

**2023
ANNUAL REPORT**

of the

**INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
COMMISSION
ON
GLOBAL GEOCHEMICAL BASELINES**

January 2024

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2023 ANNUAL REPORT of the IUGS COMMISSION ON GLOBAL GEOCHEMICAL BASELINES

URL: <http://www.globalgeochemicalbaselines.eu/>

1. TITLE OF CONSTITUENT BODY

IUGS Commission on Global Geochemical Baselines (CGGB or Commission), and for the sake of brevity will henceforth be referred to as either CGGB or Commission.

2. OVERALL OBJECTIVES

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 Terrestrial Network (GTN) similar to a geodetic network for levelling 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 global geochemical database is urgently needed by environmental and natural resource managers throughout the world. To reach this goal, the Commission established an international network of applied geochemists throughout the world to provide standards for global-scale geochemical mapping. The Commission also promotes and facilitates the implementation of harmonised sample collection, preparation, quality control, and analysis protocols for geochemical mapping programmes at any mapping scale.

Commission activities include:

- ✓ Developing partnerships with countries conducting broad-scale geochemical mapping studies.
- ✓ Providing consultation and training in the form of workshops and short courses to build the capacity for conducting geochemical mapping programmes in countries around the world.
- ✓ Organising periodic international symposia and conferences to foster communication among the geochemical mapping community.
- ✓ Developing standards for global-scale sampling in different morpho-climatic terrains.
- ✓ Developing criteria for certifying those projects that are acceptable for inclusion in a global geochemical database.
- ✓ Acting as a repository for data collected by projects which meet the standards of harmonisation.
- ✓ Preparing complete metadata for the various certified projects, and
- ✓ Preparing a global geochemical database and atlas.

3. RELATED GOALS TO OVERALL IUGS SCIENTIFIC OBJECTIVES

Current IUGS scientific policy objectives relate to global Earth Science issues, such as identification of mineral resources, global climate change, geological hazards, environmental geology and sustainable development. The work of the Commission relates directly to all of these objectives through the establishment of a land-surface global geochemical reference network, providing multi-sample media and multi-element baseline data for a wide variety of environmental and natural resource applications (Darnley *et al.*, 1995). The project is also consistent with:

- The strategic plan published by the IUGS Strategic Planning Committee (2000).
- The International Year of Planet Earth (2007-2009) of 'Earth Sciences for Society' (www.yearofplanetearth.org/).
- The objectives of the IUGS Resourcing Future Generations initiative (<https://www.iugs.org/rfg>), and
- Work of the UNESCO International Centre on Global-Scale Geochemistry (<http://www.globalgeochemistry.com/>).

4. STRUCTURE AND ORGANISATION

The Commission is led by a Steering Committee, which coordinates the activities of four Technical Committees as well as the contributions made by regional representatives. This organisation structure is continuously under review and when deemed necessary is revised, as additional countries with active geochemical mapping programmes or an interest in establishing such programmes become members.

4.1. STEERING COMMITTEE

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

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 (retired)
Patrice de Caritat, Geoscience Australia
Alecos Demetriades, Institute of Geology and Mineral Exploration, Hellas

The Commission's new Steering Committee members for the 2024-2028 period are:

Chair: Alecos Demetriades, former Director of the Division of Geochemistry and Environment, Institute of Geology and Mineral Exploration, Hellas
Deputy-chair: Maria João Batista, Laboratório Nacional de Energia e Geologia, Portugal
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
Assistant Treasurer: Zacharenia Kypridou, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

Councillors: Juan Pablo Lacassie Reyes, *Geological and Mining Survey of Chile*
Rose Turnbull, *GNS Science, New Zealand*
Umar Bature, *Nigerian Geological Survey*
Ibrahim Othman, *Saudi Geological Survey*

Advisory Panel: Anna Ladenberger, *Geological Survey of Sweden*
Kate V. Knights, *Consultant Geochemist, Dublin, Ireland*
Gloria Namwi Simubali, *Geological Survey of Namibia*
Gloria Prieto, *Servicio Geológico Colombiano (retired)*
David B. Smith, *United States Geological Survey (retired)*

4.2. SAMPLING COMMITTEE

Chair: Alecos Demetriades, *Hellas*

Supervises the development and coordination of sampling protocols in the various climatic and geomorphological provinces throughout the world.

4.3. ANALYTICAL COMMITTEE

Chair: Gwendy Hall, *Canada*

Coordinates the work plan for the analysis of Global Terrestrial Network (GTN) samples, the activities of the laboratories, and the supervision of analytical quality control data.

4.4. DATA MANAGEMENT COMMITTEE

Chair: Timo Tarvainen, *Finland*

Supervises the sampling strategy and progress of the participating countries, and manages the database of sample information and analytical results.

4.5. PUBLIC RELATIONS AND FINANCE COMMITTEE

Chair: Ariadne Argyraki, *Hellenic Republic*

Advertises and promotes the aims, objectives, and achievements of the project worldwide, including by use of the internet, and takes responsibility for trying to secure funding for the project.

4.6. REGIONAL REPRESENTATIVES

4.6.1. Africa

Theophilus C. Davies, Department of Geology, Mangosuthu University of Technology, Durban, KwaZulu-Natal, South Africa

Marthinus Cloete, Council for Geoscience, Pretoria, South Africa

J.H. Elsenbroek, Council for Geoscience, Pretoria, South Africa

Keith Sheppard, World Agroforestry Centre (ICRAF), Nairobi, Kenya

Alhaji Lamin Turay, Geological Survey Department, Ministry of Mineral Resources, Sierra Leone

4.6.2. America - North

David Smith, United States Geological Survey, Denver, USA

Robert G. Garrett, Ottawa, Ontario, Canada

Flor de Maria Harp Iturribarria, SGM, Pachuca de Soto, Hidalgo, Mexico

Enrique Espinosa, SGM, Pachuca de Soto, Hidalgo, Mexico

Jessica Rivera Perez, SGM, Pachuca de Soto, Hidalgo, Mexico

4.6.3. America - South

Carlos Alberto Lins, CPRM - Geological Survey of Brazil, Recife - PE, Brazil
João H. Larizzatti, CPRM – Geological Survey of Brazil, Rio de Janeiro, Brazil
Juan Pablo Lacassie Reyes, Servicio Nacional de Geología y Minería, Valdivia, Chile
Gloria Prieto, Servicio Geológico Colombiano, Bogotá, Colombia (retired)

4.6.4. Australasia

Philip Main, Geoscience Australia, Canberra, Australia
Adam Martin, GNS Science, Avalon, Lower Hutt, New Zealand
Rose Turnbull, GNS Science, Dunedin, New Zealand

4.6.5. China

Xueqiu Wang, Institute of Geophysical and Geochemical Exploration, Langfang, China

4.6.6. Europe

Philippe Négrel, Bureau de Recherches Géologiques et Minières, Orléans, France
Anna Ladenberger, Geological Survey of Sweden, Uppsala, Sweden
Jasper Griffioen, Geological Survey of The Netherlands (TNO), Utrecht, The Netherlands

4.6.7. Indian Subcontinent

Pradip Govil, National Geophysical Research Institute, Hyderabad, India
Ashvin Wickramasooriya, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka

5. INTERACTION WITH OTHER INTERNATIONAL ORGANISATIONS

5.1. UNESCO INTERNATIONAL CENTRE ON GLOBAL-SCALE GEOCHEMISTRY

In May 2016, the [UNESCO International Centre on Global-Scale Geochemistry](#) (ICGG) opened in Langfang, China. The Commission was an active participant in preparing the successful proposal originally submitted to UNESCO in 2009.

One of the most important tasks for the Commission was to establish formal collaboration with the UNESCO Centre. Although there is considerable overlap in the objectives of the Commission and the Centre, the IUGS mandate is quite clear, namely that the Commission takes the lead in establishing the standards for global-scale geochemical mapping, in collaboration with the Centre; whereas, the Centre takes the lead in implementing those standards, in collaboration with the Commission. This relationship is specified in the approved Statutes of the Centre (16 October 2018), *i.e.*,

Article 7: The functions of the Centre shall be to:

- 7.1. *Apply the standardised global-scale geochemical methods developed by the IUGS Commission on Global Geochemical Baselines, so as to document the concentration and spatial distribution of chemical elements in the various environmental compartments of the Earth's surface, and to establish global geochemical baselines for monitoring future geochemical changes;*
- 7.2. *Foster the implementation of global geochemical baseline programmes by securing funds, managing and coordinating these activities according to the scientific guidelines, determined by an External Advisory Committee cooperating with the IUGS Commission on Global Geochemical Baselines.*

The UNESCO agreement with China Geological Survey for the operation of the International Centre on Global-Scale Geochemistry (ICGG) under its auspices ended on the 30th of June 2023, and the procedure for its renewal was initiated with the evaluation of the ICGG (for more details refer to the Commission's [2022 Annual report](#)).

Since 2016, the ICGG management has never consulted or used the expertise of the International Councillors. It never:

- Informed them about planned workshops.
- Asked them to approve the material taught at the workshops.
- Asked them to approve the developed software used in the workshops.
- Informed them about the work performed in other countries.
- Submitted to them the global geochemical sampling plans used in different countries.
- Submitted to them the field photographs of the floodplain sediment sampling protocol, agreed at the October 2018 biennial meeting, to show that it is applied correctly.
- Informed them about the sample preparation and analytical procedures used.
- Informed them about the quality control procedures used, and
- *etc., etc., etc.* (see relevant sections in the Commission's Annual Reports from 2017 to 2022)

In reality, it has operated as an international centre of China Geological Survey as its objective, according to Professor Xueqiu Wang (ICGG Executive Director), is to “*enhance the international influence of China geochemical technologies*” (refer to Commission's [2022 Annual Report](#), p.99). This statement clearly explains the reason for never consulting the International Councillors, who are all Commission members. Consequently, if UNESCO renews the agreement for the operation of the ICGG under its auspices for a second six-year term, and the ICGG management continues not to consult the International Councillors, the Commission will be forced to consider withdrawing its support for the ICGG.

During the preparation of the Commission's annual report, the ICGG was contacted several times to request input regarding activities during 2023. Unfortunately, ICGG never replied to these requests.

5.2. INTERFACE WITH OTHER INTERNATIONAL ORGANISATIONS

The Global Geochemical Baselines (GGB) project is closely associated with the work of the EuroGeoSurveys (EGS) [Geochemistry Expert Group](#) (GEG; previously the Forum of European Geological Surveys, FOREGS Geochemistry Expert Group). The GGB project also has links with the International Atomic Energy Agency ([IAEA](#)) and potential links with the Global Terrestrial Observing System ([GTOS](#)). The EGS Geochemistry Expert Group has also established closer links with the European Soil Bureau Network ([ESBN](#)) over the past few years, and was actively involved in the European Union's (EU) [Soil Thematic Strategy](#) group for the preparation of the EU's Soil Protection Strategy Documents, and the final draft of the pending Soil Protection Directive.

The EGS Secretary-General has established links to other European Commission projects, such as the Global Monitoring of Environment and Security ([GMES](#)) programme, and Infrastructure for Spatial Information in Europe ([INSPIRE](#)), since the Geochemical Atlas of Europe has been produced in a harmonised manner according to IGCP 259 specifications ([Darnley et al., 1995](#)) and, therefore, compliant with INSPIRE guidelines.

In 2013, EGS became a member of the United Nations Food and Agricultural Organization's (FAO) [Global Soil Partnership](#), since the Geological Surveys of Europe are actively involved in soil geochemical mapping at the continental, regional and local scales.

In 2014, a Memorandum of Understanding (MoU) was signed by EGS and the European Commission Joint Research Centre at Ispra (northern Italy), and representatives of the two institutions met at the end of January 2014 and finalised the cooperation. The cooperation agreement, because of the two continental-scale projects, [FOREGS](#) and [GEMAS](#), included collaboration in continental-scale soil geochemistry in Europe.

In 2022, members of the EGS-GEG and IUGS-CGGB joined technical working groups at [EUSO](#) (European Soil Observatory), and participated in the [Second EUSO Stakeholders Forum between the 24th and 26th October 2022](#) (further information is included in the European report in [Appendix 3](#)). They also participated at the [3rd EU Soil Observatory Stakeholder Forum](#) from the 15th to 17th and 21st to 23rd of November 2023, and on the 17th of November 2023 delivered a presentation with the title “*The FOREGS and GEMAS continental-scale geochemical SOIL mapping projects in Europe*”, which can be downloaded from the following pCloud hyperlink: <https://u.pcloud.link/publink/show?code=kZJEgmXZG4fGHaOq9Ah5hGPMz1EezyEpOEPV>. It was agreed that a closer collaboration between the Joint Research Centre’s EUSO Working Group and EGS-GEG is required, and shall be discussed during 2024.

In 2014, the Commission established links with the Young Earth Scientists Network during the 1st International Geosciences Congress organised by the Geological Survey of Iran in Tehran (February 2014). This collaboration resulted in the organisation of four two-day workshops on ‘*Global Geochemical Baselines*’ during (i) the 3rd YES Congress in Dar es Salaam, Tanzania (12-13 August 2014) with 59 attendees (see [2014 Annual Report](#), p.25); (ii) 4th YES Congress in Tehran, Iran (29-30 August 2017), with 48 attendees (see [2017 Annual Report](#), p.28-34); (iii) RFG2018 in Vancouver, Canada (18 & 22 June 2018) – (see [2018 Annual Report](#), p.14-16 & 51-63), and (iv) on the occasion of the 5th YES Congress in Berlin (8-9 September 2019) – see [2019 Annual Report](#), p.18-19). This collaboration is continuing with the organisation of workshops on the occasion of future YES Congresses. There is also an on-going discussion about the establishment of a YES Working Group on Applied Geochemistry. Proceedings of the [5th YES Network Congress ‘Rocking the Earth’s Future’](#), held in Berlin, Germany, from 9–13 September 2019, were published in 2022 and can be downloaded from <https://doi.org/10.2312/yes19>.

EuroGeoSurveys also established cooperation with the [Organisation of African Geological Surveys](#) (OAGS) and developed a pan-African geological project proposal ([PanAfGeo](#)), which is financed by the European Commission (Directorate-General of Development and International Cooperation) and by a Consortium of 12 European Geological Surveys coordinated by the French Geological Survey (BRGM). The project proposal was presented at a [workshop](#) on the 14th of August 2014 in Dar es Salaam (Tanzania), and the final version was presented at the OAGS Director’s meeting in Gaborone (Botswana), 13-16 October 2014. The three-year joint project (2016-2019) covered a wide range of tasks, starting from the issues of geoscientific mapping and sustainable management of mineral resources to human resources and training needs for OAGS members and their partners through innovative case studies. The first results of this project were presented at a dedicated session of the 35th International Geological Congress ([35th IGC](#)) in Cape Town in August 2016, and at the 11th OAGS Annual General Meeting (8-10 November 2018) in Dakar, Senegal, where a collaboration MoU was signed between EGS and OAGS. The [PanAfGeo](#) project was completed in 2019, and the final meeting took place from [24-25 October 2019 in Dar es Salaam, Tanzania](#). One of the EuroGeoSurveys Geochemistry Expert Group and Commission members, Maria João Batista (Laboratório Nacional de Energia e Geologia, Amadora, Portugal) has given geochemistry training in Portuguese in Work Package 4 – Environmental Management of Mines in Tete, Mozambique. The content of the lessons was from basic chemistry to case studies of waste management, also including metal mobility, sampling of solid mine waste material, analytical methods, lixiviation tests, and quality control.

Geochemical mapping was also in the programme of the Geoscientific Mapping, which was coordinated by the Geological Survey of the Czech Republic without collaboration with the EuroGeoSurveys Geochemistry Expert Group.

The Commission submitted in August 2015 a joint proposal entitled ‘Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity building phase’ to the Group on Earth Observations ([AfriGEOSS](#)) in collaboration with the [EGS Geochemistry Expert Group](#), the [Geological Society of Africa](#) and the [Organisation of African Geological Surveys](#). In August 2017, it became obvious that the GEO Group on Earth Observations is not a funding platform, and funding should be sought from other sources. Hence, the AfriGEOSS proposal was discussed with the EGS Secretary General, and Philippe Négrel, Chairperson of the EGS Geochemistry Expert Group discussed the AfriGEOSS capacity building programme to be included in Phase II of PanAfGeo, but without success.

[PanAfGeo2](#) has started in 2021 and is a continuation of the well-established [PanAfGeo](#). The project objectives are to develop a set of knowledge and best practices in exchange programmes for African geoscientists to acquire state-of-the-art tools and learn new methods and skills in several geoscientific competencies. Maria João Batista, a Commission member, is this time in charge of the coordination of WP-B – Mineral Resources Assessment (for 2023 updates see [Appendix 2](#)).

EuroGeoSurveys participated in [GEO-CRADLE](#) (Coordinating and integrating state-of-the-art Earth Observation Activities in the regions of North Africa, the Middle East, and the Balkans and Developing links with GEO-related initiatives towards GEOSS), a European Commission Horizon-2020 funded project, which was recently completed (October 2018). The results of both the [FOREGS Geochemical Atlas of Europe](#) and [GEMAS](#) (Geochemical Mapping of Agricultural and grazing land Soil of Europe) projects were used in this project.

In North America, the Commission has established links with the [North American Soil Geochemical Landscapes](#) project involving the [Geological Survey of Canada](#) (GSC), the [United States Geological Survey](#) (USGS), and the [Servicio Geológico Mexicano](#) (SGM).

In South America, the Commission established in 2019 a link with the Geochemistry Working Group of the Asociación de Servicios de Geología y Minería Iberoamericanos (ASGMI: <http://asgmi.org/en/>). This cooperation is continuing, and a Zoom Webinar was organised on the 8th of November 2023 in collaboration with the Commission. Refer to [Section §6.4.2](#) for a short report.

The Commission also interfaces with the [National Geochemical Survey of Australia](#) and the [China Geochemical Baselines](#) projects.

The Commission contributed to the IUGS initiative’s [Resourcing Future Generations](#) (RFG) by submitting comments in July 2015 on the White Paper ‘[Resourcing Future Generations: Mineral Resources and Future Supply](#)’ in collaboration with the EGS Geochemistry and Mineral Resources Expert Groups. Further, it participated with a representative in the RFG workshop in Namibia (24–30 July 2015), and in the writing of the report ‘[Resourcing Future Generations – A Global Effort to Meet the World’s Future Needs Head-on](#)’, and subsequently a paper published in Nature in March 2017 with the title ‘[Mineral supply for sustainable development requires resource governance](#)’. In 2018, on the occasion of [RFG2018](#) in Vancouver, the Commission organised a session on ‘[Global-Scale Geochemical Mapping: A Critical Component for Resourcing Future Generations](#)’ (see [Section §6.3.3 in the 2018 annual report of IUGS-CGGB](#)), and a two-day workshop ‘[Exploration Geochemistry: From fundamentals to the field](#)’ in collaboration with the [Association of Applied Geochemists](#) (see [Section §6.3.1 in 2018 annual](#)

[report of IUGS-CGGB](#)), and the Young Earth Scientists Network, which sponsored the one-day field training workshop.

5.2.1. Collaboration with FAO's GLOSOLAN project

Following information sent by Fiona Fordyce (IUGS-CGGB United Kingdom member), the Commission joined on the 12th of March 2019 the discussion forum of the Global Soil Laboratory Network (GLOSOLAN: <http://www.fao.org/global-soil-partnership/pillars-action/5-harmonization/glosolan/en/>). A confidentiality agreement was signed, as this was a requirement for participation in the GLOSOLAN programme.

GLOSOLAN's main objectives are:

- Make soil information across labs, countries and regions comparable, and interpretable.
- Build a set of agreed harmonisation principles.
- Improve quality assurance and control (QA/QC) of soil analyses, and
- Promote information and experience exchange.

The discussion is made through video conferences, and up to now there have been two video conferences, and a meeting in the FAO premises in Rome on the 28th and 29th of October 2019, which was not attended by the Commission due to lack of funds.

In 2021, GLOSOLAN published a booklet with the title '[Global Soil Laboratory Network - Basic guidelines for preparing a sample for internal quality control](#)'. These guidelines are useful for the laboratories that will be participating at some stage in the Global Geochemical Reference Network project.

5.2.2. Possible collaboration with the Global Observatory on Pollution and Health

In 2019, the Commission initiated contact with the Global Observatory on Pollution and Health. The Global Observatory was established in 2018 as a collaborative effort among Boston College, the United Nations Environment Program, and the Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health. The primary goal of the Global Observatory is to track efforts to control pollution and prevent pollution-related diseases. Mapping will be an important function of the Global Observatory. Data collected from various sources will be geocoded and entered into a Geographic Information System model for each country. Global-scale geochemical data sets from the IUGS Commission on Global Geochemical Baselines are a potentially important source of information for the Global Observatory. These data sets will provide a better understanding of the natural variation of potentially toxic elements in the Earth's near-surface environment and will provide a baseline against which future changes in the geochemistry caused either by human activities or natural processes may be recognised. Brief articles about the Global Observatory can be found at <https://www.bc.edu/bc-web/centers/schiller-institute/research/global-observatory-on-pollution-and-health.html>, and <https://www.unenvironment.org/news-and-stories/press-release/un-environment-and-boston-college-establish-global-pollution>.

5.2.3. Collaboration with the OneGeochemistry Working Group

The [OneGeochemistry](#) initiative (see Section 6.10 in the Commission's [2022 Annual Report](#)) is now an established Working Group of the Committee on Data (CODATA) of the [International Science Council](#), and it is hoped when ready a closer collaboration with the Commission will begin.

6. ACTIVITIES IN 2023

6.1. 78th IUGS EXECUTIVE COMMITTEE MEETING

The 78th IUGS open Executive Committee (EC) meeting was organised in Belfast (United Kingdom) from the 14th to the 17th of February 2023. Anna Ladenberger (1st Co-chair) represented the Commission and reported its 2022 activities and planned work for 2023. The PowerPoint presentation can be downloaded from the following pCloud hyperlink:

<https://u.pcloud.link/publink/show?code=kZurLk0ZBCt0FBxH7sb9v3efPUWieyN7b8vX>.

6.2. STEERING COMMITTEE VIRTUAL MEETINGS

A virtual Steering Committee meeting was organised on the 8th of June 2023, which was chaired by the 1st Co-chair Anna Ladenberger. At this meeting participated Kate Knights, Gloria Prieto, Paula Adánez, Christina Stouraiti, Ariadne Argyraki, David Smith and Alecos Demetriades.

A second virtual meeting was organised on the 20th of December 2023 to summarise the 2023 activities, and finalise the programme of activities planned for the year 2024. This meeting was chaired by the 1st Co-chair Anna Ladenberger and attended by Gloria Prieto, Gloria Namwi Simubali, Paula Adánez, Christina Stouraiti, Ariadne Argyraki, David Smith and Alecos Demetriades.

6.3. ANNUAL JOINT BUSINESS MEETING

The IUGS Commission on Global Geochemical Baselines co-organised the Joint Annual Meeting together with the [Geochemistry Expert Group](#) of EuroGeoSurveys (EGS-GEG) and the Geochemistry Group of ASGMI ([Ibero-American Association of Geological and Mining Surveys](#); ASGMI-GG).

A three-day physical meeting (5-7 October 2023) was hosted by the “Dipartimento di Scienze della Terra, dell’Ambiente e delle Risorse” ([DiSTAR](#)) at the “Università degli Studi di Napoli Federico II” in Monte Sant Angelo (Naples, Italy). A total of 35 participants from Europe, Chile and Armenia attended in person.

The first day was focused on the activities carried out by EGS-GEG & ASGMI-GG for the last quarter of 2022 and the first nine months of 2023, and future collaborations (publications, workshops proposals or projects in 2024). Of particular interest was the report for the capacity-building workshops for African countries. The IUGS-CGGB presented its activities during 2023 and an overview of planned activities next year, *e.g.*, the 37th IGC in Busan (South Korea) with the 4th Arthur Darnley Symposium dedicated to geochemical mapping, and a three-day workshop, as well as the activities related to the promotion of the [IUGS Manual of Standard Methods](#) and its impact on the applied geochemistry community.

The second day was devoted to presentations of geochemical studies carried out by the geological surveys (Armenia, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Poland, Portugal, Slovenia, Spain and Sweden) and associated research institutions. Discussions were held on the role of geochemistry in environmental projects, exploration of mineral resources, climate change with emphasis on destructive flooding events, urban planning, policy-making (EU Soil Directive) and even applications of geochemistry in relation to the food chain. All the original PowerPoint presentations can be downloaded from the following pCloud hyperlink:

<https://u.pcloud.link/publink/show?code=kZzcliVZh6eK0Xm3R1LBIAoRr2OIDYyl7p57>.

On the third day, an excursion to the active volcanic area of Campi Flegrei was organised, followed by an afternoon visit to the ancient city of Pompeii, which was buried under metres of

ash and pumice from the catastrophic eruption of Vesuvius in 79 AD. The minutes of this meeting are in [Appendix 1](#).

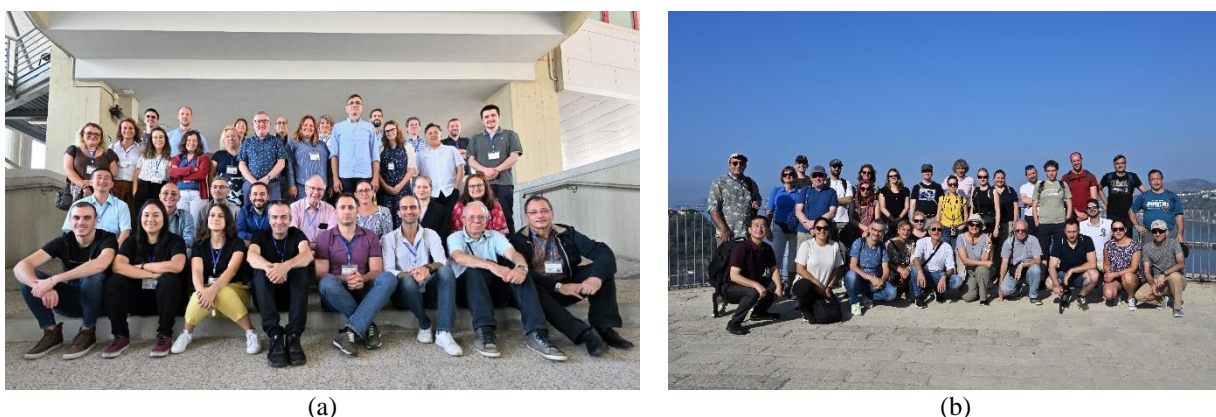


Figure 1. Photographs taken during the Joint Annual Meeting: (a) Group photograph at Naples University; (b) Group photograph during the excursion at the Campi Flegrei volcanic area. Photographs by Chaosheng Zhang.

6.4. OTHER MEETINGS AND WORK PERFORMED

6.4.1. Monthly IUGS E-Bulletin publication

Since May 2021 the IUGS E-Bulletin editorial team encouraged Commissions, Task Groups and Initiatives to send a concise report of their activities. The Commission has responded when having any important news to transmit. The 2023 contributions were published in the following seven [E-Bulletins](#):

- [IUGS E-Bulletin No. 193](#) – January 2023 (p.7–8)
- [IUGS E-Bulletin No. 196](#) – April 2023 (p. 8)
- [IUGS E-Bulletin No. 197](#) – May 2023 (p.5–6)
- [IUGS E-Bulletin No. 198](#) – June-July 2023 (p.8–9)
- [IUGS E-Bulletin No. 199](#) – August 2023 (p.21)
- [IUGS E-Bulletin No. 200](#) – September 2023 (p.6–7)
- [IUGS E-Bulletin No. 201](#) – October 2023 (p.18–19)

The Commission would like to acknowledge Gurmeet Kaur, Giuseppe di Kapua Yamirka Rojas and Daniela Muñoz-Granados for doing a great communication job.

6.4.2. Geochemical Mapping in Latin America and the Caribbean Virtual Workshop

Over 100 participants from Latin America, the Caribbean, Europe, and Africa participated in the webinar "*Geochemical Mapping in Latin America and the Caribbean - Geochemical Knowledge for Societal Use*", which was organised by the IUGS Commission on Global Geochemical Baselines (IUGS-CGGB) and the ASGMI ([Asociación de Servicios de Geología y Minería Iberoamericanos](#)) [Geochemistry Expert Group](#) (ASGMI-GECEOQ) on the 8th of November 2023.

The webinar was opened by Professor John Ludden (IUGS President), with short introductory talks by Flor de Maria Harper (ASGMI President), Anna Ladenberger (IUGS-CGGB 1st Co-chair), Philippe Négrel (Chair of the [EuroGeoSurveys Geochemistry Expert Group](#)), Maria João Batista (ASGMI-GECEOQ Coordinator), and Ozlem Adiyaman Lopez (UNESCO – IGCP- Earth Sciences and Geoparks Section) (Fig. 2).

Gloria Prieto (IUGS-CGGB 1st Deputy-chair) presented an overview of the recently published "[Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)", which contains standardised methods and procedures that should be employed across the land

surface of the Earth to map the distribution of chemical elements in various sample types, *i.e.*, rock, soil, humus, water, sediments (stream, overbank, floodplain); sample preparation; quality control; development of reference materials; data management and processing; preparation of maps, and the principles for the development of the project of global geochemical mapping. Application of these standardised methodologies will allow the production of consistent data at a global level.

Maria Joao Batista (ASGMI-GECEOQ Coordinator) presented the “[*Manual of Geochemical Methodologies of Ibero-American Countries - Geochemical Information for Society*](#)”, which summarises the current state of progress of geochemical mapping programmes in Ibero-America and provides details of the methodologies (sampling, sample preparation, analytical methodologies, data processing, map production, quality control, among others) used to produce geochemical data in Ibero-American countries.



Figure 2. Images taken during the Workshop (a) Webinar logo “Geochemical Mapping in Latin America and the Caribbean - Geochemical Knowledge for Societal Use”; (b) Participants from Geological Surveys from Latin America presented by Maria João Batista; (c) Automation techniques in field geochemical data collection presented by Juan Pablo Lacassie of the Geological Survey of Chile; (d) Multipurpose Geochemistry of soils in Peru, presented by César de la Cruz Poma from INGEMMET; (e) Actions of the Geochemistry Division presented by João Larizzatti from the Serviço Geológico do Brasil, and (f) Geochemical Prospection in Ecuador presented by Fernanda Andrade and Pablo Cabacango from the IGE of Ecuador.

Representatives of the Geological Surveys of Argentina (Angel Sebastian Jara), Brazil (João Larizzatti), Chile (Juan Pablo Lacassie), Ecuador (Fernanda Andrade/Pablo Cabacango), Peru

(Cesar de La Cruz Poma), and Spain (Ivan Martin) presented the progress of geochemical mapping in their countries (Fig. 2).

It was the first time in Latin America that two important geochemistry groups have come together to promote and encourage geochemical mapping of the Earth's land surface as an imperative social need. The webinar emphasised the importance of using standardised methodologies to increase geochemical knowledge of the Earth on a global, continental, national and local scale to satisfy the urgent need for information to plan the use of each territory in harmony with the natural environment and for the well-being of society, also to monitor the continuous changes that occur on planet Earth.

Attendees expressed interest in continuing this series of webinars, holding in-person events, and expanding discussions on geochemical mapping at different scales.

The recorded webinar can be viewed on the ASGMI YouTube channel at:
<https://www.youtube.com/watch?v=GjQx0qItfFk>

The original PowerPoint presentations can be downloaded from pCloud:
<https://u.pcloud.link/publink/show?code=kZyJ4k0ZJnQhdKEAjpfrXxHmg2NBu7lnYEnX>.

6.4.3. Lecture on Forensic Geology

The Commission's 1st Co-chair invited Prof. Duncan Pirrie (Scientific Secretary of the [IUGS Initiative on Forensic Geology](#)) to give a lecture on the application of geological methods in crime investigation at the Geological Survey of Sweden on the 5th of December 2023. The lecture was very well attended, both in person and online by more than 30 participants, including forensic doctors and researchers as well as the chair of the [International Medical Geology Association](#) Prof. Chaosheng Zhang from the University of Galway in Ireland.

6.5. INTERNATIONAL CONFERENCES: SESSIONS AND WORKSHOPS

6.5.1. Spread of information regarding relevant events

The Commission is acting as a networking information channel among Societies, Universities, Institutes, *etc.* by spreading information about their activities to all CGGB members. During 2023, the Commission has circulated information for the following virtual events:

- ✓ 15th February 2023: free webinar organised by the Society of Environmental Geochemistry and Health (SEGH) "*Creating and Sustaining International Collaborations to Support Tropical Ecosystem Science*".
- ✓ 10th March 2023: free webinar organised by the SEGH "*How the Study of Elements Can Help to Understand the Effects of Glacial Melting on Lake Community Structure*".
- ✓ 22nd February 2023: Webinar organised by the International Environmental & Health Sciences Consortium (IEHSC) in collaboration with the International Medical Geology Association "*Integrating QGIS with other GIS software and tools to address drinking water quality challenges in naturally contaminated aquifer systems*".
- ✓ February-April 2023: Online lecture series "*Distinguished Lecture Series on Basic Sciences for Sustainable Development*", which was organised by the International Science Council in collaboration with other Earth Science institutions, including the International Union of Geological Sciences (<https://council.science/current/blog/basic-sciences-webinars/>):-

- (i) Webinar 1 (21st of February 2023): “*Firepower, Geopolitics and the Future: Rethinking Environmental Security*” (<https://youtu.be/ALxz5KYwHU0?si=oIy1DsVIN33WRJBs>).
 - (ii) Webinar 2 (21st of March 2023): “*Apprehending the Duality of Disaster Risk and Sustainable Development*” (<https://youtu.be/jmtBXzsjliE?si=XwxVKc08CYpAMlo1>), and
 - (iii) Webinar 3 (18th of April 2023): “*Geospatial Information-Enabled SDGs Monitoring*” (<https://youtu.be/vhXc41nnmMA?si=dIozeDMU0PLA5rKf>).
- ✓ March 2023: Two webinars organised by EuroGeoSurveys:-
 - (i) “*Soil spectroscopy and deep learning-based modelling for decision-making in agricultural contamination*” (3rd of March 2023; <https://youtu.be/3t2IHSyrFfM?si=fJ7oOUJXiPmz4mpK>), and
 - (ii) “*Enhancing soil governance: regional and national examples of soil legislation development*” (9th of March 2023).
 - ✓ 10th March 2023: Webinar organised by the SEGH: “*How the Study of Elements Can Help to Understand the Effects of Glacial Melting on Lake Community Structure*”.
 - ✓ 9th May 2023: TRiPGiFT Webinar organised by the European Federation of Geologists: “*Training Pupils on Geosciences Through Virtual Field Trips*” (<https://youtu.be/Pf6zTOskYfQ?si=wffuP8qKSRuqTejp>; 2nd Webinar - Part 1: https://youtu.be/6jCVEKsyc6I?si=Q_M6wpralq-KvTUj; 2nd Webinar - Part 2: https://youtu.be/BkvKYyn6IgQ?si=a2QqL_s7gSPNEawy).
 - ✓ 10th May 2023: Webinar organised by the International Medical Geology Association (IEHSC/IMGA) “*Combating neonatal, maternal and child deaths from ionising radiation exposure around gold and uranium mines in Sub-Saharan Africa: A Medical Geology perspective*” by Theo Davies (<https://youtu.be/A7ftCJiUV5Q?si=A2DQIc8pyDZQeMML>).
 - ✓ 28th September 2023: Webinar organised by the EuroGeoSurveys Geological Mapping & Modelling Expert Group “*An open-source, integrative 3D geological modelling platform*” by Laurent Allières (<https://youtu.be/vxmbgEeGFiw?si=wOlaEuvk4KAUf8jv>).
 - ✓ 26-29th September 2023: 9th CARME conference “*Correspondence Analysis and Related Methods*” which was co-organised by Jörg Blasius and Michael Greenacre (<https://www.politik-soziologie.uni-bonn.de/de/veranstaltungen-und-nachrichten/veranstaltungen-2/carme23>).
 - ✓ 23-29 October 2023: The Geological Society of London concerning the International Open Access Week (https://youtu.be/fjnO_978izo?si=I5pp4jpNyBxnrqoc).
 - ✓ 12th December 2023: Fellows Seminar organised by the SEGH: “*Isotope-Based Early-Warning Model: an example of high-resolution site characterization (HRSC)*” by Maurizio Barbieri and Stefania Franchini (https://youtu.be/ZXl9ZDJQTPU?si=Uts_vM7Yy4Xa_dox).

6.5.2. European Union General Assembly

IUGS had a booth at the [European Geosciences Union General Assembly 2023](#), which was held in Vienna from the 23rd to the 28th of April 2023. Acting on the request of the IUGS Executive Committee, a hardcopy of the recently published “[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)” (IUGS Manual of Standard Methods) was sent to the IUGS Secretariat for display (Fig. 3).

The Commission thanks Mr. Ma Yongzheng (Director of IUGS Secretariat), Mrs. Mu Langfeng and the other two IUGS Secretariat officers for the photographs, and the care of the hardcopy of the IUGS Manual of Standard Methods, which will be displayed on other future occasions.



Figure 3. (a) IUGS booth displaying the IUGS Manual of Standard Methods at the inner right-hand side of the front desk, and (b) a conference participant looking at it. Photographs by Mrs. Mu Langfeng (IUGS Secretariat).

6.5.3. 38th International Conference on Geochemistry and Health (Athens, 2-6 July)

The Commission organised and sponsored a two-day pre-conference workshop "Applied geochemical methods described in the [International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)" on Saturday and Sunday, 1st and 2nd of July 2023, on the occasion of the [SEGH 2023 conference](#), which was hosted by the [Department of Geology and Geoenvironment](#) of the National and Kapodistrian University of Athens, Hellenic Republic. The SEGH Organising Committee Chair, Professor Ariadne Argyraki, is also the Commission's Public Relations and Finance Officer and a Steering Committee member.

During the [SEGH conference](#), Alecos Demetriades (Chairperson of the Sampling Committee) delivered on Tuesday, 4th July 2023, a philosophical keynote presentation entitled "Standard Methods for Establishing the Global Geochemical Reference Network" as part of Session 4 "Global databases for geochemistry and beyond". The keynote was well received, with positive comments about the need for standardisation of procedures. The keynote presentation can be downloaded from the following pCloud hyperlink: <https://u.pcloud.link/publink/show?code=kZzQDiVZQKnBqEQVgmXRcJP5vsUgqmlLKG0y>.

The workshop was attended by students, early-career researchers and professionals. All the workshop material can be downloaded from the following pCloud hyperlink: <https://u.pcloud.link/publink/show?code=kZKAgIVZ6eyTE5RjdT4nFwjJpc56RVmKsRLy>.

The first day was devoted to classroom lectures with hands-on exercises (31 participants; Fig. 4).

On the second day, the field methods of sampling rock (Figs. 5 & 6), residual soil (Fig. 7), stream water, active stream sediment and overbank/ floodplain sediment were demonstrated (Fig. 8). In total, there were 21 participants in the field training course (Fig. 9a).

The Sunday lunch was served at the premises of the [Hellenic Survey of Geology and Mineral Exploration](#) (Fig. 9b), followed by a visit to the National Geological Museum.

Tutors were Alecos Demetriades, Hatakka Tarja, Ariadne Argyraki, Stefano Albanese, Alexandros Liakopoulos, Matteo Serra and Konstantina Tsoulou.

Further, in the conference hall five Periodic Tables with maps from the [FOREGS Geochemical Atlas of Europe](#) were displayed, as well as the four [Commission publications](#) (Fig. 10).



Figure 4. Classroom lectures during the Workshop by four tutors: (a) Alecos Demetriades, (b) Hatakka Tarja, (c) Ariadne Argyraki and (d) Stefano Albanese.



Figure 5. Demonstration of rock sampling by Alecos Demetriades: (a) Breaking up of outcrop, and (b) bagged rock sample with its Global Terrestrial Network (GTN) sample site number.

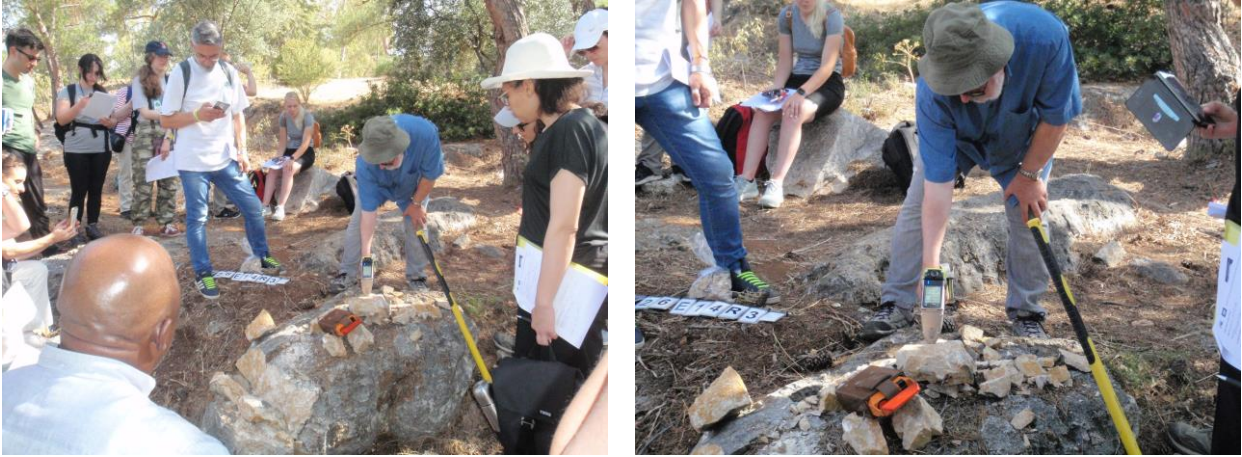


Figure 6. Demonstration of portable XRF for in situ analysis of rocks by Alexandros Liakopoulos.



(a)

(b)



(c)

Figure 7. Demonstration of residual soil sampling (terra rossa) by Alecos Demetriades (Chair of Sampling Committee): (a) Topsoil; (b) Subsoil, and (c) bagged topsoil and subsoil samples with GTN sample site number.



Figure 8. (a) Stream water, Stream sediment and Overbank sediment site; (b) Overbank sediment section; (c) Stream water sampling; (d) stream water measurements, and (e) Sieving of active stream sediment. Demonstration of field sampling methods by Hatakka Tarja and Alecos Demetriades, and stream water measurements by Konstantina Tsoulou.



Figure 9. (a) Group photograph of participants in the field training course, and (b) lunch and coffee at the premises of the Hellenic Survey of Geology and Mineral Exploration.



Figure 10. (a) FOREGS Periodic Tables of Stream water, Stream sediment, Residual Top and Bottom soil, and Floodplain sediment, and (b) the Commission's roll-up poster and the four publications on the desk. All were displayed in the conference's main hall.

6.5.4. Goldschmidt Conference 2023 (9-14th July)

The IUGS Commission on Global Geochemical Baselines (CGGB) participated at the Goldschmidt Conference, the largest international meeting for geochemists, which was held in Lyon (France) from the 9th to the 14th of July 2023. The session entitled “[Novel geochemical and mapping methods at global to local scales with applications in environmental sciences, food safety, ecology, archeology and paleontology](#)” under Theme 12 “Environmental Geochemistry and Human Health” was chaired by Anna Ladenberger (1st Co-chair of CGGB) together with conveners from Italy, Canada and the USA.

The main topic of the session was analytical developments in geochemistry including metal isotope analysis, high-throughput ICP-MS, and laser ablation technology, which have provided new tools to trace metal sources and cycling in environmental and forensic sciences, ecology, archaeology and palaeontology. In addition, novel mapping approaches, have capitalised on the growing body of geochemical data to investigate environmental and anthropogenic processes driving the large-scale spatiotemporal geochemical variations in natural and human-managed soil, water, and ecosystems. Geochemical mapping was shown to be a useful tool to trace the provenance of food, archaeological artefacts and the mobility of modern and ancient/extinct humans and animals.

The session comprised 23 oral presentations and 14 posters. The keynote lecture “[Geochemical provenancing, can it meet evidentiary standards?](#)” was delivered remotely by Jurian Hoogewerff from the National Centre for Forensic Studies (NCFS) at the University of Canberra (Fig. 11a).

Paula Adánez (CGGB Scientific Secretary) introduced the audience to the [IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#) with the oral presentation [A manual of standard methods for establishing the global geochemical reference network](#), which took place on the 12th of July (Fig. 11b). The abstract has been assigned a doi: <https://doi.org/10.7185/gold2023.18594>.

The session encompassed two half-days and was well received by the audience.

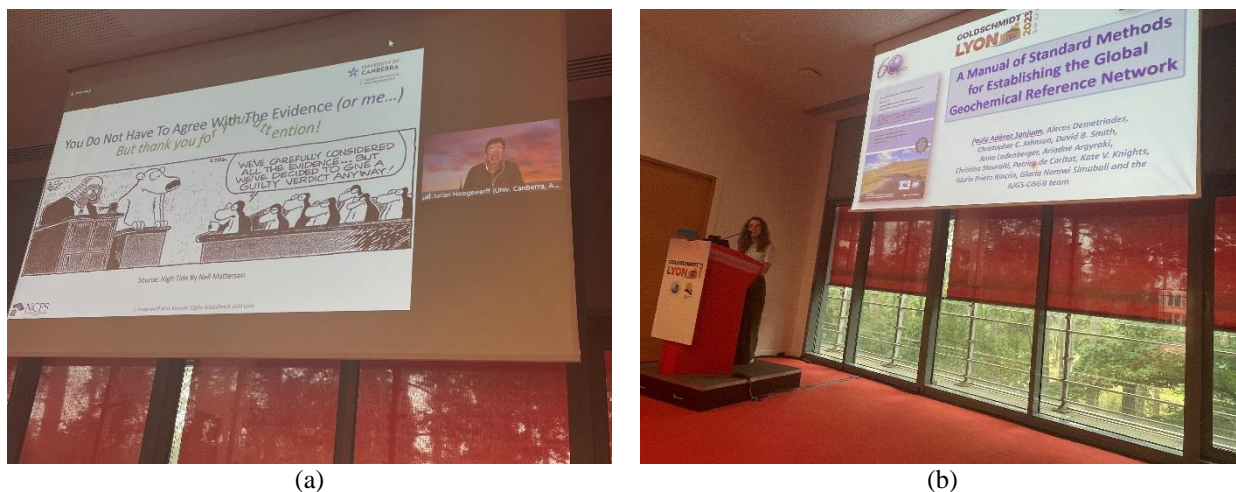


Figure 11. Goldschmidt session (a) the keynote presentation by Jurian Hoogewerff, and (b) the presentation of the Manual of Standard Methods by Paula Adánez (Commission's Scientific Secretary).

6.5.5. 2023 Geological Society of America Annual Meeting (9-14th July)

The IUGS Secretariat set up a booth at the exhibition of the 2023 Annual Meeting of the Geological Society of America (GSA), which was held in Pittsburgh, Pennsylvania, United States of America, between the 15th to the 18th of October 2023. IUGS publications were promoted, including the [Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#) (Fig. 12). We thank the IUGS Secretariat for promoting the Manual of Standard Methods on this occasion, and the provision of the booth photograph.



Figure 12. IUGS booth at the 2023 GSA Meeting displaying IUGS publications including the [Manual of Standard Methods](#). Photograph by Mrs. Mu Langfeng (IUGS Secretariat).

6.6. GLOBAL BLACK SOIL PROJECT

The [IGCP Project 665 - Sustainable Use of Black Soil Critical Zone](#) has ended this year, and the China IGCP Committee organised a two-day seminar on the 18th and 19th of December 2023 with the title “*The 2023 Academic Seminar of Chinese IGCP projects*” at the premises of the Chinese Academy of Geological Sciences (No.21, Zhongguancun Life Science Park, Beiqing Road, Haidian District, Beijing) for the presentation of all IGCP projects carried out in cooperation with our Chinese colleagues.

Two Black Soil project presentations were presented. The first with the title “*Land Resources Evolution Mechanism and Sustainable Use in Global Black Soil Critical Zone*” was delivered in Chinese by Liu Kai (Fig. 13a), and the second was a recorded presentation by Alecos Demetriades (Chair of Sampling Committee) entitled “*Global Black Soil Geochemistry: 2017 to 2023*” (Fig.

13b). About 150 people attended the seminar. According to the information received from our Chinese colleagues, Dai Huimin and Liu Kai, the China IGCP Committee was very pleased with the successful completion of the Global Black Soil project. The two presentations can be downloaded from the following pCloud hyperlink:
<https://u.pcloud.link/publink/show?code=kZ4z070ZYPMjxaD90nuUuxSi7lwbG00muRgk>.



Figure 13. (a) Liu Kai presented “Land Resources Evolution Mechanism and Sustainable Use in Global Black Soil Critical Zone”, and (b) recorded presentation “Global Black Soil Geochemistry: 2017-2023” by Alecos Demetriades (Commission’s Chair of Sampling Committee).

6.7. E-BOOKS IN PROCESS OF PUBLICATION

Program [ROBCOOP4A](#) (balanced robust ANOVA – Fig. 14a) is being translated into Spanish by Paula Adánez (Commission’s Scientific Secretary). In September 2023, the script for unbalanced robust ANOVA (Fig. 14b) was sent to us by Peter Rostrom, after Professor Michael H. Ramsey obtained approval from the [Analytical Methods Committee](#) of the Royal Society of Chemistry Analytical Science Community. Evripides Vassiliades (our in-house programmer) is in the process of modifying it to work in batch mode as ROBCOOP4A. It is expected that this work will be completed in 2024, and the English and Spanish versions published.

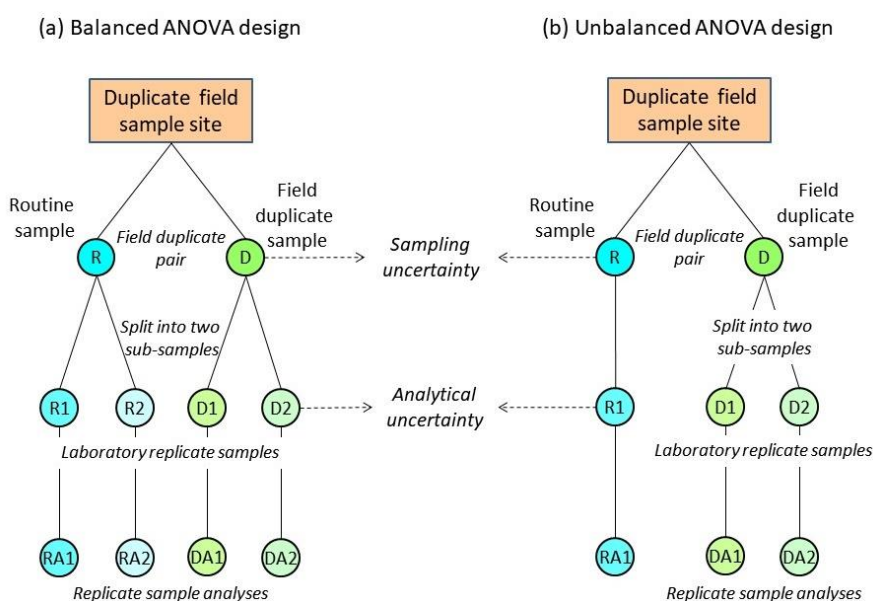


Figure 14. (a) Balanced and (b) unbalanced hierarchical geochemical sampling and analytical schemes for the estimation of geochemical, sampling, and analytical variance and random components of measurement uncertainty. Source: [Demetriades et al.](#) (2014, Fig. 6.4, p.56) slightly modified.

6.8. COMMISSION'S WEBSITE

The [Commission's website](#) is updated regularly.

6.8.1. Google Analytics statistics

Google Analytics has updated its platform for the collection of data, and has sent a new code that was added to every website page by the Web hosting company at no cost. Figure 15 shows the Google Analytics statistics for 2023. The update of Google Analytics provides statistics of user visits for each web page of the Commission's website. Table 1 shows the number of users of the top 25 web pages. It is impressive that 834 users have visited the web page of the "[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)".

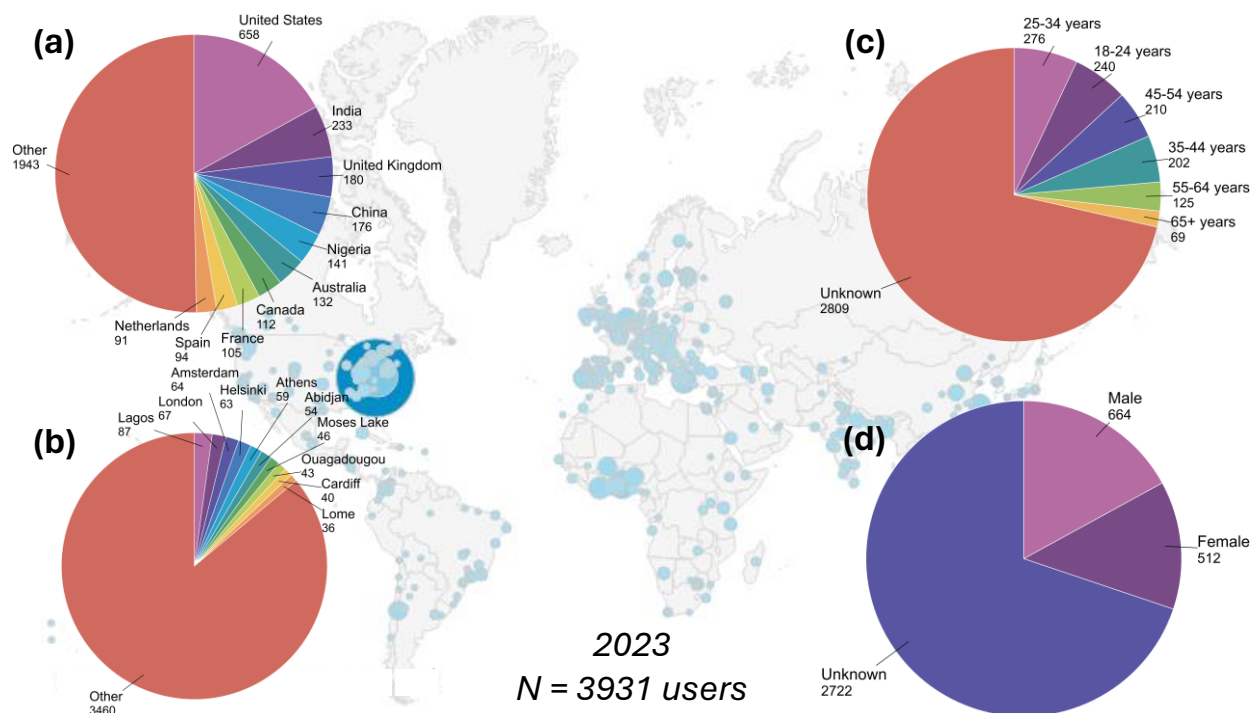


Figure 15. Shows a screenshot of Google Analytics city location map of sessions from the 1st of January to the 31st of December 2023, and pie charts of (a) the top 10 countries users; (b) the top 10 city users; (c) age class users, and (d) gender class users. The global distribution of the 3,931 users is lower than the 4,153 users in 2021 and 4,435 users in 2022. The number of countries has changed considerably from 73 countries in 2021, and 142 countries in 2022 to 139 countries in 2023. While the number of cities has changed from 1047 cities in 2021, and 1123 cities in 2022 to 1077 in 2023.

Table 1. Google Analytics table from the web page users from the 1st of January to the 31st of December 2023.

Page title and Screen class	Views	Users
Total	22,526	3817
Home web page	1804	932
IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network	834	449
GTN 160x160 km	691	533
Members	590	394
Conferences	324	170
Publications	313	131
Webinars	210	135
Annual Reports	192	82
Global or Geochemical Reference Network	185	122

<i>Page title and Screen class</i>	<i>Views</i>	<i>Users</i>
2023 Annual Autumn Business Meeting	175	102
Workshops	143	77
2023 IUGS CGGB conferences	128	91
Steering Committee	122	79
Presentations	111	43
Duplicate Field Sampling	106	82
Sampling Design	102	70
Black Soil Project Manual	90	58
Sample preparation	89	70
Recent Publications	85	49
Field methods for Regional Surveys	81	62
Sample Quantities	79	64
History	78	48
Current Work	72	56
Regional officers	71	62
Results & Database	70	47
Program ROBCOOP4A for Estimation of Classical & Robust ANOVA	69	29

6.8.2. Zenodo website statistics

The four Commission publications acquired Zenodo doi numbers as explained in Section §6.11 (p.32–33) of the [2022 Annual Report](#). In Table 2 the number of downloads of each publication are given together with the date they were uploaded to the Zenodo website. As the applied geochemistry community is comparatively small, the number of downloads of each publication is considered satisfactory. As expected, the Manual of Standard Methods has more downloads.

Table 2. Zenodo DOI download statistics for the four Commission publications from the date they were uploaded until the 31st of December 2023.

Publication name with Zenodo DOI link	Date uploaded	Downloads
International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project	1/11/2022	135
International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network	9/11/2022	242
R-scripts for Generation of 5, 8 and 16 Random Sampling Points Within Predefined Rectangles	9/11/2022	71
Program ROBCOOP4A for Estimation of Balanced Classical and Robust Analysis of Variance: Instructions for Use and Source Code	9/11/2022	78

6.9. WORK OF COMMISSION'S COMMITTEES

6.9.1. Sampling, Analytical & Data Management Committees

In 2023, the Sampling, Analytical and Data Management Committees were active in the two-day workshop organised on the occasion of the SEGH2023 conference in Athens (see [Section §6.5.3](#)). Further, questions were answered, and advice was given to colleagues from different countries.

6.9.1.1. Conversion of computer programs to 32- & 64-bit windows platform

The conversion of computer programs used by the Division of Geochemistry and Environment of the Hellenic Institute of Geology and Mineral Exploration, presently the [Hellenic Survey of Geology and Mineral Exploration](#), by the in-house retired computer programmer, Evripides Vassiliades, is still ongoing. It is noted that the work of conversion of Fortran IV programs in Davis (1973) to the 32- and 64-bit Microsoft Windows® platforms by SimplyFortran is voluntary, and a deadline cannot be placed when there are personal problems and family commitments. Presently, the Merge program is ready for running on 32- and 64-bit computers. The plan is to publish these programs in 2024.

6.9.2. Public Relations and Finance Committee

The Public Relations and Finance Committee's main work was the updating of the Commission's website in collaboration with the web hosting company where necessary.

The work schedule included still the exploitation of a few options for obtaining sponsorships. Discussions have already started with a Hellenic mining company, and a non-profit company, and will continue in 2024.

During 2023, a major activity of the Public Relations and Finance Committee was informing all Commission members about webinars and conferences of interest as is indicated in [Section §6.5.1](#).

Constant updates of all Commission's activities as well as hyperlinks to related topics of other organisations are also uploaded on the social media pages of CGGB (Twitter: [@CGGB_IUGS](#) and Facebook: [@CGGBIUGS](#)). A steady increase in follower numbers is noted for 2023, reaching 263 (+132) followers on Twitter, 711 (+82) followers on Facebook and 13 (+1) subscribers to our YouTube channel. In July 2023 the Commission started its presence on LinkedIn (@IUGS_CGGB) reaching 59 contacts by the 31st of December 2023.

6.10. ASSISTANCE TO MEMBERS AND WORKSHOP PARTICIPANTS

The Geochemistry Group of the [Asociación de Servicios de Geología y Minería Iberoamericanos](#) (ASGMI) at their meetings at the beginning of 2023 decided to start the planning of the continental-scale geochemical mapping of Latin American countries by using to begin with readily available data from each country. ASGMI has compiled a general inventory of the existing geochemical data sets of each country, which are included in the ASGMI Geochemical Manual entitled "[Manual de Metodologías Geoquímicas de Países Iberoamericanos: Información Geoquímica para la Sociedad](#)" (in Spanish). Each country must thoroughly review the available geochemical data for inclusion in the proposed geochemical map based on the agreed unit cell size, sample media, analytical methods, *etc.* This first Latin America and the Iberian Peninsula Atlas aims to draw attention to the importance of geochemistry at the continental-scale and to open new frontiers of knowledge as achieved in Europe with the [FOREGS Geochemical Atlas of Europe](#), the first multinational and multi-sample media continental-scale project, which produced harmonised geochemical data sets for 26 European countries. In the future, the Group hopes to carry out global-scale geochemical mapping according to the instructions and specifications of the recently published "[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)".

The Group contacted Alecos Demetriades (Chair of the Sampling Committee) for assistance, *i.e.*, the provision of (a) the shape file of the Latin American Global Terrestrial Network grid cells of 160x160 km, and (b) the Excel files of 5, 8 and 16 random points for future purposes. All requested files were provided (an example is presented in Fig. 16).

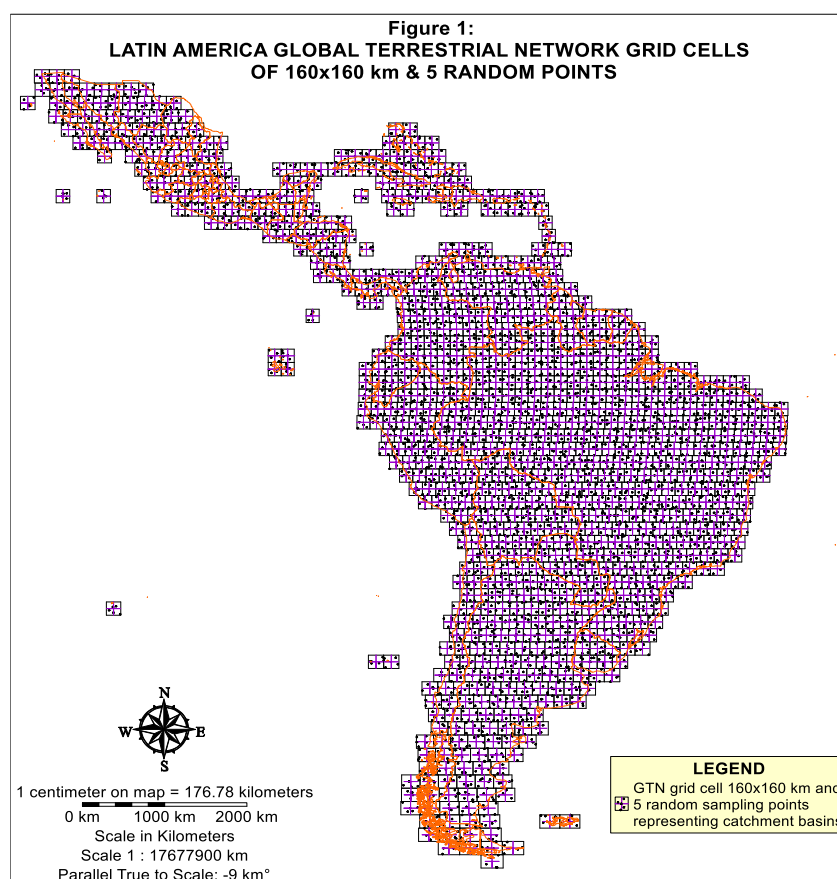


Figure 16. Latin America Global Terrestrial Network Grid Cells of 160x160 km and 5 random points within each grid cell. Map plotted with Golden Software's MapViewer™ v8 by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.

6.11. PUBLICATIONS

The Commission submitted one-page reports, which were published in the [IUGS E-Bulletin](#) (see [Section §6.4.1](#)). The [ASGMI Geochemistry Group](#) has published in Spanish a “[Manual de Metodologías Geoquímicas de Países Iberoamericanos: Información Geoquímica para la Sociedad](#)”. Other publications for the continental-, regional- and local-scale projects carried out in different continents will be found in [Appendix 2: Regional reports](#).

7. REGIONAL REPORTS

Regional reports were provided from [Africa](#) and collaboration projects in the continent, [America North \(USA, Mexico\)](#), [America South \(ASGMI Geochemistry Group, Chile\)](#), [Asia \(Armenia, India, Japan\)](#), [Australasia \(Australia and New Zealand\)](#), and [Europe \(EuroGeoSurveys Geochemistry Expert Group\)](#). These reports are in [Appendix 2: Regional Reports](#).

8. NEW MEMBERS

In 2023, the Commission made 28 new members from [Cameroon \(1\)](#), [Chile \(1\)](#), [China \(1\)](#), [Czech Republic \(1\)](#), [Finland \(1\)](#), [Germany \(1\)](#), [Ghana \(1\)](#), [Hellenic Republic \(5\)](#), [Italy \(2\)](#), [Iran \(3\)](#), [Kenya \(1\)](#), [New Zealand \(1\)](#), [Nigeria \(2\)](#), [Rwanda \(1\)](#), [South Africa \(4\)](#), [South Korea \(1\)](#) and [Sweden \(1\)](#). Although some members retire and do not send a contact E-mail address, the number of members is growing year by year. In total, the Commission has 240 members in 78 countries (see [Members list](#) on Commission's web page, and their countries are shown in [Figure 17](#)).

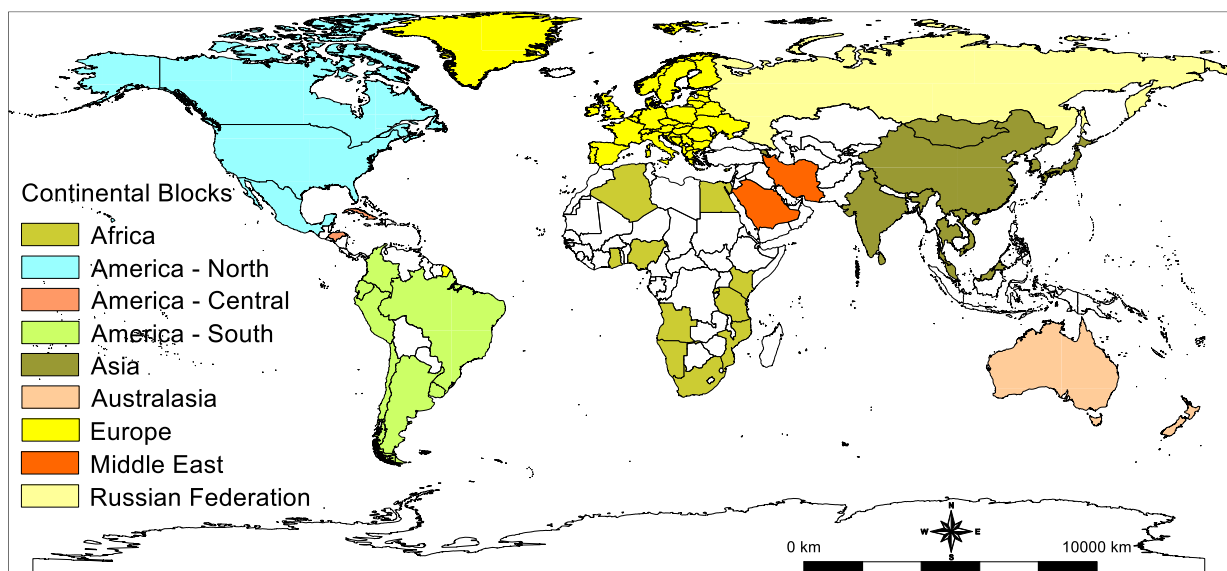


Figure 17. Map showing countries with Commission members. The different colours represent continental blocks. The Russian Federation has its own colour because it is in two continental blocks, Europe and Asia. Map plotted with Golden Software's MapViewer™ v8 by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.

9. IUGS FUNDING FROM 2016 TO 2023

The Commission's funding allocation from IUGS has consisted of US\$5000 for 2016; US\$4500 for 2017; US\$4000 for 2018; US\$2800 for 2019; US\$2800 for 2020, US\$4000 for 2021; US\$6000 for 2022 and US\$10,000 for 2023.

Additional amounts allocated were: (i) US\$3500 for the two-day Workshop organised on the occasion of the 5th YES Congress in Berlin in September 2019, and (ii) US\$3200 for the 36th IGC in Delhi in March 2020.

10. USAGE OF IUGS 2023 FUNDING ALLOCATION

Usage of US\$ 10,000 allocated in 2023 together with the outstanding 2022 balance of US\$ 6,893.49, making an overall total of **US\$ 16,893.49** is shown in Table 3.

Table 3. Expenses incurred during 2023.

<i>Expenses incurred</i>	<i>US\$</i>
Bank commission charge on the transfer of the IUGS 2023 allocation	3.90
Anna Ladenberger's (Commission's 1 st Co-chair) expenses for participation at the 78 th EC meeting in Belfast (US\$ 1329.97) plus bank transfer charges (US\$ 23.20)	1,353.17
Printing and hard binding of seven (7) copies of the <i>International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network</i>	1,641.97
DHL cost for sending to Vienna one hardbound copy of the <i>International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network</i> for display by the IUGS Secretariat at the IUGS booth on the occasion of EGU 2023	67.43
Participation of Paula Adánez Sanjuan (Scientific Secretary) at the Goldschmidt 2023 conference in Lyons (France) for the presentation of the IUGS Manual of Standard Methods (Abstract submission US\$ 109.72), Registration fee (US\$ 676.44), travel and sustenance expenses (US\$ 902.97) and bank transfer charges (US\$ 23.90)	1,713.03
Organisational expenses of the two-day Workshop on the occasion of SEGH 2023 in Athens (1 st and 2 nd July 2023): (i) Participation expenses of Ivan Martin (Deputy chair of Sampling Committee, <i>i.e.</i> , return airline ticket Madrid-Athens, local transportation, hotel and sustenance	4,482.11

<i>Expenses incurred</i>		<i>US\$</i>
expenses (US\$1261.65); (ii) Lunch, morning & afternoon coffee for 31 Workshop participants, 3 tutors & 3 assistants on Saturday, 1 st of July 2023 (US\$ 1207.80); (iii) Sunday (2 nd of July 2023) expenses of field-training workshop (21 Participants & 4 tutors): (a) Coach hire (US\$ 446.92), (b) Lunch and coffees (US\$ 787.29), and (c) other expenses, including printing of field observation sheets, attendance certificates & field slides (US\$ 193.45); (d) purchase of two white buckets with lid, hard bristle brush, cotton lint, wooden handle for mattock cutter, hard bristle brush, Scotch clear tapes, 50 plastic pockets, <i>etc.</i> (US\$ 193.94); (e) cutting of bushy vegetation from the road to the stream water & sediment, and overbank sediment site (US\$ 391.06)		
Printing of 5 FOREGS Geochemical Atlas of Europe Periodic Tables: (i) Residual topsoil; (ii) Residual subsoil; (iii) Stream water; (iv) Stream sediment, and (v) Floodplain sediment on canvas for display in the reception hall of SEGH 2003 in Athens		196.23
Expenses for the participation of three Steering Committee members at the annual meeting of the IUGS-CGGB, EGS-GEG & ASGMI-GG in Naples (Italy) – 5 to 7 October 2023: (a) Paula Adánez Sanjuan - Scientific Secretary, <i>i.e.</i> , hotel, local transportation and sustenance expenses (US\$ 728.83); (b) Ariadne Argyraki - Public relations Officer and Alecos Demetriades (Chairperson of Sampling Committee & member of Steering Committee’s Advisory Panel), <i>i.e.</i> , return airline ticket Athens-Naples, local transportation, hotel, and sustenance expenses (US\$ 2069.97), and (c) payment of coach for Saturday’s (7 th October 2023) excursion (US\$ 803.39)		3,602.19
Participation of Gloria Namwi Simubali (Deputy Chair) at the 79 th EC meeting in Nairobi, Kenya (air travel, hotel and sustenance expenses (US\$3000), and bank transfer charges (US\$42.23))		3,042.23
Annual Commission’s website hosting fee and domain renewal (US\$ 325.07) for 2023-2024 and bank transfer charges (US\$ 2.58)		325.07
Annual Zoom fee (2023-2024)		193.25
Total 2023 expenses:		16,620.58
Balance at the end of 2022	US\$ 6,893.49	
2023 IUGS Annual allocation funding	US\$ 10,000.00	
Interest	US\$ 1.06	
Income tax on interest	US\$ -0.16	
Total available amount for 2023	US\$ 16,894.39	
2023 Expenses	US\$ 16,620.58	
Balance carried forward to 2024	US\$ 273.81	

For the SEG2023 workshop in Athens (Hellenic Republic), fifty 16 GB USB memory sticks were donated by the company [Plaesio Computers](#), which was thanked. The cost of these USB memory sticks is about 250 Euro, thus, approximately US\$281 was saved.

11. FUNDING REQUEST FROM IUGS FOR 2024-2025

11.1. PLANNED 2024 ACTIVITIES REQUIRING NO FUNDS

The main Commission activities in 2024 that require no funds are:

- Continued preparation of material for the promotion of the ‘[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)’, and the two accompanying eBooks (a) [R-scripts for Generation of 5, 8 and 16 Random Sampling Points Within Predefined Rectangles](#), and (b) [Program ROBCOOP4A for Estimation of Balanced Classical and Robust Analysis of Variance: Instructions for Use and Source Code](#).
- Preparation of material for the IUGS booth, and the scheduled three-day workshop on the standard methods for establishing the global geochemical reference network on the 30th and 31st August and 1st September 2024 on the occasion of the 37th International Geological Conference in Busan (Republic of Korea).

- Organisation of webinars and videos for the promotion of the ‘[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)’, and other aspects of applied geochemistry.
- Conversion of statistical programs from MS-DOS Fortran 77/Power Station 4 to 32- and 64-bit Windows platform, and made freely available through the Commission’s website (refer to [Section §6.9.1.1](#) in the Commission’s 2023 Annual Report).
- Writing short articles about work performed to be published in the [IUGS E-Bulletin](#).
- Updating the Commission’s website.
- Writing a review paper about the Manual to be published in Episodes (IUGS journal).
- Organisation of dedicated webinars on statistical data processing, such as Compositional Data Analysis.
- Organisation of sponsored physical Workshops in (a) Nigeria on the occasion of the [39th International Conference on Geochemistry and Health](#) to be held in Abuja, Nigeria, and (b) a possible workshop in Iran (Geological Survey of Iran).
- Looking for sponsors for the preparation of reference materials, *etc.* (refer to [Section §6.9.2](#)).
- Affiliation with other professional Geochemical associations.
- Providing assistance and information to requests from different geological surveys and individuals, especially participants in past workshops.
- Starting the compilation of a popular well-illustrated book for lobbying at the United Nations and UNESCO level for all 196 Member States to agree to carry out the Global project as detailed in the IUGS Manual of Standard Methods. This activity is in-line with the objective ‘*to increase the awareness of policy and decision makers of the need for harmonised geochemical data at the global scale.*’ The promotion of the Global Geochemical Reference Network project is an activity that will be carried out beyond 2024.
- Revision of the IGCP 259 Report, the ‘[Blue Book](#)’ (Darnley *et al.*, 1995) by removing all contradictory parts. The sections have been identified, and the method of how to delete them from the pdf file is being discussed with experts.

Although no funds are requested for the above work, it should be stressed that they are funded by Commission member Geological Surveys and Universities. Hence, it is considered important that a conservative estimate of person-months should be made. It is estimated that all colleagues from all over the world contributing to the above work is between 30 to 40 person-months.

11.2. PLANNED 2024-2025 ACTIVITIES REQUIRING IUGS FUNDING

The following planned activities in 2024, and the first quarter of 2025, require IUGS funding:

- Organisation of workshops/webinars using Zoom in different continental- and time-blocks. We have the material to organise two- to three-day webinars. Organising webinars will be an important activity for the promotion of the techniques described in the ‘[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network and Regional Geochemical Surveys](#)’. This activity requires the continued use of Zoom and add-on licences for virtual meetings and workshops (webinars), depending on the number of registered participants (the existing licence for 100 participants is until November 2024).
- Printing of posters on canvas of the Periodic Table of mapped elements of the [Geochemical Atlas of Europe](#) for stream water, stream sediment, topsoil, subsoil and floodplain sediment for promotion of the Global Geochemical Reference Network project for the workshop with the title: “*Fases y protocolos a seguir para una red de referencia geoquímica global*” (Phases and protocols to be followed for the global geochemical reference network), which is organised on the occasion of the XI Congreso Geológico de España (CGE24) in Madrid (2-6 July 2024) (<https://congresogeologicosge.es/>).

- Participation in the [37th International Geological Conference](https://www.igc2024korea.org/content/14403) (IGC), which will be held in Busan (Republic of Korea) between the 25th and 31st of August 2024. A session with the title ‘*Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley Symposium)*’ is organised as Session 1 under Theme 14 ‘Low Temperature Geochemistry’ (<https://www.igc2024korea.org/content/14403>).
- Organisation of the second person-to-person three-day Workshop on the standard methods for establishing the global geochemical reference network scheduled for the 30th and 31st of August and 1st of September 2024 on the occasion of the [37th International Geological Conference](https://www.igc2024korea.org/content/14404) (IGC), which will be held in Busan (Republic of Korea) as Workshop 21 with the title ‘*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*’ (<https://www.igc2024korea.org/content/14404>). The first two days will be devoted to lectures, and the third to demonstration of all sampling methods in the field with the assistance of two South Korean University Professors.
- Reporting by the 2020-24 Chair of the Commission’s work from 2020 to 2024 and anticipated 2024 to 2028 activities to the IUGS Council at the General IUGS Council meeting on the occasion of the 37th IGC in Busan.
- Organisation of the joint three-day autumn annual business meeting of the Commission in collaboration with the EuroGeoSurveys Geochemistry Expert Group (EGS-GEG) and Asociación de Servicios de Geología y Minería Iberoamericanos Geochemistry Group (ASGMI-GG), which is planned for October 2024 in Prague (Czech Republic). The Commission will jointly host the meeting with the Czech Geological Survey.
- Web-hosting annual fee and domain renewal (2024-2025) of the Commission’s website.
- Renewal of the Zoom licence, and
- Participation in the 80th IUGS Executive Committee meeting in February 2025 at a place to be determined by the IUGS EC, subject to be safe for travel.

It should be mentioned that in the 2024 budget (Table 4), the cost of US\$30,000 for the organisation of training workshops for the countries of the [Coordinating Committee for Geoscience Programmes in East and Southeast Asia](#) (CCOP), which was recommended in the 2019 ARC report is not included, as this depends on the availability of funds from IUGS, and because of Covid-19 is still with us any physical workshops during 2024 in south-east Asia may be difficult. Nevertheless, if such an amount is made available, it should not be restricted to CCOP countries, but it should include African and Latin American countries. It is hoped that applied geochemists from the CCOP countries will be participating in the 37th IGC in Busan (South Korea) and the planned three-day workshop.

Table 4. Estimated expenses for 2024 and first quarter of 2025.

<i>Event category</i>	<i>Cost in US\$</i>
Organisation of webinars for up to 300 participants using the Zoom platform about the methods described in the ‘ International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network ’. Apart of the annual Zoom fee, it may be necessary to purchase add-on licences, depending on the number of registered participants.	500.00
XI Congreso Geológico de España (CGE24), Madrid, Spain:- Printing on canvas of the Periodic Table of mapped elements of the Geochemical Atlas of Europe for stream water, stream sediment, subsoil and floodplain sediment for promotion of the Global Geochemical Reference Network project at an international conference in Madrid: the workshop title is: “ <i>Fases y protocolos a seguir para una red de referencia geoquímica global</i> ” (Phases and protocols to be followed for a global geochemical reference network). The estimate includes the cost of sending the posters by air courier service.	300.00
37th IGC, Busan, Republic of Korea:- Organisation of and participation in Session 1 with the title ‘ <i>Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley</i>	8,400.00

<i>Event category</i>	<i>Cost in US\$</i>
<i>Symposium</i>)’ under Theme 14 ‘Low Temperature Geochemistry’. Cost of two young members of the IUGS-CGGB Commission: Travel expenses US\$4000; Hotel and sustenance expenses US\$3000; Early Bird Registration fees US\$1400	
37th IGC, Busan, Republic of Korea:- Organisation of the 2 nd person-to-person three-day Workshop on the methods described in the ‘ International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network ’, 30 th & 31 st August and 1 st of September 2024 (Coach hire US\$1500; Packed lunches US\$500; Memory sticks with workshop material and bibliography US\$600 (Note: The estimates are based on 35 Workshop participants); Travel expenses for 3 tutors US\$6000; Hotel and sustenance expenses for 3 tutors US\$4500; Early Bird Registration fees US\$2,100; Purchase of necessary equipment (e.g., spade, mattock cutter, two white buckets with lids, sieves – US\$700). Other necessary equipment will be transported.	15,900.00
IUGS General Council meeting (37 th IGC, Busan, Republic of Korea):- Commission’s Steering Committee Chair reporting the 2020 to 2024 activities at the IUGS Council meeting, and 2024 to 2028 plans: Travel expenses US\$2,000; Hotel and sustenance expenses US\$1500; Early Bird Registration fee US\$700	4,200.00
Organisation of the three-day autumn annual joint business meeting of the Commission, the EuroGeoSurveys Geochemistry Expert Group and ASGMI Geochemistry Group in the autumn in Prague (Czech Republic). The amount includes organisation expenses and providing financial support to members of the Steering Committee	5,000.00
Printing and book-binding of new eBooks	500.00
Annual Commission’s website hosting fee and domain renewal (2024-2025) and additional space on server	600.00
Participation in the 80 th IUGS Executive Committee meeting in January/February 2025 at a place to be decided by the IUGS Executive Committee	3,000.00
Total estimated expenses in US\$ for 2024-2025:	38,400.00
Outstanding balance (US\$) in Commission’s bank account at the end of 2023:	273.81

Taking into account the outstanding balance in the Commission’s bank account of **US\$273.81**, the estimated smallest amount required to cover 2024–25 expenses, as well as unforeseen expenses, is in the region of about **US\$38,000**.

The comparatively high allocation funding request is due to the Commission’s active participation in the 37th IGC in Busan with a dedicated session (‘*Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley Symposium)*’), and a three-day workshop in which the standard methods and techniques of the ‘[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)’ will be taught, and demonstrated in the field. It is hoped that applied geochemists from South Korea, South-east Asia and the Far East countries will be participating.

The Commission is, therefore, requesting financial support from IUGS in the order of **US\$38,000** to cover planned expenses in 2024 and first quarter of 2025.

11.2.1. IUGS Annual funding allocation to cover first six months of following fiscal year

The IUGS Executive Committee must consider the provision of an extra amount in addition to the annual amount requested. The reason is that without any reserve funds, it is difficult to plan activities and make commitments for the following fiscal year, and especially the first four months, because the annual allocation is usually made available round about April or May of the calendar year. Therefore, it is proposed that the IUGS funding should cover part of the first four months of the following fiscal year.

11.2.2. Development of IUGS analytical reference materials

An important activity is the development of IUGS analytical reference materials. All IUGS Commissions are charged to set up standards for their geoscientific discipline. Therefore, the Commission is mandated to set up standards in geochemical mapping. The first such standard is the '[*International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project*](#)', which was approved by the IUGS EC and published in 2020, and is freely available from the Commission's website. The second and most significant standard work is the publication in 2022 of the '[*International Union of Geological Sciences Manual of Standard Methods for the Global Geochemical Reference Network and Regional Geochemical Surveys*](#)', which was approved by the IUGS Executive Committee as the "*Official publication for the IUGS 60th anniversary celebration 2022*", and the foreword signed by three IUGS Presidents, Professors John Ludden (2020-24), Qiuming Cheng (2016-20) and Roland Oberhänsli (2012-16).

However, the global project, as envisaged by Darnley *et al.* (1995) in the '[*Blue Book*](#)' and elaborated further in the aforementioned Manual of Standard Methods, requires the development of five large reference analytical materials of different chemical composition of at least one tonne each for all the sampling types that will be collected, *i.e.*, stream sediment, overbank/floodplain sediment, residual soil, and rock.

As IUGS is the global geoscientific body that sets standards in geosciences, it is appropriate to start the development of analytical reference materials. The Commission has the expertise and the laboratory that can make these reference materials. It is planned to contact private mining companies and applied geochemistry professional associations for sponsorship. In this venture, the support of the IUGS EC will most likely be needed with the provision of a cover letter stressing the importance for the development of these analytical reference materials.

12. LINK TO IUGS WEBSITE

The Commission's website has a link to the IUGS website through its logo, which is displayed on all web pages, and also in the Links web page at <http://www.globalgeochemicalbaselines.eu/content/104/links-/>.

13. DETAILS OF ANNUAL REPORT AUTHORS

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REFERENCES

- Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steenfelt, A., Tauchid, M., Xuejing, Xie., Garrett, R.G. & Hall, G.E.M., 1995. A Global Geochemical Database for Environmental and Resource Management. Recommendations for International Geochemical Mapping – Final Report of IGCP Project 259. Earth Science Report 19. UNESCO Publishing, Paris, 122 pp.; http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/Blue_Book_GGD_IGCP259.pdf.
- Davis, J.C., 1973. Statistics and Data Analysis in Geology. John Wiley & Sons, Inc., N.Y., 550 pp.
- Demetriades, A., Reimann, C. & Filzmoser, P., 2014. Evaluation of GEMAS project quality control results. Chapter 6 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part A: Methodology and interpretation of the GEMAS data set Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 47–60; <http://www.schweizerbart.de/publications/detail/isbn/9783510968466>.

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APPENDIX 1. IUGS-CGGB ANNUAL BUSINESS MEETING

Minutes of the joint meeting of
IUGS-CGGB, EGS-GEG and ASGMI-GG
5-7.10.2022

Department of Earth, Environment and Resources Science (DiSTAR),
University of Naples Federico II, Naples, Italy



Group photograph at DiSTAR (Photograph by Chaosheng Zhang)

List of participants (in person):

Participant	Country
Gevorg Tepanosyan	Armenia
Juan Pablo Lacassie Reyes	Chile
Nicolás Cádiz	Chile
Julie Erban Kocergina	Czechia
Rasmus Jakobsen	Denmark
Elina Kuusma	Estonia
Timo Tarvainen	Finland
Jaana Jarva	Finland
Philippe Négrel	France
Dennis Kraemer	Germany
Alecos Demetriades	Hellas
Ariadne Argyraki	Hellas
Chaozheng Zhang	Ireland
Ray Scanlon	Ireland
Stefano Albanese	Italy
Annalise Guarino	Italy
Benedetto De Vivo	Italy
Annamaria Lima	Italy

Participant	Country
Domenico Cicchella	Italy
Maurizio Ambrosino	Italy
Paolo Valera	Italy
Pooria Ebrahimi	Italy
Antonio Iannone	Italy
Lucia Rita Pacifico	Italy
Matteo Serra	Italy
Irena Wysocka	Poland
Pedro Simunovic Dalannais	Poland
Maria João Batista	Portugal
Mateja Gosar	Slovenia
Martin Gaberšek	Slovenia
Paula Adánez Sanjuan	Spain
Iván Martín Mendez	Spain
Anna Ladenberger	Sweden
George Morris	Sweden
Martiya Sadeghi	Sweden

1st Day, Thursday, 5th October 2023, 09:30-17:00 (CET)

NOTE: The numbers in front of discussion items refer to the PowerPoint presentations, which can be downloaded from the following pCloud hyperlink:

<https://u.pcloud.link/publink/show?code=kZzcliVZh6eK0Xm3R1LBIAoRr2OIDYyl7p57>.

ACRONYMS

- EGS-GEG: [EuroGeoSurveys Geochemistry Expert Group](#)
- IUGS-CGGB: [International Union of Geological Sciences Commission on Global Geochemical Baselines](#)
- ASGMI-GG: [Asociación de Servicios de Geología y Minería Iberoamericanos Geochemistry Group](#)
- GEMAS: GEOchemical Mapping of Agricultural and grazing land Soil

Opening of the meeting:

- Welcome by Philippe Négrel (PN), EGS-GEG Chairperson. Thanks to Stefano and apologies for not being present last year.
- Welcome by Anna Ladenberger (AL), IUGS-CGGB 1st Co-Chair. Welcome and acknowledgement of close relations with EGS-GEG and ASGMI-GG as beneficiary for sharing contacts, knowledge, *etc.*
- Welcome by Maria João Batista (MJB), ASGMI-GG Chairperson: she welcomes on behalf of ASGMI (good that these two groups are connected). She has also a connection with the Organization of African Geological Surveys. Special welcome to the participants from south America (Juan Pablo Lacassie Reyes and Nicolás Cádiz).

Round table self-introduction: All the participants introduced themselves by presenting their background and research interests.

Organisation arrangements by Stefano Albanese (SA) (local host): meeting schedule, coffee, lunch breaks, optional evening dinners, last-day excursion to Campi Flegrei-Pozzuoli-Pompeii.

- **(01) EGS-GEG 2022-2023 activities report (PN)**

There are 60 official EGS-GEG members and 40 external coworkers. Philippe Négrel presents the main activities carried out during 2022-2023 by EGS-GEG:

- Collaboration with the [European Union Soil Observatory](#) (EUSO) and its working groups (soil pollution, soil data integration and soil erosion).
- Public consultation for the Horizon Europe candidate partnership agriculture data.
- EU Soil Directive (EGS-GEG members are involved in national-level consultations). Preparation of the document on the EGS-GEG feedback to the EU Soil Directive.
- Publications of GEMAS results (published 1, external review 1, internal reading 1).
- Collaboration for the publication of the [IUGS-CGGB Manual of Standard Methods](#) (several EGS-GEG members participated).
- Participation in scientific conferences, *e.g.*, [38th International Conference of the Society of Environmental Geochemistry and Health \(SEGH\) in Athens](#) (2-6 July 2023), [Goldschmidt Conference in Lyons](#) (9-14 July 2023), and the 50th Worldwide Groundwater Congress of the [International Association of Hydrogeologists \(IAH\) in Cape Town](#) (17-22 September 2023).

Action 1: PN informed that the GEMAS data sets are waiting to be published and all EGS-GEG members have access to them. All GEMAS publications are available at the following pCloud hyperlink: <https://u.pcloud.link/publink/show?code=kZ4JfDZURdEoTF0F0fzFyqWGxGDRbApslv7>.

- **(02) IUGS-CGGB 2022-23 activities report & 37th IGC in Busan, South Korea (AL)**

Anna Ladenberger informed that every EGS-GEG member is automatically a member of the [IUGS Commission on Global Geochemical Baselines](#).

- The mission of the CGGB is the implementation of the Global Geochemical Terrestrial Network; exchange of knowledge; providing protocols at the continental scale; organising workshops and field courses, *etc.*
- The [Commission's website](#) is continuously updated.
- Almost 700 people looked for the [IUGS-CGGB Manual of Standard Methods](#), which was available online from June 2022.
- FOREGS project celebrated its 25th anniversary in 2022.
- Many events were organised on the occasion of the [60th IUGS anniversary](#).
- Promotion of the Manual is ongoing: article in [Explore No. 196](#); presented at international conferences (invited lecture at the “*Geochemistry, Mineralogy, Petrology and Volcanology*” session of the [16th International Conference of the Geological Society of Greece](#) (University of Patras, 17-19 October 2022); keynote presentation at the [38th International Conference of the Society of Environmental Geochemistry and Health \(SEGH\) in Athens](#) (2-6 July 2023); oral presentation at the Goldschmidt conference in Lyons (9-14 July 2023), Session 12gO1 under Theme 12– “*Novel geochemical and mapping methods at global to local scales with applications in environmental sciences, food safety, ecology, archeology and palaeontology*”; hard copy of the Manual displayed at the IUGS booth during the [EGU General Assembly 2023](#) congress in Vienna (23-28 April 2023), and the [2023 Annual Meeting of the Geological Society of America](#) (Pittsburgh, USA, 15-18 October 2023).
- Some planned activities: preparation of promotion material, webinars, periodic table maps, workshops, *etc.* The next webinar is organised together with ASGMI-GG on the 8th of November 2023 (Languages: English and Spanish).

Action 2: Looking for sponsors; affiliation with other professional associations; compilation of a popular book; revision of [Blue Book](#), *etc.*; at the [37th International Geological Congress](#) in Busan (South Korea), a session is organised under [Theme 14 Low Temperature Geochemistry](#) with the title “Session 1 - *Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley Symposium)*”, and a three-day workshop (21) “[International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network](#)”.

- **(03a) ASGMI-GG activities report (MJB)**

MJB presents the **main activities of the ASGMI** Geochemistry Group. She presented the recent [Ibero-American Manual of Geochemical Methodologies](#) and also explained the reality of geochemical mapping in south America.

Development of products:

- Geochemical Atlas of Latin America-levelling/sampling.
- Monography by groups of chemical elements (energy transition, high-tech uses) with mineral resources and environmental groups, development of standard samples for Latin America (using the experience from Europe).

Collaboration with other ASGMI groups like mineral and secondary.

- **(03b) African continent report (MJB)**

MJB presented the main activities related to the African Continent. One of the main actions is capacity building workshops. Examples of projects in Africa:

- Africa MaVal: led by BRGM (critical RM project, map of Africa, supply potential pan African inventory of mineral resources and of CRM, predictive pan-African mapping assessment).

- Panaf geo 2: 2021-2024 (training of teachers, mineral resources assessment) Training online at LNEG and Mozambique (digital mapping, geoenvironmental maps, *etc.*).

Planageo: Publication of the maps that were produced by integrating geological, geophysical and geochemical data.

- **(04) CGSG 2022 and SEGH 2023 conferences and first physical workshop about the IUGS-CGGB Manual of Standard Methods (Ariadne Argyraki (AA) and Alecos Demetriades (AD))**

The Manual was presented at two events in the Hellenic Republic:

- October 2022: Invited presentation at the “*Geochemistry, Mineralogy, Petrology and Volcanology*” session of the [16th International Conference of the Geological Society of Greece](#) (University of Patras, 17-19 October 2022).
- July 2023: Keynote presentation at the [38th International Conference of the Society of Environmental Geochemistry and Health \(SEGH\) in Athens](#) (2-6 July 2023); the five FOREGS Periodic Tables (Topsoil, Subsoil, Stream water, Stream sediment, Floodplain sediment) were displayed as well as hardcopies of the Commission’s publications.
- 38th SEGH short course: This was the first two-day physical workshop with hands-on exercises, and essentially it was a test, *i.e.*, one-day lectures with hands-on-exercises, and one-day field-training. Although the workshop was successful, the conclusion was that it was very dense, and a second day is needed for teaching and handling of computer programs. Mateo Serra set up the R-scripts for the hands-on-exercises. Second day was devoted to field training trip (how to take the photographs, demonstration of sampling of all sample types, portable XRF measurements, and recording of field observations, *etc.*).

Action 3: AL suggested to mass produce and distribute the scale with the IUGS-CGGB logo on it.

- **(05) Goldschmidt 2023 report (AL)**

Anna Ladenberger presented a summary of the Session Co-organised by the Commission and EGS-GEG. “[Novel geochemical and mapping methods at global to local scales with applications in environmental sciences, food safety, ecology, archeology and paleontology](#)” under Theme 12 “Environmental Geochemistry and Human Health”.

EUSO data working group presented a poster on soil data sharing in EU, and available soil data sets found in the scientific literature.

Announcement: EGS-GEG and IUGS-CGGB are organising a session at the ISEH+ICEPH+ISEG: Joint conference in Galway (Ireland), originally planned for 2020, now August 2024, GEG is welcome to organise a session.

- **(06) GEMAS - latest GEMAS valorisations and status of publications (PN),**

Update on status of the GEMAS publications (refer to the pCloud hyperlink where all publications are stored: <https://u.pcloud.link/publink/show?code=kZ4JfDZURdEoTF0F0fzFyqWGxGDRbApshv7>) Current list of pending GEMAS publications was discussed, and leading authors indicated that these will be completed and published in 2024 Z (*For the list of published and pending papers refer to Presentation 07).

- **(07) GEMAS website, GEMAS mapviewer at BGR, GEMAS sample archive at BGS & GEMAS Ap standard at GSRS (AD, Paolo Valera, Sebastian Pfeleiderer, Dennis Krämer, Louis Ander, Henrietta Soltysova & Katarina Boksanska)**

Most active year for publications of the GEMAS project results was 2015.

Action 5: There is still GEMAS data and topics to be published, volunteers needed to take the lead and

write publications.

Action 6: AL recommended that we should have an article on GEMAS in-house standards (AD undertook to lead it).

GEMAS website is hosted now by EGS (<https://gemas.eurogeosurveys.org/>). Before removing it from the servers of the Geological Survey of Austria, the final checks are ongoing.

Action 7: A volunteer is wanted to check that all material has been transferred properly to the new EGS website.

BGR is hosting the GEMAS geoportal with WMS services, the website presents different types of files (shapefile, pdf, *etc.*). A variety of maps can be downloaded. The remaining GEMAS maps were completed by Uwe Rauch.

GEMAS samples are now stored at the BGS, and a concise report was sent by Louise Ander.

Important note: the agricultural (Ap) and grazing land (Gr) soil standard samples have not been located yet.

The GEMAS Ap standard, which was made in 2015 is still at the Geological Survey of Slovakia. It should be transferred for permanent storage to BGS.

Action 8: We have to find the financial resources to transport the Ap standard to BGS (for now, it is safe). The vials of the Ap standard are in 15 large carton boxes with a total weight of 1450 kg. The funding has to be secured for its transportation.

- **(08) Other activities report, e.g., ongoing EU projects, GSEU (AL)**

GSEU ([Geological Service for the European Union](#)): AL presented the general mission, objectives, and Work Packages. EGS-GEG is not an official partner, but many colleagues are actively participating in the project's various work packages.

Important note: It is important to promote our presence in the GSEU.

Action 9: [European Geological Data Infrastructure](#) (EGDI). The presentation of the GEMAS project results should be discussed, especially, how can they be improved on the EGDI platform.

- **(09) GEG-EGS policy work, e.g., Soil Strategy, Critical Raw Material Act, etc. (AL)**

AL presented the EU Soil Directive. Three months ago, the proposal was published. The consultation at the national level is ongoing. EGS-GEG was asked by the EGS Secretary General to write a feedback on this document which will be presented at the EGS National Delegates meeting and the Directors workshop in the middle of October 2023.

The European Commission soil week is organised by the European Commission in late November 2023. Registration for online participation is possible.

Open discussion about the EU Soil Directive with the general consensus that the directive is difficult to understand because articles can be interpreted in many ways. There are many problems that cannot be solved in the time proposed.

- **(10) Discussion about next year activities IUGS-CGGB, EGS-GEG and ASGMI-GG**
Postponed to the last hour.

- **(11) Presentation of the material of the IUGS-CGGB manual of standard methods (AD) – <http://www.globalgeochemicalbaselines.eu/content/174/iugs-manual-of-standard-methods-for-establishing-the-global-geochemical-reference-network/> (Explanation of the IUGS-CGGB relationship with EGS-GEG & ASGMI-GG)**

AD focused on the material that is available on the internet webpage of the Manual. Supplementary material is an important part of the Manual (Global reference network files, Google earth files, random points, R-scripts, Geodetic levelling, Supplementary material for soil -world soil data, *etc.*). There are zip files containing all the information from each chapter. All the information is free and available for downloading.

- **(12) IUGS E-Bulletin contributions and reporting (Paula Adánez Sanjuan)**

Paula Adánez presented a summary of the contributions to the [IUGS E-Bulletin](#) that are monthly published. She also explains the “Regional Reports” section of the [Annual Report](#), which is always included and is a compilation of activities related to applied geochemistry all over the World.

- **(10) Discussion about next year activities IUGS-CGGB, EGS-GEG and ASGMI-GG**

PN requests active participation in the work of the expert group, supported by the EGS secretariat. He informed that the new Geophysics expert group has been established.

Action 11: The Group has to show how geochemical data are needed by other groups (*e.g.*, mineral resources), exchange experiences and information.

Action 12: The Geochemistry of spring water should be re-discussed with the Groundwater Group.

Action 13: To focus on the application of the GEG data to specific objectives (*e.g.*, exploration of critical raw materials, contamination, geochemistry applied to climate change). Such applications may get EU funding.

Action 14: To have online meetings every three or four months could foster communication between EGS-GEG members to be more active.

Action 15: We need to focus on the funding, sponsorships, *etc.* (EU Horizon).

Action 16: It would be good to make mineralogical analysis on the GEMAS samples, **but** it seems impossible to find new funding for this work.

Action 17: It is important that the EGS-GEG and geochemistry in general to respond to societal needs.

Action 18: AL will compile some Excel files with projects proposals discussed. Everybody has to respond with ideas or funding suggestions.

*****END OF DAY 1*****

2nd Day, Friday, 6th October 2022, 09:00-17:30

Presentations from EGS-GEG, ASGMI-GG and local hosts:

(13) 09.10: *ISLANDR project – gathering information on European soil contamination data* – Timo Tarvainen

(14) 09.25: *The rare earth element Gd as a far-field tracer for persistent waste-water derived substances in the environment: A case study on the southern North Sea, the Elbe, Ems and Weser estuaries and other major river systems in Europe* – Dennis Krämer

- (15) 09.40: *Innovation in the capture and dissemination of geochemical information: experience in SERNAGEOMIN-Chile* – Juan Pablo Lacassie Reyes
- (16) 09.55: *Geochemistry of Andean salt flats and their potential for Li and K* – Nicolás Cádiz
- (17) 10.10: *Towards 'Local' Thinking in Geochemical Data Analysis* – Chaosheng Zhang
- (18) 10.45: *Geochemical Mapping and applied products at GSI* – Ray Scanlon
- (19) 11.00: *Geochemical activities at LNEG during 2022-23* – Maria João Batista
- (20) 11.15: *IGME-CSIC recent projects and international cooperation* – Iván Martín & Paula Adánez
- (21) 11.30: *Geochemical data on Gd-microcontaminant diffusion in surface and groundwaters of Poland* – Irena Wysocka
- (22) 11.45: *Regional mapping at SGU, 2022-2023, and lab developments* – George Morris, Anna Ladenberger, Merita Murtola & Patrick Casey
- (23) 12.00: *Geochemistry at SGU: a couple of special projects* – Anna Ladenberger, George Morris *et al.*
- (24) 12.15: *Ongoing geochemical projects in the Geological Survey of Estonia* – Elina Kuusma
- (25) 12.30: *The Collstrop site – a 16 ha legacy wood impregnation site with 30 tons of As – current investigations on fixation possibilities involving magnetite* – Rasmus Jakobsen
- (26) 12.45: *The concern over child health because of exposure to lead in soil: a geochemical study in a densely populated volcanic area* – Pooria Ebrahimi
- (27) 14.00: *Is the future of geochemistry in cooperation with non-geological sciences? Experience of the Czech Geological Survey* – Julie Erban Kočergina
- (28) 14.15: *Oral bioaccessibility of potentially toxic elements in various environmental media* – Martin Gaberšek and Mateja Gosar
- (29) 14.30: *Using old methods/data to discover new lithium pegmatites: case study in Västernorrland county, Sweden* – Martiya Sadeghi
- (30) 14.45: *Development of Geochemical Maps to Ensure Sustainable Agricultural Development and Food Safety in Armenia* – Gevorg Tepanosyan
- (31) 15.30: *Assessing the Transfer Factors (TFs) of Potentially Toxic Elements from soil to agricultural Products: a case study of Campania region, southern Italy* – Lucia Rita Pacifico
- (32) 15.45: *Stream sediments and environmental contamination assessment: a case study from southern Italy based on the sample catchment basin approach* – Antonio Iannone
- (33) 16.00: *GEMAS: Chemical weathering of silicate parent materials revealed by agricultural soil of Europe* – Philippe Négrel *et al.*

Free discussion (SUMMARY OF CONCLUSIONS FROM PRESENTATIONS)

After the presentations, an open discussion took place. Some of the topics that were discussed:

- Levelling of data and the use of EGS-GEG data sets for complete studies.
- A webinar or workshop on levelling planned for the next year and led by MJB.
- EGS-GEG has so many data sets that if anybody has an idea they should be utilised, and if any help is required it will be given.
- After the recent destructive floods, it was proposed to establish monitoring sites all over Europe on floodplains and to collect floodplain sediments *sensu stricto*.
- Next year is the 10th anniversary of the GEMAS project (webinars, via IUGS and EGS channel, maybe with the collaboration of Clemens Reimann and Manfred Birke).

Next year's meeting: There is a proposal from The Netherlands. Also, we have an offer from the Czech Geological Survey (Prague). Prague will be easier for Clemens and Manfred to attend due to its central location and cheaper transportation.

Philippe thanked everybody for their participation. Thanks to Stefano and colleagues for the excellent organisation of the meeting.

The meeting closed at 17:00 (Naples's time)

*****END OF DAY 2*****

3rd Day, Saturday, 7th October 2023, start at 08:30 and return at 18:00

EXCURSION TO CAMPI FLEGREY AND POMPEII (All day)

Visit the Campi Flegrei and the ancient city of Pompeii, where the participants saw the devastating destruction, as it was buried under metres of ash and pumice from the catastrophic eruption of Vesuvius in 79 A.D. The IUGS Commission on Global Geochemical Baselines sponsored the coach cost.



Group photograph at Parco Virgiliano where an overview of the Campi Flegrei caldera was seen (Photograph by Chaosheng Zhang).



Group photograph at Pompeii (Photograph by Chaosheng Zhang).

APPENDIX 2. REGIONAL REPORTS

A2.1. AFRICA

A2.1.1. Africa

Report by T. C. Davies (theo.clavellpr3@gmail.com) (Mangosuthu University of Technology, Mangosuthu Highway, KwaZuluNatal Province, 4031 South Africa)

During 2023, very few of the Applied Geochemistry applications bore direct relevance to the Africa Geochemical Database (AGD) programme. African governments and their geological surveys, as well as university management have never been ardent in formulating specific policies for advancing the AGD programme.

I. Published studies

Examples from the few studies published in 2023 that were pertinent to the AGD effort include the following:

(i) Humphrey, O.S., Cave, M., Hamilton, E.M., Osano, O., Many, D. and Watts, M.J., 2023. Predictive geochemical mapping using machine learning in western Kenya. [Geoderma Regional Volume 35](#), December 2023, e00731. <https://www.sciencedirect.com/science/article/pii/S235200942300127X> (accessed 15.12.2023)

Humphrey et al. (2023) have developed machine learning (ML) algorithms using random forest (RF) models for classification, pattern recognition and regression tasks capable of modelling non-linear relationships using a range of datasets, identifying hierarchical relationships, and determining the importance of predictor variables. The model was applied to predict the total concentration ($\text{mg}\cdot\text{kg}^{-1}$) and assess the prediction uncertainty of 56 elements, soil pH and organic matter content using 466 soil samples in western Kenya; the results of iodine (I), selenium (Se), zinc (Zn) and soil pH are highlighted in this work.

(ii) Zhang, Nwaila, G.T., Bourdeau, J.E., Ghorbani, Y. and Carranza, E.J.M., 2023. Deriving big geochemical data from high-resolution remote sensing data via machine learning: Application to a tailing storage facility in the Witwatersrand goldfields. [Artificial Intelligence in Geosciences, Volume 4](#), December 2023, Pages 9–21. <https://www.sciencedirect.com/science/article/pii/S2666544123000059> (accessed 15.12.2023)

Using gold grade data from a South African tailing storage facility (TSF), and data from both Landsat-8 and Sentinel remote sensing satellites, Zhang et al. (2023) demonstrate that fusing geostatistically-augmented geochemical and remote sensing data produces an abundance of data that enables a more generalised machine learning-based geochemical data generation. These authors showed that various machine learning algorithms can be used given the abundance of training data. They were consequently able to produce a high resolution (10 m grid size) gold concentration map of the TSF, which demonstrates the potential of the method to be used to guide extraction planning, online resource exploration, environmental monitoring and resource estimation.

(iii) Sibolile, B., Embula, W., Kavindikiza, G. and Kasuto, U., 2023. Regional geochemical mapping of the Okahandja area of central Namibia. Book of Abstracts, 29th Colloquium of African Geology, 26-29 September, 2023, Windhoek, Namibia, p. 181. https://www.mme.gov.na/files/publications/643_29th%20COLLOQUIUM%20OF%20AFRICAN%20GEOLOGY%20BOOK%20OF%20ABSTRACT-09-2023.pdf (accessed 15.12.2023)

As a contribution towards completion of the geochemical map of Namibia, Sibolile et al. (2023) garnered geochemical data from the Okahandja area of central Namibia. These data were evaluated, interpreted and plotted on geochemical maps in order to delineate regional geochemical trends and anomalies. Generalised spatial distribution maps showing the concentrations of the elements Cu, Sr, Zn, Fe and Pb were compiled using ESRI ArcGIS software.

II. Forthcoming Conferences

A few forthcoming major conferences having regional geochemical mapping sub-themes pertinent to the AGD programme will be held in Africa during 2024; e.g.:

- (i) ICRGG 2024: 18th International Conference on Regional Geochemistry and Geomodelling, April 11 - 12, 2024, Cape Town, South Africa. <https://waset.org/regional-geochemistry-and-geomodeling-conference-in-april-2024-in-cape-town> (accessed 15.12.2023)
- (ii) International Conference on Environmental Geochemistry, Soil and Water Contamination (ICEGSWC): February 02, 2024 Durban, South Africa.
- (iii) <https://conferencealerts.co.in/event/2218128> (accessed 15.12.2023)
- (iv) 11th World Conference on Sampling and Blending, May 21 - 23, 2024, Muldersdrift, South Africa. <https://www.saimm.co.za/saimm-events/upcoming-events/the-11th-world-conference-of-sampling-and-blending> (accessed 15.12.2023)
- (v) SEGH 2024, 39th International Conference on Geochemistry and Health, July 01 - 04, 2024, Abuja, Nigeria. <https://segh.net/events#:~:text=SEGH%202024,-1st%2D4th%20July&text=The%20conference%20aims%20to%20bring,of%20Geochemistry%20for%20sustainable%20development> (accessed 15.12.2023)

III. The Future of the Africa Geochemical Database Project

The Africa Geochemical Database Project continues delayed, due to a number of reasons which include the lack of conviction of a veritable justification for the investment of huge resources on the Project by national governments and other potential donors; and, the lack of capacity and, in some cases, expertise, by many geochemistry departments on the Continent to carry out such large scale sampling and analytical campaigns. Fortunately the latter challenge is slowly being overcome, as Geochemistry research at African geochemistry departments continue to gather strength since the late 2000s; partly as a result of the acquisition by a number of laboratories of portable, analytical instrumentation (e.g., p-XRF) that require little technical expertise for their operation. There is thus some evidence that the coming years will see the AGD project gathering some pace.

A2.1.2. PanAfGeo-2 project in Africa

Report by Maria João Batista (LNEG) (mjoao.batista@lneg.pt)

Maria João Batista (LNEG), member of GEG-ASGMI-IUGS participates in activities in Africa and South America. [AfricaMaval project](#) studies the Value Chain of Extended Critical Raw Materials (ECRM) and business opportunities between European and African countries. The participation of these members was the elaboration of case studies in Morocco and Mozambique.

The [PanAfGeo-2](#) project, funded by the European Commission and coordinated by the [Bureau de Recherches Géologiques et Minières](#) (BRGM) with [EuroGeoSurveys](#) and [Organisation of](#)

[African Geological Surveys](#) (OAGS), supports the training of the OAGS geoscientific staff in professional geoscientific skills.

In the framework of this project, a training workshop was organised on “[Successful Mineral Resource Assessment Training](#)” in Quelimane in Mozambique from the 19th to the 29th of June 2023 (Figure A2.1). Maria João Batista (LNEG) in charge of coordination of WP-B – Mineral Resources Assessment of PanAfGeo-2, organized the training in collaboration with the Direccção Nacional de Geologia e Minas and the Instituto de Minas of Mozambique, including among other subjects, exploration geochemistry methods, exploration case studies, and mining experience of the different Portuguese Speaking countries and Nigeria and Namibia, which are co-leaders of WP-B-Mineral Resources Assessment.

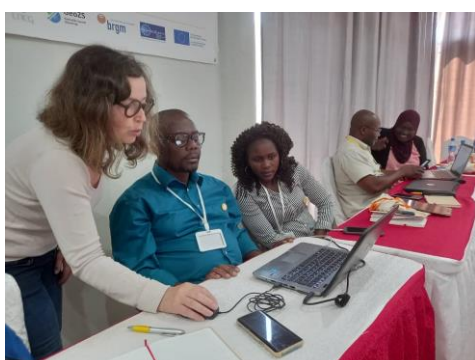
The training focussed on lithium-rich pegmatites of Alto Ligonha, and had a total duration of 37 hours, with presentations of 1h and 1:30 h. There were 2 practical classes, and a two-day field trip to visit the Muiane Mine and the Naípa underground and open pit mine. Both mines exploit tantalum minerals contained in pegmatitic rocks. The training included various topics of mineral exploration, such as portable-XRF and the advantages of using this technique in the early phase of mineral exploration and how to read, with caution, the data produced. The training also included lectures on data treatment, with practical exercises, and statistical approaches with different quality of data. Geochemical mapping training was also included, as well as the use of the methods and techniques described in the [IUGS Manual](#).



(a)



(b)



(c)



(d)

Figure A2.1. (a) Group photograph of the Mozambique workshop trainees; (b) partial group photograph of the trainees in the classroom; (c) Maria João Batista teaching trainees about database preparation for geochemical map plotting; (d) Maria giving the attendance certificate to one of the trainees.

During November and beginning of December MJB went to Zambia to contact the Geological Surveys of Zambia and the mines in the Copperbelt to start organizing a training also from WP-B of PanAfGeo-2. The training will also include the harmonized methodologies and quality control

using the guidelines of the Manual of IUGS. In PanAfGeo project trainees are the staff members of the African Geological Surveys, the trainers and organizers are European Geological Survey staff and local specialists invited to the training.

A2.2. AMERICA, NORTH

A2.2.1. Mexico

Report by Flor de Maria Harp Iturribarria (florh@sgm.gob.mx), Enrique Espinosa (enriqueespinosa@sgm.gob.mx) and Sofia del Pilar Mendoza Castillo (sofiamendoza@sgm.gob.mx), Mexican Geological Survey (SGM), Pachuca de Soto, Hidalgo, Mexico.

In 2023 multipurpose geochemical mapping programs in the Mexican territory were led by the Mexican Geological Survey.

The current projects include total cover of 1:250,000 scale geochemical stream sediments maps and databases, along with technical reports associated, available in the SGM web viewer. (Figure A2.2). (<https://www.sgm.gob.mx/GeoInfoMexGobMx/#>).

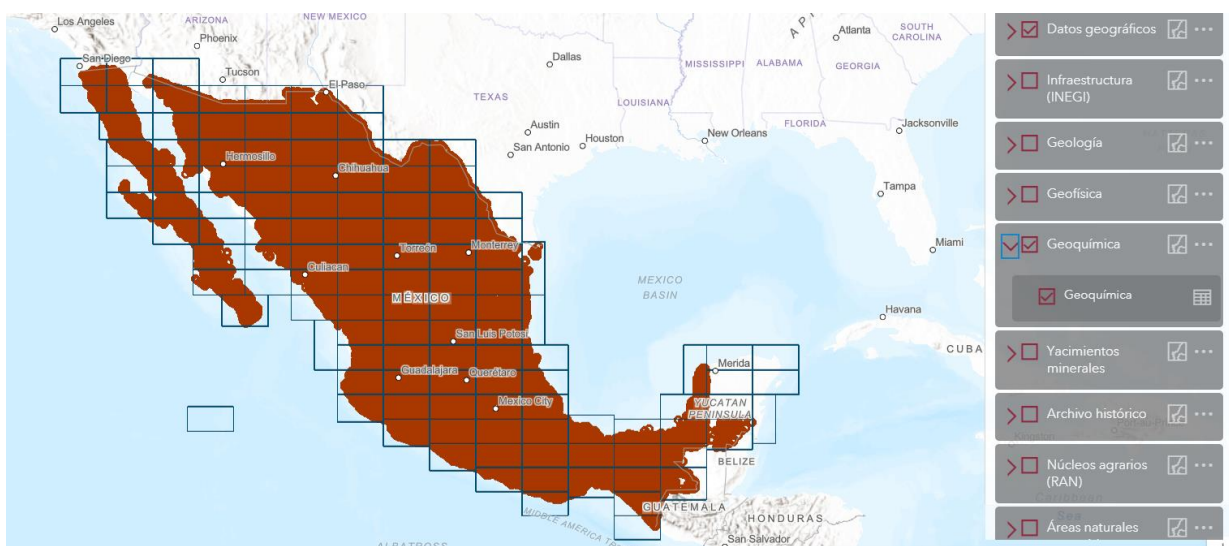


Figure A2.2: SGM web viewer where geochemical stream sediments maps and databases can be accessed

Progress was made in **Baseline and geochemical anomaly of Mexico**; the objective is to define geochemical baselines and the identification of mineral anomalies and resources. The field protocols were designed for sampling 4 soil horizons: 0-5, A, B and C, spaced in a grid of 10 x 10 km, quality control of the field and analytical information, processing and interpretation of the geochemical data. The results are under process, so it is expected that the geochemical results will supply geological evaluation of sites and localities at which it is inferred that there are some background data on the occurrence of some sort of mineral deposits related to lithium, radioactive, critical minerals and rare earth elements.

A2.2.2 United States

Report by David Smith (dbsmith13@gmail.com)

In 2019, the U.S. Geological Survey, in partnership with State Geological Surveys, began the Earth Mapping Resources Initiative (Earth MRI). This effort involves collecting new geological, geophysical, and geochemical data in areas across the U.S. with potential for hosting critical mineral resources. The geochemical component, at the present time, involves primarily regional reconnaissance geochemistry on rocks such as Devonian metalliferous black shales of the Illinois Basin and Ordovician REE-enriched phosphorites of the central U.S. Some states have also begun requesting reanalysis of the archived sediment and soil geochemical samples collected during the National Uranium Resource Evaluation program conducted during the 1980s. The following URL provides information on where samples are being collected at the present time:

<https://ngmdb.usgs.gov/emri/#3/40/-96>. Geochemical data from Earth MRI are being periodically released at <https://doi.org/10.5066/P9WHRLXH>.

A2.3. AMERICA, SOUTH

A2.3.1. ASGMI Geochemistry Group

Report by Maria Joao Batista (LNEG) (mjoao.batista@lneg.pt)

In relation with the activities in ASGMI ([Asociación de Servicios de Geología y Minería Iberoamericanos](#)) geochemistry group, after the presentation of the “[Manual de Metodologías Geoquímicas de Países Iberoamericanos](#)” of ASGMI, the group started the preparation of the methodologies to use in the compilation, criteria of selection and the statistics to be used in each unit cell of 40x40 km wide for the Geochemical Map of Latin America and the Geochemical Atlas of IberoAmerican countries. Monographies are also being prepared in different subgroups of the ASGMI Geochemistry group about different association of elements W-Sn, Au, REE and Li-Nb-Ta. A webinar in collaboration with IUGS and GEG to present of the manuals (IUGS and ASGMI) and geochemical mapping in different ASGMI Geological Surveys occurred on 8 November and was a very successful event. Another event is being prepared within ASGMI group to next year about Physical Treatment of Geological Samples to be organized by the Mexican Geological Survey.

A2.3.2. Chile

Report prepared by the professionals of the Unit of Geochemistry of the Geological and Mining Survey of Chile (SERNAGEOMIN):

- Juan Pablo Lacassie Reyes (Chief Geologist; juan.lacassie@sernageomin.cl)
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I. General information

The Geochemical Map of Chile is a Government programme that since 2011 has been carried out by the Unit of Geochemistry of SERNAGEOMIN (Geological and Mining Survey of Chile). Its objective is to promote the sustainable growth of Chile by the definition of geochemical baselines and the identification of mineral resources.

The Unit of Geochemistry is composed by 4 geologists, with a publication rate of 2 products per year, including 1:250,000 scale geochemical atlases, maps and databases, along with technical reports associated with geochemical studies of fluvial basins.

During the year 2023, the following achievements and activities stand out:

- First stage of the Chile-Honduras Cooperation Project.
- Institutional approval of the first Geochemical Web-Map.
- Publication of the geochemical study of the Limarí river basin.
- Participation in three international meetings.
- Publication of two relevant papers on archaeology based on our geochemical maps.

II. Chile-Honduras Cooperation Project:

As a result of the technical meetings of the ASGMI Geochemistry Group, a cooperation project was established between the geological and mining services of Chile and Honduras. During the year 2023, the first two missions of the project were carried out. In the first of them, for 10 days in June a team of 4 professionals of SERNAGEOMIN (2 geochemists and 2 economic geologists) visited INHGEOMIN in Honduras (Figures A2.3 and A2.4). Among other activities, it was possible to detect the general and specific training requirements present in INHGEOMIN and to jointly define the Training Program to be carried out in SERNAGEOMIN-Chile. Later, in November, 2 INHGEOMIN professionals participated in an internship in Chile, where they received training in geochemical sampling techniques (Figure A2.5). During the year 2024, two more training missions are expected to be carried out in Chile and Honduras.



Figure A2.3. Mission 1 of the Honduras Project (June 2023). Protocol meeting held at the Ministry of Foreign Affairs of Honduras. Participating are Mrs. Siomara Majon, General Director of International Cooperation of the Honduran Foreign Ministry (fourth from left to right), Carlos Madariaga, Executive Director of INHGEOMIN (sixth from left to right) and members of the SERNAGEOMIN delegation. The book “Chile Volcanic Territory” edited by SERNAGEOMIN is delivered to Mrs. Majon.



Figure A2.4. Mission 1 of the Honduras Project (June 2023). Above: Technical meeting session held at INHGEOMIN. Presentation by Mr. Pablo Oliva (SERNAGEOMIN). An INHGEOMIN professional is using his smartphone to read the QR code displayed in the presentation. Below: The QR code scan allows online viewing, using smartphones, of web-type geochemical maps, a new format to bring SERNAGEOMIN information to the public. Photograph by J.P. Lacassie.



Figure A2.5. Mission 2 of the Honduras Project (November 2023). Training in geochemical sampling carried out in the Antofagasta Region, northern Chile. Above: Mr. Sergio Montoya and Mr. Miguel Martínez (INHGEOMIN) together with Mr. Pablo Oliva (SERNAGEOMIN), review the mineralogy of the sampled sediments. Below: Mr. Miguel Martínez (INHGEOMIN) during geochemical sampling training in the Kesar stream. Photograph by J.P. Lacassie.

III. First Geochemical Web-Map:

As a result of an innovation project, during the year 2023, SERNAGEOMIN coordinated the publication of the first geochemical map in web format. This corresponds to the Geochemical Map of the Vallenar area, which will be published in 2024 (Figure A2.6). This new format will allow the public to access the geochemical map through their cell phones, PC and Tablet PC. It only requires a connection to the web. This new format will help disseminate geochemical mapping products to a greater number of people and institutions.

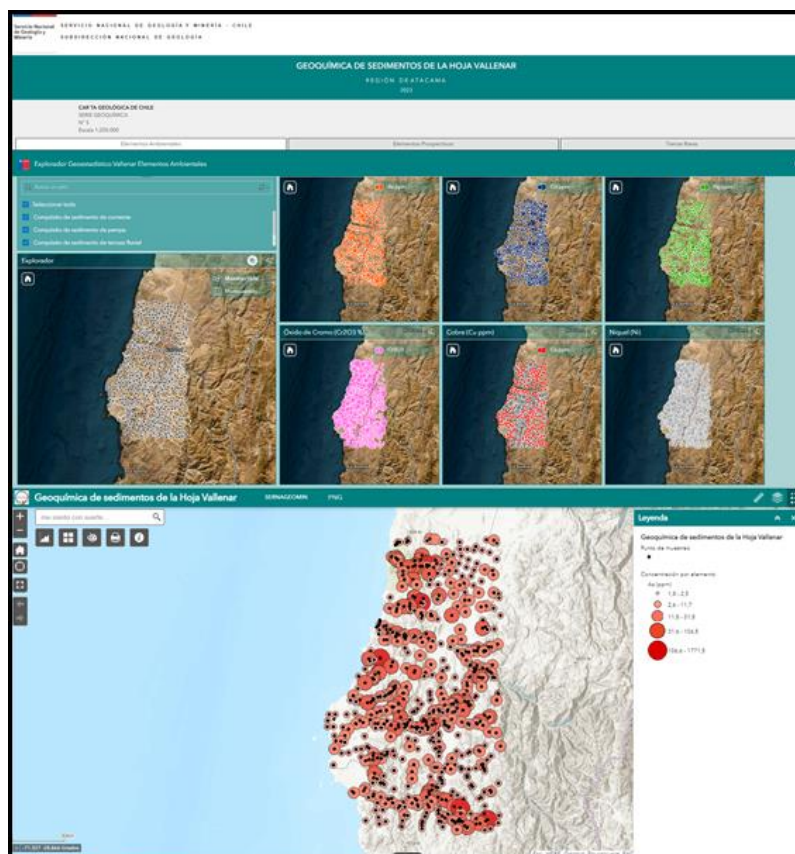


Figure A2.6. Geochemical map of the Vallenar area in web format (preliminary version). It consists of an interface that allows visualizing and interacting with the geochemical, geological and geographic information of the study area. This web platform allows to review and consult the information contained in the map through a "Map Viewer" and a "Geostatistical Explorer". Figure created by R. Mardones.

IV. Geochemical Study of the Limari basin

This year the geochemical study of the Limari River basin was published. In this 12,000 km² basin there are important cities and towns where nearly 200,000 people live. The study has a prospective and environmental emphasis. In this last aspect, the application of various geochemical indices to evaluate the environmental conditions of the basin stands out (Figures. A2.7 and A2.8). The objectives are: 1) to establish base values for the chemical and mineralogical composition of the sediments of the Limarí river basin; 2) to characterize the main geochemical patterns; 3) to identify the main geochemical anomalies; 4) to identify areas of prospective interest; 5) to evaluate the environmental quality of the sediments by comparing them with environmental parameters; 6) to identify the main natural and anthropic factors that control the chemical composition of the sediments.

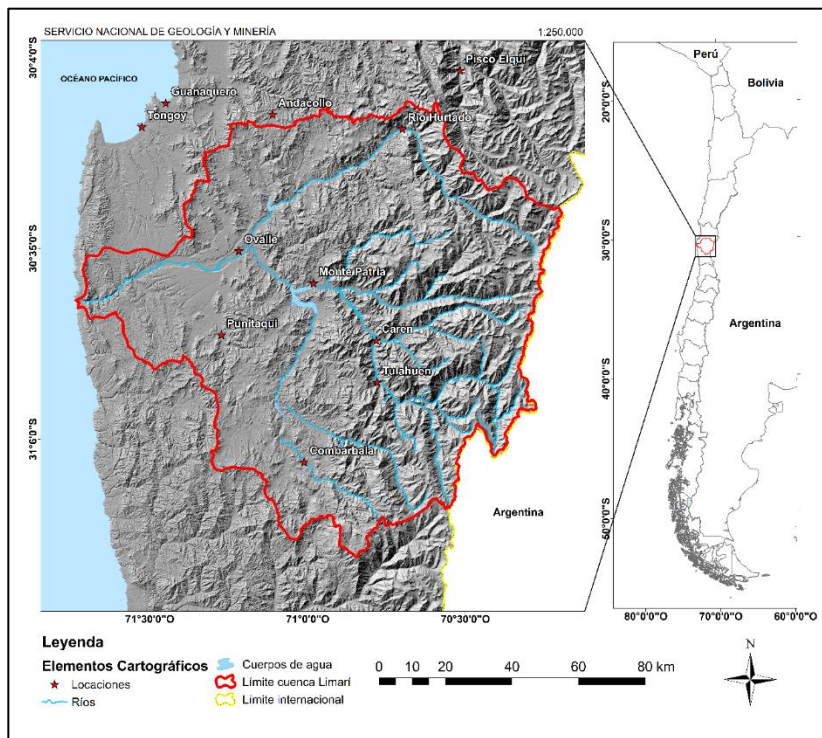


Figure A2.7. Location of the Limari River basin in Chile. Figure created by F. Astudillo & R. Mardones.

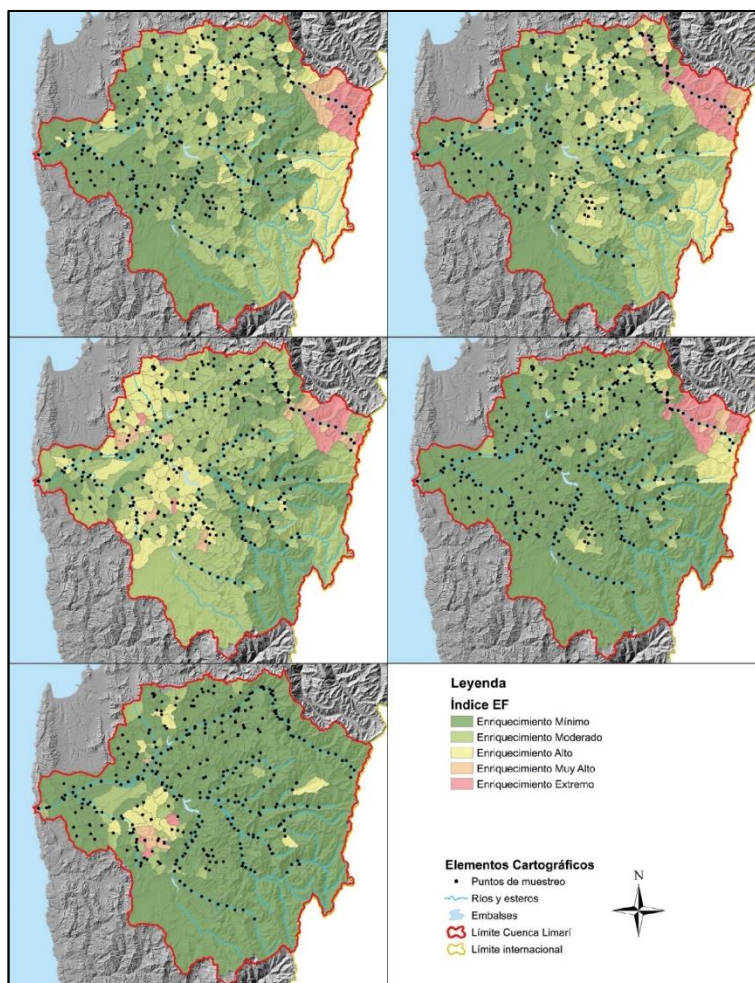


Figure A2.8. Distribution maps of the enrichment factor index (EF index) for arsenic, cadmium, copper, zinc and mercury. Figure created by F. Astudillo & R. Mardones.

V. International meetings

During 2023, professionals from the Geochemistry Unit participated in 3 international seminars, including:

1. Joint Annual Meeting of IUGS-CGGB, EGS-GEG and ASGMI-GG, carried out in the premises of the Department of Earth Sciences of the Federico II National University, in Naples (Figure A2.9).
2. XVI Chilean Geological Congress, carried out on the premises of the Universidad del Desarrollo, in Santiago, Chile. (Figure A2.10). The contributions of the Unit of Geochemistry are as follow:
 - J. Lacassie R. Mardones P. Castillo, 2023. Evaluation of the north-south climatic variation in Chile: use of indices in fluvial sediments. Preliminary results.
 - Oliva P., Astudillo F., Lacassie J.P., Mardones R., 2023. Indicadores ambientales y distribución de elementos prospectivos en sedimentos de corriente de la Hoja Taltal, Región de Antofagasta y de Atacama, Chile.
 - Oliva P., León J., Neira H., Lacassie J.P., Astudillo F., Mardones R., Gárate. A., 2023. Captura de datos y mapas webs: Innovación SIG de la Unidad de Geoquímica de Sernageomin.
 - Oliva P., Lara L., Flores F., Qüense J.A., 2023. Modelamiento de fases diluidas de lahares usando LaharFlow: Caso de estudio Volcán Villarrica, Chile (39°S)
3. Webinar "Geochemical Mapping in Latin America and the Caribbean - Geochemical Knowledge for Societal Use" on the 8th November 2023 at 8 AM (EST) | 15.00 h CET hours.



Figure A2. Presentation by Juan Pablo Lacassie (SERNAGEOMIN Geochemistry Unit), in the Joint Annual Meeting of IUGS-CGGB, EGS-GEG and ASGMI-GG, carried out in the premises of the Department of Earth Sciences of the Federico II National University, Naples. It includes the recent technological advances applied by SERNAGEOMIN for the collection of terrain data using smartphones, real-time control of progress in the field and new type formats interactive web-maps of geochemical maps. Photograph by N. Cádiz.

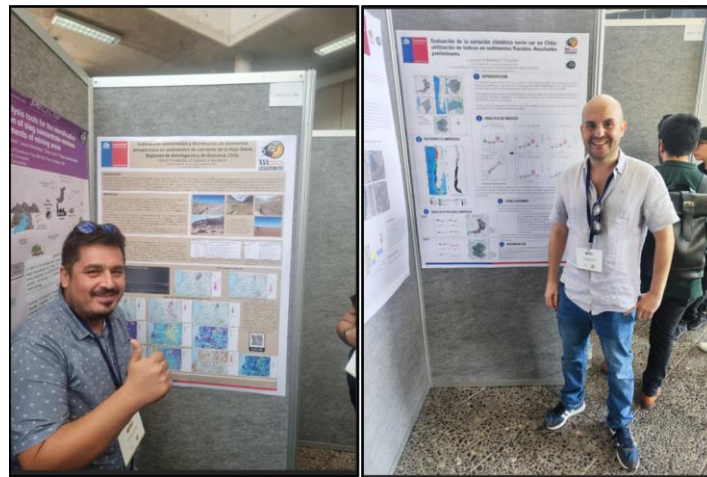


Figure A2.10. Posters presented by the Unit of Geochemistry in the XVI Chilean Geological Congress. Left: Presentation of Mr. Pablo Oliva “Geochemical environmental and prospective indicators elements of the Taltal Area, Antofagasta and Atacama Regions, Chile”. Right: Presentation of Mr. Rafael Mardones “Evaluation of north-south climate variation in Chile, using geochemical indices in river sediments”.

VI. Archaeology & Geochemistry in Chile

During 2023, 2 papers in archeological topics in Chile were published. Stands out the contribution of the geochemical maps of SERNAGEOMIN for resolving long-discussed issues such as the origin of the manganese used in the Chinchorro mummies (6000 BC) and the impact of archaic populations as a result of natural geochemical factors. (Figure A2.11). The papers are as follows:

- Arriaza B, Ogalde JP, Vizcarra A, Aravena N, Standen V, Figueroa L, Zelaya G, Reich M, Halcrow S, Van Hoesen J (2023b). To move or not to move? Manganese oxide procurement during the Archaic Period in the Atacama Desert. JAS Reports 51. <https://doi.org/10.1016/j.jasrep.2023.104157>
- Arriaza, B., Figueroa, L., Ogalde, J.P. et al. An archaeometric approach to biocontamination with manganese pigments in ancient marine hunter-gatherers of the Atacama Desert: health, ideological, and socioeconomic considerations. Archaeol Anthropol Sci 15, 188 (2023). <https://doi.org/10.1007/s12520-023-01884-4>

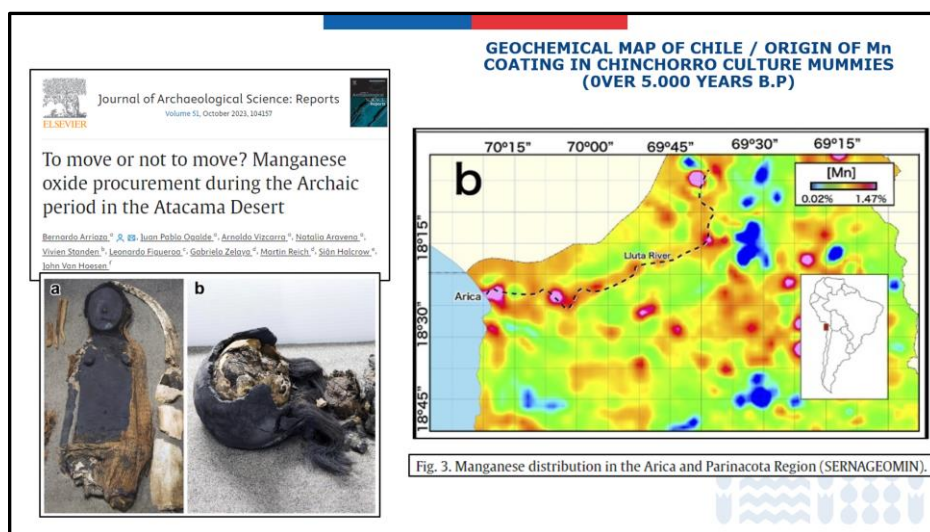


Figure A2.11. Excerpts from the publication by Arriaza et al. (2023), on the use of the geochemical map of manganese in the Arica area, to discover the source of this element, possibly used by the Chinchorro culture. Figure created by J. Lacassie.

A2.4. ASIA

A2.4.1. Armenia

Report by Gevorg Tepanosyan, Olga Belyaeva, Lilit Sahakyan (Center for Ecological Noosphere Studies NAS RA; gevorg.tepanosyan@cens.am, olga.belyaeva@cens.am, lilit.sahakyan@cens.am)

A2.4.1.1. Report of Environmental Geochemical and Radioecological Surveys

The main activities of the Environmental Geochemistry Department at the Center for Ecological-Noosphere Studies (CENS) of the National Academy of Sciences of the Republic of Armenia in 2023 is the continuation of the soil geochemical survey of Armenia regions, as well as the urban geochemistry of street dust.

1. In 2023 within the project funded by the Science Committee of the MES of RA entitled “Development of Geochemical Maps to Ensure Sustainable Agricultural Development and Food Safety – GeoMAS” (1-12/TB, 2019-2023), the results of the soil survey of the Lori region were processed. In total, 158 soil samples (1 sample per 25 km²) were collected and analyzed by X-ray fluorescence spectrometry and gross alpha/beta counting system. The results showed that the contents and spatial distribution of the studied elements (Cr, V, Ti, As, Zn, Cu, Co, Fe, Mn, Ba, Pb, Ca, K and Mo) are conditioned by both the region’s geological bedrock composition and mining activities. Moreover, the k-means clustering combined with the compositional clr-biplot revealed two clusters of samples. The first cluster is represented by Ca and Cu, and partially by Fe and Co. The second one is represented by Cr, V, Ti, As, Zn, Co, Fe, Mn, Ba, Pb, and K. The detailed inspection of the spatial locations and compositional geochemical features of these clusters showed that Cu, Ca, Pb, Ba and Cr play a pivotal role in the formation of the geochemical associations in the studied area.
2. During the period 2022-2023, street dust (186 samples), residential yard deposited dust (113 samples), as well as street dust samples from a transect passing through the capital city of Yerevan (18 samples per season) were collected to investigate the potentially toxic element (PTE) content of dust, PTE seasonal variability, and to assess the potential health risk to the population of Yerevan. The chemical composition data of street dust samples collected from a transect showed that during 1 year the median value and underlying distribution of Cr, V, Mo, Zr, As, Co, Mn, Pb, and Ba remained the same, while statistically significant differences in the median contents of Ti, Ca, K, Sr, Rb, Zn, Cu, and Mn were observed.
3. The Radioecology Department of the Center for Ecological-Noosphere Studies (CENS) of NAS RA implemented studies aiming at the determination of spatial patterns of naturally occurring radioactive materials as well as fallout radionuclides in Armenia’s environment. In 2023 spatiotemporal variation and special patterns of artificial radionuclide ¹³⁷Cs were studied in the soils of Aragats Massif, the highest point of the Republic of Armenia. The reference values of ¹³⁷Cs activity concentrations were estimated based on the data generated during two sampling campaigns of 2016–2018 and 2021. Linear regression analysis was applied for ¹³⁷Cs and altitude using both old and new data, and the regression model was significant. The predicted values from the linear regression model revealed 0.03 Bq/kg increase of ¹³⁷Cs in each meter on average in 2021. Reference values of activity concentrations of ¹³⁷Cs in soils was estimated for 1000–1500, 1500–2000, 2000–2500, 2500–3000, and 3000–3500 m altitudinal intervals. This first assessment of the ¹³⁷Cs

reference activity will be a part of the national inventory assessment of ^{137}Cs and other airborne artificial radionuclides in Armenia's soil.

Articles, papers, atlases and books

- Tepanosyan G., Yenokyan T., Sahakyan L., 2023. Geospatial patterns and geochemical compositional characteristics of molybdenum in different mediums of an urban environment. *Environmental Research*, 239(1), 117340, <https://doi.org/10.1016/j.envres.2023.117340>
- Tepanosyan G., Muradyan V., Tepanosyan G., Avetisyan R., Asmaryan Sh., Sahakyan L., Denk M., Gläßer C., 2023. Exploring relationship of soil PTE geochemical and “VIS-NIR spectroscopy” patterns near Cu–Mo mine (Armenia), 323, 121180, <https://doi.org/10.1016/j.envpol.2023.121180>
- Tepanosyan G., Baldacchini Ch., Asmaryan Sh., Sahakyan L., 2023. Geochemical characterization and health risk assessment of surface and green barrier deposited PM particles in the proximity of a kindergarten, *Building and Environment*, 236, 110234, <https://doi.org/10.1016/j.buildenv.2023.110234>
- Movsisyan N., Albanese S., Pyuskyulyan K., Hovhannisyan S., Belyaeva O., 2023. The spatiotemporal variation, background, and baseline activities of radionuclides in the soil of Aragats Massif (Armenia). *Environ Sci Pollut Res* 30, 82647–82660, <https://doi.org/10.1007/s11356-023-28231-3>

Acknowledgments

1. This work was supported by the RA MESCS Higher Education and Science Committee in the frames of the research project №1-12/20TB entitled “Development of Geochemical Maps to Ensure Sustainable Agricultural Development and Food Safety”.
2. This work was supported by the state budget programme “Geochemical studies of the environment in different regions of Armenia” and RA MESCS Higher Education and Science Committee in the frames of the research project №21T-1E242 entitled “Complex studies of atmospheric particulate matter, dust and associated potentially toxic elements in Yerevan: geochemistry, risks and solutions”

A2.4.2. India

Report by Pradip K. Govil (National Geophysical Research Institute, Hyderabad, India; govilpk@gmail.com)

In 2019, the topsoil geochemical atlas of India was published (refer to the Commission's [2019 Annual Report](#), Section §A2.4.2, p.58), and an article was subsequently published:

Govil, P.K., Keshav Krishna, A. & Dimri, V.P., 2020. *Global Geochemical Baseline Mapping in India for Environmental Management Using Topsoil*. *Journal of the Geological Society of India* volume 95, 9–16; <https://doi.org/10.1007/s12594-020-1381-8>.

Presently the subsoil geochemical data are being processed, and it is expected that an atlas with maps and interpretation will be published in 2024.

A2.4.3. Japan

Report by Atsuyuki Ohta (Geological Survey of Japan, AIST, Tsukuba; a.ohta@aist.go.jp).

The soil geochemical atlas of Japan has been completed, and is expected to be published in 2024.

A2.5. AUSTRALASIA

A2.5.1. Australia

Report by Philip T. Main and Evgeniy Bastrakov (Geoscience Australia; philip.main@ga.gov.au)

Utilising the archive of National Geochemical Survey of Australia (NGSA) samples, the Heavy Mineral Map of Australia (HMMA) has released the full dataset of heavy minerals and final report. The HMMA project, a collaboration between Geoscience Australia (funded through the Australian Government's Exploring for the Future program; <https://www.eftf.ga.gov.au/australias-resources-framework>) and Curtin University, separated and analysed the heavy mineral fraction (those with a specific gravity > 2.9 g/cm³) from 1315 NGSA bottom catchment outlet sediment samples (taken on average from 60 to 80 cm depth). The heavy minerals were separated by a combination of dense fluids and centrifuging before being mounted on cylindrical epoxy mounts. After polishing and carbon-coating, the mounts were subjected to automated mineralogical analysis on a TESCAN® Integrated Mineral Analyzer (TIMA). Using scanning electron microscopy and backscatter electron imaging integrated with energy dispersive X-ray analysis, the TIMA identified 163 unique mineral phases in the NGSA sample set. The dataset, consisting of over 145 million individual mineral grains, was quality controlled and validated by an expert team. The final data report, quantitative mineralogy dataset, minerals property file, samples metadata, and the Heavy Minerals Atlas of Australia (Figure A2.12) are available at: <https://dx.doi.org/10.26186/148916>.

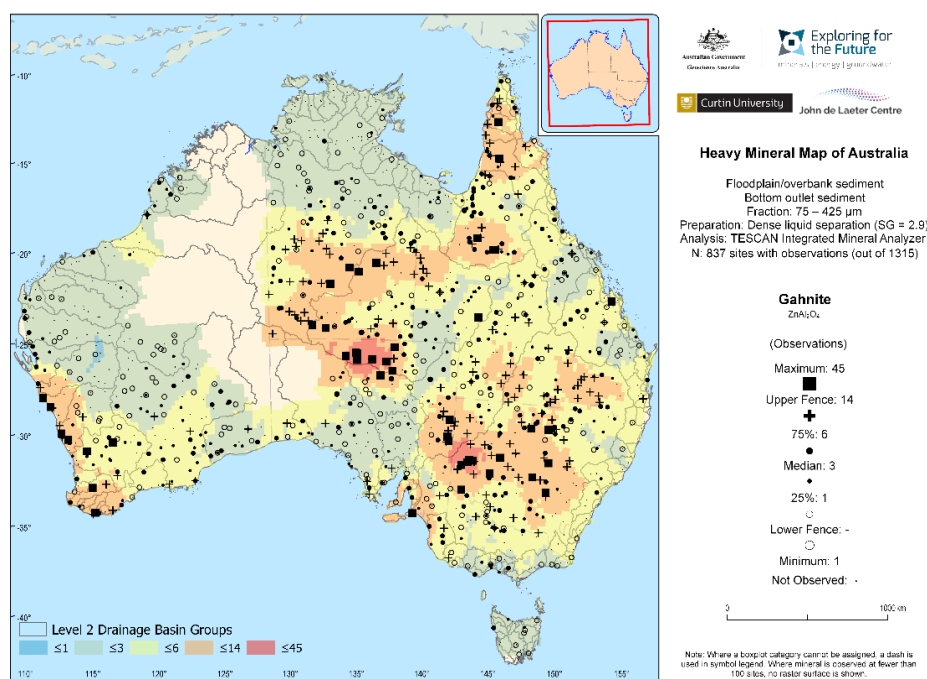


Figure A2.12. An example map from the HMMA atlas, available with the report, showing the distribution of Gahnite within the dataset, overlain on a grided map of the data.

Due to the large volume of data generated by the HMMA project an automated tool was developed. The Mineral Network Analysis (MNA) tool applies network analysis to provide a dynamic, quantitative, and predictive visualisation to uncover complex and otherwise hidden higher-dimensional patterns of diversity and distribution in mineralogical data (Figure A2.13). The main purpose of the MNA tool is to reveal persistent associations (co-occurrences) of heavy minerals, their spatial distribution, and relations to first-order geological and geomorphological features such as geological provinces, mineral deposits, topography, and hydrological catchments. The online tool can be accessed through <https://geoscienceaustralia.shinyapps.io/mna4hm/> with a detailed description of the tool found in the HMMA final report.

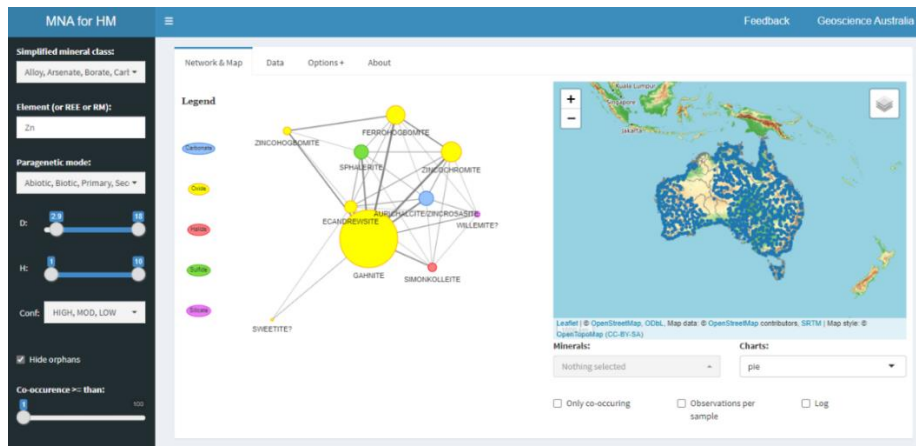


Figure A2.13: Screenshot of the Mineral Network Analysis tool visualising the HMMA data and the data distribution. This view is focused on the relationship and abundance of Zn minerals within the dataset.

As part of Geoscience Australia’s Exploring for the Future program the Levelled Geochemical Baselines project (a project aimed at creating a seamless dataset of surface sediment geochemistry) ~9000 legacy archive samples have been reanalysed. These samples cover several regions within Australia, including Kakadu, Cape York, the Mount Isa region, and near the Canberra region (Figure A2.14). The samples were reanalysed using modern analytical techniques for a suite of 60 chemical elements to gain information on important elements for modern use, such as critical minerals (i.e. Co, Bi, REEs) which weren’t analysed originally. The new analytical data maximise the value of the historical geochemical surveys and will provide new insights into the mineral potential of these regions and improve the quality of geochemical environmental baselines. In addition, these legacy samples can provide valuable insights into areas of Australia that are remote, difficult to access, or have since been developed. Full details of the reanalysis, data, and an atlas of maps can be found at <https://dx.doi.org/10.26186/147861>.

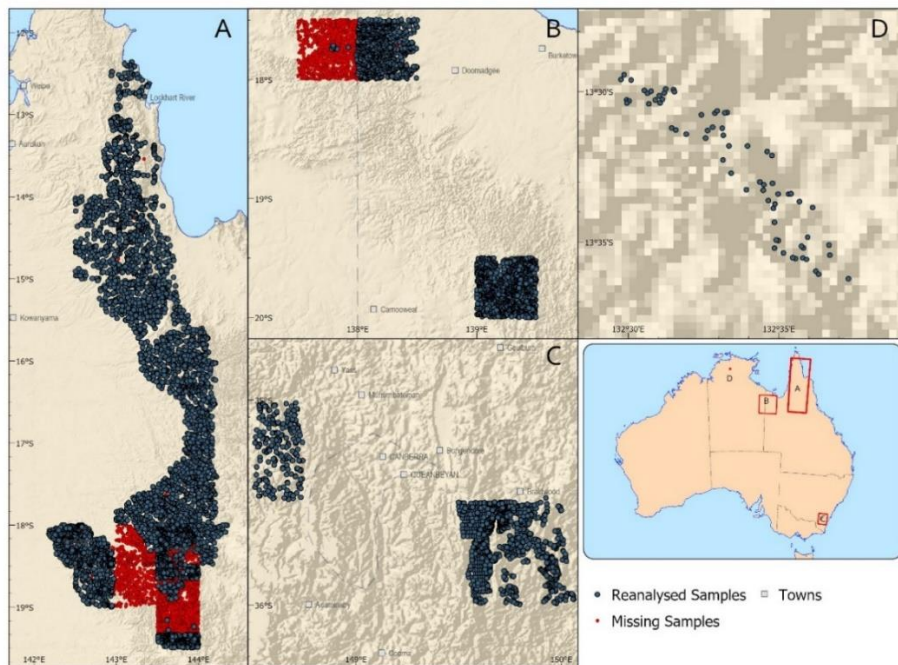


Figure A2.14. Location diagram for the samples analysed as part of this data release. The navy circles represent the samples from each of the surveys that were analysed, with the red circles representing samples that were unable to be analysed due to difficulty in locating sample material. The points are overlain onto the GEODATA 9 Second Digital Elevation Model (Hutchinson et al., 2008).

As part of the Geochemistry for Basin Prospectivity project of the Exploring for the Future program, funded by the Australian Government (<https://www.eftf.ga.gov.au/australias-resources-framework>), Geoscience Australia has been undertaking studies of Australian sedimentary basins. These basins are known for, or have potential for, basin-hosted base-metal mineral systems (Pb-Zn, Cu-Co). A major objective of the study is to provide comprehensive geochemical data for lithologically variable stratigraphic units. This aims to establish the baseline (background) geochemistry and reveal geochemical variability that might be related to the evolution of the mineral systems.

As a first step, 187 legacy samples, mostly from deposits and surrounds in the Proterozoic McArthur Basin and Stuart Shelf, originally collected and analysed from the 1970s to the 1980s, have been reanalysed. They now include a fuller suite of elements using state-of-the-art methods and instrumentation. The results are released in the report by Champion et al. (2023a).

A new sampling program (2020-2024), completed in collaboration with the Geological Survey of South Australia (GSSA), focussed on the Neoproterozoic part of the Stuart Shelf region of the Adelaide Rift Complex in South Australia. The first analytical report on 534 samples has been published by Geoscience Australia (Champion et al. 2023b). The rest of the data, comprising a further 354 samples, is being prepared for publication. All the reports include comprehensive quality assurance and control analysis.

References

- Champion, D.C., Huston, D.L., Bastrakov, E., Main, P., Gilmore, S., Byass, J., Webber, S. 2023. Exploring for the Future – Baseline whole rock geochemistry Data release — geochemistry of drill core samples from the Stuart Shelf region, South Australia. GA Record: 2023/007. Geoscience Australia, Canberra. <https://dx.doi.org/10.26186/146954>
- Champion, D., Huston, D., Bastrakov, E., Krapf, C., Fabris, A., Gilmore, S., Byass, J., Webber, S. 2023. Geochemistry of drill core samples from the Stuart Shelf region, South Australia. GA Record 2023/39. Geoscience Australia, Canberra. <https://dx.doi.org/10.26186/148538>
- Caritat, P. de, Walker, A.T., Bastrakov, E., Main, P., McInnes, B.I.A. 2023. The Heavy Mineral Map of Australia Project. Final Data Release. National Dataset and Atlas. GA Record 2023/42. Geoscience Australia, Canberra. <https://dx.doi.org/10.26186/148916>
- Main, P., Champion, D., Byass, J., Gilmore, S. 2023. Legacy stream sediment sample reanalysis - Red River, Hann River, Ebagoola, Coen, Georgetown, Kakadu, Araluen, Brindabella, Hedleys Creek, and Mammoth Mines Surveys. Record 2023/013. Geoscience Australia, Canberra. <https://dx.doi.org/10.26186/147861>

A2.5.2. New Zealand

Report by Adam P. Martin (GNS Science; a.martin@gns.cri.nz)

The national geochemical soil baseline dataset for New Zealand has now been published. The *Geochemical Atlas of Aotearoa New Zealand* (Martin et al., 2023) is available for free at <https://shop.gns.cri.nz/sr-2023-23-pdf/>. The atlas shows the data as an inverse distance weighted interpolation and a Kriged interpolation (Figure A2.15) and is accompanied by a wealth of information in the appendices. A number of outputs will utilise this dataset, including *Determining Background Soil Concentration of Trace Elements in New Zealand* (Cavanagh et al., 2023), with the results of this report also available freely online in various configurations:

- i. Predicted Background Soil Concentrations, New Zealand
<https://iris.scinfo.org.nz/layer/114281-pbc-predicted-background-soil-concentrations-new-zealand-h3-resolution-9/>

- ii. Trace element background concentration explorer
<https://experience.arcgis.com/experience/4e6e25842cc6427ca850bdf644010922/page/Explorer/>
- iii. Trace element background concentration explorer, percentile maps
<https://experience.arcgis.com/experience/4e6e25842cc6427ca850bdf644010922/page/Percentile-Maps/>

A national New Zealand community science project has now been running for c. 2.5 years looking at soil metal concentration in domestic gardens. It is called SoilSafe: Aotearoa (<https://soilsafe.auckland.ac.nz/>) and is a partnership between GNS Science, The University of Auckland and Macquarie University. More than 1000 homes and more than 4650 samples have been analysed and this work is complementing the New Zealand geochemical baseline endeavours. Adjacent to this work are community science projects promoting education and outreach about soil for younger people (SoilSafe Kids: <https://soilsafe.auckland.ac.nz/soilsafe-kids/>). Two, relevant MSc thesis have been successfully completed in 2023:

- a. Sistien Sari, Land use impact on soil quality: A study of carbon and nitrogen content and trace element concentration in Wellington’s urban environment, New Zealand (<https://researchspace.auckland.ac.nz/discover>).
- b. Declan Fisher, Heavy metals in the household dust of Aotearoa, New Zealand: what factors influence their concentrations and what risks do they pose to human health (<https://researchspace.auckland.ac.nz/handle/2292/65002>).

Future work in 2024 will include journal article(s) utilising the national geochemical baseline and journal articles utilising urban baseline datasets for New Zealand cities.

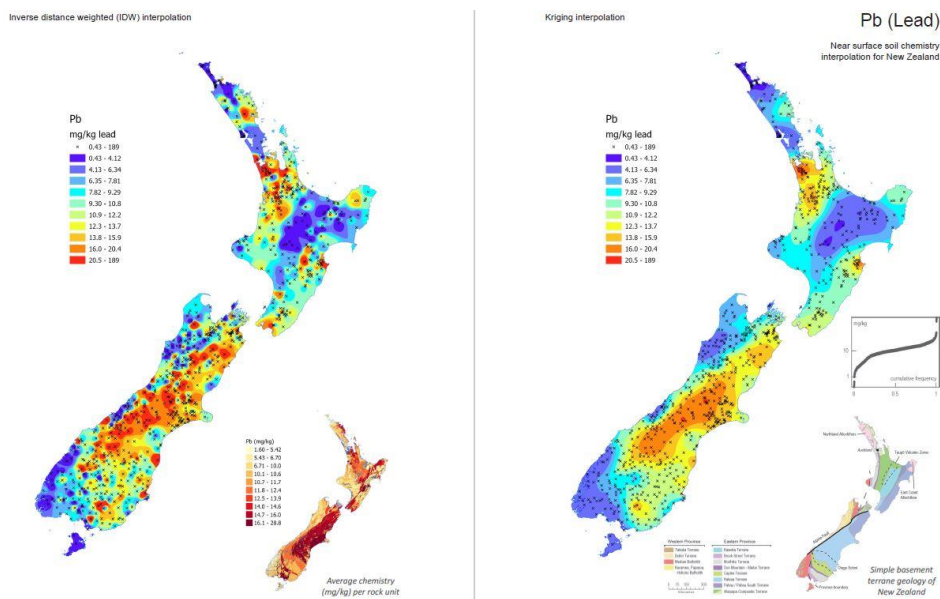


Figure A2.15. Example atlas page layout for lead (Pb) from the Geochemical Atlas of Aotearoa New Zealand (Martin et al., 2023).

Articles, papers, atlases and books

Cavanagh, J.E., McNeill, S., Roudier, P., Martin, A.P., Turnbull, R.E., 2023. Determining background soil concentration of trace elements in New Zealand. Landcare Research Report for Envirolink Advice Grant 2321-HBRC267.

Martin, A.P., Turnbull, R.E., Roudier, P., Cavanagh, J., Rattenbury, M.S., Rogers, K.M., Vandergoes, M.J., Reyes, L., Gard, H.J.L., Richardson, S.J., Clarkson, B.R., Kah, M., 2023.

Geochemical atlas of Aotearoa New Zealand. Lower Hutt, N.Z.: GNS Science. GNS Science report 2023/23. 247 p.; doi: 10.21420/P9BK-7016.

Oral and poster presentations

Martin, A.P., Turnbull, R.E., Roudier, P., Cavanagh, J., Rattenbury, M.S., Rogers, K.M., Vandergoes, M.J., Reyes, L., Gard, H.J.L., Richardson, S.J., Clarkson, B.R., Kah, M., 2023. Geochemical atlas of Aotearoa New Zealand. p. 152 IN: Frontin-Rollet, GE and Nodder, SD (eds) Geoscience Society of New Zealand Annual Conference 2023: Abstracts Volume GSNZ Miscellaneous Publication 164A: 280pp.

A2.6. EUROPE

A2.6.1. EuroGeoSurveys Geochemistry Expert Group (EGS-GEG) activities

Report by by Philippe Négrel (Chair, BRGM; p.negrel@brgm.fr)

A summary of the 2023 activities was presented at the joint Annual Meeting of the IUGS-CGGB, EGS-GEG and ASGMI-GG in Naples Italy (refer to [Appendix 1](#)).