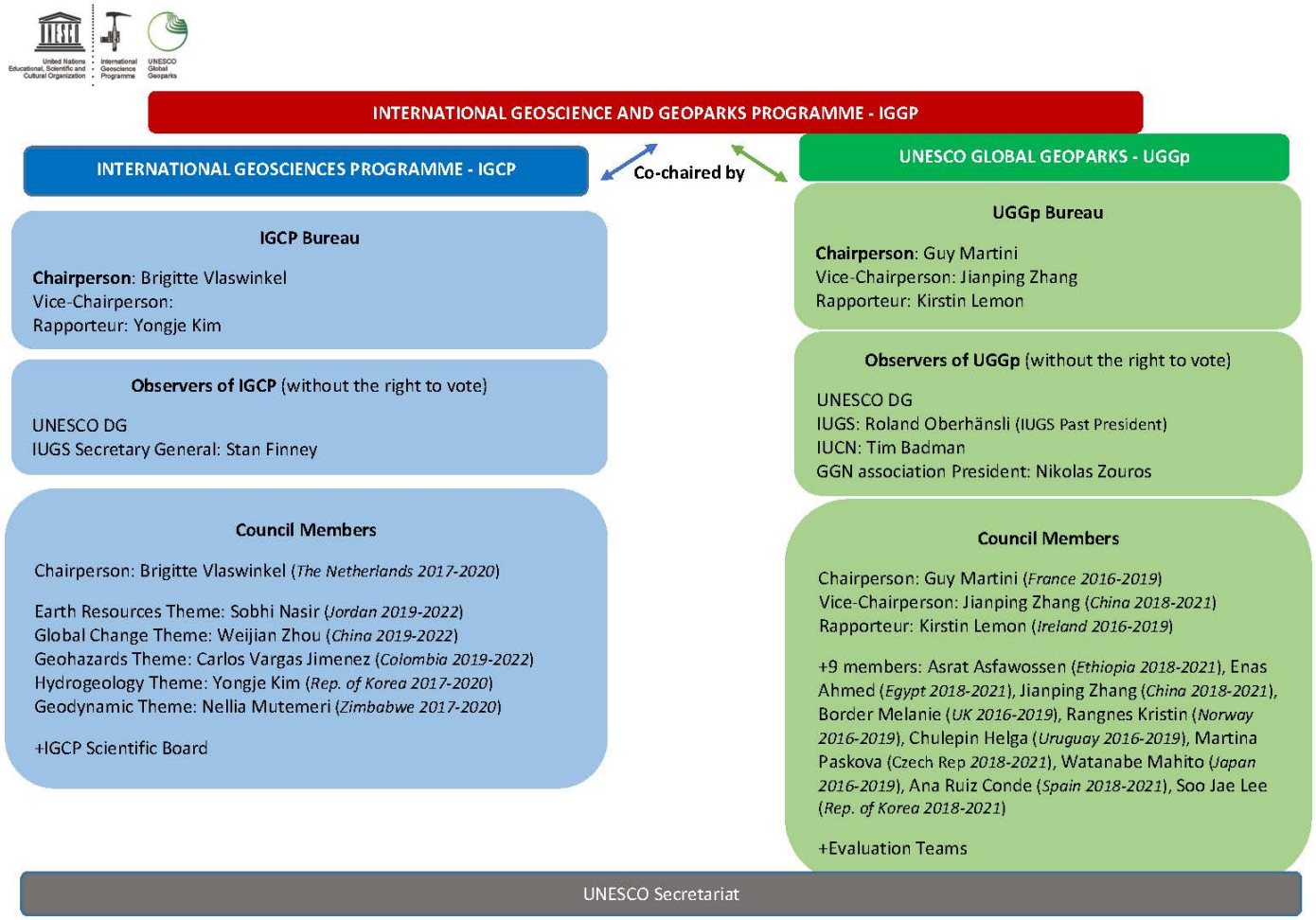
ANNEX 7: 27 Active IGCP projects in 2018 to be evaluated in February 2019

N°	Project Title	IGCP Theme	Duration
EARTH RESOURCES			
637	Heritage stone designation	Earth Resources	2015-2019
636-Y, final year, asking OET	Characterization and sustainable exploitation of geothermal resources	Earth Resources	2016-2018
638	Paleoproterozoic Birimian geology for sustainable development	Earth Resources	2016-2020
665 new	Sustainable use of black soil critical zone	Earth Resources	2018-2022
GLOBAL CHANGE			
608-OET	Asia-Pacific Cretaceous Ecosystems	Global Change	2013-2017
609-OET	Cretaceous Sea-Level Changes	Global Change	2013-2017
610-OET	From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary	Global Change	2013-2017
630, final year asking OET	Permian-Triassic Climatic and Environmental Extremes and biotic responses	Global Change	2014-2018
632, final year, asking OET	Continental Crisis of the Jurassic	Global Change	2014-2018
639	Sea Level Changes from minutes to Millenia	Global Change	2016-2020
652	Reading geologic time in Paleozoic sedimentary rocks	Global Change	2017-2021
653	The onset of the Great Ordovician Biodiversification Event	Global Change	2017-2020
655	Toarcian Oceanic Anoxic Event: Impact on marine carbon cycle and ecosystems	Global change	2017-2019
668, new in 2018	Equatorial Gondwana history and Early Palaeozoic Evolutionary Dynamics	Global change	2018-2022
GEOHAZARDS			
640	Significance of Modern and Ancient Submarine Slope and Landslides	GeoHazards	2015-2019
641-asking OET	Deformation and fissuring caused by exploitation of subsurface fluids	Geohazards	2015-2018
659- new in 2018	Seismic Risk Assessement in Africa	Geohazards	2018-2021
672-new in 2018	Himalayan glaciers and risks to local communities	Geohazards	2018-2022
HYDROGEOLOGY			
643	Water Resources in Wet Tropics of West-Central Africa	Hydrogeology	2015-2019
661	The critical Zone in Karsts Systems	Hydrogeology	2017-2021
663 new in 2018	Land subsidence in coastal cities	Hydrogeology	2018-2021
GEODYNAMIC			
628-OET	The Gondwana Map Project	Geodynamic	2013-2017
646-last year asking OET	Dynamic interaction in tropical Africa	Geodynamic	2015-2018
648	Supercontinent Cycles an Global Geodynamics	Geodynamic	2015-2019
649	Diamonds and Recycled Mantle	Geodynamic	2015-2019
662-new in 2018	Orogenic architecture and crustal growth from accretion to collision	Geodynamic	2018-2022
667-new in 2018	World Map of the Orogens	Geodynamic	2018-2020

ANNEX 8: 21 New project proposals requesting funding from 2019, these proposals will be evaluated in February 2019

N°	Project Title (short)	Main Project Leader country
Earth resources		
674	Environmental and human health impacts of mining activities in Sub-Sahara Africa	Ghana
675	Sandstone-type Uranium Deposits	China
676	Environmental and Human Health impact assessments and mapping of eastern Congo Mining Activities	Congo DR
682	Mine tailing revalorization	Chile
685	Geology for Sustainable Development	UK
686	Pollution characterization and bioremediation in mining areas	Switzerland
687	Bioremediation of environmental impacts of mining activities	Kenya
688	Identification and assessment of desert geosites in Iran for the feasibility study of the establishment of geopark and assessment of negative effect of off-road activities on the development geotourism	Iran
Global Change		
666* Resubmission	Paleodeltas - The History of the Earth	Russia
679	Cretaceous earth dynamics and climate in Asia	PR China
673	The End of a Supereon - Winners and Losers at the Precambrian-Phanerozoic Transition	Australia
681	History of Toxic Phytoplankton in Patagonia	Chile
690	Desert Kites in Persia	Iran
680	A unique biotechnology in the world to revalorize wastewater producing a fertilizing liquid from organic farming land	France
Hydrogeology		
677	An integrated approach to assess the quality of ground water in a Basement Terrain	Nigeria
678	Sustainable Water Management in Afghanistan	Afghanistan
684	The Water-Energy-Food and Groundwater Sustainability Nexus (WEF-GW Nexus)	Lebanon
689	A better management of the Ali-Sabieh aquifer	(Rep of Djibouti)
Geodynamics		
683	Pre-Atlantic geological connections among Northwest Africa, Iberia and eastern North America	Morocco
Geohazards		
691	Risk assessment of Bridges	Algeria
692	Geoheritage for Geohazard Resilience	France

ANNEX 9: IGGP Chart



ANNEX 10: IGCP Scientific Board Members and Council members 2018

	CHAIRPERSON		Nationality	appointed term
	Ms Vlaswinkel, Brigitte	The Ocean Cleanup	The Netherlands	**2017-2020**
EARTH RESOURCES	**Mr Nasir, Sobhi** Team Leader/IGCP Council Member	Sultan Qaboos University	Jordan/Canada	**2019-2022**
EARTH RESOURCES	Mr Beaudoin, Georges	University of Laval (Dep. Geology)	Canada	2017-2020
EARTH RESOURCES	Mr Pasava, Jan	Czech Geological Survey	Czech Rep.	2017-2020
EARTH RESOURCES	Mr Yigit, Ozcan	Canakkale Onsekiz Mart University (Dep. Geol. Eng)	Turkey	2017-2020
EARTH RESOURCES	Ms Baumgartner, Regina	Gold Fields, Lima, Peru	Peru	2017-2020
EARTH RESOURCES	Ms Olivo, Gema	Queen's University, Kingston	Canada	2017-2020
EARTH RESOURCES	Mr Molnar, Ferenc	Geological Survey of Finland	Finland	2017-2020
EARTH RESOURCES	Ms Castro, Liliana	University of Buenos Aires	Argentina	2019-2022
EARTH RESOURCES	Mr Canet-Miquel, Carles	UNAM – Centro de Ciencias de la Atmósfera	Mexico	2019-2022
EARTH RESOURCES	Ms Munkhtsengel, Baatar	Mongolian University of Science and Technology	Mongolia	2019-2022
GLOBAL CHANGE	**Ms Zhou, Weijian** Team Leader/IGCP Council Member	Institute of Earth Environment, CAS	China	**2019-2022**
GLOBAL CHANGE	Mr Königshof, Peter	Senckenberg Forschungsinstitut und Naturmuseum	Germany	2017-2020
GLOBAL CHANGE	Ms Leroy, Suzanne	CNRS-INSU	Belgium	2017-2020
GLOBAL CHANGE	Mr Lukeneder, Alexander	Natural History Museum Vienna	Austria	2017-2020
GLOBAL CHANGE	Ms Mangano, Maria Gabriela	University of Saskatchewan	Argentina	2017-2020
GLOBAL CHANGE	Ms Oboh-Ikuenobe, Francisca	Missouri University of Science & Technology	Nigeria	2017-2020
GLOBAL CHANGE	Ms Yanko Hombach, Valentina	Avalon Inst. of Applied Science	Ukraine	2017-2020
GLOBAL CHANGE	Ms Vickers-Rich, Patricia	Monash University	Australia	2017-2020
GLOBAL CHANGE	Mr Servais, Thomas	CNRS – Lille1	France	2017-2020
GLOBAL CHANGE	Mr Narbonne, Guy	Queen's University, Kingston	Canada	2019-2022
GLOBAL CHANGE	Ms Orgeira, Maria Julia	IGEBA (University of Buenos Aires and Conicet)	Argentina	2019-2022
GLOBAL CHANGE	Ms Marsicano, Claudia Alicia	Facultad de Cs. Exactas y Naturales, University of Buenos Aires	Argentina	2019-2022
GLOBAL CHANGE	Mr Valenzuela Rios, José Ignacio	University of Valencia	Spain	2019-2022

ANNEX 10: continued: IGCP Scientific Board Members and Council members 2018

GEOHAZARDS	**Mr Vargas, Carlos** Team Leader/IGCP Council Member	Universidad Nacional de Colombia at Bogota	Colombia	**2019-2022**
	Mr Campbell, Hamish	GNS Science	New Zealand	2017-2020
	Mr Cundy, Andy	University of Brighton	UK	2017-2020
	Mr Sintubin, Manuel	Katholieke Universiteit Leuven	Belgium	2017-2020
	Ms João Batista, Maria	National Laboratory of Energy and Geology (LNEG)	Portugal	2017-2020
	Mr Singh, Vimal	Department of Geology, University of Delhi	India	2017-2020
	Mr Gezahegn, Yirgu	School of Earth Sciences, Addis Ababa University	Ethiopia	2019-2022
	Ms Alcántara Ayala, Irasema	National Autonomous University of Mexico (UNAM)	Mexico	2019-2022
	Mr Ghafory-Ashtiany, Mohsen	International Institute of Earthquake Engineering and Seismology (IIEES)	Iran	2019-2022
HYDROGEOLOGY	**Mr Kim, Yongje** Team Leader/IGCP Council Member	Korea Institute of Geoscience and Mineral Resources (KIGAM)	Rep. of Korea	**2017-2020**
	Ms Bernal, Isabel Carolina	National Polytechnic School	Ecuador	2017-2020
	Mr Cheng, Zhang	Inst. of Karst Geology-CAGS/IRCS	China	2017-2020
	Ms Le, Thi Phuong Quynh	Vietnam Acad. of Sc. & Tech	Vietnam	2017-2020
	Mr Tshimanga, Raphael	University of Kinshasa	DR Congo	2017-2020
	Mr Dzhamalov, Roald G.	Water Problems Institute, Russian Academy of Sciences	Russia	2017-2020
	Ms Szőcs, Teodóra	The Mining and Geological Survey of Hungary	Hungary	2017-2020
	Mr Ibrahim, Reda Gamil Mohamed	Department of Hydrogeochemistry, Desert Research Center	Egypt	2017-2020
	Ms Vallejos Izquierdo, Angela	University of Almeria	Spain	2017-2020
	Ms Fidelibus, Maria Dolores	Politechnique de Bari	Italy	2017-2020
	Mr Schwartz, Frank	The Ohio State University - School of Earth Sciences	USA	2019-2022
	Mr Muzuka, Alfred	The Nelson Mandela African Institute of Science and Technology	Tanzania	2019-2022
GEODYNAMIC	**Ms Mutemeri, Nellia** Team Leader/IGCP Council Member	School of Mining, University of Witwatersrand	Zimbabwe	**2017-2020**
	Mr Charrier, Reynaldo	University of Chile (Dep. of Geology)	Chile	2017-2020
	Mr Ennih, Nasser	University of El Jadida	Morocco	2017-2020
	Ms Halla, Jaana	Helsinki Geological Museum	Finland	2017-2020
	Mr Hisada, Kenichiro	University of Tsukuba (Graduate School of Life & Envir. Sc.)	Japan	2017-2020
	Mr Jin, Xiaochi	Chinese Academy of Geological Sciences	China	2017-2020
	Mr Mocanu, Victor	University of Bucharest	Romania	2017-2020
	Ms Safak, Altunkaynak	Istanbul Technical University	Turkey	2017-2020
	Ms Toy, Virginia	University of Otago	New Zealand	2017-2020

ANNEX 11: Details of 26 IGCP Project Meetings funded by IUGS and UNESCO in 2018

N°	Project Title	Meeting title and location	Meeting date
630	Permian-Triassic Climatic and Environmental Extremes and biotic responses	The IGCP 630 events on Permian Triassic Environment & Climatic Extremes and Biotic Responses took place on the 18th to 21st of May in Hefai and Chaohu, Anhui Provice, China, the 21-24 May, 2018 in Wuhan China.	18--24 May 2018
632	Continental Crisis of the Jurassic	Continental Crisis of the Jurassic- 7th Symposium of IGCP632: Jurassic Crises in Southern-Most Gondwana, Napier, New Zealand from 27 November to 6 December 2018.	27 November – 6 December 2018
636-Y	Characterization and Sustainable Exploitation of Geothermal Resources	Characterization and sustainable exploitation of geothermal resources, Paris, Orleans, and Strasbourg, France, 5-12 October 2018.	5-12 October 2018
637	Heritage Stone Designation	Heritage Stone Designation Salamanca, Spain, 2-4 October 2018.	2-4 October 2018
638	Paleoproterozoic Birimian Geology for Sustainable Development	The Third Collquium of the International Geoscience Programme, focusing on Geodynamics and mineralisations of Paleoproterozoic formations for sustainable development, took place in Abidjan-Toumodi-Yamoussoukro, Côte d'Ivoire, from the 15th to 16th October.	15-20 October 2018
639	Sea Level Changes from minutes to millennia	The third annual IGCP 639 meeting took place in two meeting sites, Oman and South Africa, with a large community attending the symposium and field trips which occurred along the coast of southern Italy, near Taranto, Sicily, and Siracusa from the 18th to 22nd of September, 2018. The outcome of these meeting	19-22 September 2018

		was the publication of a detailed guidebook which can be used by interested participants to observe the sites in Italy.	
640	Significance of Modern and Ancient Submarine Slope and Landslides	The 8th International Symposium on Subaqueous Mass Movements and Their Consequences took place on 7th-9th May, 2018 in Victoria, Canada. The conference covered topics such as subaqueous landslides affecting lakes, coastal areas and the deep-sea, and their future directions and actions to address the related environmental challenges.	7-9 May 2018
641	Deformation and fissuring caused by exploitation of subsurface fluids	The 4th Annual Meeting, November 1 to 4, 2018 took place at the Nanjing University, Nanjing, China within the 5th Symposium on Land Subsidence Prevention and Control in China.	1-4 November 2018
643	Water Resources in Wet Tropics of West-Central Africa	Water Resources in Wet Tropics of West-Central Africa, Ivory Coast (Abidjan). 22 to 27 October 2018 at the Nangui Abrogoua University.	22-27 October 2018
646	Dynamic interaction in tropical Africa	Dynamic interaction in tropical Africa, 08-12 October 2018: Cameroon.	8-12 October 2018
648	Supercontinent Cycles an Global Geodynamics	Project Meetings on the Supercontinent Cycles a Global Geodynamics took place on: - The 16th to 21st of June, 2018 Resources for Future Generations (RFG2018) in Vancouver, BC, Canada. - The 14th to 18th of October, 2018 in Adelaide, Australia, Geoscience Council Convention.	16-21 June 2018 14-18 October 2018 1-9 November 2018

		- The 1st – 9th Nov. 2018, IGCP 648 2018 Field Symposium on the Cambrian to Palaeoproterozoic of South China took place in Yichang Three Gorges Region, China. The event included 2 days of seminars and a 6 day field workshop.	
649	Diamonds and Recycled Mantle	The 4th IGCP-649 Diamonds and Recycled Mantle Workshop and Field Trip took place from 5 – 14 July, 2018 in Australia and New Caledonia, investigating the ophiolite, chromitite, and related plate tectonic and mantle dynamic processes of both Eastern Australia and New Caledonia.	5-14 July 2018
652	Reading Geologic Time in Paleozoic Sedimentary Rocks	The Annual IGCP 652 Meeting took place on the 12th-19th of September, 2018 in Bremen, Germany, and included a three-day pre-meeting workshop and a three-day post-meeting fieldtrip focusing on the Denovian of Germany and cyclostratigraphy.	12-19 September 2018
653	The onset of the Great Ordovician Biodiversification Event	The IGCP 653 Project Workshop took place the 12-16 of February, 2018 in Marrakech, Morocco.	12-16 February 2018
655	Toarcian Oceanic Anoxic Event	Toarcian Oceanic Anoxic Event, Portugal (Coimbra). 6th – 9th September 2018.	6-9 September 2018
659 New	Seismic Risk Assessment in Africa	The EARS International Conference of the IGCP 659 took place in Dar Es Salaam, Tanzania on the 8th to 10th of October, 2018.	6-8 October 2018
661	The Critical Zone in Karst Systems	The 2018 meeting for the IGCP project 661 took place on the 19th of June, 2018 in Vancouver, Canada.	19 June 2018
662 New	Orogenic architecture and crustal growth from	Orogenic architecture and crustal growth from accretion to collision. 5-day pre-workshop field discussion and training course in Lluyuan, Gansu, China and 2-day workshop in Beijing China 16-22 September 2018.	15-23 September 2018

	accretion to collision		
663 New	Land subsidence in coastal cities	Land Subsidence in Coastal cities. Shangai, China. 30 October to 2 November in Shangai.	30 October-2 November 2018
665	Sustainable use of black soil critical zone	The IGCP 665 Second International Symposium on Global Black Soil Critical Zone Geo-Ecological Survey, and the ensuing fieldtrip, occurred in the Harbin, China, from the 8th to 12th of December, 2018.	8-12 December 2018
667 New	World Map of the Orogens	World Map of the Orogens, Paris, 3-5 December 2018.	3-5 December 2018
668	Equatorial Godwana history and early Palaeozoic Evolutionary Dynamics	Equatorial Gondwana history and Early Palaeozoic Evolutionary Dynamics, Bangkok, Thailand, 29-30 Nov. Asia Hotel, Bangkok, Thailand. 1-5 Dec: Tarutao Island, Thailand.	28 November- 6 December 2018
672 New	Himalayan glaciers and risks to local communities	The project meetings took place in: - Thimphu, Bhutan from June 3d to 8th, 2018, and involved seven project members and students from 3 countries: Nepal, Bhutan and India. - Himalayan glaciers and risks to local communities. Kathmandu (Nepal), 7-17 November 2018.	3-8 June 2018 7-17 November 2018