



**INTERNATIONAL UNION OF
GEOLOGICAL SCIENCES**

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2021 REPORT

Fostering a global voice for the geosciences

In association with ISC and UNESCO

120+ Adhering Organizations

50+ Affiliated Organizations



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THE UNION'S AIMS

The International Union of Geological Sciences (IUGS) was founded in 1961 with the mission to unite the global geological community in promoting development of the earth sciences.

The Union is the largest member organizations (about 1 million earth scientists) of the International Science Council (ISC) and one of the world's largest scientific organizations.

Origins

In 2012, IUGS redefined its missions according to a new Strategic Plan:

- Produce authoritative scientific standards
- Contribute to earth science education and public understanding of geosciences
- Represent the geological sciences in forums and decision-makers
- Encourage and support new original ideas in basic and applied geological research
- Foster collaboration between developed and developing countries in earth science research, capacity building, and applications
- Encourage more interdisciplinary involvement within the broad spectrum of the geosciences.

2012 Strategic Plan

For the period of 2021, the Union had the following aims:

- Encourage and substantiate the participation of the Adhering organizations and National Committees in promoting Geosciences
- Develop initiatives, (i.e. Resourcing Future Generations, Forensic Geology) of wide societal and applied interest
- Renew and establish closer links to UNESCO, ISC, and Geo-Unions, as well as develop new initiatives together with these organizations
- Improve visibility of IUGS through publications and presence at scientific forums.

Present Strategic Plan

GOVERNING THE UNION

The Council

Meets every four years at the International Geological Congress

Representatives appointed by the Adhering Organizations from the active IUGS member countries/regions

Inactive or non-member countries/regions may send observers (without voting rights) to Council meetings

Executive Committee (2020-2024)

Bureau

Day-to-day decisions and responsibilities

Secretary General



Prof. Dr. Stanley FINNEY

President



Prof. Dr. John LUDDEN CBE

Treasurer



Prof. Hiroshi KITAZATO

Past President



Prof. Dr. Qiuming CHENG

Vice Presidents



Prof. Dr. Hassina MOURI



Prof. Dr. Daekyo CHEONG

Councilors (2018-2022)



Dr. Silvia PEPPOLONI



Dr. Claudia Inés MORA

Councilors (2020-2024)



Prof. Dr. Jennifer MCKINLEY



Dr. Ludwig STROINK

Prof. Dr. John LUDDEN CBE



PRESIDENT (2020-2024)

This has been a difficult year for everyone. I expect we all be looking forward to getting back to some degree of normalcy with more travel, meetings, and fieldwork. Most of us will have been involved in web-based meetings and these have been very good at allowing a greater global reach and broader involvement - they can be efficient but lack the social aspects of meetings and decision making.

The full IUGS executive met virtually in March 2021 and has held three intermediate meetings of the entire executive. We are pleased that our finances have now been transferred to Japan under the scrutiny of our treasurer. As requested by the IUGS council we have published full accounts and are aiming for complete transparency through our website.

In 2022 IUGS will slowly get back into more face-to-face activities. Our IUGS 60th anniversary was in 2021, but we have put off any celebrations until 2022 and we will distribute a series of events throughout 2022 as IUGS60 www.iugs60.org that will link to these events and to a significantly enhanced visibility for example on <https://twitter.com/theIUGS>.

IUGS officially joined the International Science Council (ISC) group on gender equality <https://www.iugs.org/scges> and we will be taking this very seriously in nominating commissions and working groups and in accepting science and engagement programmes. Geoethics has been an important part of the activity that IUGS

is ramping up <https://www.geoethics.org/>.

We are active in the ISC GeoUnions and notably on the group on disaster risk reduction <https://council.science/actionplan/disaster-risk-reduction/>.

Running from 2020 to 2021 we held the UNESCO Lecture Series: Earth Materials for a Sustainable and Thriving Society <https://www.iugs.org/unesco-lectures> This highly successful series stemmed from our Resourcing Future Generations initiative and was co-sponsored by iCRAG Dublin and the UNESCO Earth sciences division. It has led to the development of an IUGS60 initiative on the energy transition <https://iugs60.org/energy-transition-series/>. I hope that this will be a means of reviving the IUGS activities in Resourcing Future Generations (RFG) <https://www.iugs.org/rfg>.

The International Commission on Stratigraphy presented the case for ratification of the Artinskian Stage of the Cisuralian Series and Permian System to the executive, and this was approved. Work continued through 2021 largely from desk-based studies, but with some groups managing fieldwork in the summer periods.

The UNESCO and IUGS sponsored International Geological programme IGCP funded a further 18 new projects and supported 39 ongoing projects in 2021. More than 5000 participants from 126 countries worked together to deliver the objectives of IGCP projects involving 39% Female participants of whom 46% are project

leaders. Of note, 42% are early career scientists and 47% of these are from the developing world which is a continued increase in participation. With UNESCO, IUGS will continue to reflect on the evolution of this programme with an increasing focus on responding to the UN Sustainability goals.

We were also pleased that International Geodiversity Day was agreed as the 6th October and this is a great opportunity to raise awareness of geosciences by IUGS and others. Similarly, 2022 will be an important year for the launch of 100 Geoheritage sites and the preparation for this event in northern Spain has been ongoing in 2022.

The Commission for Geoscience Information released a fold-out flier on their activity <https://c-gi-iugs.org/docs/CGI%20Flyer-trifold-s.pdf> and IUGS will be sponsoring activities in Data-driven Geoscience in 2020, including a UNESCO-based event involving the Deep Digital Earth project of IUGS <https://www.ddeworld.org/>

I am very pleased with the continued success of Episodes which has maintained an impact factor at >2 this year and I thank the editorial staff and those who write in Episodes for their hard work.

The International Geological Congress was

postponed from March 2020 and then further postponed from the late summer 2021. The closing event of the IGC-36 will now be held in Delhi in March 2022 and will be a reduced scope virtual event. IUGS has worked through 2021 with the IGC -36 committee towards full reimbursement of registration fees for participants. This is now largely complete, and I thank registrants for their patience in this difficult process.

The IGC trophy will now be passed to the Republic of Korea in preparation of the Busan 2024 meeting of IGC-37 http://www.igc2024korea.org/2024/english/main/index_en.asp

I emphasise once more that we have transferred activities for the IUGS 60th anniversary and the UNESCO-IUGS IGCP 50th anniversary to 2022. There will be several events which we hope will reach a much wider audience and allow us to celebrate the role of geoscience in discovery of how the Earth has evolved but most importantly as a solution to the climate crisis and following recommendations of COP26 <https://uk-cop26.org/cop26-goals/> that must be a major preoccupation for all with specific actions that we can make as geoscientists.

I thank all contributors to IUGS activities over 2021 and I look forward to meeting some of you in 2022.

Prof. Dr. Stanley C. FINNEY



SECRETARY GENERAL (2020-2024)

2021 was a challenging year for IUGS, just as it was for everyone and every organization worldwide. Activities were greatly reduced; for meetings, virtual replaced in-person. The 76th Annual Meeting of the IUGS Executive Committee was held via Zoom 22-24 February, and virtual progress meetings of the EC were held February 10th, May 19th, September 29th, and November 29th. The IUGS Bureau members and the Secretariat maintained regular email contact throughout the year.

President John Ludden, the Secretary General and other EC members, and the IUGS Secretariat staff devoted much time to facilitating the reimbursement of registration, field trip, and exhibit booth fees to delegates and delegations registered for the 36th IGC. In fact, the IUGS role in securely gathering and transferring bank information to India was essential to ensuring reimbursements. The Secretary General worked with IUGS Treasurer Hiroshi Kitazato to secure IUGS reimbursement of financial losses suffered by awardees of Hutchison travel grants.

Normal activities of the Secretary General included editing the 2020 IUGS Annual Report, which was distributed in May 2021, participating in the annual meeting of the Publications Committee, held virtually on August 1, and managing votes by the IUGS EC to ratify three proposals from the Commission on Stratigraphy – the

GSSPs for the Kimmeridgian and Coniacian Stages and for the chronostratigraphic rank of subseries.

The Secretary General consulted throughout the year with leaders of IUGS constituent groups, serving as their direct link to the Executive Committee, calling for annual reports and budget requests, informing them of budget allocations, giving advice as requested on IUGS procedures and expectations of the EC. The IUGS SG maintains an awareness of all IUGS constituent groups and all activities of the Publications Committee and conveys their status to the EC. Considerable attention was devoted in 2021 to the Commission on Geoheritage. The SG oversaw the dissolution of the previous commission and the establishment of a new commission in 2020. This was the only administrative path available for a needed reorganization of the commission. In 2021, the new executive offices of the Commission worked to develop statutes and terms of reference for the Commission and its Subcommissions, following advice of the SG. Asier Hilario, the chair of the Commission on Stratigraphy recruited colleagues worldwide to participate in an IGCP project to develop the standards and procedures for recognition of IUGS Geological Heritage Sites. This proposal was funded, and it further links IUGS to UNESCO through both IGCP and the UNESCO Global Geopark



Meeting in Zumaia, Spain (L to R): Asier Hilario – Chair, Commission on Geoheritage; Juana Vegas – Secretary General, Commission on Geoheritage; Gurmeet Kaur – Chair, Subcommission on Heritage Stone Resources; Angela Gehling – Vice Chair, Commission on Geoheritage; Benjamin van Wky de Vries – Chair, Subcommission on Sites; Jabier Garmendia – Councillor for Economic Promotion, Tourism and Natural Environment, Gipuzkoa, Spain; Stan Finney – Secretary General, IUGS; Victor Cardenes – Secretary General of Subcommission on Heritage Stone Resources; participating virtually, Jianping Zhang – Vice Chair, Commission on Geoheritage.

program. The SG met with the executive officers of the Commission on Geoheritage in Zumaia, Spain on November 18 and 19, 2021. During two long days, a final draft of statutes for the Commission was approved; procedures and standards to be used by the Subcommission on

Geosites and the Subcommission on Heritage Stone Resources were developed, and creation of a Subcommission on Geocollections was initiated.

In spite of all constraints, IUGS constituent groups made significant progress in 2021.

**Prof. Dr. Hiroshi
KITAZATO**



**TREASURER
(2020-2024)**

Ms. Yoshiko OKADA



SECRETARY

General Financial Situation of IUGS

For the period from 01/01/2021 to 31/12/2021, IUGS' income and expense are USD 527,776.00 and USD 482,627.96 respectively, with the net income of USD 45,148.04. The balance of IUGS current account as of 31/12/2021 is USD 1,765,286.84. It is noteworthy that Gambia and Peru have become IUGS active members.

IUGS' s financial statements of 2021 prepared by the Treasurer was duly audited by an independent Japanese certified public accountant in January 2022.

The table below reflects more detailed information of the financial situation during the recent four years.

(USD)			
year	income	expense	net income
2021	527,766.00	482,627.96	45,148.04
2020	553,016.44	323,610.24	229,406.20
2019	496,303.42	579,104.88	-82,801.46
2018	605,233.43	418,611.07	186,622.36

Description of income

The total income we received in 2021 is USD 527,776.00, including USD 400,782.35 of membership dues

The table below reflects detailed information of the income situation in 2021 and 2020.

Income	Amount (USD)	
	2021	2020
Membership Fees	400,782.35	493,002.01
For 2018 & 2019	3,170.00	61,965.61
For 2020	11,018.52	431,036.40
For 2021	386,593.83	-
Contribution from UNESCO	84,100.00	26,317.58
Final payment for last year	-	20,382.16
1st payment for current year	34,100.00	5,935.42
2nd payment for current year	50,000.00	-
Other Income*1	42,893.65	33,696.85
Total Income	527,776.00	553,016.44

* 1 Other income includes refund of Geo Expo Stand Fee paid in 2019, royalty and bank interest

Status of Countries by Fees Category – 2021

Category	Active	Inactive	Total	Number of Countries paid for		
				2021	2020	2019
1	20	50	70	13	8	5
2	14	3	17	11	1	-
3	13	2	15	10	-	-
4	8	1	9	6	2	-
5	-	-	-	-	-	-
6	2	-	2	1	-	-
7	4	-	4	3	-	-
8	5	-	5	5	-	-
Total	66	56	122	49	11	5

Description of Expense

The total expense is USD 482,627.96.

The table below reflects more detailed information of expenditure situation in 2021 and 2020.

Expense	(USD)	
	2021	2020
IGCP	170,600.00	34,555.53
Joint Programmes	21,278.98	21,106.50
IUGS Commissions	78,529.07	72,200.00
IUGS Task Groups	-	1,400.00
Initiatives	47,165.00*2	3,600.00
Affiliated Organizations	29,000.00	27,000.00
Contributions	14,226.39	14,717.89
Committees	-	2,539.07
Episodes	28,000.00	28,000.00
Hutchison Award	12,427.00	8,000.00
Secretariat Expense	15,000.00	15,000.00
Disbursement from Deposit Payable	6,482.65	6,517.60
ICS Special Funding Program	-	47,000.00
IGC Special Expense	-	9,297.95
IGC Cancellation Fee	-	6,973.30
IUGS Associated Event	5,008.66*3	-
Other expense	54,910.21*4	25,702.40
Total Expense	482,627.96	323,610.24
Net Income	45,148.04	229,406.20

*2 includes payment of USD 20,000 (Deep-Time Digital Earth Research Program) allocated for and transferred from 2020.

*3 is the expense for preparation and promotion of the 60th Anniversary of IUGS in 2022.

*4 includes management expenses of Treasurer's office (USD 13,160.17) and exchange translation loss (USD 33,361.45 with no cash out).

Mr. MA Yongzheng



PERMANENT SECRETARIAT

The IUGS Secretariat is hosted within the premises of the Chinese Academy of Geological Sciences (CAGS) under the China Geological Survey, the Ministry of Natural Resources of China. Since the relocation of the Secretariat to Beijing in December 2012, the Chinese government has been providing tremendous and stable financial and logistical support for the smooth operation of the Secretariat.

Under the guidance of the IUGS Bureau and Executive Committee, the Secretariat has maintained professional and efficient operation in line with its duties, and played an active role of communication and coordination in the scientific activities and daily administration of IUGS.

In 2021, the Secretariat assisted in the organization of several regular administrative meetings, including the organization of the 76th Executive Committee Meeting (virtual, on 22-24 February & 22 March, 2021), three EC progress meetings (virtual, on 19 May 2021 & 29 September & 29 November, 2021) and the Nominating Committee Meeting (virtual, on 6 December, 2021).

The Secretariat did a large amount of daily correspondence with regard to the 36th IGC reimbursements. It is a demanding and time-consuming task. The Secretariat assisted the EC in contacting the delegates for the collection of bank information, responded to the requests from the 36th IGC delegates on reimbursements and transferred all the bank information received to the 36th IGC

Secretariat. Although we were unable to provide direct answers to the questions of the delegates sometimes, we tried our best to explain the situation and forwarded their requests to the 36th IGC Secretariat.

The Secretariat was actively involved in the IUGS 60th anniversary events. We updated the IUGS Book of Facts (1961-2021) referring to a large number of documents, designed the IUGS 60th anniversary logo, participated in the stakeholder mapping of the IUGS Adhering Members and Affiliated Organizations, and distributed the information of the IUGS 60th anniversary events to the IUGS family in a timely manner.

The Secretariat completed the following work related to the outreach and publications: designing and formatting the 2020 IUGS Annual Report; mailing the hardcopies of Episodes to the IUGS Constituent Groups; distributing E-Bulletins monthly to over 14,000 recipients. The Secretariat updated the IUGS Contact Database on a timely basis and assisted the EC in membership maintenance to strengthen links with IUGS bodies.

The Secretariat would like to thank the Executive Committee for guidance and great support to the Secretariat for its smooth operation during the past year. The Secretariat staff members will continue full devotion to the Secretariat duties with concerted efforts to actively support the work of the IUGS Bureau and Executive Committee and the broad-ranging scientific activities of IUGS.



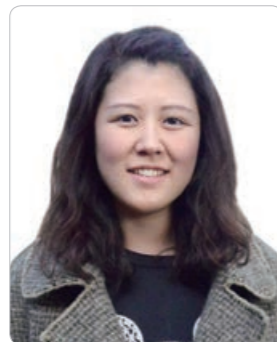
Ms. LI Wei
Secretary



Ms. SITU Yu
Secretary



Ms. GU Yanfei
Secretary



Ms. XU Yaqi
Secretary



Ms. MU Langfeng
Secretary

2021 HIGHLIGHTS

JANUARY 2021

In collaboration with IUGS and iCRAG, UNESCO Lecture Series: Earth Materials for a Sustainable and Thriving Society were held between 26th January and 9th March 2021 with more than 4,000 registrations from 145 countries. The themes of the Session included: (1) Earth materials: the foundation for development; (2) Climate neutrality, the circular economy, and earth materials; (3) The neglected minerals and materials of development; (4) Mineral extraction and communities; (5) Suppliers, consumers, and the global minerals supply chain; and (6) Earth materials and a sustainable future.

FEBRUARY 2021

The IUGS Executive Committee (EC) held a virtual progress meeting on 10 February 2021 to discuss the reimbursements for the 36th IGC and to receive updates on the preparation of the 37th IGC.

The 76th IUGS EC Meeting was held virtually on 22-24 February 2021. The EC members were updated on the latest reimbursements of the 36th IGC. Work reports from the IUGS Constituent Groups, Adhering Members and Affiliated Organizations were carefully reviewed and discussed.

The IUGS Initiative on Forensic Geology (IFG) celebrated its 10th Anniversary in February 2021. Laurance Donnelly established the group at the 62nd IUGS Executive Committee meeting in February 2011, following on the earlier efforts by the IUGS Working Group on Forensic Geology (2009-2011) and the Geological Society of London (GSL) Forensic Geoscience Group

(2006-ongoing). In the past decade, IUGS-IFG has advanced forensic geology and provided numerous training, capacity building, and outreach events around the world. Its efforts include books and publications on forensic geology, operational support for police and law enforcement including crime scene examination, the provision of geological trace evidence and searches for graves and other buried items associated with homicide, serious and organised crime, and counter terrorism.

MARCH 2021

The second part of the 76th IUGS EC Meeting was held virtually on 22 March 2021 to discuss the actions and resolutions at the Extraordinary Session of the IUGS-IGC Council, strategic development of IUGS, and celebration events concerning the 60th anniversary of IUGS and 50th anniversary of IGCP.

UNESCO Secretariat organized 6th session of the Council meeting in March 2021 (online via zoom facility) with the participation of IUGS President. IGCP Council decided to continue supporting 39 ongoing projects and approved 18 new ones, totaling at 57 active IGCP projects in 2021, led by 326 project leaders from 92 countries. IGCP Council members recorded their theme's presentations about the status of IGCP projects and these recordings are available from UNESCO website. IGCP Council adopted a new special topic (Enhancing Societal Acceptance of the Sustainable Development of Earth's Geological Resources) for call for proposals prioritization in the IGCP 2021 call for project proposal which was published by UNESCO Secretariat.



IUGS Executive Committee voted unanimously to ratify the GSSP proposal for the base of the Kimmeridgian Stage (Upper Jurassic Series, Jurassic System) as approved by the International Commission on Stratigraphy. The agreement represents the culmination of two decades of work by an international team lead by Professor Andrzej Wierzbowski (University of Warsaw, Poland).

APRIL 2021

The International GeoScience Education Organization (IGEO) is delighted to announce the first full translation of the Exploring Geoscience across the world textbook into Turkish.

MAY 2021

IUGS-IFG appointed Dr Elisa Bergslien (SUNY, Buffalo State University of New York, USA) as the Officer for Women in Forensic Geology. Elisa will focus on the development and advancement of women in forensic geology and related geosciences throughout the world.

IUGS endorsed books produced by IFG 'A Guide to Forensic Geology' and 'Special Publication: Forensic Soil Science and Geology', which are in the process of publication by the Geological Society of London.

Geoscientists from the Subcommittee on Quaternary Stratigraphy (SQS) in the collaborative project of the Anthropocene Working Group (AWG), Haus der Kulturen der Welt (HKW) and Max-Planck-Institut für Wissenschaftsgeschichte (MPIWG) are making progress towards identifying Anthropocene GSSP locations. Multi-proxy stratigraphic analysis has continued at sites proposed in 2019 and those recently joined. Progress in the formalisation of the GSSP was presented during a session at vEGU 2021 'The physical record of the Anthropocene in geological archives'.

The IUGS Executive Committee (EC) held a virtual progress meeting on 19th May 2021 to discuss about the IGCP projects and budget, strategic opportunities for IUGS and anniversary

activities.

The IUGS Task Group on Geohazards and the Japan Geoscience organized an online symposium on Research of New Aspects of Geohazards and Challenges of Social Implementation on 26th May 2021.

The conference 'Cryogenian glaciation: the extraordinary Port Askaig record' went live online through zoom on 26th and 27th May 2021. This international workshop was in association with the Cryogenian Subcommittee of the International Commission on Stratigraphy.

JUNE 2021

A new logo has been launched for International Commission on Geoheritage.

It has been designed by the team of Zhang Jianping, Vice Chair of this Commission. This new logo signifies the role of geological heritage within IUGS, keeping its general emblem, but adding a large 'G' representing geoheritage, which also shows the layers of the Earth. With this new logo the commission will recognize Global Geosites, Heritage Stones and Geo-Collections of international relevance.

CGI is actively supporting Deep-Time Digital Earth (DDE), and current grants are supporting work on docker packages and vocabulary. On June 23rd, a two-hour webinar hosted with partners featured GeoSciML, Ontology, EarthResourceML, Geoscience Terminology, CGI/OGC Geoscience Domain, and the DDE Standards Task Group.

In a partnership between the IFG Student Chapters at UFPEI, UFRO and UBA, an event entitled 'Charlas's Cycle: Una Nueva Perspectiva de las Forenses Ciencias in Latin America' took place on 1st, 3rd and 6th June 2021.

June this year, an open access paper in the Journal of the Geological Society was published. This paper shows the consensus understanding of many Precambrian stratigraphers who make up the ICS working group on pre-Cryogenian subdivision, chaired by Prof. Graham Shields at UCL, UK.

JULY 2021

The Publications Committee (PC) announced good news related to the new Impact Factor for the IUGS journal Episodes, published by Clarivate Analytics 2021. The impact factor of Episodes has increased from 1.393 to 2.490 for the year 2020. The journal has moved from Q4 to Q3. The PC congratulates the Editor and Managing Editor of Episodes for the big effort to promote the journal and to increase the quality of the papers published in Episodes to gain higher citation.

The International Association for Promoting Geoethics (IAPG) announces the publication of the book: Di Capua G., Bobrowsky P.T., Kieffer S.W. and Palinkas C. (2021). Geoethics: Status and Future Perspectives. Geological Society. This is the second volume focused on geoethics published by the Geological Society of London, under the MoU with the IUGS. This is a significant step forward in which authors address the maturation of geoethics.

The IUGS Commission on Global Geochemical Baselines (CGGB) together with the Geochemistry Expert Group (GEG) of EuroGeoSurveys organised a session entitled "Geochemical mapping at all scales for all reasons" under Theme 12 "Environmental Geochemistry and Human Health" at the Goldschmidt 2021 conference, which was held as a virtual conference this year due to the COVID-19 pandemic. The main topic of the session was systematic

geochemical mapping and its methodology to document the spatial variation of chemical elements in geomaterials occurring at or below the Earth's surface, i.e., rock, soil, sediment, stream water, groundwater, and vegetation.

SEPTEMBER 2021

The IUGS Executive Committee (EC) held a virtual progress meeting on 29 September 2021 to discuss about the planning of the events for the UNESCO 75th, IUGS 60th and IGCP 50th Anniversary.

The book, 'A Guide to Forensic Geology', has now been published by the Geological Society of London.

The proceedings of the 5th YES Network Congress 'Rocking the Earth's Future', held in Berlin, Germany, from 9–13 September 2019, have been published and can be downloaded from <https://doi.org/10.2312/yes19>. The CGGB took an active part in the plenary session with Alecos Demetriades (Advisory Panel member and Chairperson of Sampling Committee) delivering a keynote presentation with the title 'Global Geochemical Mapping for Resource and Environmental Management'.

Successful holding of the international GEL-STRAT symposium and fieldtrip, recently held in Sicily (southern Italy), comprising a scientific session in Palermo on September 1-2, 2021, followed by the fieldtrip to Capo Rossello and Monte San Nicola on September 2, 2021, and resampling of the Piacenzian-Gelasian transition September 4-6, 2021.

The Anthropocene Working Group held a meeting at the Haus de Kulturen der Welt in Berlin in September 2021, to describe the excellent progress being made in multi-proxy analysis of 12 sections currently being examined as potential

candidate stratotypes for the Anthropocene.

OCTOBER 2021

President Prof. John Ludden attended the 2nd ISC General Assembly on 11-15 October. IUGS was active in nominating candidates for the ISC Governing Board, ISC medals and voting on the ISC General Assembly.

The IUGS Executive Committee (EC) voted to ratify the proposal for Neogene Subseries/Subepochs for the Miocene and Pliocene Series/Epochs approved by the International Commission on Stratigraphy and forwarded to the IUGS EC on 24 September 2021.

IUGS and The Earth Project are proud to announce the winners of the first round of our COP26 Photography Countdown Event.

The online geoscience standards training workshop for IUGS big science program Deep-time Digital Earth (DDE) was held with great success on 26th -28th October 2021. The training workshop was planned and co-organized by DDE and CGI, the commission for geoscience information of IUGS. There were 93 registered and 152 attendees from DDE Working Groups and Task Groups (DDE-WTGs) and professionals worldwide participated this 3-day training workshop.

NOVEMBER 2021

The IUGS Executive Committee (EC) held a virtual progress meeting on 29 November 2021 on the planning for March Executive Session and Open Meetings at UNESCO, report on meetings and additional developments with IUGS constituent bodies, presentation and discussion on activities for the 60th Anniversary Year.

Between the 18th and 20th of November, the

Secretary General – IUGS and the officers of the International Commission on Geoheritage (IUGS-ICG) met in the Basque Coast UNESCO Global Geopark to discuss the new structure, statutes, logo, webpage, and future strategy for the rejuvenated ICG. The meeting was a big step forward in the consolidation of this important commission within the IUGS.

The 2021 Annual Meeting of the China National Committee for IGCP was successfully convened on November 13-14, 2021. The meeting attracted a large number of geoscientists and students on the virtual meeting platform, with the accumulated number of audiences reaching 3,734 and a total of 11,600 clicks during the two-day meeting period.

IUGS-IFG was represented at InterForensics 2021, in Brazil. This included the search for burials, missing persons, crimes against humanity attributed to dictatorships, organized crime and radical groups. There was specific

reference to searches in Colombia to locate victims that have disappeared and to provide closure for family members. The applications of geophysical methods to find graves with skeletonized bodies has been successful in several forensic cases.

IUGS-IFG was represented at the British Association of Forensic Medicine (BAFM) on 20 November 2021, in Aberdeen, Scotland. A presentation was given on search and the applications of forensic geophysics.

The highlight of the CGGB activities in the fourth quarter of 2021 was an online training workshop on "Extracting, visualising and interpreting structure in geochemical data through compositional data analysis (CoDa)", which was held with a great success on the 18th of November 2021. There were 397 participants registered from 60 countries and online attendance reached a maximum of 191 during the live session.

2022 Celebrating 60 years of IUGS

New IUGS60.org website launched today.

Why not join our celebrations and events..

What is live today?:

- The 'What on Earth' geoquiz**
- President's New Year's Address**
- Showcasing Planet Earth Photography Competition**
- Pebble Hunters Gallery**



On 18 November 2021, the proposal for the Global Stratotype Section and Point (GSSP) for the base of the Artinskian Stage (Permian System) at 0.6 m above the base of bed 4b at the Dal'ny Tulkas section, southern Urals, Russia, corresponding to the First Appearance Datum of the conodont *Sweetognathus asymmetricus*, was approved by the Subcommittee on Permian Stratigraphy.

DECEMBER 2021

To mark the 60 years of celebration of IUGS, the new website has been launched. IUGS plans to celebrate many of the extraordinary scientific breakthroughs made by our members over the past decades and aim to showcase the societal benefits IUGS has brought to the world. Our anniversary events will span the whole of 2022.

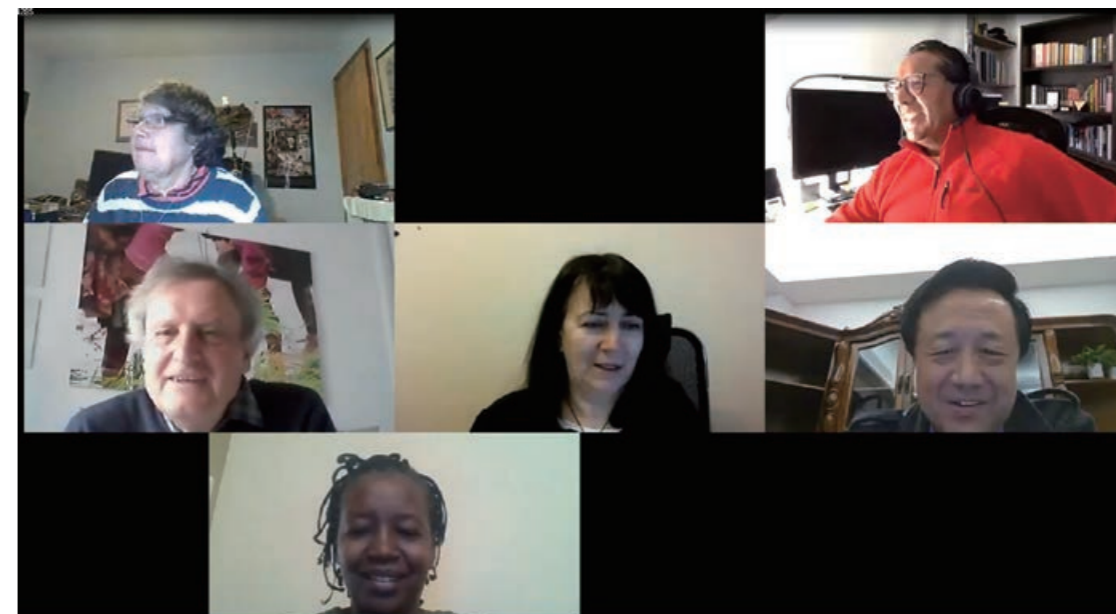
Many of the celebratory activities planned will showcase Planet Earth, the important scientific work undertaken by our members and will explore pathways towards achieving a more sustainable planet.

Within the framework of a special project awarded by ICS, the board of ISPS has been working to digitalize Spanish and Italian outcrops where GSSPs have been formally defined. Image and video filming has been carried out to construct 3D models of the outcrops, which will be accessible for the scientific community and the general public through the ISPS website.

The first meeting of the IUGS Nominating Committee (NC, 2020-2024) was held virtually on 6 December, 2021. During the meeting, the NC got familiarized with the IUGS Statutes and

Bylaws regarding the functions and duties of the NC and discussed extensively on the principles and criteria of nominations. With the consideration of the timeline requirements set out in the

Statutes and Bylaws and in order to allocate sufficient time for nominations, the NC proposed a work plan.



IUGS BODIES THE REAL LIFE OF THE UNION

The International Union of Geological Sciences promotes and encourages the study of geological problems, especially those of world-wide significance throughout the activities of IUGS Commissions, Task Groups and Initiatives.

At present IUGS gives special consideration to:

- International standards;
- Geoscience education;
- Geoscience information;
- Environmental management.

IUGS believes that it is of mutual benefit to establish close links with other organizations engaged in geosciences activities and especially those organizations whose work relates to some of the major activities of IUGS.

The list of currently active IUGS bodies testifies to these major aims of the Union. Links allowing description of the organization and activities of the IUGS bodies are provided on the IUGS website (www.iugs.org):

Scientific Commissions

Commission on Geoscience Education, Training & Technology Transfer (COGE)
International Commission on Stratigraphy (ICS)
International Commission on History of Geological Sciences (INHIGEO)
Commission for the Management and Application of Geoscience Information (CGI)
Commission on Tectonics and Structural Geology (TECTASK)
International Commission on GeoHeritage (ICG)
Commission on Global Geochemical Baselines (CGGB)

Joint Programs

International Geoscience Programme (IGCP)
International Geological Congress (IGC)
International Lithosphere Program (ILP)

Task Groups

Task Group on Isotope Geology and Geochronology (TGIG)
Task Group on Igneous Rocks (TGIR)

Initiatives

Resourcing Future Generations (RFG)
Initiative on Forensic Geology (IFG)

Big Science Program

Deep-Time Digital Earth (DDE)

Mr. Edmund NICKLESS



NASIC /RFG

NASIC/RFG REPORT FOR 2021

The Covid-19 pandemic with lockdowns, social distancing and restrictions on both domestic and international travel has significantly affected the way we work. As a consequence, many educational institutions from Primary- to Tertiary-level have reconfigured the way they teach, many repurposing classroom face-to-face lessons or lectures for online delivery. And scientific and professional bodies have followed suit, designing and delivering lectures and workshops online. The result has been a significant loss of social interaction which has adversely impacted the learning experience and research collaborations.

Against this background, the principal challenge facing the New Activities Strategic Implementation Committee (NASIC), established in 2013, was how to continue to implement the Resourcing Future Generations (RFG) initiative.

Global economic and social development relies upon the discovery and extraction of mineral, energy and water resources and the rationale in establishing RFG is to consider:

- How demand for these resources can be met with continued population growth and the right of all peoples to improved living standards;
- How to secure resources for future generations in ways that are economically, environmentally and socially responsible.

The prime objective of RFG is to help ensure

the multigenerational needs for raw materials, energy and water while ensuring social equity. To do that requires four fundamental actions by the global geoscience community:

- Comprehensive evaluation and quantification of 21st century supply and demand;
- Enhanced understanding of the subsurface as it relates to resource deposits;
- Assessment of where new resources are likely to be found;
- Building the needed and advanced skills capacity, particularly in lesser developed nations, to discover and responsibly develop mineral resources.

At the beginning of the 20th Century the range of elements in general use had not changed significantly since Roman times. In contrast, by the beginning of the 21st Century more than 60 elements were routinely used (Figure 1).

With restrictions on travel and face-to-face meetings, the focus of work during 2021 has been on advancing the RFG initiative in different ways, recognising that since the RFG initiative was launched in 2013, the world has changed in many ways

- The concept of the circular economy is now mainstream, but does not recognise primary mineral production;
- Much work has been done by groups mainly in Australia and The Netherlands forecasting

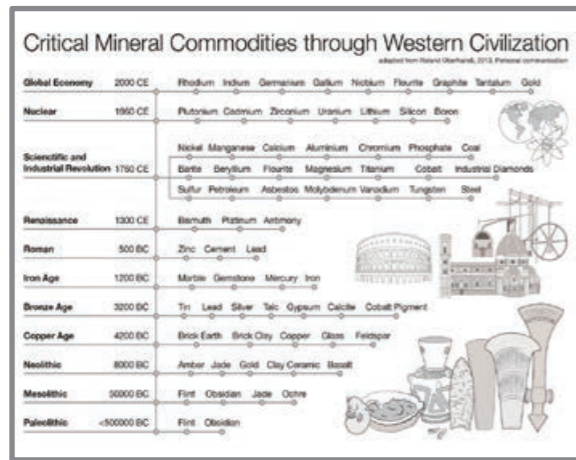


Figure 1. Technology has fuelled development. This graphic shows how through time humankind has used increasingly more diverse elements and materials (after Roland Oberhänsli).



Figure 2. SGA Short Course visit to Lepidoco (lithium) Mine and instruction by Chief Geologist, Simon Kahovera (image Beate Orbinger).



Figure 3. ReStoRE 1 field excursion to the Wicklow Mountains (image iCRAG).

future mineral demand needed to realise the energy transition;

- There is increasing concern among major manufacturers about security of supply and ethical supply chains;
- There is increasing emphasis on design for recoverability;
- In 2015 the UN launched the Sustainable Development Goals;
- In December of the same year the Paris Agreement to combat Climate Change was adopted by most countries.

The NASIC/RFG Report for 2019/2020 set out a tripartite approach to deliver tailored capacity-building activities to three specific audiences. All activities would be held under the umbrella of the IUGS Resourcing Future Generations initiative.

- ReStoRE Summer Schools, modelled on the 2019 ReStoRE summer school, that will bring together early-career researchers and practi-

tioners at the intersection of the social sciences and geosciences from developing and developed countries to address critical issues related to resources. Summer schools would be held every second year.

- RFG Technical Workshops series to address locally identified training needs. The workshops would be run on an as-needed basis in collaboration with local organisations. Topics would be selected through a competitive proposal process.

- RFG Developing Researchers Programme (FoRGe - Fostering Researchers in Geosciences: potentially in collaboration with UNESCO, a workshop-based programme to be held in developing countries in collaboration with Tertiary-level educational institutions aimed at building research capacity and supporting professional development among early career university faculty who study earth resource topics. Experienced mentors would lead the 3- to 5-day workshops and would maintain a mentoring role with participants after the workshop.

During 2021 work continued on broadening the RFG initiative under the first two strands (ReStoRE and Technical Workshops). It was not possible to make any progress on FoRGe, because attempts to identify a champion in an African university to act as a local point of contact and course supervisor were unsuccessful.

The emphasis was to support the professional development of young researchers and professionals, especially those in developing countries, who are working on issues relating to earth resources. The goal is to build global capacity, expand understanding, and improve practice in the societal aspects of earth resources, particularly among early career academics, professionals, and practitioners in Africa, Latin America, and Asia.

One of the biggest challenges facing our profession is the future supply of well-trained practitioners. To that end and although not foreseen as an objective for 2021, considerable effort was spent putting together a proposal to UNESCO and the IGCP for funds to support a

series of six professionally produced lectures to be broadcast and made freely available online. The UNESCO Lecture Series was entitled 'Earth Materials for a sustainable and thriving Society'. There were eleven speakers plus introductory remarks from UNESCO and IUGS. The lecturers included six women and five men from nine countries in four continents with expertise in the geosciences and social sciences.

Lecture 1 Earth materials: the foundation for development – Dr Larry Meinert (USA) & Dr Nellie Mutemeri (South Africa)

Lecture 2 Climate neutrality, the circular economy and Earth materials – Prof John Thompson (Canada) & Prof Frances Wall (UK)

Lecture 3 The neglected minerals and materials of development – Prof Daniel Franks (Australia)

Lecture 4 Mineral extraction and communities – Dr Rajiv Maher (Mexico) & Dr Melba Kapesa Wasumma (Kenya)

Lecture 5 Suppliers, consumers, and the global minerals supply chain – Dr Kathryn Moore (UK) & Dr Judy Muthuri (UK)

Lecture 6 Earth materials and a sustainable future – Prof Murray Hitzman & Ms Halleluya Naantu Ekandjo (Namibia)

The lectures were broadcast as webinar-style events, followed by live Question and Answer sessions, at approximately weekly intervals between 26 January 2021 and 9 March 2021. A total of 4,306 people from 145 countries registered for the series and 1,704 Certificates of Attendance were issued to participants from 91 different countries. Feedback on the series was overwhelmingly positive, with 94% of 409 respondents saying they were very likely or likely to recommend the UNESCO Lecture Series to others. There is strong interest in participating in similar events in the future. We have heard from a number of university lecturers who plan to incorporate material from the series in their courses either when the lectures are broadcast or later in their teaching schedule. The publicity flyer for the series was available in English, Arabic, Portuguese, French, and Spanish. We partnered with 11 professional, scientific, or non-profit groups who served as media partners and helped to publicise the lecture series to their networks. These partnerships, and the associated traditional media and social media outreach, enabled us to reach a broad global audience. Because we did not collect personal data from attendees and issues such as internet connectivity and blocking software can distort the crude numbers captured by the broadcasting platform, it is only possible to give the approximate minimum attendance at live lectures, which ranges from 680 to 300. As a legacy, all the lectures are available to view

online as YouTube recordings at <https://www.icrag-centre.org/news-and-media/conferences-and-events/earthmaterialssustainability.html>

In collaboration with the Society for Geology Applied to Mineral Deposits, as part of their 7th Short Course on African Metallogeny, it was hoped to hold an RFG-related event in Windhoek, Namibia in during late 2020 or during the Spring of 2021, which turned out not to be possible. The much-delayed Short Course eventually took place from 29 November to 3 December 2021 as a hybrid event, preceded by an icebreaker with a traditional Namibian dance group on Sunday 28 November. The first three days comprised a programme of lectures and practical work including examination of drill cores and in-field geochemical analysis, and were followed by two days of field excursions. The Short Course event attracted 72 pre-registered delegates of whom 61 attended in person and 11 online. There were 24 lecturers, 10 foreign students, 17 Namibian students, 20 from government/academic and 1 from industry. 46 of the attendees were from Namibia. A further 37 attended online. Of the total 109 participants, about 51% were present in-person and 49% online. The lectures covered topics ranging from the role of the minerals sector in the transition to low-carbon energy and meeting the Sustainable Development Goals, the geology and metallogeny of Namibia, exploration potential of Namibia for metals such as Uranium, Vanadium, Zinc, Copper, Lithium, Rare Earth Elements, quantifying the demand for energy metals, and navigating the social issues related to exploration and mining for energy metals. The field excursions included visits to the Lepidico Mine project, led by Simon Kahovera (Figure 2), the Eureka Exploration Project, a REE occurrence in carbon-

atites, prepared by Pete Siegfried, and the world's-largest open pit Uranium mine and processing plant at Rössing, led by Gabi Schneider. Textbook outcrops of badlands, dolerite dykes emplaced into Upper Precambrian during the opening of the Atlantic Ocean, skarn mineralogy and contact metamorphic features as well as amazing landscapes and geological landmarks such as Spitzkoppe, which are part of the future Geopark, were seen.

In 2019 the first of a hoped-for biennial series of international Summer Schools called ReStoRE (Researching Social Theories, Resources, and Environment International) was held at University College Dublin. It brought together some 40 early-career researchers and practitioners at the intersection of the social sciences and geosciences from 28 nations, including 18 developing countries, to address critical issues related to resources.

Looking forward, considerable effort has been

spent planning ReStoRE 2. It was not possible to hold the second Summer School in 2021 but the event will now take place, hopefully in person but, if not, online, from 4 to 8 July 2022. Further details are at <https://www.icrag-centre.org/restore/>

During the Summer School, workshops will address six themes: Circular economy, Just transition, Community engagement, Ethical resourcing and Action Leadership.

Hopefully, restrictions imposed as a result of Covid-19 will be eased and in the coming year, we will continue to look to identify opportunities to work with others, as we did with UNESCO and SGA in 2021, to advance FoRGe and to deliver ReStoRE 2.

Edmund Nickless, Chair NASIC/RFG

14 January 2022

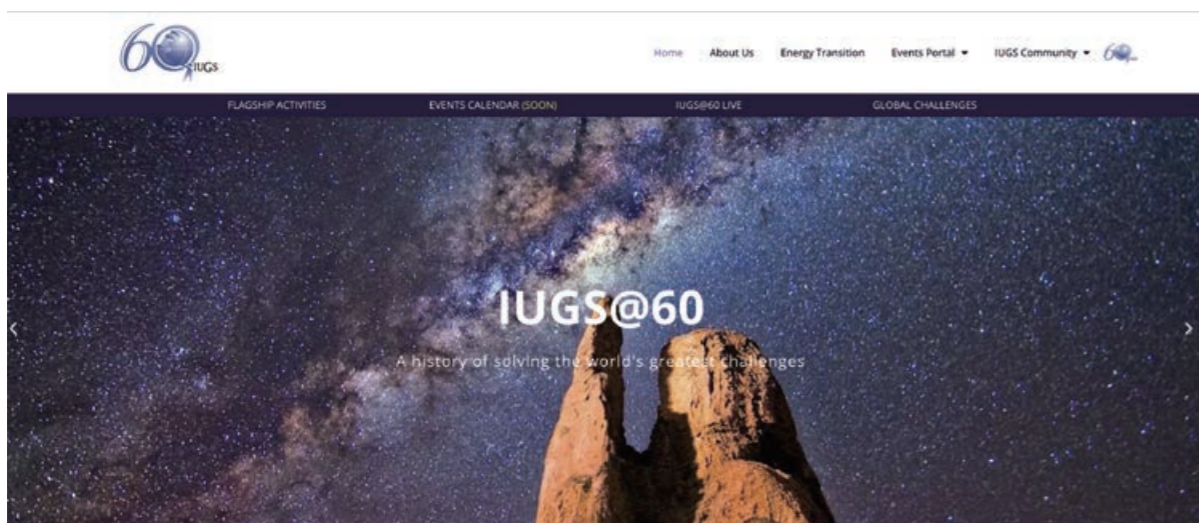
Dolores PEREIRA



IUGS PUBLICATIONS COMMITTEE

The Publications Committee consists of:

- Chair – Prof Dolores Pereira
 - Prof. Stanley J Finney – IUGS Secretary General
 - Mr Giuseppe di Capua – Webmaster
 - Dr Gurmeet Kaur – member responsible for social media and eBulletin
 - Prof. Jin-Yong Lee – Editor of Episodes
- Managing editor of Episodes is Dr Heejung Kim.



View of the new web page.

Due to traveling restrictions, the Publications Committee met online, once again, to discuss the evolution and achievements during 2021. This year was important to trigger promotion of the IUGS 60th anniversary, and Jane Husse was contracted to adjust IUGS tools to a more catching and impact way. A new, ad hoc, IUGS@60 website was created and launched on 1st January 2022 to highlight the events to

take place to celebrate the 60 years of IUGS. The information was posted on all the IUGS social media.

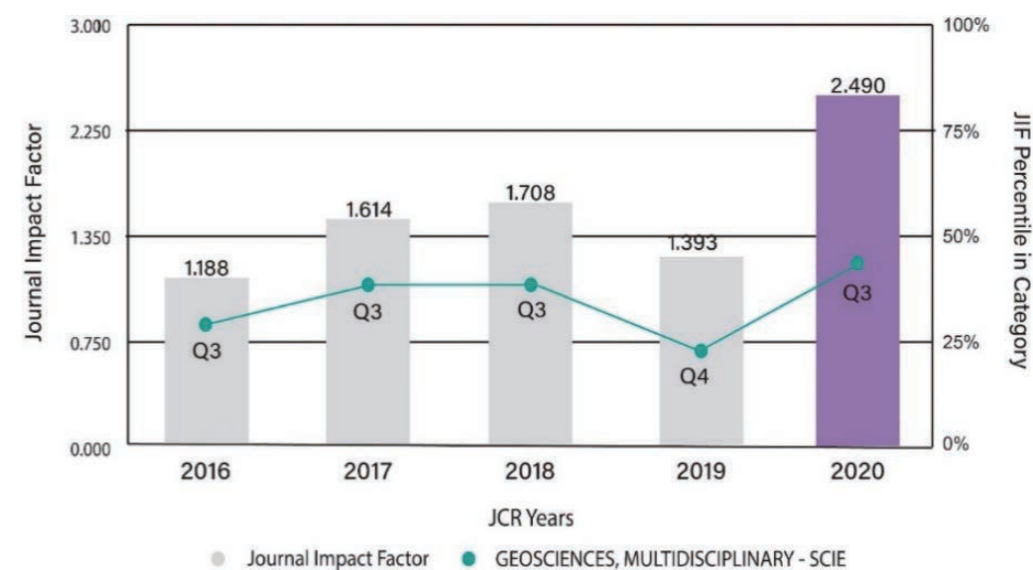
Episodes is the flag-ship publication of IUGS. In 2021, the journal received 327 original submissions, besides the 43 additional submissions for the IGC 36th Special Issue Vol. 43, No. 1. The submissions included 23 original

articles, IUGS communications, book reviews, reports, obituaries, and editorials. At present, Episodes first decision after submission has dropped to 37 days.

During 2021, Episodes updated the editorial board, considering resignations and opening a call with the main goal of achieving gender parity among its members. IUGS Publications Committee is proud to announce that we have

achieved gender parity, with 14 female researchers and 14 male researchers making up the editorial board. We will continue to work on diversity, both in gender and in geography, also in the reviewing panel.

Another achievement was the increase of the Impact Factor. According to Clarivate Analysis (2021), the new IF is 2.490 (2019 IF was 1.293), moving from Q4 to Q3.



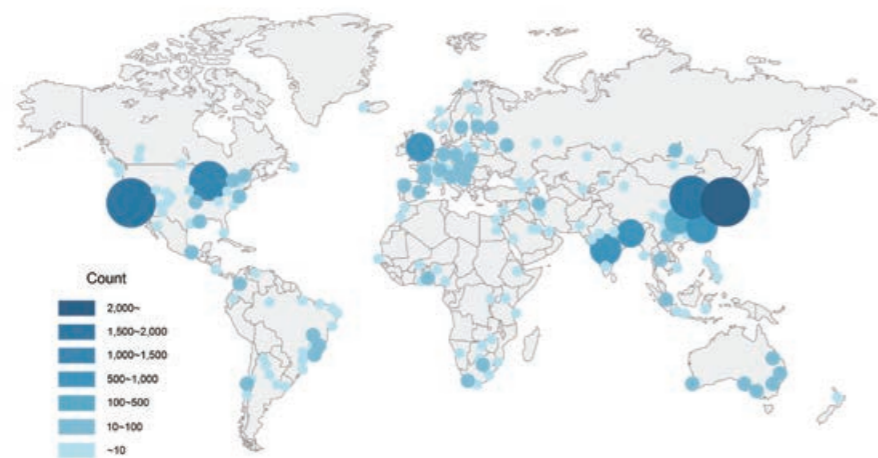
Impact factor of Episodes in the past five years (2016–2020).

Visits to Episodes web page have also increased, coming mostly from the following the United States of America, India, China, South Korea, and the United Kingdom.

There is a commitment to increase the citable items by inviting and encouraging talented scientists to submit manuscripts to Episodes, with special interest in female researchers and experts from developing countries. The editor of Episodes will work in the promotion of the IUGS 60th anniversary actively utilizing E-TOC and homepage pop-ups.

Regarding promotion of IUGS events through social media platforms (Facebook, Twitter and LinkedIn), regular reports with relevant information and activities (e.g. reports from IUGS commissions, joint programs, task groups and initiatives) were published, including the contents of the eBulletin and the new inclusions in the web site. The total Facebook followers have crossed a 7.7 k mark now.

The webmaster's activity was focused to maintain efficient the website of the IUGS (<https://www.iugs.org>, published in December 2019), by



Distribution of visitors to the Episodes website (2020, January to December)

updating pages regularly. The IUGS website is monitored through Google Analytics: more than 29,930 unique visitors from 183 countries accessed the website in 2021 in more than 32,080 visits, with an average value of 82 visitors/day, 2.0 pages/visit, 1:25 minutes/visit. This is an increase, compared to the last year's numbers. Visitors reached the website mainly from google.com (48%) or direct access (30%), mainly from USA (16%), China (11%), India (9%). All other countries have less than 5% of visitors.

IUGS publishes an ebulletin every month to disseminate news about IUGS initiatives, activities, achievements, events, and publications. All IUGS Commissions, Task Groups, Initiatives, IGCP projects and Adhering Bodies are monthly invited to provide a steady flow of material, consisting of concise texts accompanied by few illustrations (photographs, diagrams, etc). The ebulletin is distributed to more than 16,000 recipients.

2021 was a very fruitful year for books produced from IUGS activities and published by the Geological Society of London through the common MoU. Seven books were published as Special Publications, but many others are in the production peep-line: four of these books are in final production and many of them have already papers online first. The Chair of the Publications Committee is in permanent contact with the GSL editorial manager to keep updated and promote IUGS books.

Signed:

Lola Pereira
Chair of the IUGS Publications Committee
Date: 25 of January, 2022



INTERNATIONAL COMMISSION ON STRATIGRAPHY (ICS)



David A.T. Harper
Chair



Shuzhong Shen
Vice Chair



Philip L. Gibbard
Secretary General

The International Commission on Stratigraphy is the largest of the clusters within the International Union of Geosciences. It has 17 subcommissions and involves over 500 scientists, globally. This year, in the absence of many planned field campaigns, the focus of the Commission has switched to desk and laboratory-based studies. Two key areas, the ICS Chronostratigraphic Chart itself and the webpages have been a focus. The 2021 version has been kept up to date on the ICS website: ten updates appeared as new GSSPs were ratified and numerical ages revised. An interactive chart is also available on the website and the iPhone timescale App was updated. The website also serves translated versions of the chart. A Chinese language paper describing the ICS chart and GSSP inventory has been published. Four translations of the chart are in progress: Slovakian, Czech, Korean and Italian, in addition to the 20 that already exist. The formal status for subseries/subepoch divisions was approved for inclusion in the stratigraphic guide. Following this, subseries/subepoch divisions proposed for the Neogene System/Period (i.e., the Miocene and Pliocene Series/Epochs) were ratified by IUGS. These outcomes have been published in Episodes. The Stratigraphic Guide online (<https://stratigraphy.org/guide/>) has been updated with changes from the Stratigraphic Classification subcommis-

sion (Piller & Aubry, eds).

The official GSSP paper for the base of the Capitanian Stage has been accepted for publication in Episodes. The GSSP proposal for the base of the Coniacian Stage in the Salzgitter-Salder section, Germany (Fig. 1a,b) was approved by the Subcommittee on Cretaceous Stratigraphy and the ICS in early 2021, and ratified by IUGS on May 2021. Primary criterion for correlation is the appearance of the inoceramid *Cremnoceramus deformis erectus* at the base of bed 46. The proposal for the Global Boundary Stratotype Section and Point (GSSP) for the base of the Artinskian Stage at the point indicated by the FAD of the conodont *Sweetognathus asymmetricus* at the Dal'ny Tulkas section (Fig. 2a,b), Russia was accepted by the Subcommittee on Permian Stratigraphy. A formal proposal of the Artinskian-base GSSP was accepted by International Commission on Stratigraphy and was ratified by the IUGS in February 2022. Many subcommissions (Cryogenian, Ediacaran, Cambrian, Silurian, Permian, Triassic, Jurassic, Cretaceous, Paleogene and Neogene) have proposals in various states of maturity. The Cretaceous subcommission has a new ambitious plan to tackle all its outstanding GSSPs whereas the Quaternary subcommission continues its focus on the status of the Anthropocene

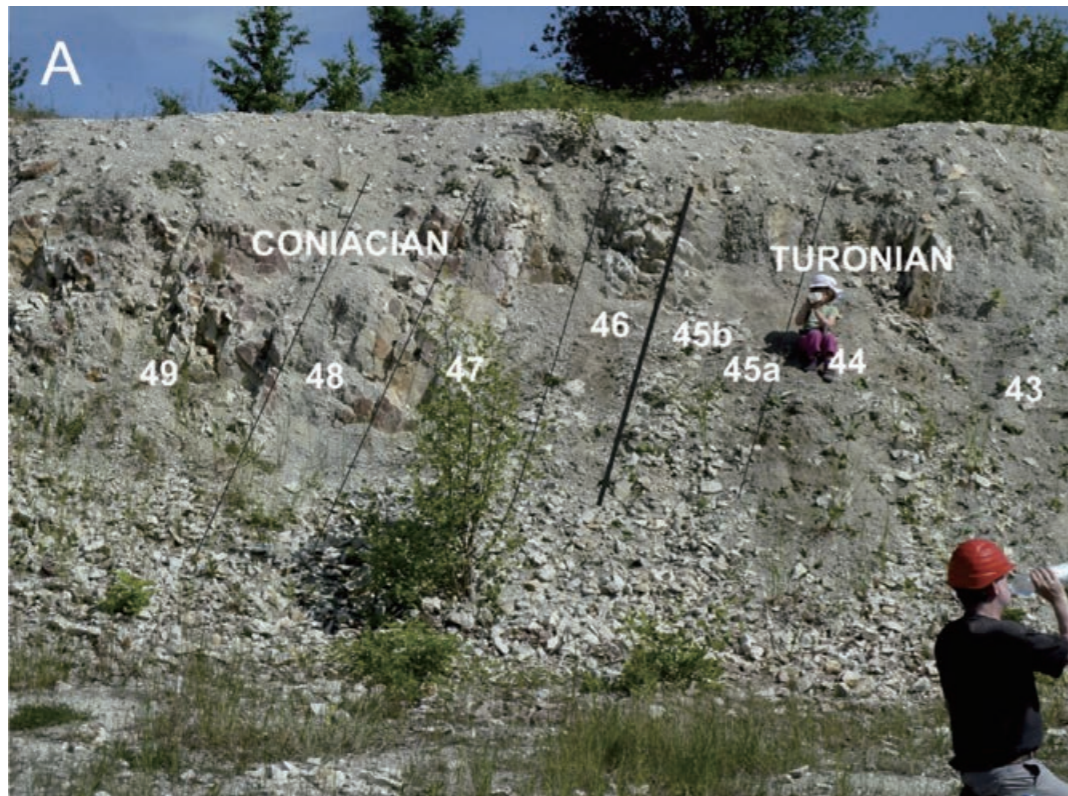


Fig. 1a. Turonian-Coniacian boundary succession in the Salzgitter-Salder quarry (lower Saxony, Germany). The GSSP is defined at the dark line, at the base of bed 46. Courtesy of Maria Rose Petrizzo.



Fig. 2a. The Dal'ny Tulkas section; GSSP for the base of the Artinskian is 3.5 m below the top of bed 5 (boundary indicated by the red arrow). Courtesy of Lucia Angiolini.

(Holocene) and refinement of the base of Gelasian (Pleistocene).

Data remodelling work on the Semantic Web

representation of the Chart (<http://resource.geosciml.org/vocabulary/timescale/gts2020>) to better represent stratigraphic and temporal typologies has commenced with a new Knowl-

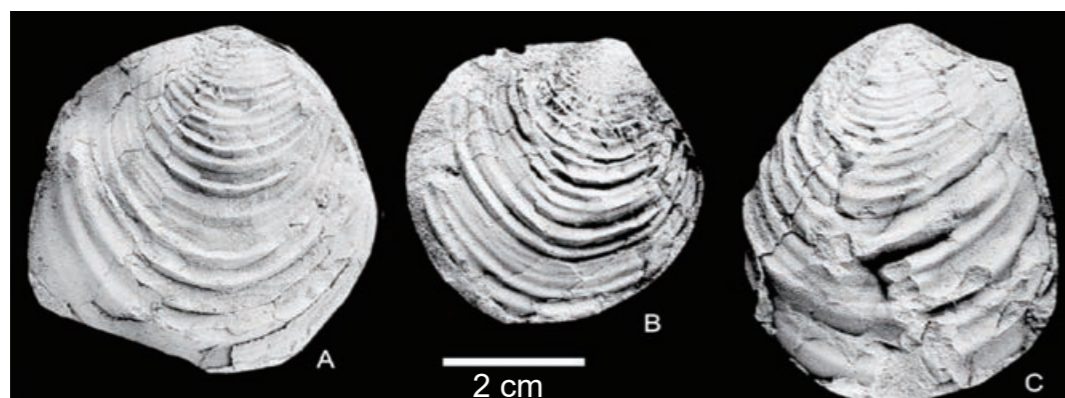


Fig. 1b. The lower boundary of the Coniacian Stage is placed at the base of bed 46, and marked by the first appearance of the inoceramid bivalve species *Cremonceramus deformis erectus* (Meek) and complemented by the Navigation carbon isotope event. Courtesy of Maria Rose Petrizzo.

edge Graph of Chart and related information being built at <https://github.com/i-c-stratigraphy/geologic-timescale-kg>. Co-authoring this remodelling with Nicholas Car is Steve Richard, one of the two main contributors of the Semantic Web form of the Chart.

Eight out of seventeen Subcommissions are operating their own websites within the new ICS family system: Precryogenian; Cambrian; Ordovician; Devonian; Permian; Jurassic; Cretaceous; Neogene. The status of Subcommissions' website standardisations can be seen online (www.stratigraphy.org).

In education, the chart continues as a teaching resource for schools and colleges. Several authors, university teachers and other educators together with professional societies were granted permission to use and reproduce the ICS

International Chronostratigraphic Chart in their productions. Many members of the Commission have contributed to 'Deciphering Earth's history' a guide to stratigraphical practice (edited by Angela Coe) to be published in 2022 by the Geological Society and supported by the ICS and IUGS. The Timescale Calibration Subcommission has helped develop teaching materials for the Cyclostratigraphy Intercomparison Project (CIP: cyclostratigraphy.org) to explain the use of tools for detecting cyclicity in the stratigraphical record.

The chart has consistently initiated and supported a range of research programmes in the earth and planetary sciences. The chart continues to be used extensively in scientific papers, sometimes cited (the original chart-describing paper by Cohen, Finney, Gibbard & Fan 2013 in Episodes


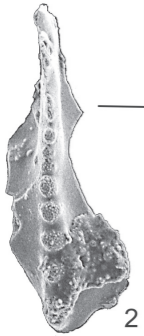
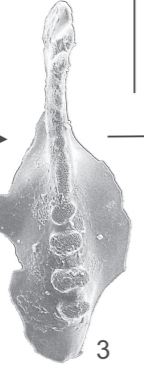
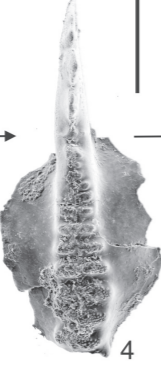
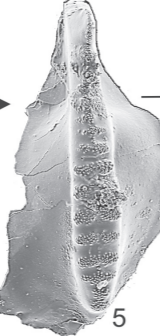
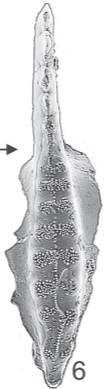
Asselian Stage		Sakmarian Stage		Artinskian Stage	
Conodont Zone					
<i>postfusus</i>	<i>aff. merrilli</i>	<i>binodosus</i>	<i>anceps</i>	<i>asymmetricus</i>	
					
1	2	3	4	5	6

Figure 2b. The Sweetognathus conodont lineage leading to asymmetricus, the primary marker for correlation of the boundary between the Sakmarian and Artinskian stages. Courtesy of Lucia Angiolini.

has been cited some 2400 times, whereas specific versions of the chart published in the last three years have been cited some 60 times). It is the authorized geological timescale.

A number of subcommissions have published substantial volumes on their respective systems, for example publication of a special volume of Palaeobiodiversity and Palaeoenvironments “Global Review of the Devonian-Carboniferous Boundary” (Guest-editors: M. Aretz & C. Corradini) 370 pp., and a special volume of the Scientific Journal of the Hassan II Academy of Science and Technology “Devonian to Lower Carboniferous stratigraphy and facies of the Western Moroccan Meseta: implications for palaeogeography and structural interpretation” (Guest-editors: R.T. Becker, A. El Hassani & Z.S. Aboussalam), 194 pp.

A two-volume work on ‘Global Synthesis of the Ordovician’ is far advanced and will be published by the Geological Society in early 2023, supported by the ICS and IUGS. The volume includes a global coverage of Ordovician successions and includes topical subjects such as palaeobiogeography, sea-level changes and the Ordovician timescale.

A template for an improved rock-based subdivision of the pre-Cryogenian timescale was published in the Journal of the Geological Society (2021). This exciting paper shows the consensus understanding of many Precambrian stratigraphers who make up the ICS working group on pre-Cryogenian subdivision, chaired by Graham Shields. The working group involves ~35 Precambrian researchers globally, who worked out how the first 85% of Earth history can

best be subdivided, based on GSSPs, so that the names and ages of periods, eras and eons match known tectonic, environmental and palaeobiological events recorded in the rock record. The paper is currently under discussion in the pre-Cryogenian subcommission, prior to discussion in the Commission. The current focus of that group is the Hadean/Archaean boundary – a proposal for which is expected imminently.

Direct outreach through the dedication of GSSPs has been severely curtailed during the pandemic, nevertheless subcommissions are developing a range of products. The ICS endorsed a volume (in Chinese) on all 77 of the current ‘Golden Spikes’ to mark the 90th Anniversary of Nanjing Institute for Geology and Palaeontology. The Paleogene subcommission has produced some remarkable drone videos of key GSSPs and related sections. Plans are far advanced to dedicate the Kimmeridgian (Jurassic) GSSP on the misty Isle of Skye, Scotland and the Coniacian (Cretaceous) GSSP at Salzgitter-Salder, Germany.

Strong links remain and are being enhanced with the DDE (Deep-time Digital Earth)

programme and the Geobiodiversity Database (NIGPAS). The ICS, through the DDE’s Stratigraphy Working Group, has worked with DDE to build a so-far most comprehensive domain ontology for stratigraphic knowledge, which contains ontologies for seven major stratigraphic subdisciplines and over 1200 knowledge nodes. This work forms the foundation for the interchange of stratigraphic data in a computer-readable way in the future.

The Commission has a focus on sustainability and contributes to a range of UN Sustainability Development Goals, especially Quality Education through its outreach and use of the chart (4), Gender Equality across the subcommissions, task and working groups (5), Industry, Innovation and Infrastructure through development of big science databases and electronic communication (9), Reduced Inequalities through capacity building in its focused work groups and at meetings (10), Responsible Consumption by electronic communication and encouragement of sustainable travel (12) and Climate Action through presenting the lessons from deep time (13).



COMMISSION FOR GEOSCIENCE INFORMATION (CGI)

Chair Harvey Thorleifson



The IUGS Commission for the Management and Application of Geoscience Information (CGI) fosters the interoperability of geoscience information, through leadership, collaboration, education, as well as provision of geoscience information standards and best practices.

CGI strives to ensure that geoscience information can be exchanged, understood, used without limitation, and readily integrated with standards-based information from other domains. Geoscience information needs to be semantically rich and structured to enable seamless interaction in all environments. Global education about the management, modeling, exchange, and use of information enables its application for the benefit of society.

CGI represents IUGS on geoscience information matters, provides the means for transferring knowledge on geoscience information and systems, assists international dissemination of best practice in geosciences information, stimulates and supports initiatives that are developing standards, and its Council members hold leadership positions in the information community.

During 2021, CGI was active, utilizing the online

means that have been dictated by the pandemic. CGI Council meetings were held on January 18, April 14, June 30, and on September 16. Grants were awarded to important projects needed to advance CGI goals. The superb new web site is up to date, and excellent CGI Newsletters were produced in May and August. The highly capable and active CGI secretariat (CGIsecretariat@mail.cgs.gov.cn) is located at the Development Research Center of China Geological Survey, Ministry of Land and Resources. The CGI bank account is superbly managed in New Zealand.

CGI now has over 500 members in more than 80 countries. CGI coordinates closely with partners such as Open Geospatial Consortium, CODATA, CGMW, Loop, and OneGeology. CGI hosted a successful webinar on June 23rd, and an equally successful Technical Seminar on September 9th. CGI leaders made major contributions to DDE Standards Training on October 26-28. Updated CGI flyers were released on the IUGS website, and CGI Activities were reported in IUGS E-Bulletins 174, 176, and 180.

The webinar hosted by CGI on 23 June 2021, from 10 AM to Noon UTC, was attended by 91 experts from around the world. Harvey Thor-

leifson, CGI Chair, indicated that the objective of the webinar was to share updates on the work that CGI is carrying out with partners, and to hear discussion. He thanked partners who were mentioned in the six presentations that followed. Discussion and feedback indicated that the webinar was a great success. Videos are available on YouTube.

At the June Webinar, Mickael Beauflis of BRGM spoke as Chair of the Open Geospatial Consortium (OGC) Geoscience Domain Working Group (DWG), that partners with CGI and many other organizations in making spatial information findable, accessible, interoperable, and reusable (FAIR). Éric Boisvert of the Geological Survey of Canada spoke on behalf of the OGC Standard Working Group (SWG) for GeoSciML (Geoscience Markup Language), an XML- and GML-based machine-readable format for geological maps that has been stable for almost two decades since emanating from work such as XMML, NADM, and G-XML. Michael Sexton

of Geoscience Australia provided an overview of EarthResourceML (ERML), a markup language for the delivery of mineral occurrence, deposit, mining, and resource data that was initiated in 2006 as a collaboration between Australian state and federal agencies.

Mark Rattenbury of GNS Science in New Zealand, Te Pū Ao, spoke for the CGI Geoscience Terminology Working Group, which has been separate from the GeoSciML group since 2014, and which maintain lists of terms for earth features, properties, quantities, techniques, and processes that are collaboratively agreed upon and are widely accessible, including to machines. Boyan Brodaric of the Geological Survey of Canada, and Stephen Richard of the USGIN Foundation in USA, reported on GeoScience Ontology research being conducted in association with Loop, an integrated and interoperable platform enabling 3D stochastic geological modeling. Zhang Minghua of the China Geological Survey, Co-Secretary General of CGI, described the work of the Deep-time Digital Earth Standards Task Group (DDE-STG).

Then, on September 9, 2021, at 10 UTC, we held an informal technical seminar on geoscience ontology and knowledge graph, that was attended by members and friends of relevant working groups of CGI and partner organizations; this seminar also is on YouTube. CGI leaders then were prominent in the comprehensive October 26th-28th DDE Standards Training.

CGI will have a busy 2022, focusing on coordination, the DDE Standard Task Group, the joint CGI/OGC Geoscience DWG work, GeoSciML, EarthResourceML, geoscience vocabularies, communications, representing IUGS in geoscience information matters, collaboration, functioning through online meetings, and completing a 4-year plan.



August 2021 CGI Newsletter

COMMISSION ON GLOBAL GEOCHEMICAL BASELINES

<https://www.globalgeochemicalbaselines.eu/>

The mission of the Commission is to:

- (i) Develop a Standard Methods Manual for the Global Geochemical Reference Network project.
- (ii) Establish a global Geochemical Reference Network similar to a geodetic network for leveling existing databases (prime objective).
- (iii) Prepare a global geochemical database and its representation in map form, and
- (iv) Document the concentration and distribution of chemical elements and species in the Earth's near-surface environment.

The database encompassing global geochemical data is urgently needed by a broad audience including policy makers, environmental and natural resource managers and researchers throughout the world. To reach this goal, the Commission works with applied geochemists throughout the world to establish standards for global- and regional-scale geochemical mapping. The Commission also promotes and facilitates the implementation of harmonised protocols for sample collection, preparation, quality control, and laboratory analysis for geochemical mapping programmes at any scale.

1. Steering Committee

The Commission's Steering Committee members for the 2020-2024 period are:

Co-Chairs: 1st Co-chair: Anna Ladenberger, Geological Survey of Sweden

2nd Co-chair: Kate V. Knights, Consultant Geochemist, Dublin, Ireland

Deputy-Chairs: 1st Deputy-chair: Gloria Prieto, Servicio Geológico Colombiano

2nd Deputy-chair: Gloria Simubali, Geological Survey of Namibia

Scientific Secretary: Paula Adánez, Instituto Geológico y Minero de España

Public Relations and Finance: Ariadne Argyraki, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

Treasurer: Christina Stouraiti, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

Advisory Panel: David B. Smith, United States Geological Survey

Patrice de Caritat, Geoscience Australia

Alecos Demetriades, Institute of Geology and Mineral Exploration, Hellas

One virtual Steering Committee meeting was organised this year on the 26th of May 2021, which was chaired by the 1st Co-chair Anna Ladenberger.

2. Participation in the 4th Workshop of the Global Black Soil Project

The 4th Workshop of the Global Black Soil Critical Zone Geo-ecological Survey (BASGES – IGCP665) was virtual and was organised on the 19th of May 2021. It was reported in the June 2021 IUGS E-Bulletin. Two presentations were delivered by CGGB members.

The first presentation "International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project", by Alecos Demetriades, Dai Huimin, Liu Kai, Igor Savin, Manfred Birke, Christopher C. Johnson and Ariadne Argyraki, was to inform

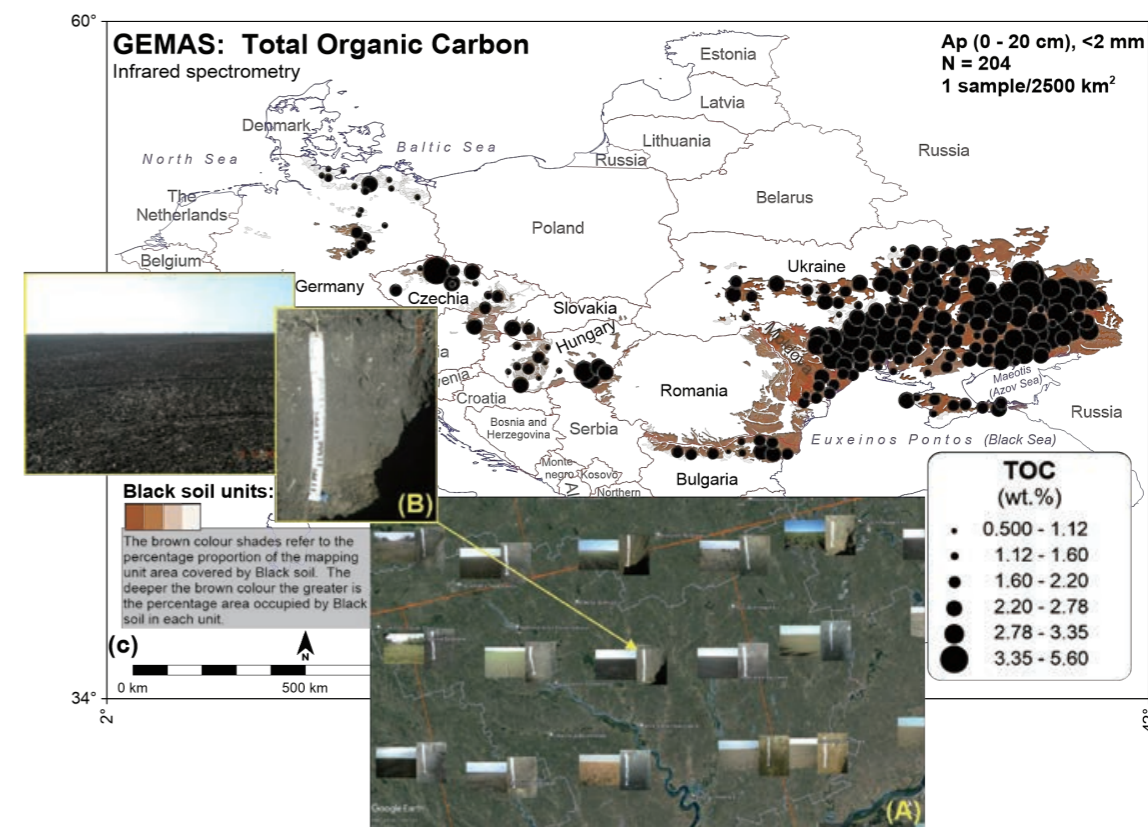


Figure 1. The map shows the distribution of Total Organic Carbon (TOC) in agricultural soil samples in the European Black Soil region, which were determined by WD-XRF. The lower set of photographs (A) from Google Earth show the soil profile and landscape at each sampling site, and the upper two (B) show an enlarged view. The black colour in the photographs indicates the richness of soil in organic matter. The results are from the EuroGeoSurveys Geochemistry Expert Group's project on the geochemistry of agricultural and grazing land soil with the acronym GEMAS. Map plotted with Golden Software's MapViewerTM v8 by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.

all Workshop participants that the Manual of Standard Methods was published in 2020 after its approval by the IUGS Executive Committee, and to report the outstanding issues that should be tackled before the project can start.

The second presentation showed a "First glimpse of the geochemistry of European Black Soil by using the GEMAS agricultural and grazing land soil data sets" by Alecos Demetriades, Manfred Birke, Anna Ladenberger, Philippe Négrel, Martiya Sadeghi, Edith Haslinger, Alan Mann and The GEMAS Project Team (Figure 1).

3. Participation in Goldschmidt 2021

The IUGS Commission on Global Geochemical

Baselines (CGGB) together with the Geochemistry Expert Group (GEG) of EuroGeoSurveys organised a session entitled "Geochemical mapping at all scales for all reasons" under Theme 12 "Environmental Geochemistry and Human Health" at the Goldschmidt 2021 conference, which was held as a virtual conference this year due to the COVID-19 pandemic. The session was chaired by Philippe Négrel (GEG Chair) and Anna Ladenberger (1st Co-Chair of CGGB and GEG Deputy Chairperson).

The main topic of the session was systematic geochemical mapping and its methodology to document the spatial variation of chemical elements in geomaterials occurring at or below

the Earth's surface, i.e., rock, soil, sediment, stream water, groundwater, and vegetation. The resulting geochemical databases have a wide range of applications, including mineral exploration, agriculture, forestry, land use planning, environmental monitoring, medical and forensic science, etc.

The keynote lecture "Geochemical mapping applications to forensics and intelligence" was delivered by Patrice de Caritat (Geoscience Australia) – (Figure 2), and the invited talk "Assessing the influence of the industrial past on an urban environment - what does the soil geochemistry?" was given by Joanna Wragg (British Geological Survey). In total, the session comprised of 17 oral presentations. The session was attended by about 70 persons.

The keynote lecture given by Patrice de Caritat (Geoscience Australia and member of CGGB Advisory Panel) gained enormous media attention. The presentation was selected as one of only eight talks among over 1000 presentations

by the conference press centre for a media release. The Goldschmidt press release was widely disseminated, including the Science Magazine, Eos Magazine, Forensic Magazine, Technology Networks, National Geographic (Spain), Forbes, Radio Canada and other media outlets in Australia, Europe, the USA, and Asia.

The keynote lecture retraced Patrice de Caritat's journey from being a resource and environmental geochemist, carrying out geochemical surveys at various scales, to his recent forays into soil geochemistry applied to forensic provenancing. Some of this work was published in the Journal of Forensic Sciences in 2019 and 2021. The team is currently extending the provenancing capability to include mineralogical and genomic data of soil and soil-derived dust under a Defence Innovation Partnership (South Australia)-funded research and development project entitled "InFoDust: The Intelligence and Forensic potential of dust traces for counter-terrorism and national security".

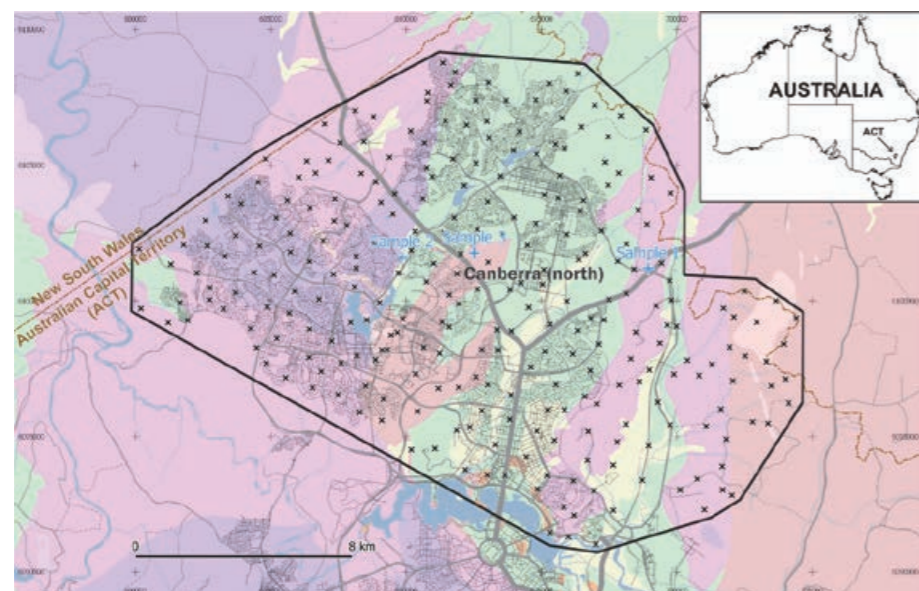


Figure 2. Simplified geological map of north Canberra, showing the location of the soil geochemical survey samples (black crosses) and of three simulated provenancing (blind) samples (blue crosses).

4. Organisation of Workshop on Compositional Data Analysis

The Commission organised an online training workshop on "Extracting, visualising and interpreting structure in geochemical data through compositional data analysis (CoDa)". It was held with a great success on the 18th of November 2021. Lectures were delivered by Prof. Eric Grunsky and Prof. Michael Greenacre, both renowned experts in multivariate statistical analysis of geochemical data.

The three-hour short course examined the compositional nature of large geochemical data sets and application of logratio analysis to geochemical data with the intention of extracting, visualising and interpreting their internal structure and correlations. Statistical and graphical tools and applications of predictive geochemical mapping in the geospatial domain were demonstrated through different case studies.

There were 397 participants registered from 60 countries and online attendance reached a maximum of 191 during the live session.

The recorded video of the workshop is available to watch on the CGGB YouTube channel: https://youtu.be/8lLd_hDnAok. The 6 workshop presentations (Figure 3), as well as a selection of related bibliographic references, are available for download from the CGGB website by using the following hyperlink:

<https://www.globalgeochemicalbaselines.eu/content/129/workshops/>

5. Progress of the Manual of Standard Methods for Establishing the global GRN

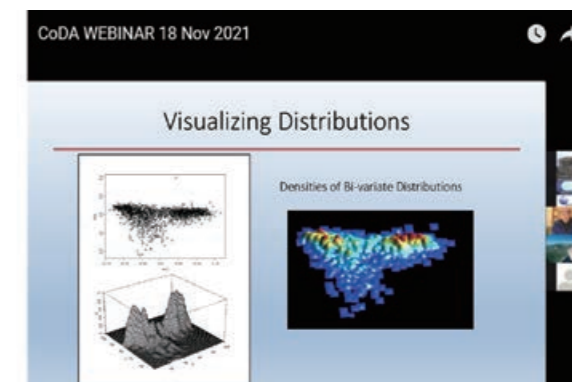


Figure 3. Screenshot of CoDa webinar presented by Eric Grunsky and Michael Greenacre.

The Commission is continuing the work on the compilation of the comprehensive 'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network', which started in the first quarter of 2018. It will be a unique manual of methods used in applied geochemistry.

The work is at the final stage of revision and editing. All chapters have been peer-reviewed by two external reviewers. The plan is to complete the manual, if possible, in the first couple of months of 2022 in order to be submitted for publication approval at the pending March 2022 meeting of the IUGS Executive Committee.

6. Regional reports

An important part of the annual reports is the reports about geochemical surveys carried out in each country, which most are considered as spin-offs of the Blue Book, and the FOREGS Geochemical Atlas of Europe. These will be found in the appendix of the annual report.

COMMISSION OF TECTONICS & STRUCTURAL GEOLOGY (TECTASK)

The Commission on Tectonics and Structural Geology (TecTask) of the International Union of Geological Sciences represents an initiative of Earth Scientists dedicated to stimulating communication and coordination within the international science community and to provide information to the public. The group encourages innovative research and continued education in Tectonics and Structural Geology, the growth of intellectual capital and hence the impact of our science on the wealth of the global society. TecTask reaches out to scientists and students, particularly those from developing countries and early career researchers, to share cutting-edge research and development, and state-of-the-art training. Dialogue and cooperation are welcomed with organisations, industry and administrations regarding applications in Structural Geology and Tectonics for sustainable use of the world's natural resources, the preservation of the environment and the prevention of natural hazards.

The current TecTask executive committee (EC) has the mission to focus on the activities that the commission has been running over the years and to carry out the transition of the commission to form the International Association for Structural Geology and Tectonics (IASGT).

The main activities of the TecTask commission in 2021 were:

1. Maintenance of the TecTask Web Portal (<http://www.tectask.org/>) and social network accounts, as our arena for communication and exposure to the public and science community. These include Facebook ([\[book.com/Tectask/\]\(https://www.facebook.com/Tectask/\)\), Twitter \(<https://twitter.com/iugsc>\) and LinkedIn \(<https://www.linkedin.com/company/tectask>\) accounts.](https://www.face-</p></div><div data-bbox=)

2. Open Terminology & Standards initiative with a wiki-like Internet Platform: This is a major initiative that aims to define and maintain a database of professional terminology and scientific standards. It provisionally works as a dynamic wiki (<http://www.tectonique.net/ttt>). We have developed this platform and populated it with terms and their definition, which can be publicly discussed by the enrolled members before those are elevated into formal glossaries or a dictionary published regularly (e.g., every five years). The open-source and open-access nature of Open Terminology & Standards aims to provide a tool to promote the dynamic changes in geologic terminology over time. We intend to migrate this wiki to a more professional website, link it to Outcropedia (see below) and organise the publication of the first book/dictionary.

3. Organization of the YORSGET conference series: TecTask is the umbrella organization for the YORSGET conference series (International Conference of Young Researchers in Structural Geology and Tectonics). This is a conference series in which PhD, MSc students, postdocs and early career researchers present their research to a wide audience that also includes more senior academics. The 3rd YORSGET was planned for June 2020, but it had to be postponed to 2022 due to the covid-19 pandemic. In 2021 we ran the virtual conference Waiting for YORSGET (<https://www.socgeol.it/N3457/new-event-waiting-for-the-yorgset-on-21-and-22-june-2021.html>), and the onsite YORSGET-2020 will take place

in June 2022 in Catania (Italy) ([http://www.dip.biogeo.unict.it/it/content/young-research-](http://www.dip.biogeo.unict.it/it/content/young-research-ers-structural-geology-and-tectonics)



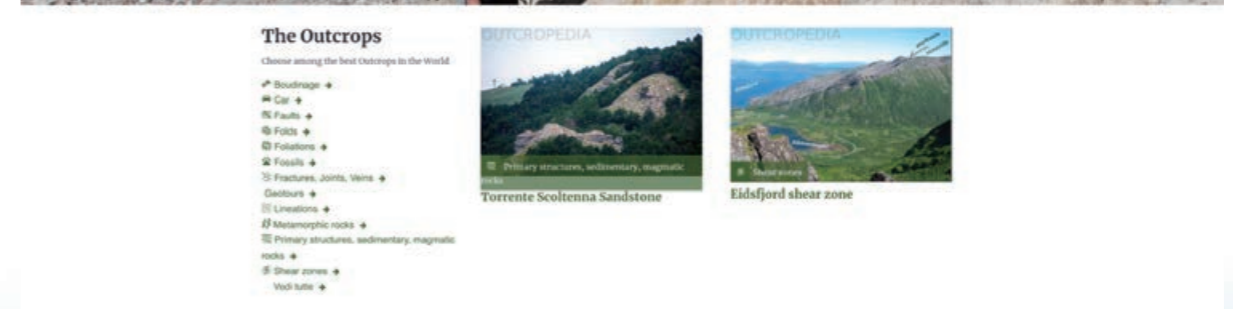
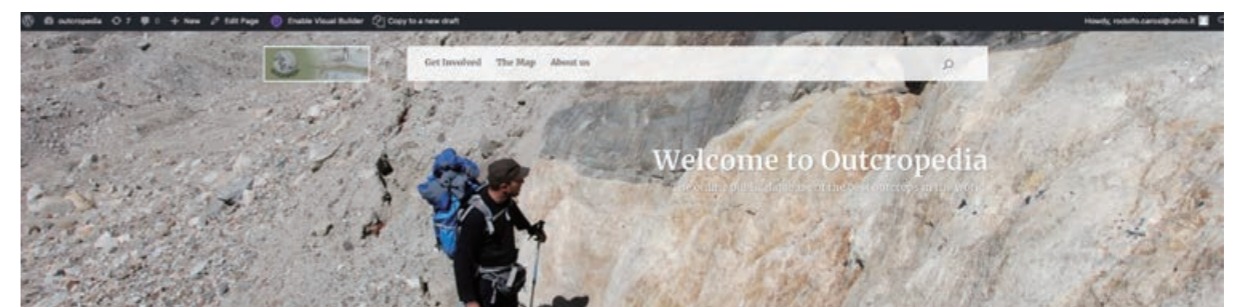
[ers-structural-geology-and-tectonics](http://www.dip.biogeo.unict.it/it/content/young-research-ers-structural-geology-and-tectonics)). It will be organized by the University of Catania.



4. Organization of the DRT conference series: TecTask supports and contributes to organize DRT conferences. The International Conference on Deformation Mechanisms, Rheology and Tectonics is run every two years since 1976. The 23rd edition was planned for 2021, but it was postponed to 2022. It will be held in Catania (Italy) in July 2022, and it is organised by the University of Catania and the DRT-Society (<https://drt-society.org/>), with the TecTask support and participation. We plan to award the

Henk Zwart medal at this event.

5. World Web Cast seminars on Structural Geology and Tectonics published at the TecTask YouTube channel. TecTask created a global monthly seminar on structural geology and tectonics in June 2018, long before the popularization of online seminars. The seminar is published the TecTask You Tube channel (with over 1,100 subscribers): (<https://www.youtube.com/channel/UCXFYiccBYX->



w85bneuMm4Xgg). There are currently 24 talks, with more than 35,000 views in total.

6. Outcropedia portal and new phone app: This is definitively our primary show piece, born in 2004. Outcropedia is tool to collect, publish and disseminate key outcrops. The site was refurbished in 2018 (<http://outcropedia.tectask.org/>) and currently hosts about 800 photos of world-class outcrops. Outcropedia also allows creating Geo-Tours. A new smartphone and tablet app that allows collecting and uploading georeferenced outcrop photos, descriptions and geotours directly from the field was launched in 2021. It is available both from Google Play and the Apple Store.

7. Transition of the TecTask commission towards an International Association for Structural Geology and Tectonics (IASGT):

The IUGS Executive Committee requested TecTask to form an International Association for Structural Geology and Tectonics (IASGT), and was asked to focus the 2020-2024 mandate to achieve this aim. Following this recommendation, the TecTask executive committee started this process in 2021, with a strategy in three steps:

Step 1 (2020-2021): we developed formal discussions within the TecTask executive committee, together with other scientists from the wider community, to design the key aspects

of the new association and to establish a route for the transition.

Step 2 (2022): a founding executive committee for the new IASGT has been appointed by TecTask in March 2022. The founding IASGT chair is Prof. Manish A. Mamtani (IIT Kharagpur), who formerly was TecTask officer (2012-2016) and vice-Chair (2016-2020). From April 2022 the IASGT EC will organize a series of meetings to establish the association. It has been decided that IASGT will be legally based in India, a big and diverse country with a long tradition of research and teaching in structural geology and tectonics, and a very young and motivated geoscience community. During the transitional period (2022-2024) IASGT will use the legal structure of the Geological Society of India Regional Center in Kharagpur.

Step 3 (2022-2024): all the TecTask activities will be transferred to IASGT as soon as the IUGS EC wishes. IASGT will prepare its own legal structure during this time (bylaws, bank account, etc.) and will recruit members. The activities that IASGT will run will include those currently promoted by TecTask plus a series of new initiatives, with the overarching aim of promoting structural geology & tectonics (especially in developing countries) and coordinating national and local groups.



INTERNATIONAL COMMISSION ON GEOHERITAGE(ICG)

The International Commission on Geoheritage was restructured by the IUGS EC in September 2020. The main mandate of this reformulation was to create a unified and well-structured organization as well as to define the global standards and guidelines for the recognition of Sites, Stone Heritage and Geo-Collections and to strengthen cooperation with other international organizations related to geological heritage.

The new officers have created a very favourable, intense and enthusiastic work atmosphere with highly valuable results during 2021. The commission has adopted unified statutes; has created a unified webpage and logo and has worked under a unified budget. After a very fruitful discussion a new sub-commission on

Geocollections has been established and all sub-commissions have reviewed and formalized their voting member list as well as the guidelines for the programs of recognitions of sites, stone heritage and Geo-collections. All this work was very well reflected in the meeting celebrated in Zumaia (Basque Coast UGGp) among all officers and IUGS secretary general. After three days of intense work all the documents were discussed and adopted, and above all, all officers had the chance to meet and enjoy the work of international cooperation.

International Commission on Geoheritage is playing a very important role on the assessment of the international value of the geological heritage of aspiring UGGp. In 2021 IGC



assessed 16 new candidatures and each of them was examined by 5 IUGS reviewers. This is an important contribution for the development of UNESCO Global Geoparks program and strengthens significantly the collaboration between IUGS and UNESCO. A good proof of this active collaboration is that the chair of the IUGS ICG is part of the UGGP Council and has been recently invited to be part of the Global Geoparks Network Executive Committee.

But the most exciting initiative has come through the IGCP 731 project. The IUGS ICG has reformulated and put into work the long-demanded idea of IUGS Global Geosites. More

than 100 scientist from more than 30 countries and representatives of many of the IUGS commissions and affiliated organizations have participated in a very active work flow of cooperation that has defined the main standards of the program. The First 100 IUGS Global Geosites will be announced in a big event of the IUGS 60th and IGCP 50th anniversary celebration that will be held in Basque Coast UGGP. Be attentive to this beautiful milestone for the recognition of referential site both for their scientific importance or for their important contribution to the development of geological sciences.

THE INTERNATIONAL GEOSCIENCE PROGRAMME AND IUGS, AN HALF A CENTURY PARTNERSHIP

The International Geoscience Programme (IGCP) serves as a knowledge hub of UNESCO to facilitate international scientific cooperation in the geosciences. Its mission includes promoting sustainable use of natural resources, advancing new initiatives related to geo-diversity; geo-heritage and geohazards risk mitigation. Created in 1972, IGCP has partnered with the International Union of Geo-

logical Sciences (IUGS) since its inception to bring together thousands of Earth scientists from around the world, allowing them to benefit from the cooperative spirit generated under the umbrella of UNESCO.

UNESCO Secretariat organized the 6th session of the IGCP Council meeting in March 2021 (online) with the participation of the IUGS President, Professor John Ludden.



IGCP Council members, IUGS and UNESCO Secretariat representatives during 6th IGCP Council closed session in March 2021

The Council decided to continue supporting 39 ongoing projects and approved 18 new entries, totalling 57 active IGCP projects in 2021. IGCP Council warmly welcomed seven new IGCP projects which will be delivered in collaboration between the IUGS and Global Geoparks Network (GGN) using UNESCO Global Geoparks territories as learning laboratories:

- IGCP 727- Geological heritage - sustainable

management of geological hazards and water resources in transboundary region of Kyrgyzstan

- IGCP 731- IUGS Geological Heritage sites
- IGCP 730- Hydrogeological Significance of Mediterranean Geoparks
- IGCP 715- A new karst modelling approach along different tectonic contacts

•IGCP 714- 3GEO – Geoclimbing & Geotrekking in Geoparks

•IGCP 736- SEDSNet - Science and Education for Sustainable Development Networks in UGGp

•IGCP 726- GEOfood for sustainable development in UNESCO Global Geoparks

Since 2016, IUGS experts have been supporting the evaluation of UNESCO Global Geoparks applications evaluation process and with the addition of 2021 Special Topic (Heritage for Sustainable development) to the IGCP, IUGS and UNESCO jointly support IGCP projects delivered within aspiring and existing Geoparks.

UNESCO IGCP Council members recorded their theme' s presentations about the status of IGCP projects and these recordings are available at UNESCO' s website. The Council also adopted a new special topic - Enhancing Societal Acceptance of the Sustainable Development of Earth' s Geological Resources - and launched a call for project proposals published by UNESCO Secretariat on the website and social media.

In 2021, 84 capacity building (51 Online/digital events and 16 field trips) IGCP events were organised outreaching more than 5000 scientists from 126 countries. Female (39% of participants, 46% of project leaders), early career (42%) and developing world (47%) participants continued to increase. In 2021, IGCP projects contributed to the UN2030 agenda, the Sendai Framework for Disaster Risk Reduction and international agreements such as COP26 by delivering IGCP' s vision defined by its council with a special focus on:

1. Efficient, safe, sustainable and renewable

natural resources exploration and extraction

Within this thematic the IGCP projects conducted not only cutting-edge science on issues such as mineral, water and geothermal resources, but also capacity-building activities aimed at researchers, students, civil society and local authorities which play a relevant role in enhancing societal acceptance of the exploitation of geo-resources for sustainable development. In 2021, ten projects organised 15 professional development courses such as: Geographic Information System (GIS) techniques to equip Southern African geoscientists with knowledge that allows them to produce a sustainability atlas; a work-integrated course on "development minerals" in Pacific, Africa and South America; water resources and mining in Abidjan, Côte d'Ivoire; water resources research within the territory of aspiring geoparks sites in Spain, Palestine, Jordan, Egypt, Morocco and Tunisia as well as on Palaeozoic carbonate build-ups in Loei-Phetchabun (Thailand) fold belt and regional correlation.

2. Improved understanding, prediction and mitigation of climate change and geohazards

During 2021, 8 projects organized a total of 25 webinars, mini-courses, research meetings, field workshops and even a science-art residency, some examples are: the origin and geochemistry of arsenic as well as its effects on human health; remediation technologies in the Altiplano-Puna plateau of South America and comparative case studies around the world; the "World Map of Orogens"; the Transformations of the Eastern Rift Valley Lakes in Nairobi; the West Makran Paleo-tsunami Investigation in Iran, Oman, India; field courses about Geoheritage for Geohazard Resilience in Nicaragua, Peru, Italy which were followed by eight

international webinars followed by thousands of participants on Volcanic Gas Studies: Methods, Best Practices, and Interactions in the Northern Andes, organised in Ecuador.

3. Geodiversity, Geoheritage for sustainable developments and Geoparks

As a way of raising awareness of the many benefits geodiversity provides for people, society and the environment, and following a request from the International Union of Geological Sciences and 108 other scientific organisations, the UNESCO General Conference approved the adoption of the International Geodiversity Day. The commemoration, to be held every year on the 6th of October, was approved on 22 November 2021 by 193 member states attending UNESCO' s biennial General Conference in Paris. In 2021, IGCP projects contributed to the strengthening and empower-

ing of local communities and ensured that the geological importance of an area can be preserved and promoted for science, education and culture. With that in mind several field trips, meetings and fruitful discussions were organised amongst project leaders and researchers, some examples are: initiation of international collaboration to study natural resources and geoheritage connections for the establishment of a transboundary geopark in the southwest of Tien-Shan - an area with an outstanding geological heritage covering part of the territory of Kyrgyzstan and Tajikistan; Geofood and its connection with geodiversity and contribution to the SDGs in UNESCO Global Geoparks; Definition and Main Standards of an IUGS Geological Heritage Site regarding the selection of "The First 100 IUGS Global Geosites".



IGCP 727 Project fieldwork in Kirgizstan in June 2021

4. Geology for Sustainable Development

Led by UNESCO Chair Prof. Iain Stewart, IGCP 685 project created the Earth Futures Festival to showcase the role of geoscience in our sustainable future. Submissions are open to all until 15th of May. Join the Festival!

The project also conducted a series of talks with geoscience "thought leaders", focused on questions such as:

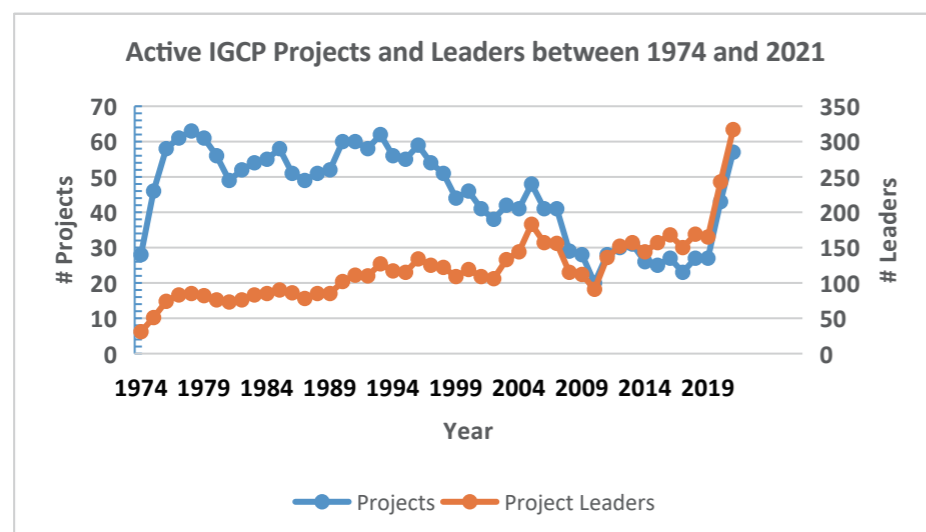
- What role will geoscience have to play in delivering society's goals in the next 30 years?
- How does geoscience need to change to meet the challenges of the future?
- How can we increase the profile and attractiveness of geoscience

The result is a series of fascinating and surprising talks are available here.

In order to better inform and engage the

researchers involved in the 57 active IGCP projects, UNESCO and IUGS initiated in 2021 the dissemination of a biannual newsletter showing how the oldest geoscience cooperation programme in the world, the IGCP, has been delivering a multitude of actions that contribute for the advancement of science, science literacy and sustainable development despite the difficulties imposed by the COVID-19 pandemic.

In 2021 IGCP projects received financial support from UNESCO, IUGS, Jeju Province Development Corporation (JPDC), and the National Commission of the People's Republic of China for UNESCO, due to increasing interest to the programme and high number of new project proposals and new projects joining the programme, UNESCO Secretariat and IUGS are looking for new opportunities for fund raising to better support these projects.



IGCP 727 Project fieldwork in Kirgizstan in June 2021



Hans Thybo, President

INTERNATIONAL LITHOSPHERE PROGRAM (ILP)



The lithosphere forms the connection between deep Earth and the surface. This basic observation was the background for International Union of Scientific Unions (ICSU - today ISC) to form ILP in 1980 charged to:

- promote interdisciplinary research on the lithosphere
- at the interface between IUGS and IUGG
- through multidisciplinary research projects

ILP's activities build on the understanding that major breakthroughs in the study of the Lithosphere require integration of imaging and monitoring, reconstruction and process modelling. ILP seeks to achieve a fine balance between "addressing societal needs", e.g. understanding natural catastrophes and other solid earth processes that affect the biosphere, providing information for improved resource exploration and environmental protection; and "satisfying scientific curiosity" to promote high-level fundamental research.

Background for the initiation of ILP was the recent acceptance of plate tectonics and experience from the successful International Geophysical Year 1957-59, International Upper Mantle project 1964-70 and International Geodynamic Project 1972-79 which, together, demonstrated the need for a sustainable interdisciplinary geoscience programme. ILP is financed through national contributions from member countries and annual contributions from IUGS and IUGG,

and Nanjing University complimentary runs the secretariat.

ILP is a bottom-up organisation that takes initiatives to bring together individuals and organisations in Task Forces and Regional Committees, selected solely on the basis of scientific quality and societal needs. Key features are their dynamic nature and focus on bringing in new talent. Task forces exist for a period of five years, which may be extended for one term after successful review. The task forces are organised within four thematic subjects:

- Geoscience of Global Change
- Contemporary Dynamics and Deep Processes
- Continental Lithosphere
- Oceanic Lithosphere

Several major successful international research programmes have grown from ILP projects, and many continue as high level organisations outside ILP, including International Continental Drilling Program (ICDP), Global Seismic Hazard Map, World Stress Map, Global Geoscience Transects and regional committees, such as EGT, EUROPROBE, TOPOEUROPE, TOPOASIA.

The activities in 2021 were, unfortunately, strongly affected by the ongoing pandemic, but the projects stayed active and held a series of, primarily, virtual meetings. ILP was represented through several symposia and workshops held

by its task forces and regional committees at the annual meetings of EGU and AGU, which also included a 40-years anniversary symposium. ILP co-sponsored and was strongly represented at the DEEP21 meeting organised virtually in Beijing by the new SinoProbe programme. Several ILP projects organised symposia, the ILP President gave a key-note lecture, and a key-note symposium was organised for the new Coordinating Committee CC4: Global Geosciences Transects.

The virtual business meeting was held on 17 May 2021 with presentation of the Evgenii Burov medal to Prof. Thorsten Becker for “his ground-breaking contributions to studies of Geodynamics, his noteworthy scientific leadership, and his selfless service to the Earth science community”. The medallist gave a presentation with overview of his scientific achievements. The meeting included short presentations on the achievements of the TFs/CCs that ended by the start of the year, and short presentations of the new TFs/CCs, introduction to IUGS and IUGG, and discussion of ILP’s strategic plan.

One new task force was approved: 2021-TF8 - Lithospheric Heat Flow – Global Data Assessment Project. This project will coordinate quality assessment of the global heat flow database; it is also supported by International Heat Flow Commission (IHFC).

Ten new projects began in January 2021 and ILP presently has a record number of 13 active projects:

- 2019-TF1: Lithosphere Structure and Mineral

Resources, Lithospheric Stress

- 2021-TF2: Deformation and Magmatic Processes from the Lithosphere to the Surface: Integrated Multidisciplinary Approaches
- 2021-TF3: Global Lithospheric Stress - The World Stress Map in 3D
- 2021-TF4: Continental Lithosphere: a Broad-scale Investigation (CoLiBrI)
- 2021-TF5: LithoMar - Assessing the Relationships Between Lithospheric Processes and Seafloor Topography at Oceanic Hotspots and Divergent Margins
- 2021-TF6: Sedimentary Basins
- 2021-TF7: Bio-Geodynamics of the Lithosphere
- 2021-TF8: Lithospheric Heat Flow – Global Data Assessment Project
- 2021-CC1 TOPO-EUROPE
- 2019-CC2 Lithospheric Seismicity and Tectonics in the Himalaya
- 2021-CC3 Anatolian Tectonics (ANATEC)
- 2021-CC4 Global Geo Transects (GGT)
- 2021-CC5 Lithosphere of East Antarctica

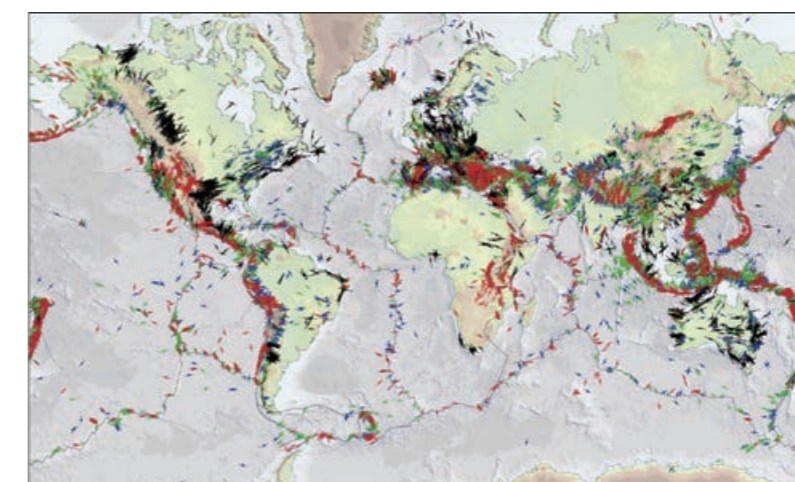
This broad coverage of lithosphere research includes researchers from all continents, and we are pleased that the group of PIs include an increasing number of early career scientists.

Hans Thybo, President, Mian Liu, Secretary General and Qin Wang, Executive Secretary February 2021, web-site: <https://ilp.nju.edu.cn>

The Evgenii Burov Medal for 2021 was awarded to professor Thorsten Becker for “his ground-breaking contributions to studies of Geodynamics, his noteworthy scientific leadership, and his selfless service to the Earth science community”.



Task force 2021-TF3: Global Lithospheric Stress - The World Stress Map in 3D. Current global density of stress measurements in the lithosphere, and key questions to be addressed by this new task force.



Key Questions

- What drives stress tensor rotations at regional to local scale?
- How far is the stress from criticality in stable continental regions?
- What is the relative importance of plate boundary forces?

Task Force Objectives

- Systematic compilation of a public stress magnitude database.
- Develop a quality ranking scheme for stress magnitude data.
- Cluster analysis of focal mechanisms for stress regime assignment.



INITIATIVE ON FORENSIC GEOLOGY (IFG)

In 2021, IUGS-IFG celebrated its 10th anniversary. This initiative was established by Dr Laurance Donnelly at the 62nd IUGS Executive Committee meeting, at UNESCO headquarters, in Paris, France, on 22 February 2011. This followed his successful establishment of two preceding groups; the IUGS Working Group on Forensic Geology (2009-2011) and the Geological Society of London, Forensic Geoscience Group, (2006-ongoing). Over the past decade and more IUGS has provided financial support and the foundation for the global advancement and diversification of forensic geology. This has benefited not only the geology profession, but also the police and law enforcement agencies around the world and society. Principally, by the applications of geology to crime scene examinations, the provision of geological evidence (samples) and searches to locate burials associated with homicide, serious and organised crime, and counter terrorism. Coinciding with this milestone year, IUGS-IFG published two books with the Geological Society of London (GSL). Firstly, 'A Guide to Forensic Geology' provides the first practical guidance for professional forensic geologists. This is based on operational case work experiences gained over the last 25 years and over 300 serious crime investigations. Secondly, the GSL Special Publication, 'Forensic Soil Science Geology and Geology', provides information to assist forensic geologists the police and law enforcement, and is also based

on international operational case work and best practice. Also published was a GSL publication on 'Geoethics', including a paper from IUGS-IFG. Furthermore, IUGS-IFG agreed to edit a special issue of, 'Forensic Sciences', on 'Forensic Geoscience and Death Investigations'. IUGS-IFG was invited to review a draft paper on X-ray diffraction and soil colour, by the OSAC-Geological Materials Group (USA), under ballot by the ASTM-International E30 Committee (Committee on Forensic Sciences).

Although the ongoing global pandemic, COVID-19, restricted international travel IUGS-IFG adapted well and developed new ways of working, using virtual meeting platforms for training, workshops and conferences. This included; (a) 3rd British-Finnish Natural Resources Initiative, hosted by the Geological Survey of Finland (GTK), British Geological Survey and the British Embassy, in Helsinki, Finland (b) Preliminary development of forensic geology in Rwanda, Uganda, DRC and other central Africa countries, (c) 1st Undergraduate Geoforensic Research Workshop in South America, (d) Workshop with Forensic Investigators in Rio de Janeiro, Brazil, (e) 1st Brazilian Geoforensic Virtual Workshop, (f) InterForensics 2021, (g) 26th International Conference on Battery Recycling, Geneva, Switzerland, (h) Conflict Minerals in the DRC and (i) London Bullion Market Association conference. Preliminary planning took place for forensic geology

events in 2022 including; (a) IUGS-IFG 'Special Project' meetings in Brazil and with the GSL, Forensic Geoscience Group, London, UK (b) Annual Meeting of the Geological Association of Canada (GAC) and Mineralogical Association of Canada (MAC), Halifax, Canada, (c) 22nd World Congress of Soil Science, Glasgow, Scotland and (d) Japan Geoscience Union, Chiba, Japan.

Regarding the IUGS-IFG Special Project, 'Forensic Geological Analysis of Crimes in International Mining, Minerals and Metals', the scope and chapter headings for a special publication of 'Episodes' were finalised and advanced. This project expanded to include social and environmental impacts. Workshops in South America (Brazil, Colombia) and Africa (South Africa, Rwanda, Uganda, DRC) did not take place due to 'the pandemic', but were postponed to 2022 and 2023. There was collaboration with the Brazilian Federal Police, other law enforcement authorities in South America, USA, Europe and Australia (confidential). This included the tracking and provenance determination of precious minerals and metals (doré, gold, silver, platinum, palladium), conflict minerals (tin, tungsten, tantalum), battery minerals, (lithium, cobalt), diamonds and gemstones, and fossils.

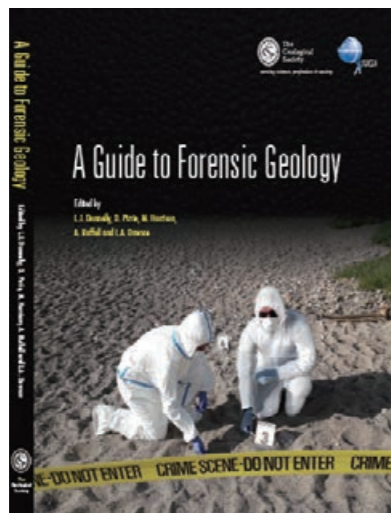
The IUGS-IFG 'Student Chapter' was established in Brazil during the global lockdown in 2020 and expanded in 2021. This has created an academic network for the development of forensic geology amongst student, initially in South America and to promote the next generation of forensic geologists. This includes 12 universities in Brazil, 1 in Chile and 1 in Argentina with approximately 155 members, 14 experts and 11 teachers. This sub-group plans to extend in Europe, India and Australia.

Operationally, IUGS-IFG were invited to support actual crime investigations and UK members remained affiliated to the National Crime Agency 'Expert Advisers Database' as forensic geologists. Following on from the IUGS-IFG supported FBI training video on forensic soil collection, the, 'Geoforensic Search Strategy (GSS)' (Donnelly and Harrison 2021)', was adopted by the FBI, under a five year licence from IUGS and the Geological Society of London, based on the publication of 'A Guide to Forensic Geology'. IUGS-IFG launched a new web site and expanded the committee to appoint an, 'Officer for Women in Forensic Geology'. A second officer was also appointed to assist in promoting forensic geology in Japan. The 'Geoforensic Interna-



Those countries represented in GIN include: Australia, Argentina, Bangladesh, Belize, Belgium, Belarus, Bolivia, Brazil, Canada, China, Chile, Colombia, Democratic Republic of Congo (DRC), Denmark, Ecuador, Egypt, England, France, Finland, Georgia, Germany, Greece, Hungary, India, Iran, Iraq, Ireland, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Malaysia, Malta, Mexico, Mongolia, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nigeria, Northern Ireland, Pakistan, Poland, Portugal, Republic of Ireland, Russia, South Africa, Spain, Switzerland, United States of America, United Arab Emirates, Wales and the West Indies (Caribbean), Zambia, Zimbabwe.

IUGS-IFG GIN Membership in 2021 (source: Dr Laurance Donnelly, IUGS-IFG Chair). <https://geoforenses.com/ifg-brasil/>



The book, 'A Guide to Forensic Geology,' published in September 2021.
<https://www.geolsoc.org.uk/MPGFG>



The book, 'Forensic Soil Science and Geology,' published in October 2021.
<https://sp.lyellcollection.org/content/492/1/NP>



DDE ANNUAL REPORT – 2021 SUMMARY

Following endorsement by IUGS' Executive Committee in late 2018, Deep-time Digital Earth (DDE), the first-ever big-science initiative launched by IUGS, "kicked-off" during a meeting held in February 2019, at the Fragrance Hill Hotel, Beijing Paris, attended by more than 80 experts representing well over 40 geological organizations. DDE and the global geological science community were actively engaged, throughout 2019, in preparing a for the global launch of DDE at the 36th IUGS/IGC, which was due to be convened in March 2020, New Delhi, India.

In early 2020, the world entered a historically unprecedented period of hibernation to avoid the impacts of a global pandemic. IUGS/IGC 36 was

cancelled. No international travel or face-to-face meetings of the Governing Council (GC), Executive Committee (EC), the Scientific Committee (SC), the Steering Committee (Stc), Working and Task Groups (WTGs) or the globally distributed Secretariat staff was feasible. Yet, DDE developed and progressed; details could accessed in the DDE report for 2019-2020 at: www.ddeworld.org/.... for details.

2021 turned out to be a better year; although majority of communications and meetings continued to be conducted on-line. Some national events, such as the gatherings of the Geological Society of America (GSA) and the American Geological Union (AGU) in the last quarter of 2021 permitted face-to-face interactions, albeit

tional Network (GIN)' increased in global membership.

The work of IFG has increased the diversity and visibility of IUGS reaching out to, and collaborating with, new stakeholders and audiences for example; school children, university students (BSc, MSc and PhD), industry (minerals, mining,

metals and geotechnical), police, law enforcement agencies, legal profession, politicians, governments, media and journalists, military, low income and developing countries, and hard to reach communities. This would not have been possible without the sustained commitment, vision and support of IUGS over the past decade.



In 2021, IUGS-IFG celebrated its 10th Anniversary, which was established by Dr Laurance Donnelly at the 62nd Executive Committee meeting of the IUGS, at UNESCO headquarters, in Paris, France, on 22 February 2011. This followed on from his establishment of the IUGS Working Group on Forensic Geology (2009-2011) and the Geological Society of London, Forensic Geoscience Group, (2006-ongoing). These three Groups and have significantly advanced forensic geology around the world in research and operationally.



Fig. 1. Prof. Ogg represented DDE in GSA & AGU conference



Fig. 2. A short report of DDE geoscience standards training

at a level much below what was possible during pre-pandemic times. Nevertheless the impacts of direct networking and informal discussions among experts was clearly demonstrated; a group of DDE-linked experts and scientists have initiated a process to launch DDE-USA which we hope will gather momentum and come to fruition in 2022.

DDE EC met 4 times, the GC twice and SC once during 2021; StC met regularly between EC session to ensure that decisions and recommendations were implemented in a timely manner. Secretariat staff from across Suzhou, China, Paris, France, Oklahoma, USA and Nottingham, UK communicated regularly to keep DDE development on the move. All these meetings and communications were on-line. But the results and outcome were notable:

- 3 projects, all of them including design and development of databases, were financed with grants of US\$ 40,000-50,000 per year over a period of 2-3 years; a DDE project to develop a DDE China node was fully funded by the

Chinese Geological Survey (CGS). All of them are under implementation and progress reports are included in the annual report.

- 10 WTGs received US\$ 5000 each to implement their DDE related activities in 2021. Brief reports from 5 of the 10 WTGs on activities undertaken and their outcome are included in the annual report.

- Construction of DDE cyber-infrastructure showed considerable progress: The Deep-time Platform, with a Deep-time Engine Workspace and Deep-time Engine Earth Explorer, has been established; DDE Knowledge Editor was created to assist scientists to connect data platforms and sources; the preparation of the first DDE Scholar report based on bibliometric and altmetric surveys and expert inputs has been initiated; and a document on the establishment of the DDE Data Alliance has been drafted and is being improved.

- The infrastructure for the first Research Center of Excellence (RCE), in Suzhou, China, was completed and processes for recruitment of an

Executive Director and post-doctoral candidates are underway. The establishment of the second DDE/RCE, in Kazan, Russia showed encouraging progress;

- The number of DDE Founding Members grew from 18 at the end of 2020 to 22 by the end of 2021.

- The constitution of DDE Advisory body with the representation of IUGS, IUGG and UNESCO and two internationally reputed individual specialists is nearing finalization.

The DDE community is awaiting, with much hope, the organization of the DDE Forum, its first face-to-face event after 3 years, and jointly sponsored by IUGS, UNESCO and DDE, on 8 June 2022 at UNESCO Headquarters in Paris, France. The Forum will focus on IUGS' 60th anniversary, DDE achievements and outputs and the discussions on a DDE pilot project for the implementation of the UNESCO Open Science Recommendation adopted by the UNESCO General Conference in November 2021. Organization of a data-driven discovery

scientific symposium, immediately after the Forum, from 9 to 11 June in Orleans, France, is also under discussion.

DDE plans to be represented in several international, regional and national events during 2022. Face-to-face events will be given priority for DDE representation in 2022.

DDE already has the commitment of the Kunshan City Government for continuing support to the Secretariat and the establishment of a Seed Grant Facility in 2022 for supporting an additional round of projects, similar to that supported in 2021. The catalytic support to WTGs of US\$ 5000/year will continue with those WTGs showing excellent results from their 2021 activities receiving higher amounts up to US \$ 10,000 in 2022.

A DDE initiative on geothermal energy mapping, led by the DDE petroleum geology (re-named as Energy) working group, is showing encouraging potential for delivering important outputs that could coincide with the end of the UN Decade on Sustainable Energy for All at the end of 2023. In

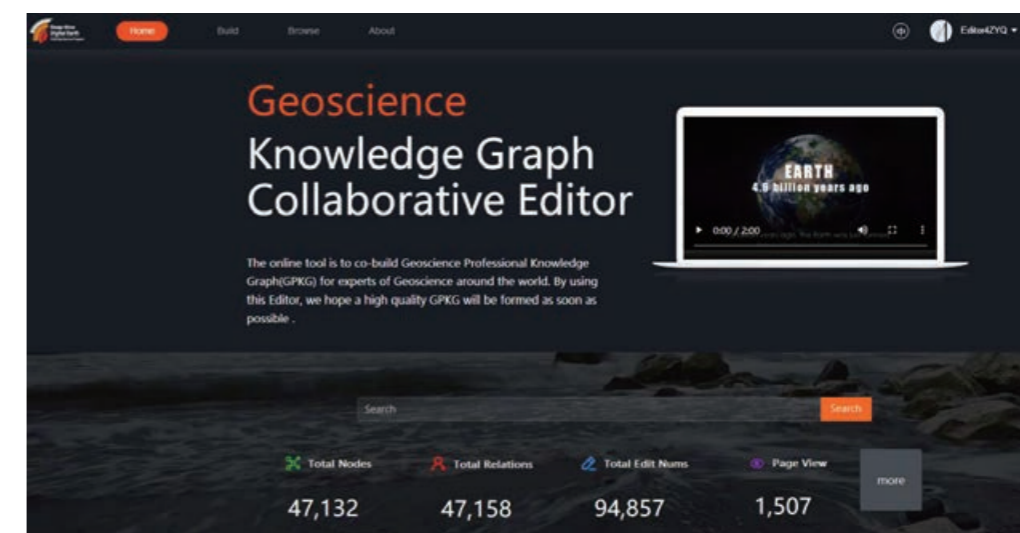


Fig. 3. The construction of geoscience knowledge editor system

2022, collaboration between DDE and the Geodata Science Journal will produce two special issues covering themes such as: new datasets/databases; new tools for data processing and analyses; recent progress in data mining and knowledge discovery; and AI aided data-driven discoveries and transdisciplinary

research.

The year 2022, where a return to pre-covid international travel and direct, face-to-face scientific contacts and communications is widely anticipated, could be a turning point for the level of DDE performance in fulfilling its vision and mission.

ACKNOWLEDGEMENT

The invaluable contributions of the following persons are acknowledged with deep appreciation and gratitude:

Prof. Dr. Stanley FINNEY, the IUGS Secretary-General, for his great efforts in and contributions to compiling the IUGS 2021 Report.

Sincere gratitude is also given to those who have contributed to the 2021 IUGS Annual Report

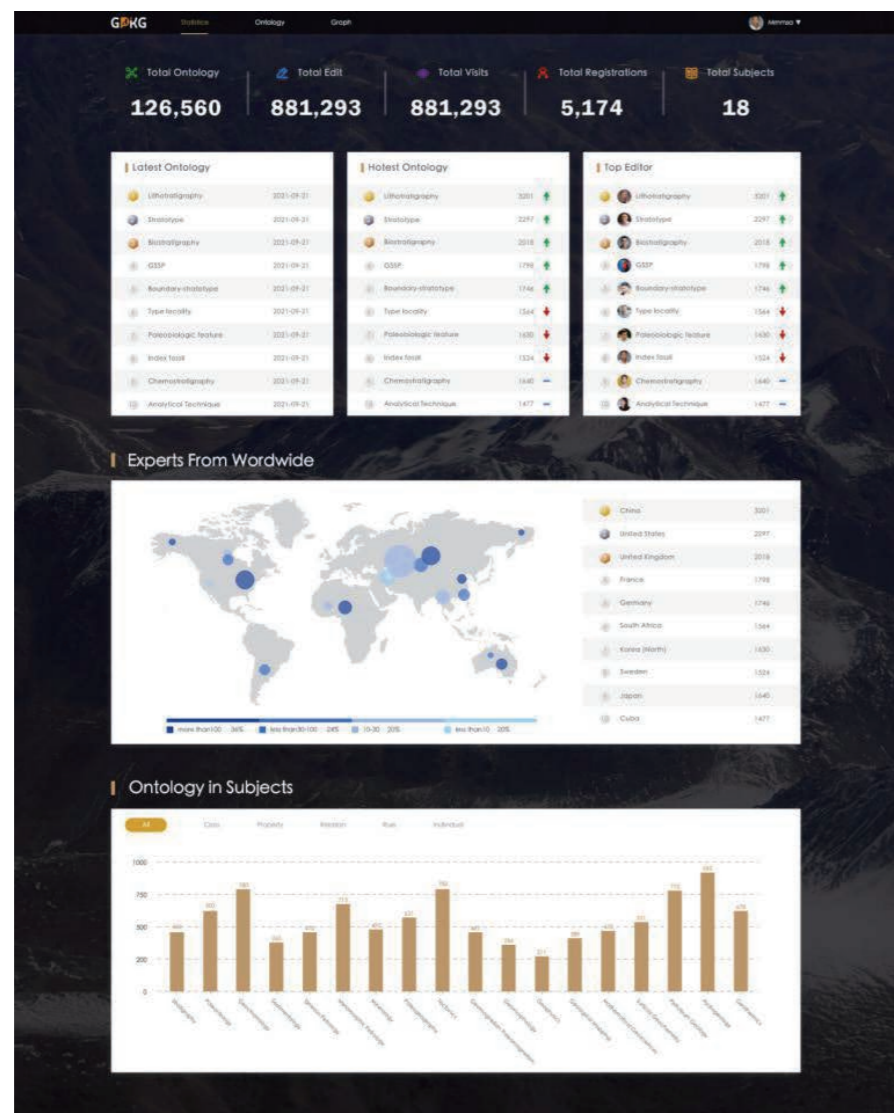


Fig.4. Real-time statistics chart of home page data