2024
ANNUAL REPORT

of the

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
COMMISSION
ON
GLOBAL GEOCHEMICAL BASELINES

January 2025

Blank back page

CONTENTS

Blank back page

2024 ANNUAL REPORT of the
IUGS COMMISSION ON GLOBAL GEOCHEMICAL BASELINES
URL: http://www.globalgeochemicalbaselines.eu/

1. TITLE OF CONSTITUENT BODY

Commission on **G**lobal **G**eochemical **B**aselines of the International Union of Geological Sciences (IUGS). For the sake of brevity, it will henceforth be referred to as either CGGB or Commission.

1.1. Establishment of CGGB

The current Commission traces its origins to 1988 as Project 259 *'International Geochemical Mapping'* of UNESCO's International Geological Correlation Programme (IGCP), now known as the International Geoscience Programme. IGCP is the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and IUGS cooperative enterprise. This first phase was concluded with the publication of UNESCO Report 19, '*A Global Geochemical Database for Environmental and Resource Management*' (Darnley *et al.*, 1995 – known as the 'Blue Book' because of the colour of its cover).

From 1993 to 1997, the project continued under the auspices of IGCP as Project 360, '*Global Geochemical Baselines*'. After completing the two IGCP projects, the International Union of Geological Sciences (IUGS), in collaboration with the International Association of Geochemistry (IAGC), established the Task Group on '*Global Geochemical Baselines*' in 1998.

Following the UNESCO decision on the 13th of November 2013 at its 37th session in Paris to establish the International Centre on Global-Scale Geochemistry in Langfang, P.R. China (http://www.globalgeochemistry.com/ - see Section §5.1), the councillors of the IUGS Executive Committee (2012-2016) at their 68th sitting on the 28th of January 2015 in Vancouver, Canada, judged the proposal for the establishment of an IUGS Commission on Global Geochemical Baselines positively (see p.10 of the Minutes: https://www.iugs.org/_files/ugd/f1fc07_a7026713000b4d2baa13ea9985c3d5ef.pdf?index=true). This decision was reaffirmed at the 70th sitting on the 26-27 August 2016 in Cape Town, South Africa (see p.14 of the Minutes: https://www.iugs.org/_files/ugd/f1fc07_a7026713000b4d2baa13ea9985c3d5ef.pdf?index=true). Finally, the IUGS President, Professor Roland Oberhänsli, proposed the upgrading of the Task Group to Commission at the Fourth Ordinary Session of the IUGS Council meeting in Cape Town (South Africa) on the 31st of August 2016, which the IUGS Council members approved.

2. OVERALL OBJECTIVES

The mission of the Commission is to:

(i) Develop a Manual of Standard Methods 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.

Environmental and natural resource managers worldwide urgently need a harmonised global geochemical database. To achieve this goal, the Commission is establishing an international network of applied geochemists worldwide 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 through workshops and short courses to build the capacity for conducting geochemical mapping programmes in countries worldwide.
- ✓ Organising periodic sessions in international symposia and conferences to foster communication among the geochemical mapping community.
- ✓ Developing standards for global- and regional-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 that meet harmonisation standards.
- ✓ Preparing complete metadata for the various certified projects, and
- ✓ Preparing a harmonised global geochemical database and atlas (the final goal).

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 by establishing 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 following:

- 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/), and
- The objectives of the IUGS Resourcing Future Generations initiative (https://www.iugs.org/rfg).

3.1. Activities aligned with United Nations Sustainable Development Goals

Geochemistry, the geoscience studying the chemistry of earth materials that humans are in touch with and use, contributes to a variable degree to the fulfilment of at least 15 out of the 17 UN Sustainable Development Goals, namely: (1) No poverty; (2) Zero hunger; (3) Good health and well-being; (4) Quality of education; (5) Gender equality; (6) Clean water and sanitation; (7) Affordable and clean energy; (8) Decent work and economic growth; (9) Industry, innovation and infrastructure; (10) Reduced inequalities; (11) Sustainable cities and communities; (12) Sustainable development; (13) Climate action; (14) Life below water; (15) Life on land, and (17) Partnership for the goals. Table 1 shows how the UN Sustainable Development Goals are implemented in Chile with respect to information and results generated by applied geochemical projects.

Table 1. Implementation of the United Nations 17 Sustainable Development Goals in Chile with respect to Applied Geochemistry. Juan Pablo Lacassie Reyes (Geological and Mining Survey of Chile), Councillor of the Commission' s Steering Committee, compiled the table below.

N°	United Nations Sustainable Development Goals	Alingment				Work carried out for the implementation of UN Goals in Chile
		Strong	Medium	Weak	None	
1	**No poverty:** End poverty in all its forms everywhere		X			Supervision of the geochemical map of Chile. Through it, prospective information is generated, with mining being one of the fundamental pillars of Chile's economic development, including job creation.
2	**Zero hunger:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture	X				Supervision of the geochemical map of Chile. Through it, information on geochemical baselines of soil and sediments is generated, allowing the environmental evaluation of extensive areas of arable soil.
3	**Good health and well-being:** Ensure healthy lives and promote well-being for all at all ages	X				Supervision of the geochemical map of Chile. Through it, information on geochemical baselines of soil and sediments is generated, allowing the environmental evaluation of extensive areas of arable soil. Additionally, the generation of geochemical baselines of urban soil in Chile is being promoted, for environmental purposes.
4	**Quality of education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all			X		Chile's geochemical mapping programme has promoted (i) the dissemination of geochemistry at the government and community levels and (ii) the formation of advanced human capital through degree theses in geology and geochemistry.
5	**Gender equality:** Achieve gender equality and empower all women and girls			X		Care has been taken to generate work teams with a sense of parity including the participation of 6 women and 7 men. The current need to balance the gender parity in the profesional team has been emphasised.
6	**Clean water and sanitation:** Ensure availability and sustainable management of water and sanitation for all	X				Supervision of the geochemical map of Chile. Through it, information is generated on geochemical baselines of soil and sediments, all of them materials that present a constant interaction with surface and groundwater, potentially affecting their quality.
7	**Affordable and clean energy**: Ensure access to affordable, reliable, sustainable and modern energy for all		X			Supervision of the geochemical map of Chile. Through it, prospective information is generated that promotes the acquisition of critical raw materials for the global energy transition (Cu, REE, Co, Li, *etc* .).
8	**Decent work and economic growth:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	X				Supervision of the geochemical map of Chile. Through it, prospective information is generated, with mining being one of the fundamental pillars of Chile's economic development, including job creation.
9	**Industry, innovation and infrastructure:** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation			X		Supervision of the geochemical map of Chile. Through it, prospective information is generated that promotes the acquisition of critical raw materials for the generation of resilient infrastructure (*e.g* ., Fe, Al, Ti, Cr, Ni).
10	**Reduced inequalities:** Reduce inequality within and among countries			X		Coordination of international cooperation programmes aimed at training professionals from other countries (e.g., Honduras, Rep. of Guyana) in geological cartography, geochemistry and metallogenesis. This is in order to promote the sustainable development of these countries.
11	**Sustainable cities and communities:** Make cities and human settlements inclusive, safe, resilient and sustainable		X			Supervision of the geochemical map of Chile. Through it, information on geochemical baselines of soil and sediments is generated, allowing the environmental evaluation of extensive areas used by agricultural communities. Additionally, the generation of geochemical baselines of urban soil in Chile is being promoted for environmental purposes.
12	**Sustainable development:** Ensure sustainable consumption and production patterns				X	-
13	**Climate action:** Take urgent action to combat climate change and its impacts			X		Supervision of the geochemical map of Chile. Through it, prospective information is generated that promotes the acquisition of critical raw materials for the global energy transition (Cu, REE, Co, Li, *etc* .).
14	**Life below water:** Conserve and sustainably use the oceans, seas and marine resources for sustainable development			X		Supervision of the geochemical map of Chile. Through it, the first geochemical and mineralogical baselines of extensive river basins in Chile have been generated. All of these basins discharge their sediments into the sea, along the nearly 4000 km of Chilean coast.
15	**Life on land:** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	X				Supervision of the geochemical map of Chile. Through it, information on geochemical baselines of soil and sediments is generated, allowing the environmental evaluation of extensive areas of arable soil. Additionally, the generation of geochemical baselines of urban soil in Chile is being promoted for environmental purposes.
16	**Peace, justice and strong institutions:** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels				X	-
17	**Partnership for the goals:** Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development				X	-

4. STRUCTURE AND ORGANISATION

The Commission is led by a Steering Committee, which coordinates the activities of four Technical Committees and the contributions made by regional representatives. This organisational structure is continuously under review and, when necessary, 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-Sanjuan, *Instituto Geológico y Minero de España*
Public Relations and Finance: Ariadne Argyraki, *Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas*
Treasurer: Christina Stouraiti, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas
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 as of the 1st of September 2024 are:

Chair: Alecos Demetriades, *former Director of the Division of Geochemistry and Environment, Institute of Geology and Mineral Exploration, Athens, Hellas (retired)*
Deputy-chair: Maria João Batista, *Laboratório Nacional de Energia e Geologia, Portugal*
Scientific Secretary: Paula Adánez-Sanjuan, *Instituto Geológico y Minero de España*
Public Relations and Finance: Ariadne Argyraki, *Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas*
Treasurer: Christina Stouraiti, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas
Assistant Treasurer: Zacharenia Kypritidou, *Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas*
Councillors: Juan Pablo Lacassie Reyes, *Geological and Mining Survey of Chile*
Rose Turnbull, *Geological Survey and Resource Strategy Division, Department of Energy, Mines, Industry Regulation and Safety, Government of Western Australia*
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
Deputy Chair: Iván Martín-Méndez (Spain)

Supervises developing and coordinating sampling protocols in various climatic and geomorphological provinces worldwide.

4.3. Analytical Committee

Chair: Gwendy Hall, *Canada* (retired)
Deputy Chair: Manfred Birke, *Germany* (retired)

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 sample information and analytical results database.

4.5. Public Relations and Finance Committee

Chair: Ariadne Argyraki, *Hellenic Republic*

Advertises and promotes the project's aims, objectives, and achievements worldwide, including through the Internet, and takes responsibility for securing 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 (retired)
Robert G. Garrett, Ottawa, Ontario, Canada (retired)
Flor de Maria Harp Iturribarría, 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
Mark Rattenbury, GNS Science, Avalon, Lower Hutt, 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 then IUGS Task Group on Global Geochemical Baselines (1997-2016) actively prepared the successful proposal initially submitted to UNESCO in 2009.

One of the Commission's most important tasks was establishing formal collaboration with the UNESCO Centre. Although there appears to be an overlap in the objectives of the Commission and the Centre, the IUGS mandate is pretty straightforward, 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 partnership 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 June 30, 2023. The procedure for its renewal was initiated with the evaluation of the ICGG (for more details on the procedure that was followed, refer to the Commission's 2022 Annual report, pp. 53−82).

The global geoscientific community needs to be aware that 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), and to Section §6.4.3.3 of this report. This statement clearly explains the reason for never consulting the International Councillors, who are all Commission members.

Unofficially, the Commission has learned that UNESCO renewed in March 2023 the agreement for the operation of the ICGG under its auspices for a second six-year term (https://unesdoc.unesco.org/ark:/48223/pf0000384841). The extract below from page 2 of this UNESCO decision is very interesting:

> "*3. The evaluation was carried out by an independent expert appointed by UNESCO. It consisted of a review of the necessary documents and interviews with relevant stakeholders, including parties to the Agreement, staff of the Centre and related institutions as well as those involved in ICGG activities*".

An objective observer has the right to question UNESCO's decision to appoint a Chinese University Professor of Palaeontology, who happens to be involved in Geoparks, to be an "*independent*" and "*objective*" evaluator. There is an apparent "*conflict of interest*".

Another interesting piece of information that the International Councillors in the UNESCO Centre's Governing Council and Scientific Committee were not aware of is the following statement:

> "*5. …… it has formulated six international guidelines and manuals to promote global geochemical mapping technologies* ".

These supposedly "*international guidelines and manuals*" have not been approved by the Centre's International Scientific Committee since the ICGG management never sent them for review. The same applies to the material used to train developing countries in geochemical mapping methods.

While preparing the Commission's annual report, the ICGG was contacted several times to request input about its activities during 2024. The ICGG never replied to these requests.

5.2. Interface with other International Organisations

The interface with other international organisations is reported in the Commission's 2023 Annual Report, Section §5, on pages 8 to 12. Any collaboration with the same organisations or new ones is reported in Appendices 1 and 2, which contain (i) the minutes of the joint annual meeting of IUGS-CGGB, EGS-GEG & ASGMI-GEG and (ii) Regional Reports, respectively.

6. ACTIVITIES IN 2024

6.1. 79th IUGS Executive Committee Meeting

The 79th IUGS Executive Committee (EC) meeting was held in Nairobi (Kenya) from Monday, 18th to 23rd February 2023. Gloria Namwi Simubali, Commission's 2nd Deputy Chair and Director of the Geological Survey of Namibia, presented on Monday, 19th of February 2024, the CGGB 2023 activities report at the open session of the 79th IUGS EC meeting (Fig. 1). The original PowerPoint presentation can be downloaded from the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZEIf55Zx0vuwmbYXrFMwWXcg1DODpTKVQt7.

The report included:

1) A short historical introduction.
2) Promotion of the IUGS Manual of Standard Methods at conferences.
3) Organisation of a two-day workshop on the applied geochemical methods described in the IUGS Manual of Standard Methods on the occasion of the 38th SEGH conference in Athens (1st and 2nd July 2023), and a keynote presentation about the IUGS Manual of Standard Methods.
4) Oral presentation of the IUGS Manual of Standard Methods at the Goldschmidt 2023 conference in Lyons (France).
5) Presentation about the work carried out in IGCP Project 665 – Sustainable Use of Black Soil Critical Zone (Fig. 2) at the Academic Seminar of Chinese IGCP projects, and
6) Reference to the four CGGB publications (see https://www.globalgeochemicalbaselines.eu/content/91/publications-/).

Figure 1. Gloria Namwi Simubali (Commission's 2nd Deputy Chair and Director of the Geological Survey of Namibia) delivered the CGGB's report. Photograph by IUGS Secretariat Office personnel.

After the EC meeting, the IUGS organised the Geoscience Event for Africa on the 22nd and 23rd of February 2024, where African Geological Surveys and other Geoscience institutions participated with presentations. Following the breakaway session, the results and requirements were summarised. One of the requirements was the training of African geoscientists in applied geochemical methods, which the CGGB shall undertake (refer to report: https://www.iugs.org/_files/ugd/f1fc07_f37dad4f2b4049f89233a0a3224a5c5d.pdf?index=true).

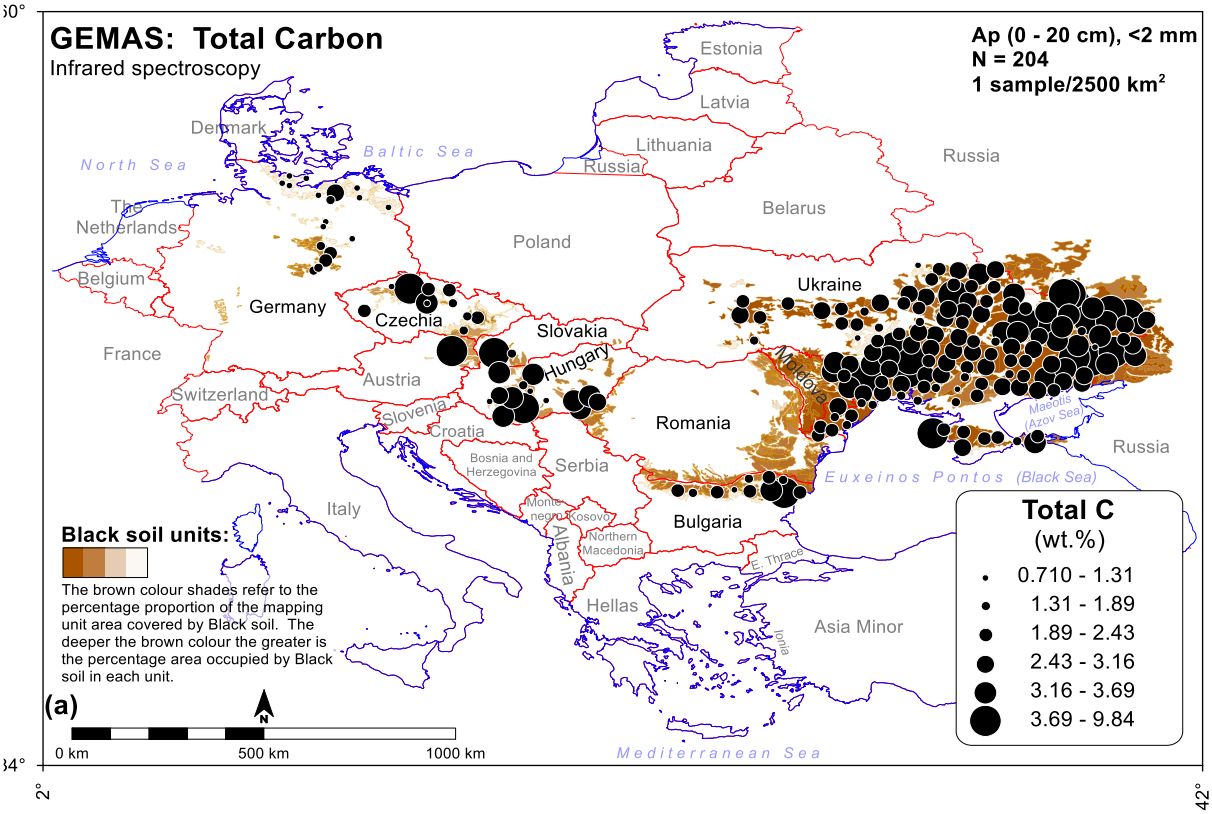


Figure 2. Distribution of Total Carbon in the ploughed agricultural soil of the European Black Soil regions. Plotted by Alecos Demetriades with Golden Software's MapViewer version 8. Note: GEMAS is the acronym for the EuroGeoSurveys Geochemistry Expert Group's project "Geochemical Mapping of Agricultural and Grazing land soil".

6.2. 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 Expert Group of ASGMI (Ibero-American Association of Geological and Mining Surveys; ASGMI-GEG) in collaboration with colleagues from the Czech Geological Survey.

The Joint Annual Meeting of the IUGS-CGGB, EGS-GEG and ASGMI-GEG) was hosted by the Czech Geological Survey at its premises in Prague from the 19th to the 21st of September 2024.

There were 23 participants in total from Austria, Czech Republic, Finland, France, Germany, Hellenic Republic, Norway, Germany, Poland, Slovenia, Spain, Sweden, and The Netherlands (refer to meeting minutes in Appendix 1). The meeting was broadcast, and colleagues from many parts of the world could participate virtually.

The first day was focused on the activities carried out by the IUGS-CGGB, EGS-GEG & ASGMI-GEG for the last quarter of 2023 and the first nine months of 2024. The following topics were discussed:

- future collaborations,

- publications,
- workshop proposals,
- sessions in international conferences for 2025, *etc.*

The IUGS-CGGB presented its activities during 2024, especially the successful session of the 4th Arthur Darnley Symposium, and the three-day workshop on the occasion of the 37th International Geological Congress in Busan (see article in IUGS E-Bulletin No. 208-209) and Section §6.4.4.1 in this report.

The EuroGeoSurveys Secretary General, Julie Hollis, presented virtually the EuroGeoSurveys Strategic Directions.

The second day was organised as a seminar during which participants presented various geochemical work and projects carried out by the geological surveys; all the original PowerPoint presentations are available from a dedicated pCloud folder.

As the EGS-GEG celebrated the 10th anniversary of the publication of the GEMAS project atlas, the special guest was Dr. Clemens Reimann (EGS-GEG chair 2006-2017), who led the GEMAS project, and presented its historical outline and impact on the geochemistry of European agricultural and grazing land soil.

On the third day, the meeting participants visited the Příbram Pb-Ag mining area, the separation line of the state enterprise DIAMO processing of tailings after the U-ore mining, and the open-air mining museum in the Březové Hory area, approximately 2 km west of Příbram city centre.

6.3. Other Meetings and Work Performed

6.3.1. Monthly IUGS E-Bulletin publication

Since May 2021, the IUGS E-Bulletin editorial team has encouraged Commissions, Task Groups, and Initiatives to send a concise report of their activities. The Commission has responded when having any vital news to transmit. Its 2024 contributions were published in the following eight E-Bulletins:

- IUGS E-Bulletin No. 202 – January 2024 (p.19−21)
- IUGS E-Bulletin No. 203 – February-March 2024 (p.7−9)
- IUGS E-Bulletin No. 204 – April 2024 (p.9−10)
- IUGS E-Bulletin No. 205-206 – May-June 2024 (p.7−9)
- IUGS E-Bulletin No. 207 – July 2024 (p.6)
- IUGS E-Bulletin No. 208-209 – August-September 2024 (p.8−9)
- IUGS E-Bulletin No. 210 – October 2024 (p.7−8)
- IUGS E-Bulletin No. 211 – November 2024 (p.5)
- IUGS E-Bulletin No. 212 – December 2024 (not yet uploaded to IUGS website).

The Commission would like to acknowledge Gurmeet Kaur, Giuseppe di Kapua, Yamirka Rojas, and Daniela Muñoz-Granados for their excellent communication skills.

6.3.2. Reporting student activities at the Athens Science Festival 2024

The University of Athens (Hellenic Republic) made a notable contribution to the recent Athens Science Festival, which took place between the 16th and 21st of April 2024. Through a dynamic booth centred on "*Metals in a Changing World*," the university highlighted its research and educational initiatives. Geochemistry and ore geology students from the Department of Geology

and Geoenvironment led this effort under the supervision of Professor Ariadne Argyraki (CGGB Public Relations & Finance officer), offering a range of engaging demonstrations and discussions that captivated festival attendees.

One of the standout features was a demonstration showcasing the rapid extraction of pure copper in seconds (Fig. 3). The booth also tackled environmental issues associated with mining, presenting sustainable methods for treating mining waste and mitigating its impact on the ecosystem. Deep-sea mining was another critical topic of interest, with experts from the University exploring the potential and environmental considerations of mineral extraction from the ocean floor. This discussion emphasised the delicate balance between resource acquisition and marine conservation.

In addition to these technical topics, the booth promoted citizen science initiatives, inviting visitors to help monitor seawater quality in the Aegean Volcanic Arc. This interactive activity aimed to raise public awareness about marine contamination and the importance of community involvement in scientific research. Festival-goers were enthusiastic about contributing to ongoing environmental monitoring efforts, highlighting the importance of public engagement in scientific activities.

The audience showed particular interest in the FOREGS periodic table posters displayed at the booth (Fig. 4). These posters, detailing the geochemical distribution of elements across Europe, provided an educational and visually appealing resource that enhanced the overall experience for visitors. They sparked many conversations and inquiries, demonstrating an intense public curiosity about geochemical mapping and its implications. This event underscored the commitment of applied geochemistry to addressing contemporary scientific challenges and inspired attendees, reinforcing the role of science festivals in connecting academia with the broader community.

For teaching purposes, it is strongly recommended to download the five periodic tables:

- The FOREGS periodic table of residual topsoil in Europe
- The FOREGS periodic table of residual subsoil in Europe
- The FOREGS periodic table of stream water in Europe
- The FOREGS periodic table of stream sediment in Europe
- The FOREGS periodic table of floodplain sediment in Europe

Each periodic table is 90 cm in height and 130 cm in width. For a full impact, it is recommended that each table be printed on canvas at 120 cm height and 173 cm width.

Figure 3. Students showcase the rapid extraction of pure copper using the FOREGS periodic table of residual topsoil in Europe as a tablecloth (see Fig. 4). Photograph taken by Ariadne Argyraki, Commission's Public Relations and Finance officer.

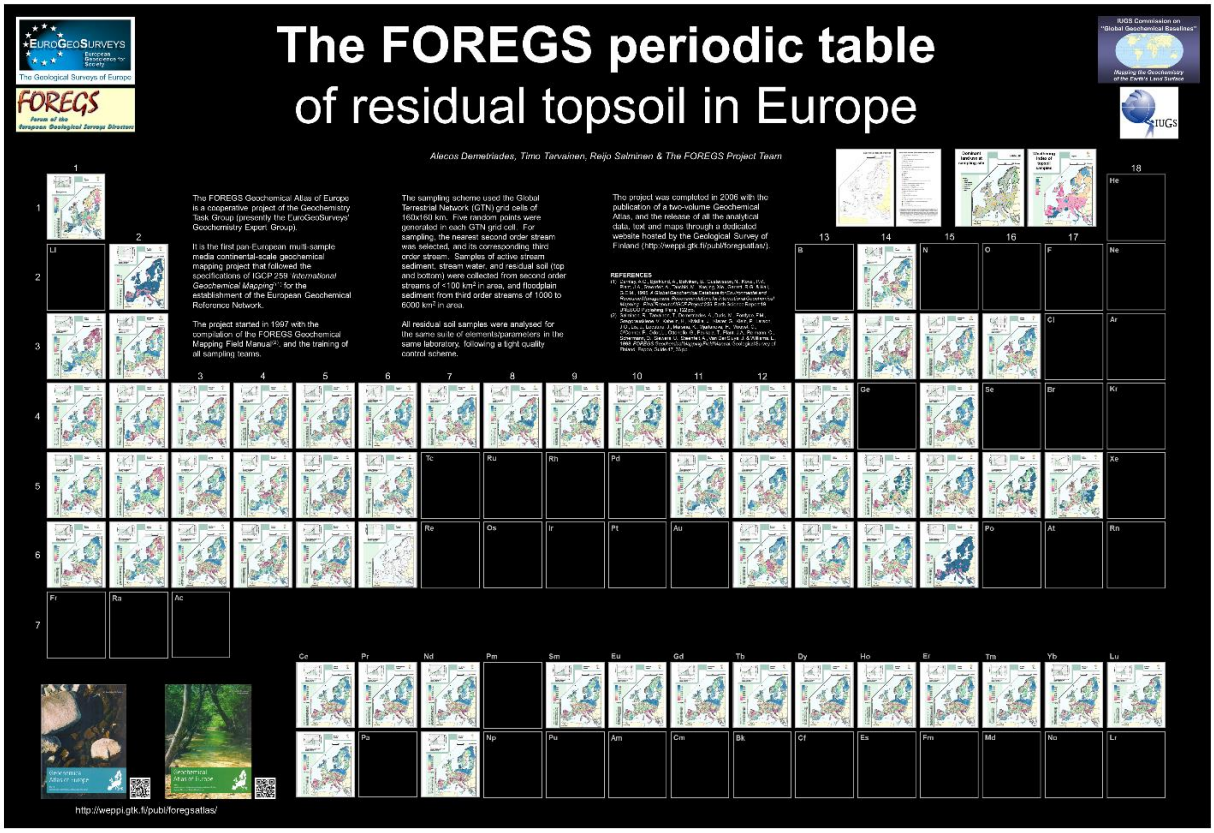


Figure 4. The [FOREGS periodic table of residual soil in Europe](#).

6.3.3. Webinar: Reporting the European groundwater geochemistry and promoting the IUGS Manual of Standard Methods

Alecos Demetriades (Chair of CGGB's Sampling Committee) presented on the 17th of May 2024 '*EGG: European Groundwater Geochemistry*' as part of the Society of Environmental Geochemistry and Health's Fellows Virtual Seminars. This is a follow-up to the presentation delivered on the occasion of the IUGS60 event for World Water Day on the 22nd of March 2022. In the introduction, it was pointed out that:

(i) slightly more than 1% of the water on Earth is fresh and available for use;

(ii) two-thirds of our freshwater is used in agriculture to grow our food;

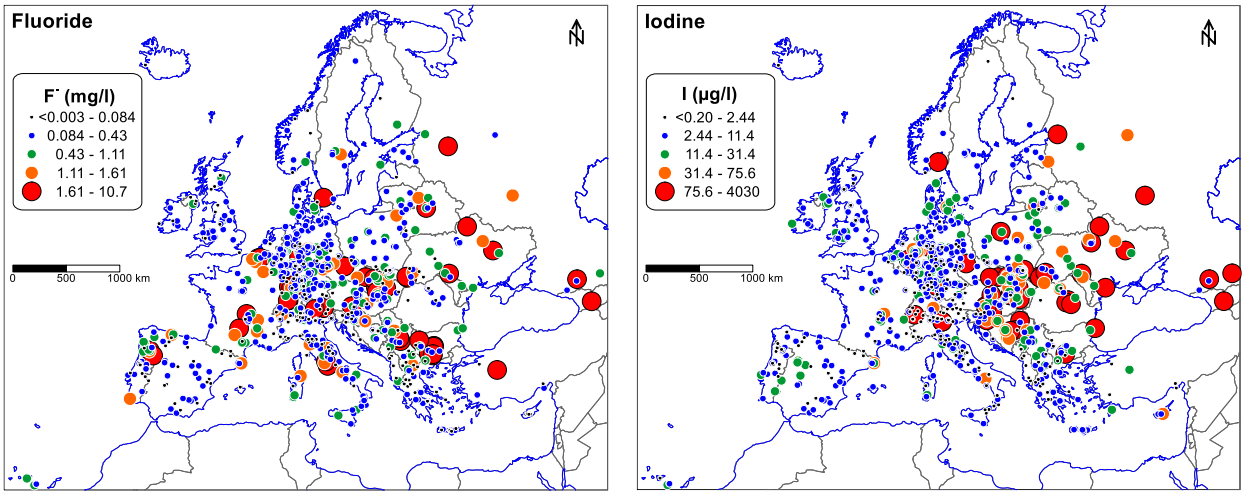
(iii) with 83 million more people on Earth each year, water demand will keep going up unless we change the ways we use it;

(iv) 1.1 billion people in developing countries have inadequate access to clean and safe water, and

(v) about 1.4 million children will die each year from lack of access to safe drinking water and adequate sanitation.

The EuroGeoSurveys Geochemistry Expert Group used the geochemistry of bottled mineral water as a 'proxy' for that of groundwater. Although the idea of using bottled mineral water was considered absurd to start with, in the end, it was concluded that the new atlas of the geochemistry of bottled mineral water is a valuable addition to the 'Geochemical Atlas of Europe' series (Figs. 5 & 6). As the Fellows's seminars are mainly focused on young and early career researchers, valuable advice was given for the designing of a geochemical project and the importance of verifying the quality of the generated analytical results. It was strongly recommended that the

International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network be consulted.



(a) (b)

Figure 5. Distribution of (a) Fluoride and (b) Iodine in bottled mineral water as a proxy to groundwater geochemistry. Maps plotted by Alecos Demetriades (IUGS-CGGB Steering Committee member) with Golden Software's MapViewer version 8.

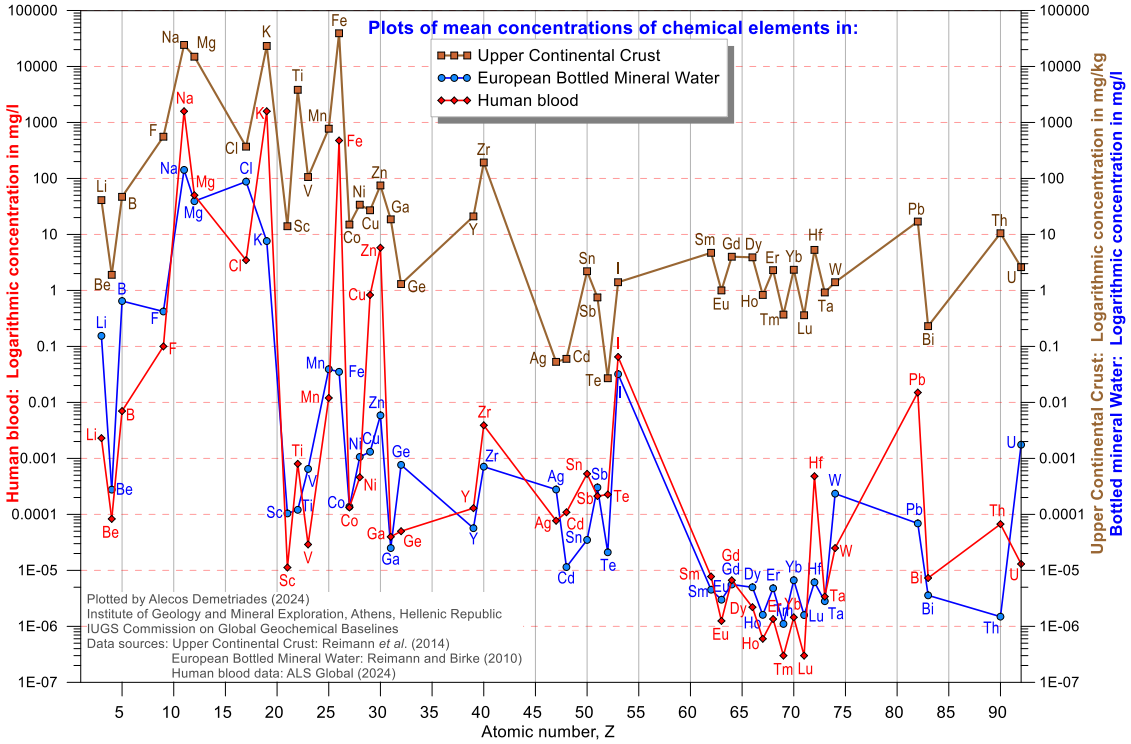


Figure 6. Distribution of chemical elements in the upper continental crust, European bottled mineral water and human blood. Note the overall pattern correlation among the three data sets, proving humans' close relationship with earth materials. The graph was plotted by Alecos Demetriades (IUGS-CGGB Steering Committee member) with Golden Software's Grapher version 22.

6.3.4. Webinar: Sample preparation: Key stage to generate geochemical information

The Geochemistry Expert Group of the Ibero-American Association of Geological and Mining Surveys (ASGMI-GEG) organised on the 13th and 14th of November 2024 the second webinar in the series "*Geochemical Knowledge for Societal Use*" with the title "*Sample Preparation: Key Stage to Generate Geochemical Information*" (Fig. 7), which was coordinated by the Instituto

Hondureño de Geología y Minas. This webinar offered a valuable opportunity to discuss sample preparation techniques and standard procedures in various matrices and sampling environments as key to the quality of geochemical data and their application in areas such as environmental planning and sustainable development.

Figure 7. Logo of the ASGMI-GEG webinar "Sample Preparation: Key Stage to Generate Geochemical Information" designed by Tatiana Cárdenas Prieto (daughter of Gloria Prieto, Advisory Panel Councillor of the IUGS-CGGB Steering Committee).

The guest speakers were:

- Prof. Hassina Mouri, IUGS President, congratulated the ASGMI-GEG for this initiative.
- Dr. Alecos Demetriades, Chair of the IUGS Commission on Global Geochemical Baselines, presenting the sample preparation of rock, soil, stream sediment, overbank and floodplain sediments described in the IUGS Manual of Standard Methods.
- Dr. Anna Ladenberger, Deputy Chair of EuroGeoSurveys Geochemistry Expert Group, who presented the geochemical sample preparation methods of the Geological Survey of Sweden, and
- Dr. Kate Campbell (USA Geological Survey) delivered a presentation on the "*Geochemistry of Mining Wastes: Characterisation and Analysis for Metal Recovery*", which is currently a hot topic.

The other virtual presentations were delivered in Spanish with concurrent translation to English, and these were:-

7) "*Quality control in sample preparation*" by Flor de María Harp Iturribarría, M.Sc., Director General of the Mexican Geological Survey. The international colleagues considered her presentation exceptional and asked her to translate the slides into English. Flor de María promised that she would translate it and make it available to the Commission for distribution to all its members.

The experiences in sample preparation of the different ASGMI geological surveys were presented by its members, *i.e.*, the preparation of:

8) *Rock samples* by Ecuador and Portugal,
9) *Soil samples* by Perú, and
10) *Sediment samples* by Argentina, Brazil, Chile and Honduras.

The webinar presentations are available on YouTube in two parts, Day 1 and Day 2, and a few of the original Microsoft® PowerPoint presentations from the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZpvkF5ZhOH0CTdsQbV3dOpg0LdSuYVMNgdk.

6.4. International Conferences: Sessions and Workshops

6.4.1. Spread of information regarding relevant events

The Commission acts as a 'networking information hub' among Associations, Societies, Institutes, Universities, *etc.* by spreading information about their activities to all CGGB members. During 2024, the Commission has circulated information for the following virtual events.

6.4.1.1. American Geosciences Institute's mapping webinars for Early Career Professionals

- ✓ 10th January 2024. *Bedrock Mapping of Sedimentary Rocks in Wild and Wonderful West Virginia* − Shadya El-Ashkar (West Virginia Geological and Economic Survey); https://youtu.be/B8Jd30HD8HA?si=XvTE7vdv8oci4YIW.
- ✓ 16th January 2024. *Glacier Geomorphological Mapping for Climate Change* – Rebecca (Becky) McCerery (Northumbria University); https://youtu.be/78HTYV_ZOM0?si=UthDBBLJc2op1Buc.
- ✓ 8th February 2024. *Using, Making and Sharing Maps* – Madeline Kelley (University of New Orleans); https://youtu.be/DYNxcxv1sKI?si=V35-JSJIg4Z5hlxf.
- ✓ 13th March 2024. *Seafloor Mapping at the USGS* – Erin Lyons (United States Geological Survey – USGS); https://youtu.be/g3LDLue8_S0?si=Xl4aIE9iqw5H1whE.
- ✓ 5th September 2024. *Soil Mapping with NRCS* – Sydney Lance (Natural Resources Conservation Service − NRCS); https://youtu.be/dz405uis8pI?si=XR0cTI9r6l0g0nqt.
- ✓ 14th November 2024. *Geospatial Technology in NRCS: From the data to the field* – Britney Allen (NRCS); https://youtu.be/3BcoVA2F0cw?si=8SAl6-pt1SOwCEKd.
- ✓ 9th October 2024. *Becoming an Alaskan Soil Scientist* – Claire Benton (NRCS); https://youtu.be/S-yAuuT658k?si=wKecL6nzlI2qKIGE.
- ✓ 15th August 2024. *Application of Geological Mapping in Geothermal Energy* – Nolan Dellerman (Cyrq Energy); https://youtu.be/QS56ykUmbXU?si=cSQ7WMLFFwD-tajN.

6.4.1.2. International Medical Geology Association's webinar

- ✓ 20th March 2024. *Olle Selinus and the Origins of Modern Medical Geology* – Robert B. Finkelman (University of Texas); https://youtu.be/mdAQUGz9cdc?si=GZNmxvdnVIgSQ6Wh.

6.4.1.3. SEGHLive: Fellowship Seminars

The Society for Environmental Geochemistry and Health Fellows organise virtual seminars annually for Early Career Researchers. In 2024, six such seminars were delivered (available from https://segh.net/seghlive-fellows):

- ✓ 16th January 2024: *Rare Earth Elements and Radiogenic Isotopes from Mineral Dust in East Antarctica: Sensitive Tracers of the Atmospheric Circulation and Climate Variability Through Time* − Nadine Mattielli (Professor at Université Libre de Bruxelles, Belgium).

- ✓ 1st March 2024: *GEMAS: Geochemistry of Agricultural and Grazing land soil for healthy food production in Europe* − Alecos Demetriades (Chair of the Sampling Committee of the IUGS Commission on Global Geochemical Baselines). The PowerPoint presentation is available from the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZXDB40Z6h5xSQzk2BBRn4zf8d2B5H64xfuV
- ✓ 17th May 2024: *EGG: European Groundwater Geochemistry* − Alecos Demetriades (Chair of the Sampling Committee of the IUGS Commission on Global Geochemical Baselines). The PowerPoint presentation is available from the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZXDB40Z6h5xSQzk2BBRn4zf8d2B5H64xfuV
- ✓ 26th April 2024: *Environmental Research and Citizen Science to Monitor the Hellenic Volcanic Arc Marine Geoenvironment - The nexusmonARC project* − Ariadne Argyraki (Department of Geology and Geoenvironment National & Kapodistrian University of Athens & Commission's Public Relations Officer).
- ✓ 8th November 2024: *Research, Innovation & Enterprise in the Waste sector: supporting the UN SDGs* − Andrew Hursthouse (Professor of Environmental Geochemistry, University of the West of Scotland).
- ✓ 18th December 2024: *Sustainable management of our nuclear wastes legacy – challenges and opportunities* − Andy Cundy (Professor of Environmental Radioactivity and Director of Internationalisation in Ocean and Earth Science, University of Southampton).

6.4.1.4. CoDa Association Webinar

- ✓ 28th November 2024. *Tensor Data Analysis* − Prof. Michelle Gallo. To download this webinar, one must be a member (http://www.coda-association.org).

6.4.2. Workshop in Spain about the IUGS Manual of Standard Methods

The IUGS Commission on Global Geochemical Baselines (CGGB) organised a 4-hour workshop in conjunction with the XI National Geological Congress of Spain (https://congresogeologicosge.es/), held in the city of Avila from the 1st to 6th of July 2024. On the 1st of July, Commission members from Spain (Paula Adánez-Sanjuan and Iván Martín-Méndez (IGME)) and Portugal (Maria João Batista (LNEG) – Fig. 8) were instructors for the short course in Spanish, entitled "*Fases y protocolos a seguir para una red de referencia geoquímica global*" (*Phases and protocols to be followed for a global geochemical reference network*).

Figure 8. Instructors and organisers of the course: (a) Maria João Batista (left), Iván Martín-Méndez and Paula Adánez-Sanjuan (right); (b) instructors and attendees during the running of the course.

The short course introduced the standard sampling methods that should be followed. The Global Reference Network was presented and explained, as well as the randomisation of sampling points together with all the supplementary material that the CGGB has available on its web pages to be used for this purpose. Sampling methods were described for the different sampling media included in the IUGS Manual of Standard Methods (rock, humus, residual soil, stream water, stream sediment, and overbank and floodplain sediments). Quality control was explained, given the importance of this procedure in any applied geochemistry project. Finally, data levelling was introduced with examples to provide hints on developing comparable data for producing seamless geochemical maps.

Twelve professionals from universities, surveys, institutes, and postgraduate students attended the workshop. The participants received the course well, and engaging discussions followed.

6.4.3. Joint Conference of ISEH, ICEPH & ISEG on Environment and Health

Professor Chaosheng Zhang (CGGB member), organiser and chair of the joint ISEH, ICEPH and ISEG conference (International Symposium on Environment and Health, International Conference on Environmental Pollution and Health & International Symposium on Environmental Geochemistry, respectively) invited Alecos Demetriades (Chair of CGGB's Sampling Committee) to present a plenary talk with the title '*Standardisation of Applied Geochemical Methods*'. The talk was delivered on the 13th of August 2024, about the "*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*." The venue was the University of Galway in the Republic of Ireland.

It was a good promotion of the IUGS Manual of Standard Methods because more than 200 participants from many parts of the World, mainly from China (Fig. 9), attended the plenary session. This was an opportunity to make three new members from the National Research Center for Geoanalysis of the Chinese Academy of Geological Sciences.

Figure 9. Plenary session participants of the ISEH, ICEPH & ISEG on Environment and Health conference in Galway (Ireland),13/08/2024. Photograph taken by a professional photographer.

6.4.3.1. Session on Geochemical Mapping

The Commission, in collaboration with the EuroGeoSurveys Geochemistry Expert Group, organised a session on Tuesday, 13th of August 2024, with the title: "*Geochemical Mapping*" (the original title was "*Geochemical mapping at all scales: evidence from soil, sediment, water and plants*"). Timo Tarvainen and Jaana Jarva, both from the Geological Survey of Finland and CGGB members, were the session conveners. In total, five oral presentations were delivered (Notes: (i) CGGB members are denoted by * after their surname, and (ii) presenter names are underlined):

- *Urban anthropogenic soils – potential urban diffuse soil contamination* ─ Timo Tarvainen*, Marja Lehtonen, Yann Lahaye, Jaana Jarva*, Stephane Belbeze, Kristiina Nuottimäki.
- *Urban geochemistry of Cagliari (Italy): towards a healthy city* ─ Matteo Serra*, Ariadne Argyraki*, Alecos Demetriades*, Zacharenia Kypritidou*, Paolo Valera*
- *Distribution of inorganic contaminants along the Uruguayan coast* ─ Florella Iaquinta, Ignacio Machado.
- *Integrating Geochemical and Magnetic Analysis for Estimating Risk-based Soil Screening Values: A Regional Study in Greece* ─ Ariadne Argyraki*, Artemis Kontomichalou*, Fotini Botsou, Zacharenia Kypritidou*, Alexandros Liakopoulos*, and
- *Geochemical baseline studies of mineral potential areas and mining surroundings in Finland* ─ Tarja Hatakka*, Jaana Jarva*, Raija Pietilä, Timo Tarvainen*.

Some of the original Galway conference Microsoft® PowerPoint presentations (above and below) can be downloaded by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZK4PI0Zsw3RrqTwvEyWFqsLk652NYYezXMy.

6.4.3.2. Other oral and poster presentations by Commission members

Professor Xueqiu Wang (CGGB's co-chair, 2016-2020; UNESCO-ICGG Scientific Director) delivered on the 14th of August 2024 a plenary presentation with the title "*Chemical Earth Program: Global Geochemical Observation Networks*".

Other oral and poster presentations by CGGB members (*) were:

Session: Air pollution and Health session (12 August 2024)

- *Are emissions from dental practice detectable in the outdoor environment?* ─ Martin Gaberšek*, Zala Žarkovič, Nastja Rogan Šmuc, Mateja Gosar*.

Session: GIS Spatial Modelling session (14 August 2024)

- *Identification of multi-element pollution hotspots and geochemical associations of PTE in urban dust (Yerevan, Armenia)* ─ Gevorg Tepanosyan*, Lilit Sahakyan.

Session: Radon Risk session (15 August 2014).

- *Combatting neonatal, maternal and child deaths from ionising radiation exposure around gold and uranium mines in South Africa: a medical geology perspective* ─ Theophilus Davies*.

- *Rn-222 in tap waters of an Italian volcanic region. Stochastic risk assessment vs. guideline approach* ─ Stefano Albanese*, Antonio Iannone, Annalise Guarino, Maurizio Ambrosino, Giancarlo Germano, Giancarlo De Tullio, Domenico Cicchella*.

- *Environmental Radiation Studies in Urban Environment: Case Study of Yerevan, Armenia* ─ Olga Belyaeva*, Nona Movsisyan, Spartak Hovhannisyan.

Poster presentations

- *Towards Local Thinking in Environmental Data Analysis* ─ Chaosheng Zhang*.

- *Soil mineralogy in support of a regional geochemical baseline study in Greece* ─ Zacharenia Kypritidou*, Artemis Kontomichalou*, Fotini Botsou, Ariadne Argyraki*, Alexandros Liakopoulos*. *This poster won the award for best poster*.

6.4.3.3. Meeting with UNESCO-ICGG Executive Director

On Wednesday, 14th of August 2024, Alecos Demetriades (AD; Chairperson of the Commission's Sampling Committee) had a meeting with Professor Xueqiu Wang (XW), who is the Executive Director of the UNESCO International Centre on Global-Scale Geochemistry (UNESCO-ICGG). The purpose of the meeting was for AD to find out what was happening with the UNESCO-ICGG. Professor Wang informed AD that, at present, there was no Director at the Institute of Geophysics and Geochemistry, and he did not know when and who would be appointed. A list of international councillors was submitted to the relevant Chinese authorities for approval. Again, XW did not know when the process would be finalised.

To AD's question about why he did not show the IUGS Manual of Standard Methods in his plenary presentation, which the Centre is obliged to use according to its Statutes (see Section §5.1), Professor Wang replied that he showed the 'Blue Book'. I commented that the IUGS Manual of Standard Methods follows the 'Blue Book' recommendations and describes in detail the methodologies that should be used for the establishment of the Global Terrestrial Network. He also co-authors "*Chapter 3.5. Overbank and Floodplain Sediment Sampling*".

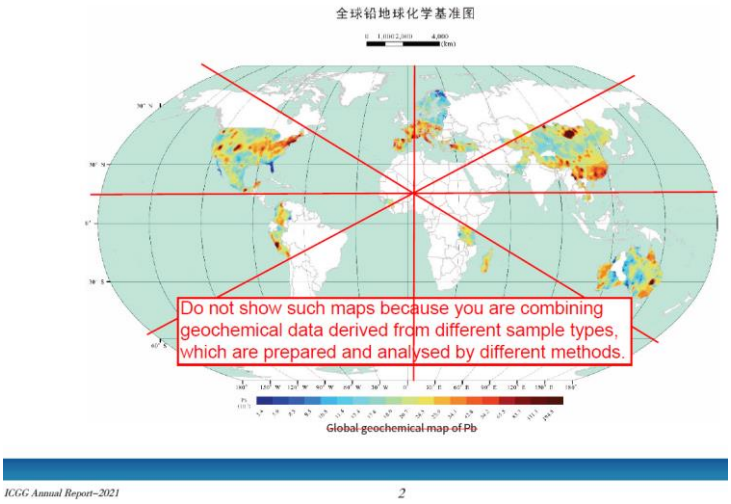


Figure 10. The global geochemical map showing the distribution of Pb was included in the first version of the UNESCO-ICGG'S 2021 report, which had the following statement "Up to now, the Global Geochemical Baselines Network involving more than 40 countries, has covered a total of 36 million square kilometers, taking up 32.7% of the global land area." As presented, the reader assumes that this is the work of UNESCO-ICGG and is a fabrication.

AD pointed out to Professor Wang that he is still showing a global map of Pb distribution (Fig. 10), which the CGGB Centre's International Councillors have repeatedly asked not to be shown since it is not professionally correct to include work that the Centre has not done and because the

different surveys did not use the same methods. Following CGGB's negative comments about the map, it was removed from the Centre's final version of the 2021 Annual Report. However, it appears that the International Councillors' comments are not accepted because he is still showing the map. AD commented that the CGGG Secretariat never sent the Councillors the final version of the Centre's 2021 report.

AD's next comment concerned the "*supposedly international independent evaluation of the Centre*", which was not carried out objectively because UNESCO appointed a Chinese Professor of Palaeontology to evaluate a centre specialising in applied geochemistry. An unbelievable and questionable decision…!!! Apart from this peculiarity, there is a direct conflict of interest, which, if reported, will make UNESCO the laughingstock of the whole scientific world. Professor Wang did not make any comment on this critical issue.

Next was the question about the UNESCO new agreement. Professor Wang informed AD that he had not seen it except for the first page. According to the information Professor Wang has, UNESCO wants more young people to be members of the Governing Council and Scientific Committee. The UNESCO document was found, and it does not state this, as seen below, and makes interesting recommendations that should be implemented:

Extract from UNESCO Executive Board 216 EX/16.III, Paris, 28 March 2023, page 2:
*"6. The evaluation contains a series of recommendations to further enhance the work of the ICGG and to assure that it attains further international achievements, including assuring a better communication with Governing Board and Scientific Committee members, investing in the wider international geochemical community, amongst others, by adapting the management team to pursue more international cooperation, restructuring its current Governing Board and Scientific Committee, improving the English language competencies of the Centre and its international communication, and **by considering the introduction of young active experts** as well as striving for more independence from the China Geological Survey."* *[Accessed 10 September 2024: https://unesdoc.unesco.org/ark:/48223/pf0000384841?posInSet=1&queryId=d398a210-62fb-4bfa-9d1d-44e43b037bdc]*

Finally, the last part of the discussion was the most interesting because AD wanted to see Professor Wang's reaction. AD hand-copied the section that was written in the first version of the Centre's 2021 Annual report (see below), and asked Professor Wang to read it first, and then not to think as a Chinese but as a European or African or whatever and to answer the question "*Why a foreign scientist should cooperate with the Centre when the aim is clearly mentioned*":-

"Since the establishment of ICGG in 2016, it has successfully held 36 international training courses in and out of China and attracted 856 participants from 52 countries, which has effectively enhanced the international influence of China geochemical technologies."
Note: Extract from the UNESCO ICGG's first version of the 2021 Annual Report (01_EN-2021年度报告20220810_Received_13.08.2022.pdf; - The above sentence is on page 9 and can be accessed by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZOXqJ5ZYa1Qi2bc17HJjHgM78Tn8JH2HLl7). The other versions of the 2021 report have been uploaded. The above statement was ultimately removed in file 05_ICGG_英-2021 20230116PM_Received_18.01.2023.pdf.

After reading the text, Professor Wang's answer was "*This is true*". So, AD commented, "*Yes, it is true, but the one-million-dollar question is why should we cooperate with you when you tell us to our face that your aim is to 'promote Chinese geochemical technology?*"". There was no answer from Professor Wang.

AD continued that after thanking Bimin Zhang (Centre's Secretariat Director) for informing the international Councillors about the Centre's aim, this part was removed from the third version of

the 2021 annual report (05_ICGG_英-2021 20230116PM_Received_18.01.2023.pdf – see file in pCloud folder). But he (Professor Xueqiu Wang) included it in his 2022 annual report to the Commission and showed him what he had written:

> *"Since the establishment of ICGG in 2016, it has successfully held international training courses in and out of China for 830 participants from 48 countries, which has built a good learning and communication platform, promoted global sharing of geochemical knowledge and technology, enhanced the international influence of China geochemical technologies, and served the UN 2030 Agenda for Sustainable Development.*"

Note: Extract from the Commission's 2022 Annual Report, p.98−99 (https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2022_Annual_Report_Final.pdf).

Professor Wang's comment was: *"I did not write this"*. AD replied: "*These are your exact written words in the report you have sent, so somebody must have written them because the regional reports submitted to the Commission are added in the appendices with just simple editing"*.

AD repeated the question: "*Why should we collaborate with the Centre when you are telling us that your interest is to promote Chinese geochemical technology?*" Professor Wang did not reply. AD's final comment was: "*I do not want to put you in a difficult position. I will be discussing this directly with the China Geological Survey*".

Concluding comments by AD:

(i) To begin with, the Centre advocates that it follows "Blue Book" specifications, which is not true because its interest is sampling only floodplain sediment of large rivers. Even this is not done correctly as was pointed out during the "*Workshop on Geochemical Mapping for 'Belt and Road' Countries*" organised by the Centre between the 23rd and 30th of September 2017. This workshop is reported in the Commission's 2017 Annual Report on pages 35 to 42; read the comments on pages 40 to 42 especially. Further, study AD's PowerPoint presentation with the title "*08_A.Demetriades_GGB_Field_Sampling_Training_course_29.Sept.2017_final.pptx*", which was shown to the participants on the last day of the workshop (Friday, 29th of September 2017), and can be downloaded by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZvJXF5ZyJWEKQyofH047YxqQFllV02AJmbk.

(ii) As the UNESCO International Centre on Global-Scale Geochemistry worked from 2016 to 2023 without any collaboration with the international Councillors of its Governing Council and Scientific Committee, will most likely continue with its way of working no matter what is clearly stated in the Centre's Statutes (refer to Section §5.1, and pages 61 to 82 in the Commission's 2022 Annual Report: https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2022_Annual_Report_Final.pdf), and expressed in the UNESCO's 2023 renewal decision, *i.e.*, "*assuring a better communication with Governing Board and Scientific Committee members*".

Fortunately, the letter that the IUGS President sent on the 4th May 2023 to Dr. Kristoff Vandenberghe (Head of the Section, Earth Sciences UNESCO) is worded correctly, *i.e.*, *"As UNESCO will be discussing the renewal of the agreement for a second six-year term, IUGS would*

like to inform you that if the current situation is not seriously addressed and acted upon for improvement, then IUGS will be forced to consider withdrawal of its support for the Centre."

6.4.4. The 37 International Geological Congress, Busan, South Korea

The International Geological Congress (IGC) is organised every four years in the year that the Olympic Games are held. Hence, it is considered the '*Olympic Games of Geosciences*'. In 2000, the forerunner of the Commission started organising a '*Symposium on Geochemical Baselines*'. After Arthur G. Darnley's passing away in 2006, it was decided to remember his dedicated input to Global Geochemical Baselines by organising a Symposium in his honour.

6.4.4.1. Fourth Arthur Darnley Symposium, 37 IGC, Busan

The CGGB, on the occasion of the 37 IGC in Busan (South Korea), organised a session on Tuesday, 24 August 2024, with the name '*Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley Symposium)*' with conveners Anna Ladenberger (CGGB Chair 2020-2024; Fig. 11a) and Maria João Batista (Chair of ASGMI-GEG).

Over 40 people attended the session, and ten presentations on different themes were delivered orally. The presentations are given below.

(a) (b)

Figure 11. (a) Anna Ladenberger (CGGB chair) introducing the keynote presenter (b) Alecos Demetriades (Chair of CGGB Sampling Committee).

6.4.4.1.1. Oral presentations, 4th Arthur Darnley Symposium

1) [Keynote] Alecos Demetriades: *International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network* (Fig. 11b).
2) Ray Scanlon: *The Geochemical Mapping of Ireland: Geological Survey Ireland's Tellus Programme - results, challenges, and outcomes*.
3) Maria João Farinha Batista: *Geochemical Map of Latin America and the Caribbean. Methods for implementation*.
4) Haezan Jangarun: *Determination of Rare Earth Element Baselines in the Brunei Darussalam Soils*.
5) Mark Rattenbury: *Soil geochemical mapping of the Aotearoa New Zealand convergent margin*.
6) Anna Ladenberger: *Geochemical Mapping in Sweden – establishing baselines at national to local scales*.

7) David Cohen: *Why stop at the regolith? Plants as an active geochemical mapping sampling media*.
8) Paula Adánez-Sanjuan: *A comprehensive review of abandoned mining waste facilities to assess the representativeness of their sampling*.
9) Badumisa Vicious Sibolile: *Spatial Distribution of Copper, Iron and Arsenic in soil from the Okahandja 2116 map area in Otjozondjupa Region, Namibia*.
10) Maria João Farinha Batista: *PLANAGEO-Methodology to conduct a geochemical survey for mineral exploration in SW Angola*.
11) Theophilus C. Davies: *Challenges and Opportunities in Compiling a Complete Africa Geochemical Database for Medical Geology Applications*.
12) Ariadne Argyraki: *Addressing the problem of microplastic contamination in soil: Challenges during separation and recovery of natural and anthropogenic organic polymers*.
13) Irena Agnieszka Wysocka: *Cadmium content in soils of the Upper Silesia Region – an analysis based on geochemical mapping in Poland*, and
14) Vicente Albino Manjate: *State of the art of global geochemical mapping in Mozambique*.

Presentations 9, 11, and 14 were not delivered for different reasons. The authors of 9 and 14 were not granted visas; presentation 11 was not delivered because of a lack of funds.

Most of the original Microsoft® PowerPoint presentations are available for downloading by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZv6fC0ZsKwQhCg2ijzKdfxgrsBC85WlNwD7.

6.4.4.1.2. Poster presentations, 4th Arthur Darnley Symposium

The conveners Anna Ladenberger (CGGB Chair 2020-2024) and Maria João Batista approved the following six poster presentations. However, our colleagues Victor Kilipko and Igor Spiridonov, both Commission members, did not come because the IUGS Executive Committee (2020-2024) decided not to allow Russian colleagues to participate due to the invasion of Ukraine.

1) Iván Martín-Méndez: *Overview of geochemical mapping in the Geological Surveys of Ibero-America*.
2) Viktor Kilipko: *The resource potential assessment of solid minerals based on the results of multi-purpose geochemical mapping of the territory of Russia*.
3) Igor Spiridonov: *Nonlinear nature-based localisation criteria for the resource potential assessment and interpretation of the anomalous structural-geochemical fields*.
4) Hanliang Liu: *Continental-scale distribution of niobium and tantalum in catchment sediments throughout China: Prospecting implications from the China geochemical Baselines project*.
5) Paula Adánez-Sanjuan: *Use of national scale geochemical data for the development of a geostatistical methodology for interaction analysis of variables at different scales*, and
6) Eva Martinkova: *Dust generated by e-waste processing: Impact of sample treatment and decomposition method on chemical and isotopic compositions*.

6.4.4.1.3. Workshop about the techniques in the IUGS Manual of Standard Methods

The Commission compiled a comprehensive Manual of Standard Methods, which, after its approval by the IUGS Executive Committee and with a foreword signed by three IUGS

Presidents, was published as the official IUGS publication for 2022. The manual is freely available from the Commission's publications web page:

Demetriades, A., Johnson, C.C., Smith, D.B., Ladenberger, A., Adánez Sanjuan, P., Argyraki, A., Stouraiti, C., Caritat, P. de, Knights, K.V., Prieto Rincón, G. & Simubali, G.N. (Editors), 2022. *International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*. IUGS Commission on Global Geochemical Baselines, Athens, Hellenic Republic, Special Publication, 2, xliv, 515 pages, 375 figures, 35 Tables, 5 Annexes and 1 Appendix, ISBN: 978-618-85049-1-2; https://doi.org/10.5281/zenodo.7307696.

The methods described in the manual, besides their use for establishing the Global Geochemical Reference Network, can be applied in other geochemical surveys at any mapping scale. Therefore, the Commission is organising workshops to promote and teach the methods described in the IUGS Manual of Standard Methods. The first workshop of two-day duration was organised 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. After assessing the workshop, it was considered that at least two days for lectures and hands-on exercises were required, and one day in the field.

The International Union of Geological Sciences and the Association of Applied Geochemists co-sponsored the workshop, and both entities are thanked for their generosity.

In Busan, the Workshop lectures were delivered in two parts, as shown in Table 2. The hands-on exercises, performed with Golden Software's Surfer™ and Grapher™ or with dedicated software programs compiled by CGGB members, are designed to be practical and applicable. These resources are available for downloading from the 'Publications' webpage, empowering participants to apply their newly acquired knowledge in their geochemical mapping surveys (https://www.globalgeochemicalbaselines.eu/content/91/publications-/).

In total, 36 participants attended the workshop on the first day (Fig. 12a), 21 on the second day (Fig. 12i), and 23 joined the field training course. Professor Hassina Mouri (current IUGS President) also participated in the field course. The distinct difference in the number of participants on the first day compared to the following two days was that the conference organisers opened the registration for workshops relatively late, and most participants had already booked their return airline tickets to their home countries.

Table 2. Workshop lectures, which, together with the hands-on exercises, can be freely downloaded by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZG9bO0ZDA94k65fvy8erLL3aqGBqLeAR777.

PART A:

An Introduction to the International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network

Global Terrestrial Network (GTN) Grid Cells, Selection of Sample Sites, and Sample Types to be Collected
- Hands-on exercise: Generation of random points in the GTN grid cells (He and Geng, 2022)

Sampling methods: Introduction
- Rock Sampling
- Residual Soil and Humus Sampling
  - The Soils of the World
  - Annotated Soil Profiles
- Stream Water Sampling
- Stream Sediment Sampling
- Overbank and Floodplain Sediment Sampling

Cyprus - *Where would you collect a sample?* (David Cohen)

Sample Preparation and Storage

Development of Reference Materials for External Quality Control

PART B:

Geoanalytical Methods and Requirements

Quality Control: Introduction

Quality Control Procedures:

- Laboratory reports hands-on exercise
- Estimation of Practical Detection Limit hands-on exercise
- Duprepplot hands-on exercise
- Thompson & Howarth plots hands-on exercise
- ANOVA-RANOVA (Vassiliades, 2022)
- Quality Control – The Cyprus Soil Geochemical Atlas study (David Cohen)

Data Conditioning Methods: Generating Time-Independent Geochemical Data

- Levelling exercise

Data management and Map Production

- Map plotting exercise with Surfer using the FOREGS data set

Interpretation and Usage of European Multinational and Continental-scale Geochemical Data Sets

Global to Local-scale Geochemical Surveys

The workshop instructors were Alecos Demetriades, Maria João Batista, Ariadne Argyraki, Anna Ladenberger, Paula Adánez-Sanjuan and Iván Martín-Méndez with interventions in the form of short, interesting tutorial presentations by David Cohen (current IUGS Treasurer) (Fig. 12b-h).

(a) (b) (c)

(d) (e) (f)

(g) (h) (i)

Figure 12. (a) Workshop participants and instructors: (b) Alecos Demetriades, (c) Iván Martín-Méndez, (d) Paula Adánez-Sanjuan, (e) Ariadne Argyraki (right), (f) David Cohen, (g) Anna Ladenberger, (h) Maria João Batista, and (i) group photograph.

It is appropriate to thank our South Korean colleagues Professors Youngsook Huh (Department of Earth and Environmental Sciences, Seoul National University) and Jong-Sik Ryu (Isotope Geochemistry Laboratory, Pukyong National University, Busan) and their Ph.D. students Hojin Park, Jeonghun Kim, and Minhxeok Park for their assistance in organising the one-day field course. Special thanks go to Professor Youngsook Huh for her valuable help during the two-day workshop.

6.4.4.1.4. Sampling training course

Planning a field sampling training course from a distance is difficult, even if there are local colleagues who volunteer to help. To begin with, it was crucial for the course to use a suitable drainage basin close to Busan (Fig. 13). So, the planning comprised the following three stages:

(i) The planning of the field sampling training course was collaborative, underscoring the sense of community that the workshop fostered. The Google Earth image of the Busan area was studied, a potential drainage basin was located, and possible sample sites were marked. This information was then shared with Professor Jong-Sik Ryu (Pukyong National University, Busan), who, together with his Ph.D. students Hojin Park and Jeonghun Kim, after studying the sampling chapters in the Manual of Standard Methods (Demetriades *et al.*, 2022), inspected the proposed sites on the 3rd of July 2024 and suggested alternative sites.

(ii) For teaching purposes, a topographical map of the drainage basin was compiled using different software and tools (Fig. 13). The plotting of this map will be explained in a tutorial to be published in 2025. The potential sample sites were marked on this map.

(iii) A preliminary survey was conducted on the 24th of August 2024 by Alecos Demetriades and Ariadne Argyraki with the assistance of Hojin Park, a Pukyong National University Ph.D. student. All potential sites and the road conditions towards the residual soil site were examined. Since the road was very narrow, it was decided that a 25-seater coach could not reach it. Hence, an alternative site for the demonstration of soil sampling was selected; this site is situated on a mountain slope with an inclination of about 40º and is unsuitable for collecting a residual soil sample because there is evidence of soil creep as indicated by curved tree trunks. Similarly, the overbank and floodplain sediment sites could not be reached because of fenced private properties, and alternative sites were identified. Although these sites were not ideal, the problems of sampling residual soil, overbank and floodplain sediment could be explained and demonstrated in practice. The sites for collecting stream water, active stream sediment and rock samples were easily located (Fig. 13).

The field training course started by demonstrating first the rock chip sampling (Fig. 14a-c), followed by the stream water (Fig. 14d-e, i), stream sediment (Fig. 14f-i), soil (Fig. 14j-l), and floodplain sediment (Fig. 14m) as almost described in the IUGS Manual of Standard Methods (Demetriades *et al.*, 2022). The '*almost*' refers to the stream sediment, soil and overbank/floodplain sediment sampling methods because the selected sites were not ideal, but served to point out the specifications detailed in the IUGS Manual of Standard Methods and the sites that should be avoided. *For example*,

(a) the stream sediment was coarse-grained, which meant that the active sediment should be collected from many traps to be able to reach the required minimum weight of about 1 kg of <0.150 mm grain size − ideally, another site downstream should have been selected;

(b) this particular soil sampling site may be suitable for mineral exploration purposes, but not for the global geochemical baseline project, which requires the top (A horizon) and bottom (C horizon) soil to be developed on-site; soil creep was expected on a slope with a 40° gradient, and was shown by curved tree trunks (Fig. 14l), and

(c) the selected overbank/floodplain sediment site showed the mechanism of deposition of overbank sediment even in an artificially oriented river, stressing that nature always follows its course (Fig. 14m) − suitable sites for the collection of overbank and floodplain sediments were pointed out and all were on private properties.

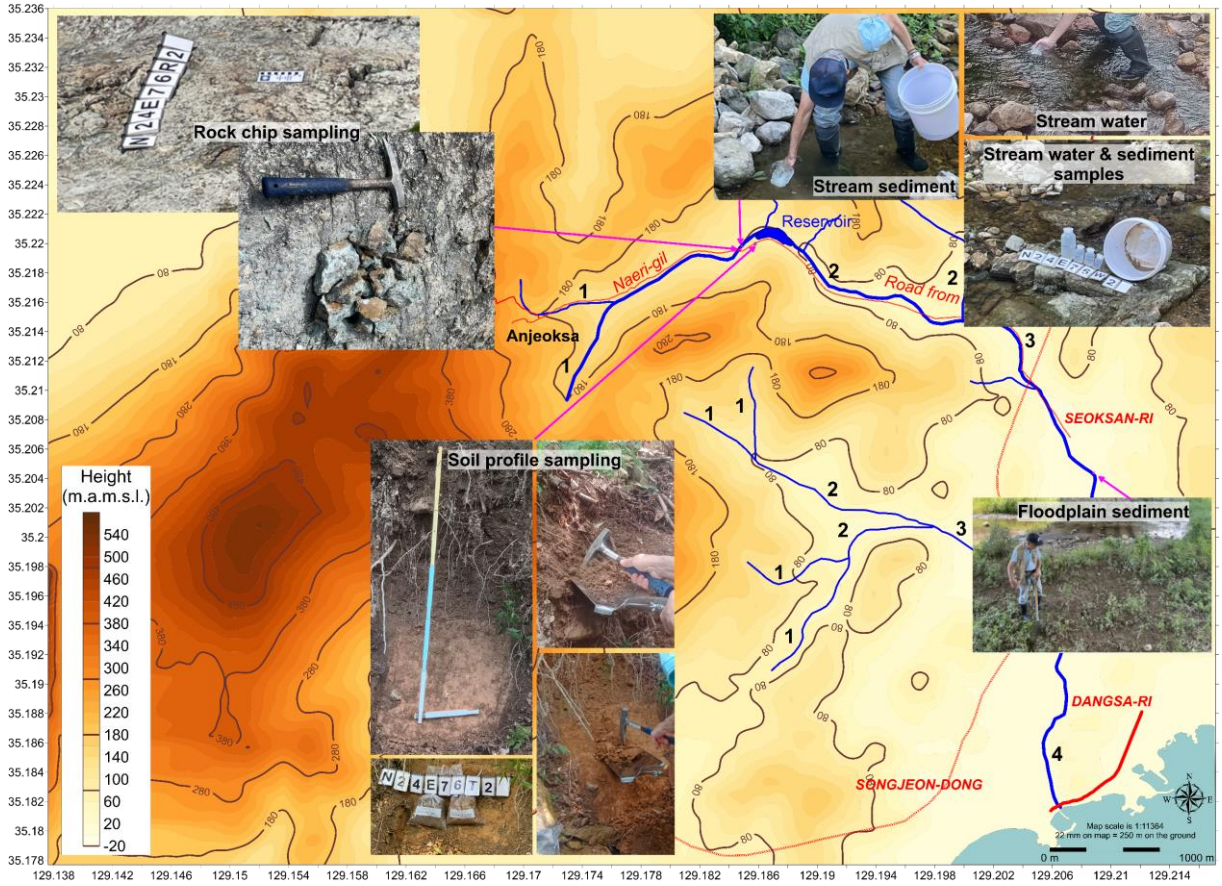


Figure 13. Topographical map of the Busan field training course area with sample sites and photographs. The black bold numbers 1, 2, 3 & 4 denote the Strahler stream order classification. Map plotted with Golden Software's Surfer version 29.

6.4.4.1.5. Comments by professionals and students about the course

After the workshop, professionals, university professors and Ph.D. students who attended the workshop sent their comments and reflections, as detailed below:−

- Ravi Ranjan Kumar, Assistant Professor, North-Eastern Hill University, Meghalaya, India (5/9/2024): "*It was a really good platform for us new people who are interested in the same type of work*."
- Basilios Tsikouras, Professor of Mineralogy and Petrology, University Brunei Darussalam (8/9/2024): "*It was an amazing experience for us and thank you for the flawless organisation of the workshop including the field trip. The material we received is invaluable*."

(a) (b) (c) (d) (e)

(f) (g) (h) (i)

(j) (k) (l) (m)

Figure 14. (a) Rock sampling site N24E76R2; (b) Professor Hassina Mouri (current IUGS President) exercising her might by breaking up the hard rhyodacite outcrop with a 6 kg sledgehammer; (c) rhyodacite outcrop and rock chips in the inset; (d, e) stream water sampling; (f, g, h) stream sediment sampling; (i) stream water samples in certified trace element free plastic bottles, and in the bucket a small amount of sieved stream sediment at <0.150 mm; (j, k) soil sample site N24E76T2 only for demonstration of sampling technique – the A, B, and C soil horizons can be distinguished; (l) field workshop participants recording observations on the soil observation sheet; (m) clayey-silt floodplain sediment deposited within the artificial oriented river. It is noted that brass-stainless sieves were used to demonstrate the sampling method for sieving the stream sediment (h) since it was impossible to transport the recommended wooden-frame sieves with nylon mesh to Busan.

- Youngsook Huh, Professor of Isotope Geochemistry, Seoul National University (27/9/2024): "*Your workshop was both informative and fun, and I heard from some of the students that they are already incorporating some of what they learned into their own sampling trips, even though their research is most strictly geochemical baselines. So, your work is flowering in unknown places.*"
- Eunje Oh, PhD student, Seoul National University (5/9/2024): "*Thank you very much for your thorough and patient guidance throughout the workshop. I have not only learned of meticulous and precise sampling and data quality control measures but also have been inspired by your passion and attitude towards producing truly reliable data. Thank you so*

much for being such a great teacher and inspiration. I'm looking forward to learning more, both from the Commission and from the upcoming publication."

- Jena Jeong, Ph.D. student, Seoul National University (5/9/2024): "*I sincerely thank you for the insightful three-day workshop, including the field session. I especially appreciated the field session on the last day. It was an invaluable experience that helped me apply what we learned in a practical setting*."

Apart from the e-mail messages sent after the workshop, Ariadne Argyraki (the Commission's Public Relations officer) circulated an evaluation questionnaire to all participants, and 15 completed it. The results are presented in Tables 3 to 5.

The participants considered the workshop "*Excellent*" (Table 3). In Table 4, with specific questions, the participants gave different answers depending on their interests, and at least one pointed out that too much information was provided in a short time and was difficult to comprehend. The comments in Table 5 essentially support what we already knew, *i.e.*, the workshop lectures and, especially, hands-on exercises were very difficult to elaborate in the required detail within the restricted time of two days. Sampling methods were emphasised because these are the most important in any geochemical mapping survey, followed by sample preparation and quality control. The hands-on exercises needed more time. However, we informed the participants that they should try all the exercises upon returning home, and any questions they may have can be answered electronically or virtually.

Table 3. The questionnaire concerns the quality of the workshop, and in total, 15 participants answered the questions.

Questions	Rating 5 = Excellent to 1 = Poor
How would you rate the quality of the workshop lectures?	5 (n=10); 4 (n=4); 3 (n=1)
How would you rate the quality of the workshop exercises?	5 (n=7); 4 (n=6); 3 (n=2)
How would you rate the quality of the workshop material in the USB memory stick?	5 (n=14); 4 (n=1)
How would you rate your experience during the field trip (please answer only if you followed the field trip)?*	5 (n=10); 3 (n=1)

* 4 persons did not participate in the field course.

Table 4. The questionnaire concerns the parts of the workshop that were most and least interesting to the participants.

Please provide your general comments. Which part of the workshop did you find most interesting, and which part was least interesting?
The workshop was very useful in general, and the field experience was quite important in making the content of the workshop one's own. The most interesting part was quality control, and the least interesting part was sample site designation, but only because it wasn't readily applicable to my own field.
The discussions from the different participants.
Most parts of the workshop are interesting because I like to learn and hear the knowledge and speaker's experience during the class. It is only a little pity that the software for workshop exercises is expensive and cannot be used on Mac systems.
I experienced a well-prepared and standardised introduction, which supports the global geochemical baseline idea.
Had an absolutely enlightening time at the workshop! The wealth of knowledge shared and the engaging discussions with fellow participants were truly invaluable. A heartfelt thanks to the organisers and presenters for making this a good learning experience.
All parts of the workshop were good. The focus on hard rock should also be heightened.
The most interesting was the fieldwork; it is good to know there is a standardised way to collect samples.
The explanation of the analytical part was interesting.
Theory session.
Honestly, I'm not major in chemical mapping. So, I was so glad to be getting new information about the mapping.

Please provide your general comments. Which part of the workshop did you find most interesting, and which part was least interesting?
I really enjoyed the fieldwork, especially because we learned what to be mindful of on-site. The lectures were also helpful and engaging, though covering so much over two days sometimes made it hard to stay alert.
Most interesting: field exercise, especially the soil sampling part. So many details are involved. Least interesting: Software dealing things. It's just a personal thought. My colleague found it interesting.
The most interesting part was the field trip, as well as the parts with the exercises on the 2nd day. Both offered hands-on experience to us. I cannot say anything was less interesting, but the Stream Sediment and the Floodplain Sediment sampling presenters were less prepared.
Most: Sampling

Table 5. The questionnaire is concerned with suggestions for improving the workshop.

Suggestions for improvement
One of the reasons I joined the workshop was to learn the usage of Surfer in geochemical applications. Due to the lack of time, the workshop didn't cover this, which was understandable but disappointing nonetheless.
More exercises would be interesting
I hope there is other substitute software that can be applied in the class. Maybe the class can be extended to more days because there is abundant information, and people would not be too tired to absorb it.
Keep up the good work.
To have a group folder to share pictures from the day of the workshops/fieldwork.
I was eager to learn the software, but we didn't get the chance to use it in class. Having more time for hands-on practice would be really beneficial!
A more proper field trip site would be good for the exercise, but I understand that there were some limitations on the location of the sampling sites.

6.4.4.2. IUGS booth at the 37 IGC in Busan, South Korea

Since the publication of the IUGS Manual of Standard Methods in 2022, the IUGS Secretariat has always displayed the bound volume in the IUGS booth at all international conferences. As can be seen, it was displayed in the IUGS booth on the occasion of the 37 IGC in Busan (Fig. 15). The Commission thanks the IUGS Secretariat for promoting the volume.

Figure 16 shows the Commission's poster that was displayed in the IUGS booth.

(a) (b)

Figure 15. IUGS Manual of Standard Methods displayed in the IUGS Booth, 37 IGC, Busan, South Korea, 25 to 31 August 2024. As Commission members were nearby the geoscientists that were examining the publication were impressed by its contents.

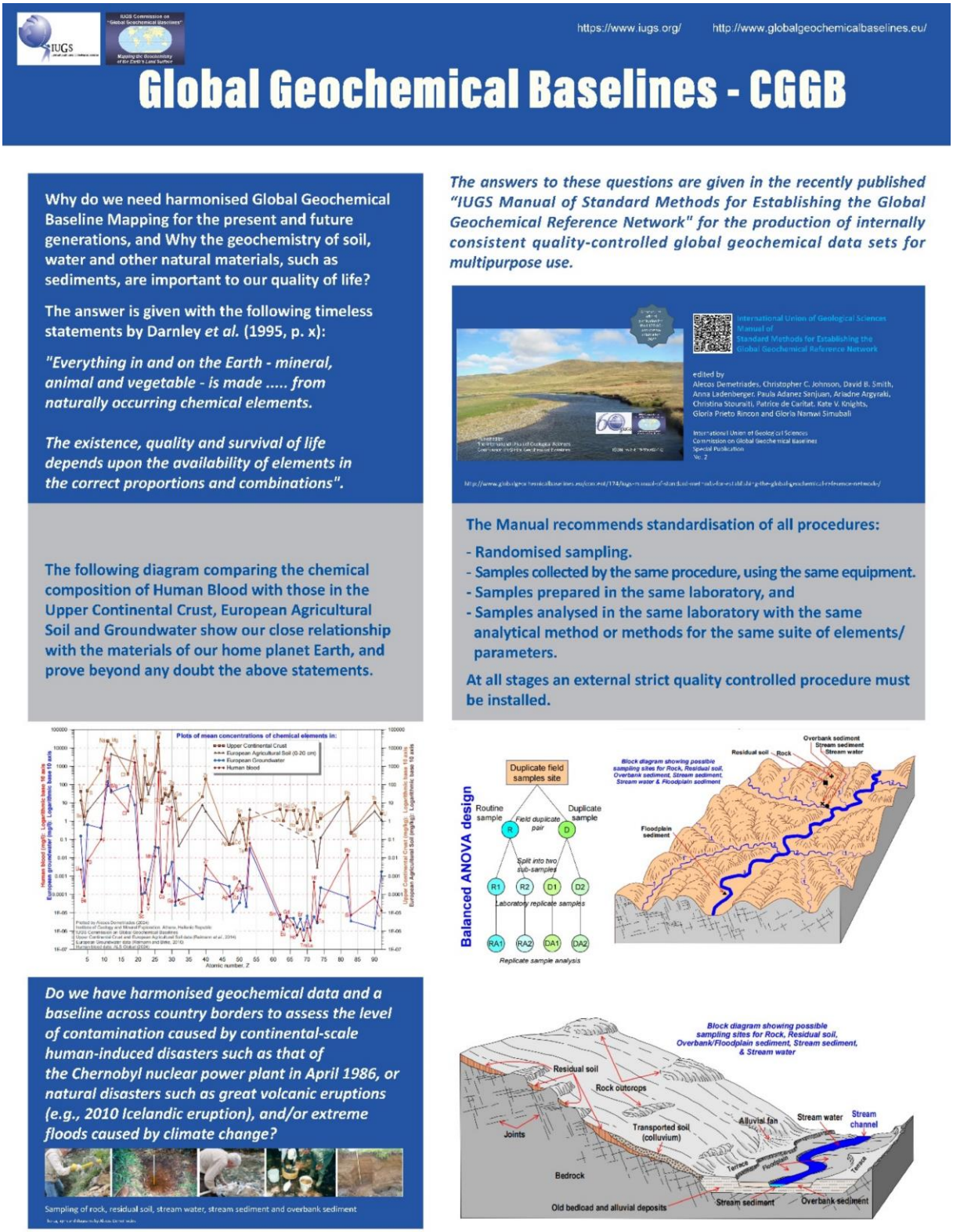


Figure 16. Commission's poster displayed at IUGS booth, 37 IGC, Busan, South Korea.

6.4.4.3. Forensic Geology and Medical Geology

6.4.4.3.1. Forensic Geology and Medical Geology

The Commission organised, together with the Initiative on Forensic Geology (IFG), a joint session on Forensic and Medical Geology, which consisted of two parts:

(i) *Forensic Geology: Illegal Mining and Associated Crimes in the Global Minerals and Metals Supply Chain*, chaired by Laurance Donnelly (IFG chair) and Duncan Pirrie, and

(ii) *Medical Geology in Honour of Professor Olle Selinus* (Special Session), chaired by Hassina Mouri (CGGB member) and Anna Ladenberger (Commission's 1st Co-Chair 2020-2024).

6.4.4.3.2. Medical Geology in Honour of Professor Olle Selinus – Oral presentations

Commission members delivered the following oral presentations, and the original Microsoft® PowerPoint files and the abstracts can be downloaded from a dedicated pCloud folder (https://u.pcloud.link/publink/show?code=kZ5cPJ5ZqkCaKy1subS2RVKsQkAb8hGnXmtV):

1) (Keynote) Robert Finkelman: *Olle Selinus (1943-2023): The Founder of Modern Medical Geology* (presented by Anna Ladenberger).

2) Lucia Rita Pacifico: *Comprehensive assessment and multivariate statistical analysis of Transfer Factors soil-to-plant estimated from bioavailable concentrations: A Case Study in the Campania Region, Southern Italy*.

3) Jennifer M. McKinley: *Investigating the relationship between health and the environment using soil and air pollution data in a coupling of neurodegenerative diseases to element distribution through geospatial statistics*.

4) Irena Agnieszka Wysocka: *Anthropogenic gadolinium in surface and groundwaters of Poland*.

5) Moses Boakye Okyere: *Occurrence, Sources, Mechanisms of Enrichment and Possible Human Health Impacts of Fluoride-Bearing Groundwater in the Central Parts of the White Volta River Basin of Ghana*.

6) Rinae Makhadi: *The occurrence of potentially harmful elements in gold mine tailings and their possible impacts on the environment and public health with reference to the Welkom goldfields in South Africa*.

7) Michaela Chapo Cossa: *Environmental risk assessment of water in the coal mining region of Moatize, Tete Province, Mozambique*.

8) Sharon Ntube Ngwese: *Assessment of potentially harmful elements on human health and agriculture of surface and groundwater sourced from the granito-gneissic phreatic aquiferous formations in Bertoua and its environs, east region Cameroon*.

9) Alecos Demetriades: *Hazard and exposure assessment in contaminated land investigations and environmental management: The Lavrion case study, Hellenic Republic*.

6.4.5. FAO: Global Symposium on Soil Information and Data

CGGB members participated in FAO's hybrid Global Symposium on Soil Information and Data, which was held in Nanjing (China) from the 25th to the 28th of September 2024. The following five presentations were delivered virtually:

1) *Application of high spatial density soil geochemical mapping: The Geochemical Atlas of Cyprus* − David Cohen, Andreas Zissimos, Neil Rutherford, Christodoulos Hadjigeorgiou.
2) *National scale soil geochemical data and their multidisciplinary use: The case of Spain* − Paula Adánez-Sanjuan & Iván Martín-Méndez.

3) *Healthy Soil For Healthy Society: Major threats in soil management at the European level – Lessons from the GEMAS Project* − Anna Ladenberger.
4) *Standardisation and harmonisation of soil geochemical methods* − Alecos Demetriades, and
5) *National-scale soil geochemical data for the conterminous United States* – David B. Smith.

The abstracts and Microsoft® PowerPoint presentations are available from a dedicated pCloud folder, which can be accessed by using the following hyperlink: https://u.pcloud.link/publink/show?code=kZ8bKI0ZBGKxctw3NqL1sxsJoyPnHjX3TR5X. Since they were uploaded on September 26th and CGGB members informed of their availability, 255 colleagues have downloaded them until October 29th, 2024.

6.4.6. Third International Student Conference on Medical Geology and Environmental Health – Europe Edition

The Commission supported the four-day 3rd International Student Conference on Medical Geology and Environmental Health – Europe Edition (26−29 November 2024), which was organised by Ph.D. students and early career researchers with minor assistance from members of the Society of Environmental Geochemistry Health, and the International Medical Geology Association.

In total, there were:

- 5 virtual keynote presentations,
- 38 oral presentations from Ph.D. students and early career researchers, and
- 2 workshops. The two workshops with the titles "*Shared Vocabulary: Communication Between Geo-Health Scientists*" and "*Preparing Manuscripts for Publication in International Journals*" were given by Prof. Robert B. Finkelman, and Alecos Demetriades (Commission Chair), respectively.

Artemis Kontomichalou and Stefania Koutsourea mentioned the IUGS Manual of Standard Methods in their presentations:

- "*Preliminary results of soil geochemical baseline pilot study in Hellas*" and
- "*Separation and recovery of natural & anthropogenic organic polymers in soils of Attica, Greece*", respectively, as both students are supervised by Ariadne Argyraki, Commission's Public Relations and Finance officer.

The senior scientists who attended the four-day workshop were very pleased with the high standard of the presentations.

6.4.7. Display of IUGS Manual of Standard Methods at the AGU 2024 annual meeting

The 2024 American Geophysical Union's (AGU) meeting was held in Washington D.C. from the 9th to the 13th of December 2024. The International Union of Geological Sciences had a booth, where its publications were displayed (Fig. 17a). Among the publications was the IUGS Manual of Standard Methods. The Commission thanks *Mr.* Ma Yongzheng (Director of IUGS Secretariat), and the Secretariat staff for the display in the booth of the IUGS Manual of Standard Methods.

Mrs. Xu Yaqi (IUGS Secretariat staff member) with her photograph (Fig. 17b) captured the amazement of *Dr.* Jia-Jia Chen when she was looking at page 85 of the IUGS Manual of Standard

Methods, where the photographs of the rock sampling procedure with sledgehammers are displayed. Since her name was visible on the meeting's registration card, we contacted her on the 20th of December 2024, and she replied on the same day. Her comments were: "*It's both surprising and delightful to hear that my reaction was captured so vividly during the conference! ..... I also want to express my admiration for the dedication of field researchers. The authors of the book have done a fantastic job documenting the rock sampling and research process in such detail. I have great respect for your work, although my focus is on large-scale ocean circulation and climate change. I can't help but imagine how wonderful it would be if we also had a manual like that for our own field (perhaps one exists, but I haven't found it)*".

The members of the Commission's Steering Committee are delighted that a geoscientist from a completely different discipline appreciated the work input of all contributors to the IUGS Manual of Standard Methods, who would like to have a similar manual for her own field.

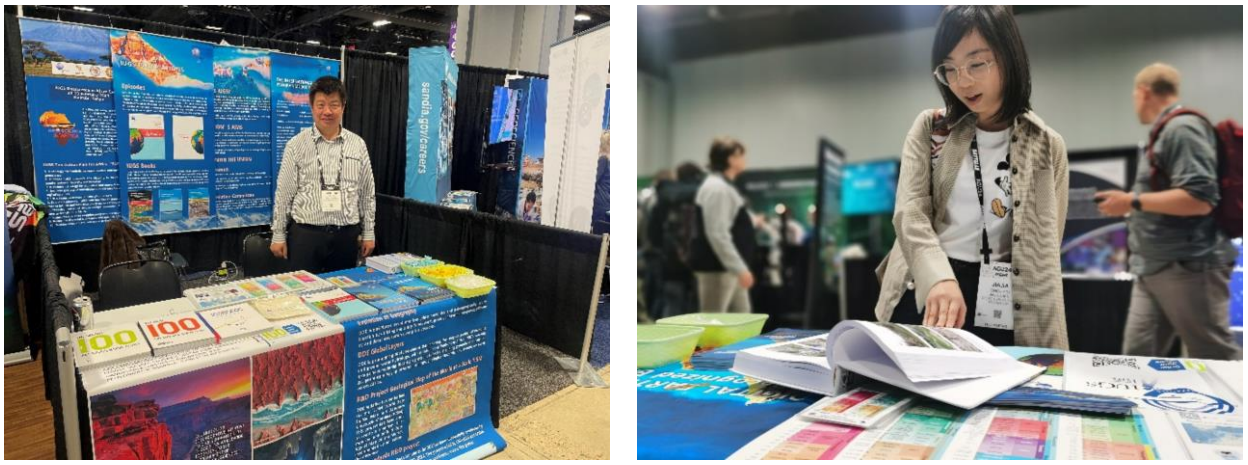


Figure 17. (a) IUGS booth in which the IUGS Manual of Standard Methods was displayed at the inner right-hand side of the desk near the left hand of Mr. Ma Yongzheng (Director of IUGS Secretariat), and (b) see the amazed facial expression of the conference participant, Dr. Jia-Jia Chen (Georgia Institute of Technology, Atlanta, USA) – the reason for her amazement is on page 85 of the Manual, where the photographs of the rock sampling procedure with the sledgehammers are displayed. Photographs by Mrs. Xu Yaqi (IUGS Secretariat staff member).

6.5. E-BOOKS IN PROCESS OF PUBLICATION

Program ROBCOOP4A (balanced robust ANOVA) is being translated into Spanish by Paula Adánez (Commission's Scientific Secretary). In September 2023, the script for unbalanced robust ANOVA 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 was expected that this work would be completed in 2024 and the English, Spanish and Hellenic versions published. However, due to technical problems this work it is hoped that it will be completed in 2025.

6.6. COMMISSION'S WEBSITE

The Commission's website is updated regularly.

6.6.1. Google Analytics statistics

Table 6 shows the number of 2024 users of the top 25 web pages of the Commission's website. It is impressive that 661 users have visited the web page of the "*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*". Further, the 642 Views and 545 Active users for the GTN 160x160 km web page are

interpreted as colleagues from all over the world who were interested in seeing their country's GTN grid cells, and at least 58 may have downloaded the files. The ones who were interested in going deeper into planning visited the 'Global or Geochemical Reference Network' web page (175 views & 117 Active users).

Figure 18 shows pictorial statistics of the users from the 10 top (a) countries, and (b) cities; (c) shows the distribution of age class users, which is very encouraging because there are 355 users below the age of 44. Finally, the mapped gender distribution of 619 male and 497 female users suggests that males still dominate applied geochemistry.

Table 6. Google Analytics table of web page users from January 1st to December 31st, 2024. Compared to 2023, there was an increase of 624 and 29 in the categories 'Views' and 'Active users', respectively.

Page title and screen class	***Views***	***Active users***
Total	23,150	3846
Home web page	2044	1064
IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network	661	293
GTN 160x160 km	642	545
Members	621	446
Conferences	420	184
Steering Committee	391	180
Publications	321	123
Annual Reports	232	128
Global or Geochemical Reference Network	175	117
Workshops	105	65
History	104	59
Black Soil Project Manual	100	75
Sample Quantities	96	78
Organisation	90	32
Results & Database	90	57
Sample preparation	90	73
Laboratory Arrangements	89	71
Sampling Design	88	68
Current Work	84	69
Regional officers	77	59
Committees	75	57
Site Location and Sampling Media	73	58
eBook: R-scripts for Generation of 5, 8 and 16 Random Sampling Points	66	20
Links	62	54
Field methods for Regional Surveys	58	54
GTN 160x160 km files	58	46
Selecting Sampling Sites	54	43
Recent Publications	48	36
Map presentation	46	37
Duplicate Field Sampling	44	39
Levelling of existing data	44	30
GMN 160 x 160 km	43	30
Webinars	43	25
Chapter files: Word text; Original figures; PowerPoint presentations	41	21

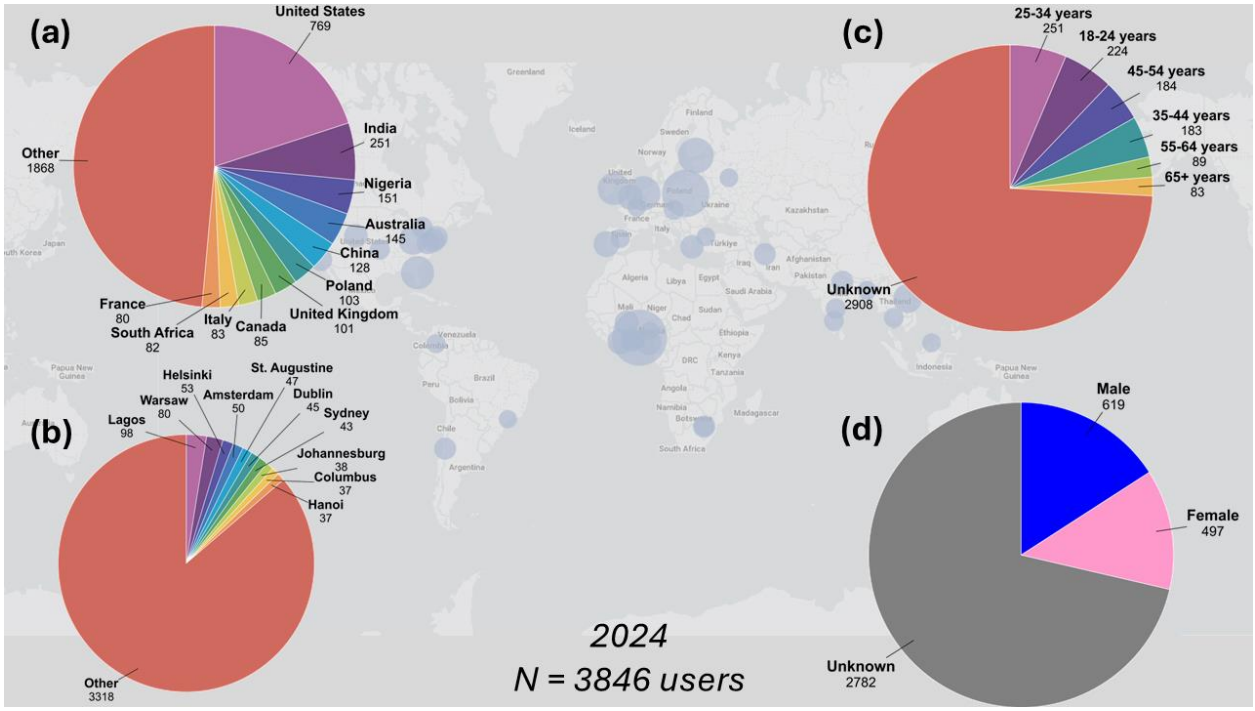


Figure 18. Shows a screenshot of Google Analytics city location map of sessions from the 1st of January to the 31st of December 2024, and pie charts of (a) the top 10 countries users (3931 users in 2023); (b) the top 10 city users; (c) age class users, and (d) gender class users. The global distribution 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.

6.6.2. Zenodo website statistics

The four Commission publications acquired Zenodo doi numbers as explained in Section §6.11 (pp. 32−33) of the 2022 Annual Report. In Table 7, the number of downloads of each publication is 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 IUGS Manual of Standard Methods has more downloads, *i.e.*, compared to 2023 there are an additional 172 downloads in 2024. Of course, during 2024 there are additional downloads for all publications.

Table 7. Zenodo DOI download statistics for the four Commission publications from the date they were uploaded until the 31st of December 2024.

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	160
International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network	9/11/2022	414
R-scripts for Generation of 5, 8 and 16 Random Sampling Points Within Predefined Rectangles	9/11/2022	88
Program ROBCOOP4A for Estimation of Balanced Classical and Robust Analysis of Variance: Instructions for Use and Source Code	9/11/2022	93

6.7. Work of Commission's Committees

6.7.1. Sampling, Analytical & Data Management Committees

In 2024, representatives of the Sampling, Analytical, and Data Management Committees participated in the three-day workshop organised on the occasion of the IGC37 conference in Busan, South Korea (see Section §6.4.4.1.3). They answered questions and gave advice to colleagues from different countries.

6.7.1.1. 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 2025 subject to the health status of Evripides Vassiliades.

6.7.2. Public Relations and Finance Committee

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

The work schedule included still exploring a few options for obtaining sponsorships. Discussions have already started with a Hellenic mining company and a non-profit company and will continue in 2025.

In 2024, a major activity of the Public Relations and Finance Committee was informing all Commission members about webinars and conferences of interest, as indicated in Section §6.4.1.

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 2024 in comparison with 2023, reaching 776 (+65) followers on Facebook and 16 (+3) subscribers to CGGB's YouTube channel. Concerning Twitter (now X), compared to 2023 the number has been reduced to 143, which means a loss of 120 followers. In July 2023, the Commission started its presence on LinkedIn (@IUGS_CGGB), reaching 96 followers by the 31st of December 2024, which is an increase of 37 followers compared to last year.

6.8. Assistance to Members and Workshop Participants

Apart from the normal questions about sampling and levelling of data, this year, there were questions from a female geologist from the '*Geology and Mineral Exploration Organization*' of Iran about a project for "*Preparing a map of the concentration distribution of geochemical elements in the Iranian crust in order to complete the global geochemistry database*". To begin with, the IUGS Manual of Standard Methods was sent to her because the answers to the questions asked were explained in the Manual. In addition, two Microsoft® Excel files were sent to her, *i.e.*,

- IUGS-CGGB_7356_GTN_160x160km_grid_cells.xlsx (Microsoft® Excel file containing the grid cells that cover the terrestrial part of our planet) – (https://www.globalgeochemicalbaselines.eu/content/110/gtn-160x160-km-/), and

- Microsoft® Excel Workbook of 5 randomly selected points in each GTN grid cell of 160x160 km (https://www.globalgeochemicalbaselines.eu/content/111/sampling-design-/),

and Figures 19 & 20 with explanations. This is hopefully an ongoing collaboration for the design of an effective sampling plan.

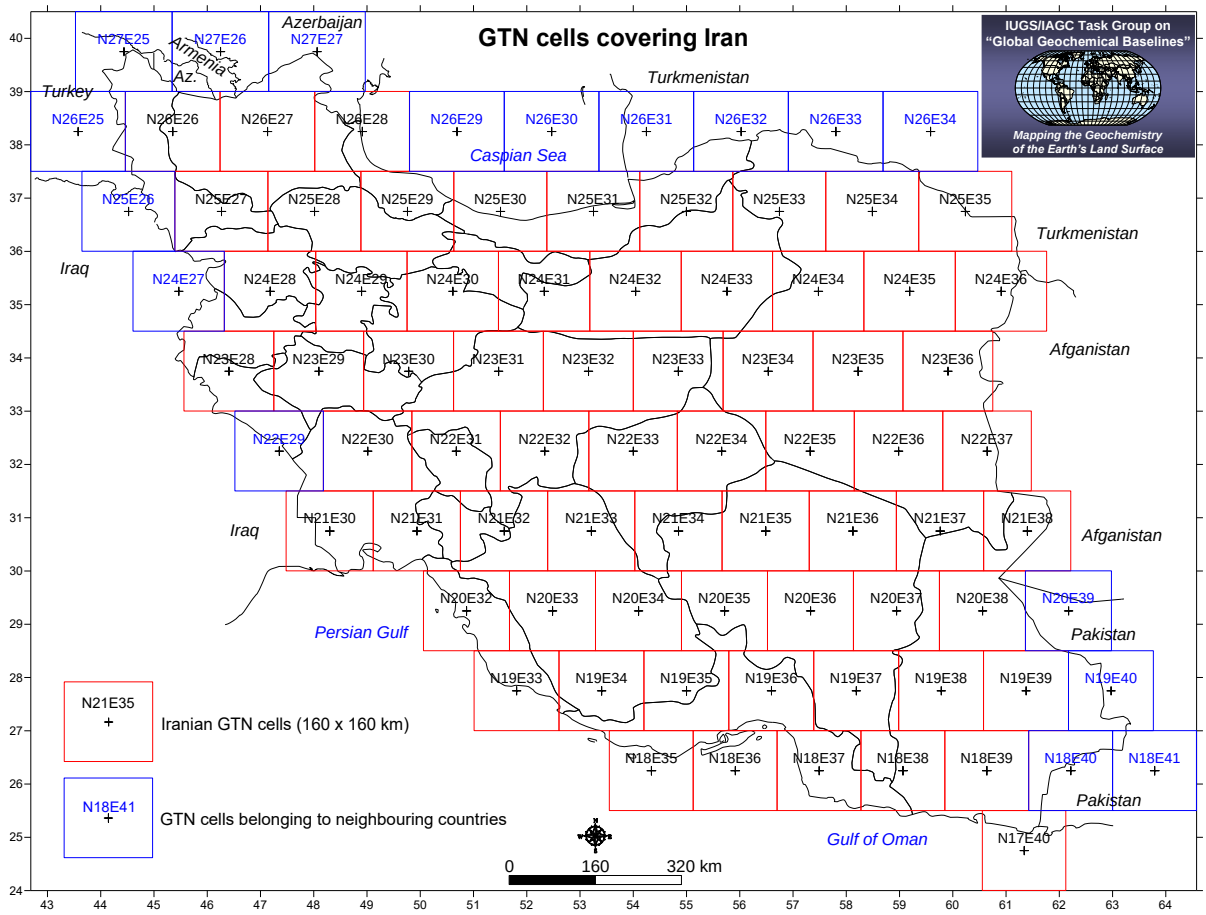


Figure 19. Global Terrestrial Network (GTN) grid cells of 160x160 km covering Iran and neighbouring countries. It is noted when the centre of the GTN grid cell falls in a neighbouring country, then that particular grid cell is coordinated by that country.

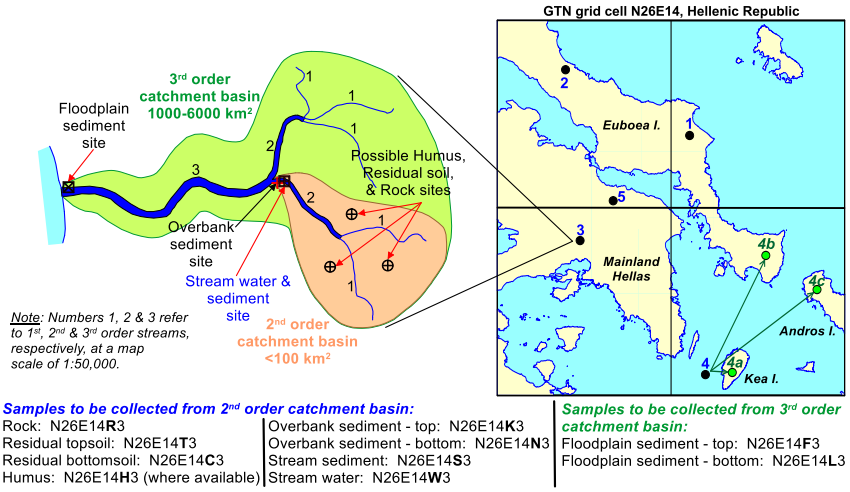


Figure 20. Example of a GTN grid cell N26E14 with 5 random points, and a schematic diagram showing the possible sample sites of rock, residual soil, humus, stream water and sediment, overbank sediment, and floodplain sediment from the catchment basin representing random point number 3. Two random points fall on mainland Hellas (3 & 5), two on Euboea Island (1 & 2), and one in the sea (4), which should be moved to a land site (Figure 2.8, p.23, from Demetriades et al., 2022).

6.9. Publications

The Commission submitted one-page reports, which were published in the IUGS E-Bulletin (see Section §6.3.1). "*Appendix 2: Regional reports*" contains other publications on continental, regional, and local-scale projects carried out on different continents.

One publication that refers to the IUGS Manual of Standard Methods is the following:

Demetriades, A., 2024. ***Applied Geochemistry - The How and Why***. Chapter 7.1 In: Volume 7, How we Know, A. Shahar (Editor), In: Treatise on Geochemistry, 3rd Edition, Elsevier, 72 pp. https://doi.org/10.1016/B978-0-323-99762-1.00004-8.

It was also mentioned in the IUGS e-Bulletin No. 203 – February-March 2024 issue.

7. REGIONAL REPORTS

Regional reports were provided from Africa (Africa, PanAfGeo-2), America-North (Mexico, United States), America-South (ASGMI Geochemistry Expert Group, Argentina, Chile, Cuba, Ecuador, Peru), Asia (Armenia, Japan), Australasia (Australia, New Zealand), Europe (EuroGeoSurveys Geochemistry Expert Group) and Middle East (Saudi Arabia). These reports are in Appendix 2: Regional Reports and all reporting colleagues are thanked for their input because they provided useful reports about the geochemical surveys carried out in their countries.

8. NEW MEMBERS

In 2024, the Commission made 29 new members from Austria (1), Belgium (1), China (4), Croatia (1), Cyprus (1), Denmark (2), Estonia (1), Germany (1), Hellenic Republic (2), Iran (1), Poland (1), Romania (1), South Korea (1), Kosovo (1), New Zealand (1), Poland (1), Slovak Republic (3), South Africa (1) and Spain (4). 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 264 members in 78 countries (see Members list on the Commission's web page, and their countries are shown in Figure 21.

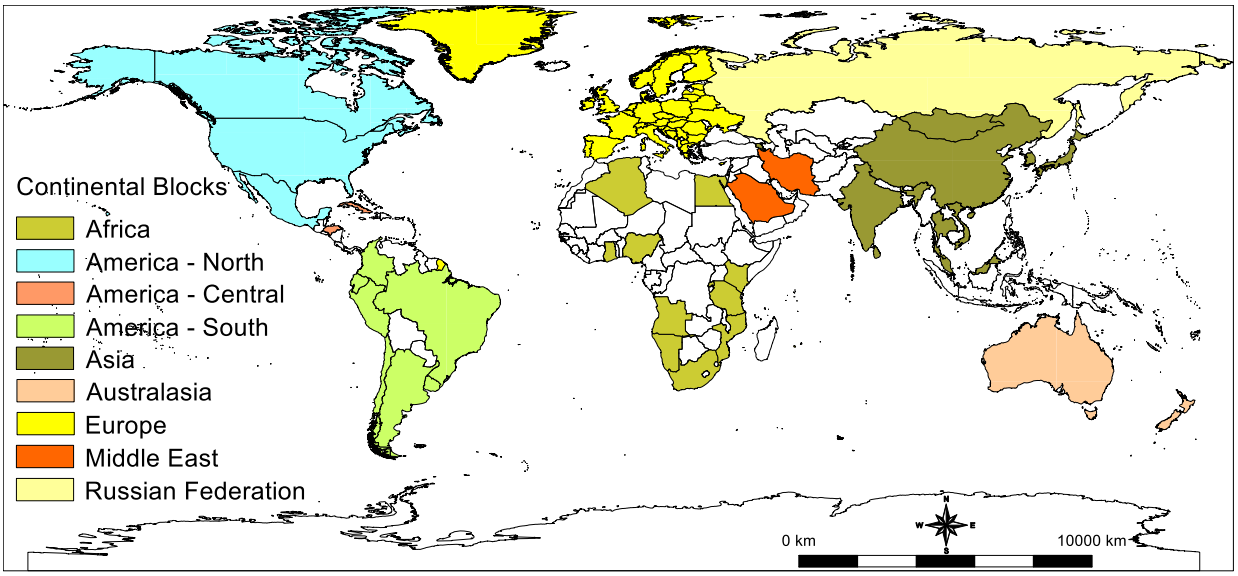


Figure 21. Map showing countries with Commission members. The different colours represent continental blocks. The Russian Federation has its own colour because it is in two continental blocks, Europe and Asia. Map plotted with Golden Software's MapViewer™ v8 by Alecos Demetriades, IUGS-CGGB member.

9. IUGS FUNDING FROM 2016 TO 2024

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, US$10,000 for 2023, and US$15,000 for 2024.

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 2024 FUNDING ALLOCATION

Table 8 shows the use of US$15,000 allocated in 2024, together with the outstanding balance of US$273.81 in 2023 making an overall total of US$15,273.81.

Table 8. Expenses incurred during 2024.

Expenditures for the year 2024 & first quarter of 2025	Number of people	TOTAL (in US$)	Support from IUGS (in US$)
Conferences/congresses - 37 IGC, Busan, South Korea (Session & Workshop			
Travel	2	3,269.55	1,634.78
Accommodation	5	2,817.96	1,408.98
Registration fees	2	1,210.45	605.23
Daily allowance and local transport expenses (total)	5	3,517.23	1,758.62
Purchase of 50 USB 32 GB memory sticks for workshop participants		438.63	219.32
Purchase of equipment (Mattock cutter, 5 & 2 kg sledgehammers)		26.78	13.39
Car hire & petrol for preliminary investigation of sampling sites		97.29	48.65
Lunch for workshop participants, Saturday, 31 August 2024	27	318.23	159.12
Lunch for field training workshop participants, Sunday, 1 Sept. 2024 (pre-ordered)	50	583.28	291.64
Hire two 25-seater minibuses for field workshop on Sunday, 1 September 2024		670.59	335.30
Printing of participant attendance certificates, field cards, map, *etc.*		195.71	97.86
Printing 5 FOREGS Periodic Tables on canvas for workshop "Phases and protocols to be followed for a global geochemical reference network", XI National Geological Congress of Spain, 1st July 2024.		367.73	367.73

	50% of the costs were paid by the sponsorship from the Association of Applied Geochemists
	50% of the costs were paid by the IUGS 2024 funding allocation

Joint Annual Business Meeting, Prague, 19-21 September 2024	Number of people		
Travel	1	481.41	481.41
Accommodation	2	979.47	979.47
Other costs (please specify): Daily allowance and local transport expenses	2	830.71	830.71

Dissemination/outreach/website			
Annual website hosting fee		338.61	338.61

Expenditures for the year 2024 & first quarter of 2025	Number of people	TOTAL (in US$)	Support from IUGS (in US$)
Zoom Annual fee		210.37	210.37
Purchase of pCloud one-time storage for 4 TB (added to existing storage of 1.49 TB) making a total of 5.49 TB		544.64	544.64
IUGS-EC meeting, Paris, March 2025	**Number of people**		
Travel	1	503.20	503.20
Accommodation	1	734.01	734.01
Other costs (please specify): Daily allowance and local transport expenses (total)	1	434.41	434.41
	TOTAL:	**18,570.26**	**11,997.41**

It is noted that without:

(i) the Association of Applied Geochemists' sponsorship of the 3-day Workshop on the occasion of the 37th International Geological Congress in Busan (South Korea) (7,950 US$), and

(ii) the partial or full payment of the expenses of workshop instructors by their geological surveys amounting to about 11,880 US$,

the workshop would not have gone ahead as originally planned, and the participants' success rating would not have been as good (see Section §6.4.4.1.5). Hence, the total actual expenses were 30,450.26 US$.

11. FUNDING REQUEST FROM IUGS FOR 2025-2026

11.1. Planned 2025 activities requiring no funds from IUGS

Although no funds are requested for the activities, described below, it should be stressed that Commission member Geological Surveys and Universities fund it. Hence, it is considered important to make a conservative estimate of person-months, and their approximate cost. It is estimated that the time of all CGGB's Steering Committee members and other colleagues from all over the world contributing to this work is between 30 and 50 person-months with an estimated cost of over 92,000 US$.

The main Commission activities in 2025 that require no funds are:

- Organisation workshops/webinars in collaboration with the ASGMI-GEG and the EGS-GEG 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 2025).
- Organisation of webinars on quality control methods.
- Organisation of dedicated webinars on statistical data processing, such as Compositional Data Analysis.
- The Commission's Iberian colleagues, Maria João Batista (CGGB Deputy Chair), Paula Adánez-Sanjuan (CGGB Scientific Secretary), and Iván Martín-Méndez (CGGB Sampling Committee's Deputy Chair), will be organising a four-hour workshop on the sampling methods described in the IUGS Manual of Standard Methods on the occasion of the International Professional Geology Conference (IPGC-5th Edition, 5-7 November 2025) in Zaragoza, Spain.
- Conversion of statistical programs from MS-DOS Fortran 77/Power Station 4 to 32- and 64-bit Windows platforms and made freely available through the Commission's website.
- Writing short articles about work performed to be published in the IUGS E-Bulletin.
- Updating the Commission's website.
- Looking for sponsors for the preparation of reference materials, *etc.*
- 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 aligns 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 2025.
- 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.
- Translation into Spanish of the Instructions for Use and Source Code of the Program ROBCOOP4A for the Estimation of Balanced Classical and Robust Analysis of Variance.
- Translation of the IUGS Manual of Standard Methods to Spanish in collaboration with the ASGMI-GEG.

11.2. Planned 2025-2026 activities requiring IUGS funding

The following planned activities in 2025, and the first quarter of 2026, require IUGS funding:

- Organisation of the third person-to-person four-day Workshop on the IUGS Manual of Standard Methods for establishing the global geochemical reference network scheduled from the 2nd to the 5th of July 2025 on the occasion of the Goldschmidt2025 conference in Prague with the title '*Global to Regional and local Scale Geochemical Mapping based on the methods described in the 'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*'. The first two days will be devoted to lectures, the third to hands-on exercises, and the fourth to

demonstration of all sampling methods in the field with the assistance of colleagues from the Czech Geological Survey (CGS). In order to reduce participant costs, the workshop will be held on the premises of the Czech Geological Survey. The Commission thanks the CGS Director, Mr Zdenek Venera, for approving its request.

- Organisation and participation in Session 05j '*Multi-scale Geochemical Mapping for Mineral Resource Management*' on the occasion of the Goldschmidt 2025 conference in Prague (Czech Republic) from 6-11 July 2025.
- 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 Expert Group (ASGMI-GEG), which is planned from the 9th to the 11th of October 2025 in Utrecht (The Netherlands). It will be hosted by the Geological Survey of The Netherlands.
- Web-hosting annual fee and domain renewal (2024-2025) of the Commission's website.
- Renewal of the Zoom licence, and
- Participation in the open session of the 2026 IUGS Executive Committee meeting 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 9), 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. 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.

Table 9. Estimated expenses for 2025 and the first quarter of 2026.

ACTIVITIES	USD
Conferences/congresses (Goldschmidt 2025 conference, Prague)	10,505
Workshop (Goldschmidt 2025 conference, Prague)	18,420
Support to early career researchers for participation in the above Workshop	2,500
Dedicated meetings (Joint Annual Business meeting, Utrecht, The Netherlands)	5,000
Dissemination/outreach/website	700
Reporting at the IUGS EC 2026 open session	3000
TOTAL REQUESTED BUDGET	**40,125**

The comparatively high allocation funding request is due to the Commission's active participation in the Goldschmidt 2025 conference with a dedicated session (05j '*Multi-scale Geochemical Mapping for Mineral Resource Management*'*)*, and a four-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. The Commission is, therefore, requesting financial support from IUGS in the order of **US$40,000** to cover planned expenses in 2025 and the first quarter of 2026.

It is worth noting that the IUGS 2024 funding allocation was $15,000 US$ for all the planned work. The total amount available, with the 2023 outstanding balance of 273.81 US$, was

$15,273.81 US$. Adding to this amount, the 7950 US$ sponsorship received from the Association of Applied Geochemists, the available total amount was 23,223.81 US$.

The expenses for 2024 were 18,570.26 plus the 11,880 paid by geological surveys, making a grand total of 30,450.26 US$. So, the missing amount was 7,226.45 US$, which fortunately was covered by project funds from Portugal, Spain and Sweden.

In conclusion, the Commission anticipates that the IUGS EC will be more generous with its 2025 funding allocation because we are not certain if there will be sponsorship or if the geological survey colleagues will be able to provide funds from their projects.

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

The IUGS Executive Committee must consider providing an additional amount in addition to the annual amount requested. Without any reserve funds, it is difficult to plan activities and make commitments for the following fiscal year, especially the first four months, because the annual allocation is usually made available around 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 IUGS 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 proper 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 of 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 on the Links web page at http://www.globalgeochemicalbaselines.eu/content/104/links-/.

13. DETAILS OF ANNUAL REPORT AUTHORS

Alecos Demetriades, Chair
Postal address: P.O. Box 640 47 Zografou, GR-157 10, Athens, Hellenic Republic
E-mail: alecos.demetriades@gmail.com

Maria João Batista, Deputy-chair
Postal address: Laboratório Nacional de Energia e Geología,
Estrada da Portela, Zambujal, Alfragide, Apartado 7586, PT 2610-999 Amadora, Portugal
E-mail address: mjoao.batista@lneg.pt

Paula Adánez-Sanjuan, Scientific Secretary
Postal address: Instituto Geológico y Minero de España, Rios Rosas, 23, CP 28003, Madrid, Spain
E-mail address: p.adanez@igme.es

Christina Stouraiti, Treasurer
Postal address: Department of Geology and Geoenvironment, National & Kapodistrian University of Athens, Panepistimiopolis Zographou, 15784 Athens, Hellenic Republic
E-mail address: chstouraiti@geol.uoa.gr

Zacharenia Kypritidou, Deputy-Treasurer
Postal address: Department of Geology and Geoenvironment, National & Kapodistrian University of Athens, Panepistimiopolis Zographou, 15784 Athens, Hellenic Republic
E-mail address: zach-kyp@geol.uoa.gr

Ariadne Argyraki, Public Relations and Finance
Postal address: Department of Geology and Geoenvironment, National & Kapodistrian University of Athens, Panepistimiopolis Zographou, 15784 Athens, Hellenic Republic
E-mail address: argyraki@geol.uoa.gr

Juan Pablo Lacassie Reyes, Councillor
Postal address: Geological and Mining Survey of Chile, Av. Santa María, 0104 Providencia, Santiago, Chile
E-mail address: juan.lacassie@sernageomin.cl

Rose Turnbull, Councillor
Postal address: Geological Survey and Resource Strategy Division, Department of Energy, Mines, Industry Regulation and Safety, Government of Western Australia, Geological Survey and Resource Strategy Division, Department of Energy, Mines, Industry Regulation and Safety, 100 Plain Street, East Perth, WA 6004, Australia
E-mail address: Rose.TURNBULL@dmirs.wa.gov.au

Umar Bature, Councillor
Postal address: Nigerian Geological Survey, 31 Shettima A. Munguno Crescent, Behind Julius Berger HQs., Utako District, PMB 616 Garki, Abuja, Nigeria
E-mail address: batureu@gmail.com

Anna Ladenberger, Advisory Panel Councillor
Postal address: Geological Survey of Sweden, Box 670, SE-751 28 Uppsala, Sweden
E-mail address: anna.ladenberger@sgu.se

Kate V. Knights, Advisory Panel Councillor
Postal address: Consultant, 18 Riverwood Dene, Castleknock, Dublin, Ireland
E-mail address: kknights@hotmail.com

Gloria Namwi Simubali, Advisory Panel Councillor
Postal address: Geological Survey of Namibia, Ministry of Mines and Energy, Private Bag 13297, 6 Aviation Road, Windhoek, Namibia
E-mail address: Gloria.Simubali@mme.gov.na; namwig@gmail.com

Gloria Prieto, Advisory Panel Councillor
Postal address: Carrera 13a # 104 - 41, Bogota D.C., Colombia
E-mail address: priglori@gmail.com; g.prietor@outlook.com

David B. Smith, Advisory Panel Councillor
Postal address: 4170 Dover Street, Wheat Ridge, CO 80033, United States of America
E-mail address: dbsmith13@gmail.com

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., Johnson, C.C., Smith, D.B., Ladenberger, A., Adánez Sanjuan, P., Argyraki, A., Stouraiti, C., Caritat, P. de, Knights, K.V., Prieto Rincón, G. & Simubali, G.N. (Editors), 2022. *International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*. IUGS Commission on Global Geochemical Baselines, Athens, Hellenic Republic, Special Publication, 2, xliv, 515 pages, 375 figures, 35 Tables, 5 Annexes and 1 Appendix, ISBN: 978-618-85049-1-2; https://doi.org/10.5281/zenodo.7307696. Further information about this Manual is available at the relevant web page: https://www.globalgeochemicalbaselines.eu/content/174/iugs-manual-of-standard-methods-for-establishing-the-global-geochemical-reference-network-/.

Blank back page

APPENDIX 1. IUGS-CGGB ANNUAL BUSINESS MEETING

Minutes of the joint meeting of
IUGS-CGGB, EGS-GEG and ASGMI-GEG
19-21/09/2024

Czech Geological Survey
Prague, Czech Republic

1st Day, Thursday, 19th September 2024, 09.30-17.00 (CET)

List of participants (in person)

Name	*Country*
Clemens Reimann	Austria
Michal Poňavič	Czech Republic
Eva Martinková	Czech Republic
Julie Erban Kocergina	Czech Republic
John Hora	Czech Republic
Filip Oulehle	Czech Republic
Kateřina Perthenová	Czech Republic
Štěpánka Mrázová	Czech Republic
Jaana Jarva	Finland
Philippe Négrel	France
Dennis Kraemer	Germany

Name	*Country*
Alecos Demetriades	Hellenic Republic
Alexandros Liakopoulos	Hellenic Republic
Artemis Kontomichalou	Hellenic Republic
Belinda Flem	Norway
Irena Wysocka	Poland
Wojciech Wołkowicz	Poland
Mateja Gosar	Slovenia
Martin Gaberšek	Slovenia
Paula Adánez-Sanjuan	Spain
Iván Martín-Méndez	Spain
Anna Ladenberger	Sweden
Jasper Griffionen	The Netherlands

ACRONYMS

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

NOTE: The numbers in front of discussion items refer to the Microsoft® PowerPoint presentations, which can be downloaded from the following pCloud hyperlink:
https://u.pcloud.link/publink/show?code=kZuXuX5ZOY7mQkM3OpzX1Bghib1Oh7Bdmruk

09.30-10.00: Registration and coffee
10.00-10.05: Welcome by Zdeněk Venera, Director of Czech Geological Survey
10.05-10.10: Welcome by Philippe Négrel (PN), EGS-GEG Chairperson
10.10-10.15: Welcome by Alecos Demetriades (AD), IUGS-CGGB Chair 2024-2028
10.15-10.45: Round table self-introduction
10.45: Organisation arrangements − Michal Poňavič (MP)

10.45-11.00: Coffee break

(01) 11.00-11.20: EGS-GEG 2022-2023 activities report (PN)

The activities performed, and papers published or in review were presented. // PN emphasises that there are few active members from the 60 official members + 40 collaborators. GEG continues collaboration with EUSO (EU Soil Observatory), which is essential for the policy strategy, and we have delegated members to different working groups (soil pollution, data integration, erosion). It is the strategic activity of EGS-GEG members; an invitation was received to participate in the next EUSO Stakeholders meeting in October 2024. // Webinars, publications (GEMAS), international conferences.

(02) 11.20-11.40: IUGS-CGGB 2023-2024 activities report (Anna Landenberger - AL)

Alecos is taking over as IUGS-CGGB chair for the next four years (2024-2028), with new Steering Committee Members. This is a summary of the latest activities, conferences, workshops, publications, IUGS e-Bulletins, *etc.* One should realise that inclusion and gender topics need more attention on a global rather than European scale. Note that all members of EGS-GEG and ASGMI-GEG are also automatically members of IUGS-CGGB.

(03) 11.40-12.00: ASGMI-GG activities report (Maria João Batista (MJB) & Iván Martín - IM)

Publication of the ASGMI-GEG Manual, meetings, and webinars past and future. Future and ongoing activities (geochemical Atlas and monographic documents focused on groups of chemical elements). Close relationship with other ASGMI Expert Groups. It is worth realising that geochemical mapping in Latin America is carried out in a broad range of landscape types and under difficult logistical conditions.

AD: The ASGMI-GEG is a very active group. Hopefully, the African Geochemistry Group could be established in the next year, although it is difficult because of different languages and other problems that need to be overcome. Establishing working groups in the Middle East and Asia is currently impossible. In Australasia, there is a small but active group.

(04) 12.00-12.20: 2024 conferences and workshops (AL & AD)

This is a summary of the conferences and workshops (SEGH webinars, ISEH ICPH and ICEPH in Galway, 37 IGC in Busan). Members of IUGS-CGGB, EGS-GEG, and ASGMI-GEG were active in different sessions. At the IGC conference in Busan (South Korea), AL recommended that we pay systematic attention to geochemical mapping because of its social relevance.

(05) 12.20-12.40: Ongoing EU projects, GSEU, SRIA & Soil Health Law (AL)

- One of the biggest projects is GSEU (Geological Service for Europe). Many EGS-GEG members are involved in various work packages but not GEG itself. Geochemistry topics and soil issues have been included in the new Strategic Research and Innovation Agenda (SRIA) document which is still under preparation.
- GEMAS data are available on EGDI (European Geological Data Infrastructure) website: (https://data.geus.dk/egdi/?mapname=egdi_new_structure#baslay=baseMapGEUS&extent=138854.01929260464,1796730,5948345.980707396,4619780&layers=gemas_ap_aquaregiaxrf).
- Soil Directive (2023): contains 27 articles (soil pollution must be reduced, 60-70% of the Union's soil is classified as deteriorated. Adaptation by 2050). Issues to be tackled: this is a political paper but not a scientific one; a description like "healthy soil" is not a good definition. It is not in line with real studies. It is okay to be seen as a framework. Annex I: soil monitoring (how?, where?, parameters to be measured?), and Annex II: Methodologies.
- IUGS-CGGB & GEG members will take part in FAO's Global Soil Symposium and European Mission Soil Week.

(06) 12.40-13.00: GEG recent and under internal review publications; strategy in relation to JRC (PN)

GEMAS overview of publications, current status and latest ones: phosphorus (published), boron (published), silica, aluminium-iron and climate change (under internal review). Publications strategy: consider how to promote, what and where, and how to make research visible. Papers can be categorised into single elements, groups of elements and geochemical behaviour topics (recommendation of going along this line).

Action 1: **PN** recommendation to go along the line of publications on the behaviour of elements in soil.

Comparison between JRC LUCAS's project and EGS FOREGS and GEMAS projects. And discussion about how LUCAS publications do not cite the GEMAS project data. Scientific disagreement.
Further Discussion is to be developed during the meeting.

13.00-14.00: Lunch break

(07) 14.00-14.10: Update on ongoing geochemical projects at IGME-CSIC (IM and Paula Adánez)

(08) 14.10-14:30: FOREGS, EGG & GEMAS publications; EGS-GEMAS website; GEMAS mapviewer at BGR, GEMAS & FOREGS sample archive at BGS; GEMAS Ap standard at GSRS (AD, Paolo Valera, Sebastian Pfleiderer, Uwe Rauch, Manfred Birke, Dennis Krämer, Louis Ander, Henrietta Soltysova & Katarina Boksanska)

- Over 60 WEGS-FOREGS publications and EGG atlas publications have been published since 1989, and all are available from dedicated pCloud folders.
- Transfer of the GEMAS website has been accomplished. We have a permanent website on EuroGeoSurveys' server (https://gemas.eurogeosurveys.org/); the last updates this year will be made by Paolo Valera in collaboration with AD. A volunteer is needed to take over from AD. New publications should be sent to AD. GEMAS geoportal at BGR has been completed and is operational. Performance problems solved by Uwe Rauch. All maps are available online and can be downloaded by using the following hyperlinks:

- https://geoportal.bgr.de/mapapps/resources/apps/geoportal/index.html?lang=en#/
- https://geoportal.bgr.de/mapapps/resources/apps/geoportal/index.html?lang
- https://geoviewer.bgr.de/mapapps4/resources/apps/geoviewer/index.html?lang=en
- https://geoportal.bgr.de/mapapps/resources/apps/geoportal/index.html?lang=en#/.

- Sample archive at the British Geological Survey. PROBLEM: the standards. They must be moved (11,040 bottles) from the Slovak Geological Survey to the British Geological Survey. These samples are of great value and must be handled with care.

7) **Action 2**: We have to find a way to move these valuable samples during the next year. There are 92 small boxes, totalling 1450 kg in weight. The EGS Secretary General, Julie Hollis, was informed about this task as she joined the meeting virtually.

(09) 14.30-15.00: Discussion about next year's activities: IUGS-CGGB (Alecos Demetriades), EGS-GEG (Philippe Négrel), ASGMI-GEG (Iván Martín Méndez - IMM)

Discussion about next year's activities, and strategic directions:
(9A) IUGS-CGGB (AD)
(9B) EGS-GEG (PN) and
(9C) ASGMI-GEG (IMM)

AD: Planned activities by IUGS CGGB: organisation of webinars; affiliation with other associations; revision of the Blue Book; looking for sponsors; Anna proposed the writing of a manual on Isotopes and other compounds, in collaboration with colleagues who are experts in these topics. Discussion on how flexible or fixed the methods should be. Not only the procedure, but the materials are also important, homogenisation, *etc.*

PN: Ideas to energise the EGS-GEG group. Give more energy to the group to be able to answer the requests of EGS. The main goal of EGS-GEG was to establish a standardised multielement database for Europe. Regarding the publications, only a small part of the group is involved. With respect to external actions, few members are active with EUSO. Ways to check how people are really involved in the group (how people are selected to be national delegates), maybe knowing the area of expertise of each member. Reinforcing the GEG dynamics: The idea of appointing more vice-chairs is being discussed. Members of EGS-GEG can indicate their interest in the coming weeks. Pick 3-5 topics with a respective chair. Examples: EU policy, groundwater, soil, mineral resources, geothermal energy. These themes could be linked with other expert groups.

Action 3: The EGS-GEG could be divided into areas of expertise, with vice-chairs appointed as coordinators. The aim would be to find projects, contact other groups, *etc.*

IMM: Introduced the work being carried out for the future Atlas of Latin America. It includes maps from systematic campaigns.

(09D) Presentation by July Hollis: EuroGeoSurveys' Strategic Direction Updates

EGS is working on the Strategic Research and Innovation Agenda amongst others. Mission and vision of the Surveys. GSEU project. Projects must provide all the data.

15.00-15.30: Coffee break

(10) 15.30-15.50: Biogeochemistry of Sr in the Bohemian Massif − Filip Uolehle (first oral presentation because Filip is not available on Friday).

(11) 15.50-17.00: Discussion of pan-European project proposals

AL: EUROLITH Lithogeochemical map of Europe initiative. Pilot project. In cooperation with the geological mapping and modelling expert group. Some positive feedback, but we need a motivation for such a map. Sampling density of GEMAS. It can be done in collaboration with other groups. The data that exist can be compiled during the pilot project.

17.00: Julie Erban Kocergina and John Hora led a tour around the historical part of Prague, which ended at the restaurant where the joint shared-cost evening dinner was organised at 19.30.

2nd Day, Friday, 20th September 2024, 09.00-17.30

Presentations from EGS-GEG, ASGMI-GEG and local hosts (20 minutes each, *i.e.*, 15 min presentation plus 5 minutes for questions, each presenter is expected to share her/his original PowerPoint presentation):

09.00: Organisation arrangements by MP
09.05: Presentation Moderators - PN & AL

General Session – Part 2:

(12) 09.10: *Precision Farming: A New Approach to Mapping Alum Shale in Agricultural Soil for Risk Reduction in Vegetable Cultivation* – Belinda Flem
(13) 09.30: *Cadmium isotope fractionation of materials originating from various industrial processes* – Eva Martinková
(14) 09.50: *Cadmium content in soils of the Upper Silesia Region: An analysis based on geochemical mapping in Poland* – Irena Wysocka
(15) 10.10: *Preliminary results of the soil geochemical baseline pilot study in Hellas* – Artemis Kontomichalou

10.30-11.00: Coffee break

(16) 11.00: *FUTURAM: Developing methodologies for mining waste characterization-case Håkansboda* – AL
(17) 11.20: *Geochemical baseline studies of mineral potential areas and mining surroundings in Finland* – Jaana Jarva
(18) 11.40: *A comprehensive review of abandoned mining waste facilities to assess the representativeness of their sampling* – Paula Adánez-Sanjuan
12.00: *Hydrogeochemistry of bromide in surface water and groundwater in the Netherlands* − Jasper J. Griffioen
(19) 12.20: *Mobility, Reactivity and Bioavailability of TCE's in the Environment and the Relevance of Geo-Bio-Interactions for TCE mobility* - Dennis Krämer (TCE = Technology-critical elements).
(20) 12.40: *The Kirki mining area: environmental considerations and future prospectives* – Alexandros Liakopoulos
(21) 13.00: *Are emissions from dental practice detectable in the outdoor environment?* – Martin Gaberšek
Urban soil geochemistry results for citizens: example Maribor (Slovenia) – Martin Gaberšek

13.30-14.30: Lunch break

GEMAS 10th Anniversary Celebration

(22) 14.30-14.50: ***GEMAS: Introduction, history, and main achievements*** **– Clemens Reimann**

The GEMAS project was initiated in 2007 with a presentation of the project idea to the EuroGeosurveys Directors by stressing that geochemical data were needed in many applications. Sampling started in 2008 and was completed in early 2009. In total, 2180 agricultural soil and 2024 grazing land soil samples were collected from 33 countries, covering about 5.6 million km^2. Analytical methods used were (a) total concentration XRF, (b) hot aqua regia extraction, and (c) MMI® leach; pH, Pb & Sr isotopes, *etc.* More than 60 organisations participated in the GEMAS project.

(23) 14.50-15.10: ***GEMAS: Data quality control procedures, etc.*** **– AD**

AD recommended that the three GEMAS quality control reports be consulted and that similar reports be written for all geochemical projects. Quality control procedures should be set up from the start of an applied geochemical survey. In all the geochemical surveys AD has managed, whether for mineral exploration or environmental purposes, field duplicate samples were collected at 10% of the sampling sites.

(24) 15.10-15.30: ***GEMAS: Low-density geochemical mapping of agricultural soil for multipurpose applications*** **– AL**

(25) 15.30-15.50: ***GEMAS: The silica-aluminium-iron triptych, the composition of soils and the climate change: facts versus concepts at the European continental scale*** **– PN**

15.50-16.30: Coffee break and GEMAS 10th Anniversary Celebration

Clemens Reimann blowing out candles of the 10th GEMAS anniversary cake held by Anna Ladenberger, EGS-GEG Deputy Chair (Photograph taken by Philippe Négrel).

Action 4: Comments to be written by each country for LUCAS's recently published papers. One comment per country, comments by EGS-GEG (PN).

Next year's annual meeting will be held in The Netherlands.

16.30 - 17.00: Conclusions, meeting closes.

17.30 – 18.30: Visit the laboratories of the Czech Geological Survey

Some of the meeting participants visited the laboratories where they met Anna Vymazalová (Head of the Geochemical Division and Central Laboratories), who informed visitors of the survey's facilities. Afterwards, Julie Erban Kocergina and John Hora took them around the laboratories. Frantisek Laufek (XRD analyst) showed the XRD laboratory, and Irana Vanisova (Chemist) - the chemical laboratory.

20.00: JOINT SHARED-COST EVENING DINNER

3rd Day, Saturday, 21st September 2024

EXCURSION (All day) - Start at 09.30 and return 16.00

Excursion to Příbram - the separation line of the state enterprise DIAMO, processing of tailings after the U-ore mining; visited waste dumps.

Michal Čurda, Economic Geologist of the Czech Geological Survey, led the excursion to Příbram. Apart from the meeting participants, Anna Vymazalová (Head of the Geochemical Division and Central Laboratories) joined the excursion. AD discussed with her the possibility for the CGS laboratory to determine the mineralogy of the GEMAS samples.

Příbram Shaft (Photograph by Czech Geological Survey)

Blank back page

APPENDIX 2. REGIONAL REPORTS

A2.1. AFRICA

A2.1.1. Africa

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

The African report was published in EXPLORE – the Newsletter of the Association of Applied Geochemists *(Explore Number 205, December 2024, pp.12 & 15-16), https://www.appliedgeochemists.org/sites/default/files/documents/Explore%20issues/EXPLORE205-December2024.pdf with the title:-*

A 2024 Review of Successes and Challenges in the Application of Applied Geochemistry in Southern Africa

by Theo Davies, AAG Regional Councillor for Southern Africa

(The article was edited for the purposes of this report).

INTRODUCTION

There has been an increase in the application of Applied Geochemistry in southern African laboratories in the last few years, coinciding with the acquisition of smaller, more compact, accurate and easy-to-use analytical instrumentation such as the portable X-ray fluorescence spectrometer and the proliferation of high-integrity commercial geochemical laboratories. A brief synopsis of examples involving successes in Applied Geochemistry teaching and research in southern Africa is presented.

Research capacity has been strengthened through a number of training programmes offered to graduate students and laboratory technicians in higher education institutions (HEIs) in Africa, including collaboration with national, regional and international research institutions. Although substantial gains have been realised (as of 2024) contributing to increasing the self-reliance and sustainability of Applied Geochemistry programmes within the region, many challenges remain, and massive investment is required.

Applied Geochemistry Teaching and Research

Teaching at southern African geochemistry departments has continued to blossom since the early 2000s, mainly because laboratories have acquired portable analytical instrumentation that requires little technical expertise for operation. A number of high-integrity commercial geochemistry enterprises have also emerged in the Subregion.

The B.Sc. Honours degree in Geochemistry at the University of the Witwatersrand provides an opportunity for students to combine fieldwork with laboratory studies and receive hands-on training by working with a range of state-of-the-art analytical equipment (https://www.wits.ac.za/course-finder/postgraduate/science/geochemistry/#anchor3; accessed 12.09.2024). The practical component focuses on actual laboratory analysis of rock and mineral samples using X-ray Fluorescence Spectroscopy (XRF), Inductively-Coupled Plasma Mass Spectrometry (ICP-MS), Thermal Ionisation Mass Spectrometry (TIMS), Secondary Ionisation Mass Spectrometry (SIMS) and Electron Microprobe Analysis (EPMA).

The Marine and Environmental Geochemistry Department at Stellenbosch University focuses on macronutrient (*e.g.*, N, P, Si) and trace metal cycling in the modern ocean (*e.g.*, Fe, Mg, Zn, Cd, Co, Cu) interactions with biological organisms (especially microbes and algae), and the impact of atmospheric deposition (dust) – (https://www.sun.ac.za/english/faculty/science/earthsciences/research/Environmental-

Geochemistry#:~:text=Currently%20our%20research%20at%20Stellenbosch,of%20atmospheric%20deposition%20(dust); accessed 12.09.2024).

The Analytical Geochemistry and Laboratory Division of the Geological Survey of Namibia houses geochemical laboratories equipped with a wide range of modern facilities and instruments to provide analytical services to a wide range of clientele. The Regional Geochemistry subdivision conducts countrywide baseline geochemical mapping (https://www.mme.gov.na/directorates/gsn/geochem/; accessed 12.09.2024).

The acquisition of a portable XRF by Mangosuthu University of Technology of South Africa in October 2022, continues to provide valuable services to graduate students through sampling and analyses, of the concentration of potentially harmful elements (PHEs) and assessment of their levels of contamination in soil, natural water and food crops at several abandoned mine sites in South Africa.

In February 2023, Fortune Business Insights announced Attom's desire to revolutionise geochemistry research in the coming years. Analytical instruments were deployed in the Department of Geological Sciences at UCT as part of the BIOGRIP network of new research facilities to provision and progress biogeochemical research in South Africa (https://www.fortunebusinessinsights.com/industry-reports/geochemical-services-market-100398; accessed 12.09.2024).

In February 2024, the Council of Geosciences (CGS) of South Africa presented a summary of the results of geochemical studies conducted as part of the CGS 10-year mapping programme that began in 2013. The seven (7) comprehensive Geochemical Synthesis Reports (FY23/24) provide an in-depth analysis of the soil samples collected, along with interpretations and conclusions concerning the geochemical characteristics of the studied environments (https://www.geoscience.org.za/media/press-release/release-of-geochemical-synthesis-reports/; accessed 12.09.2024).

The Africa Geochemical Database Programme

The "Africa Geochemical Database Project", which has suffered considerable setbacks since its initiation in the early 1990s, has produced a couple of recent successes in the last few years. Examples include:

1) The report in 2023 by Sun *et al.*, who, through "The Sino–Zambian Cooperation Project," has filled the gap in Zambia's national-scale geochemical mapping, providing basic geochemical guarantees for Zambia's basic geology, mineral development, environmental protection, agricultural production, and other aspects.

2) In 2024, the ongoing "Regional Geochemistry Sampling Programme" (RGSP) of the Geological Survey of Namibia (Fig. A2.1) continued its focus on a country-wide baseline geochemical sampling (1:250 000 scale) that is envisaged to generate valuable information with respect to potential economic deposits, land use planning, environmental monitoring, pollution control and many other applications (https://www.mme.gov.na/directorates/gsn/geochem/; accessed 12.09.2024).

Commercial laboratories

SGS, one of the world's leading testing, inspection, and certification companies, provides the southern African market with analyses on a wide range of geological materials containing precious, base, rare-earth, and battery metals, as well as bulk commodities like bauxite and iron ore.

"Spectrometer Technologies," with regional headquarters in Johannesburg, Cape Town, and Kigali (Rwanda), supplies high-integrity and reliable handheld XRF and other scientific analytical equipment (AAS, UV-Vis, EA, NIR, *etc.*) for the mining and mineral industry in the Sub-Saharan Africa region (https://us-tech.co.za/; accessed 12.09.2024).

Southern Africa also boasts several other large commercial geochemical laboratories, including ALS and UIS Analytical Services (Pty), which specialise in mining, exploration, and environmental samples.

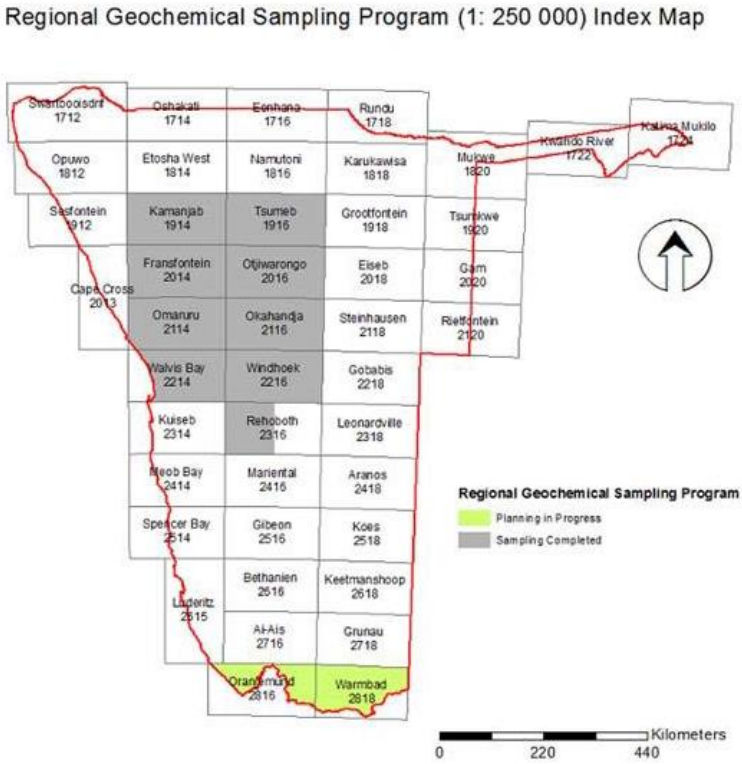


Figure A2.1. Regional geochemical mapping in Namibia. Credit: Geological Survey of Namibia. https://www.mme.gov.na/directorates/gsn/geochem/ (Accessed 12.09.2024).

CHALLENGES IN THE APPLICATION OF APPLIED GEOCHEMISTRY RESEARCH IN AFRICA

Summary of Challenges

1. Geochemical complexities of the surface environment of Africa – new standardised sampling and analytical protocols needed Darnley *et al.* (1995) recommendations. This has not been fully achieved;

2. Lack of sufficient analytical capacity (*e.g.*, modern highly sensitive analytical instrumentation) at regional centres to perform such large-scale ultraprecise undertaking. This has been partly achieved.

3. There is a lack of a sufficient number of highly trained technicians able to install, maintain, troubleshoot, and operate today's modern analytical instrumentation. This has been partly achieved.

4. Geochemists have not fully achieved unanimity on determining "background value. "

5. Lack of conviction by African governments (Geological Surveys), parastatals, other stakeholders and potential donors, of the value of geochemical knowledge of Africa's surface environment; hence,

6. The investment of large sums of money required to carry out such a large scale and dedicated exercise in the production of regional geochemical maps of the region.

BIBLIOGRAPHY

Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steenfelt, A., Tauchid, M., Xie, X., Garrett, R.G. and Hall, G.E.M., 1995. A Global Geochemical Database for Environmental and Resource Management: Final Report of IGCP Project 259. Earth Sciences 19, UNESCO Publishing, Paris, 122 pp.; https://unesdoc.unesco.org/ark:/48223/pf0000101010; https://www.globalgeochemicalbaselines.eu/datafiles/file/Blue_Book_GGD_IGCP259.pdf (Accessed 26.08.2024)

Manzeke-Kangara, M.G., Ligowe, I.S., Kaninga, B., Nalivata, P., Kabambe, V., *et al.*, 2024. Doctoral training to support sustainable soil geochemistry research in Africa. Interface Focus (The Royal Society)14 (4):20230058; https://doi.org/10.1098/rsfs.2023.0058 (Accessed 12.09.2024).

Sun, H., Ren, J., Wang, J., Zuo, L., Gu, A., Wu, X., Xu, K., Mukofu, C., Dokowe, A.P., Cao, S., & Cheng, X., 2024. Enrichment characteristics and metallogenic significance of rare elements in Zambia: Based on 1:1,000,000 geochemical mapping. *Geological Journal*, 59(3), 934–950; https://doi.org/10.1002/gj.4900 (Accessed 12.09.2024).

A2.1.2. PanAfGeo-2 project in Africa

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

The third training session of WP-B was conducted from 11-21 March 2024. It was jointly organised by LNEG, Portugal (Maria João Batista, WP-B leader) and the Geological Survey Department of Zambia.

The workpackage B Mineral Resources Assessment was delivered in Kitwe, Zambia. It brought together 21 participants from twelve African English-speaking countries, *i.e.*, Egypt, Tanzania, Zambia, Zimbabwe, Ghana, Botswana, Kenya, Eswatini, Libya, Malawi, Nigeria, and Liberia. Trainers from Europe were Stanislaw Wolkovicz from PGI- Geological Institute of Poland, Duska Rokavec and Emil Pucko from the Geological Survey of Slovenia (GeoZS), João Xavier Matos and Maria João Batista (WPB Leader) from LNEG, Geological Survey of Portugal. The Co-Leader from Nigeria Geological Survey Agency, Umar Bature (CGGB Steering Committee Councillor) presented his experience in Exploration Geochemistry. We also had 3 guests, Prof. Michael Musialike from Kitwe University, giving an overview of the mineral resources of the Copperbelt, Mr. Frederike Ngona from the mining sector, a geologist with wide experience (thirty-three years) in both the Zambian and Congolese Copperbelt, and Mrs Rovina from Gentina Mines Ltd and President of the Association of women in Emerald mining in Zambia.

The last training was delivered in Morocco from September 23 to October 4, 2024. The Kingdom of Morocco hosted the last WPB training session in Ouarzazate and Tinghir as part of the PanAfGeo project. The session, focusing on "Mineral Resources Assessment" was organised in collaboration with the Geological Surveys of Morocco, Portugal (LNEG), France (BRGM), Poland (PGI-NRI), and Nigeria (NGSA), with support from the European Union and EuroGeoSurveys.

The event welcomed 19 geoscientists from 14 French-speaking African nations. They engaged in theoretical discussions and field visits, including trips to the Imiter silver mine and a semi-artisanal barite mine. The training explored key challenges and opportunities in mineral resource exploration, governance, and sustainable development.

The last WPB-PanAfGeo2 seminar will be held in Kampala, Uganda. During the seminar, the training in mineral resources will be discussed, along with conversations with companies operating in Uganda.

A2.2. AMERICA, NORTH

A2.2.1. Mexico

Report by Flor de Maria Harp Iturribarría (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 2024, the Mexican Geological Survey carried out activities related to geochemistry at different scales and purposes throughout the territory.

An advance was made in a specific programme called Background Values and Reference Limits for Soil Geochemical Contents **in Mexico.** Its objective is to promote and define geochemical baselines together with the identification of certain mineral anomalies in soil. The results are in progress, including the preparation of a Soil Geochemistry Atlas of the Mexican Republic (under revision), which includes geochemical maps, histograms, box plots, empirical distributions and tables with statistics for each element in different soil horizons. This report will have many useful purposes.

Maps of the geochemistry of active stream sediment show the results and a primary interpretation of the analysis of contents in samples collected in stream sediment. The objective is to provide, together with geological maps, a tool to assist in the prospecting of mineral deposits throughout the analysis and statistical interpretation of the laboratory results for samples collected at a density of 1 sample per 5 square km, in combination with the geological context.

Geochemical maps are easily available in digital format at scales of 1:250 000 or 1:50 000, one per element. Maps and databases, along with related technical reports, are offered in the SGM web viewer (https://www.sgm.gob.mx/GeoInfoMexGobMx/#).

A2.2.2. United States of America

Report by David Smith (dbsmith13@gmail.com)

In 2024, the U.S. Geological Survey (USGS) published the Alaska Geochemical Database Version 4.0. This database contains geochemical data compilations for Alaska (1.72 million km^2) in which each sample type has one best value determination for each analysed species, greatly improving efficiency of use. The relational database includes historical geochemical data archived in the USGS National Geochemical Database, the Atomic Energy Commission National Uranium Resource Evaluation Hydrogeochemical and Stream Sediment Reconnaissance databases, and the Alaska Division of Geological and Geophysical Surveys Geochemistry database. Data from the U.S. Bureau of Mines and the U.S. Bureau of Land Management are included as well. The analytical results were determined by 120 laboratory and field analytical methods performed on

416,333 rock, sediment, soil, mineral, heavy-mineral concentrate, and oxalic acid leachate samples. The complete database, with accompanying metadata, is available at https://doi.org/10.5066/P14THGQH.

A2.3. AMERICA, SOUTH

A2.3.1. ASGMI Geochemistry Expert Group

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

During the year 2024, the Geochemistry Expert Group of ASGMI started the preparation of the criteria to select the appropriate geochemical data for the Atlas of Latin America. A file with all countries of Latin America divided into different sheets with columns of coordinates and grid cell designation (GTN plus an order number from 1-16 to go from 160x160 km^2 into 40x40 km^2). The Microsoft Excel® file and the GIS files of the Geology and Tectonics of South America, Caribe and Mexico will be added to the existing GIS and distributed to all members of the Expert Group. The metadata to make the data suitable for the map will be:

- Regional geochemical campaigns (considering the objective);
- Area covered by samples with the same fraction/extraction method of analysis (excluding cold extractions);
- Area covered by samples with the same instrumental method (AAS, ICP-OES, ICP-MS, INAA, XRF, *etc.*).

As a first approach, a GIS procedure was made in SEGEMAR-Argentina to select the data elected by the country and calculate the median in each cell and the number of samples that were responsible for the calculation. In the next steps, the same procedure is being applied in the member countries. Countries such as Argentina, Chile, Peru, and Ecuador have already tested the methodology. This methodology was presented at the 37th International Geological Congress in Busan, Korea (refer to presentation 03 at https://u.pcloud.link/publink/show?code=kZv6fC0ZsKwQhCg2ijzKdfxgrsBC85WlNwD7.

The ASGMI group organised a second webinar on the theme "*Geochemical Information for Social Service*" entitled "*Sample Preparation: Key Stage to Generate Geochemical Information*," organised by Honduras under the ASGMI Geochemistry Expert Group on November 13 and 14, 2024. The IUGS-CGGB and EGS-GEG supported the webinar (refer to Section §6.3.4).

The invited guests were the President of the IUGS, Prof. Hassina Mouri; EuroGeoSurveys Geochemical Expert Group's Deputy Chair, Dr. Anna Ladenberger; the Chair of the Commission on Global Geochemical Baselines, Dr. Alecos Demetriades, and from the Geological Survey of the United States of America (USGS) Dr. Kate Campbell. The main presentation of the subject of the webinar, the group had the pleasure to have the President of Mexico Geological Survey, Mrs. Flor de Maria, a specialist in Quality Control in Sample Preparation. The members of the ASGMI Group presented the experiences of the different Geological Surveys in sample preparation: (a) Rocks were presented by Ecuador and Portugal; (b) Soils were presented by Peru, and (c) Sediments were presented by Argentina, Honduras, Brazil and Chile (refer to Section §6.3.4).

A2.3.2. Argentina

Report by Andrea V. Turel (SEGEMAR) (andrea.turel@segemar.gov.ar)

The systematic regional geochemical survey is conducted by the Geological and Mining Service of Argentina (SEGEMAR). In 2024, progress was achieved in two key projects:

1. Global Geochemical Baselines
2. Low-Density Geochemical Mapping

A2.3.2.1. Global Geochemical Baselines

As part of the agreement between SEGEMAR and China Geological Survey (Chinese-Argentine Geosciences Cooperation Center), global geochemical baseline sampling has commenced in Argentina. Floodplain samples were collected from 62 sampling sites within 80x80 km cells, at both surface and deep levels. This initial phase focused on southern Patagonia (*Fig. A2.2*), covering the provinces of Santa Cruz, Chubut, and Tierra del Fuego, Antártida e Islas del Atlántico Sur. The samples will be sent to the IGGE chemical laboratory in Langfang for analysis of 76 chemical elements. Sampling is expected to resume throughout the country by mid-2025.

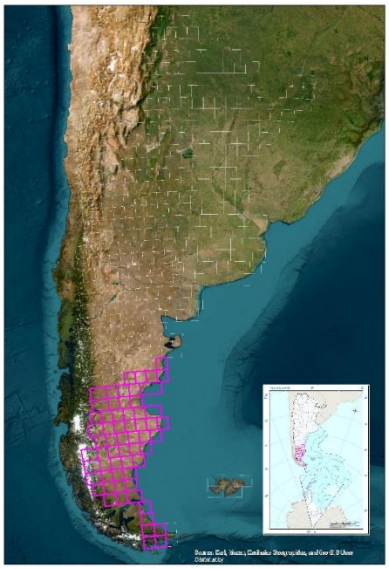


Figure A2.2. Global Terrestrial Network grid cells of 80x80 km sampled in 2024.

A2.3.2.2. Low-Density Geochemical Mapping

The multi-element, multi-purpose low-density geochemical study aims to assess geochemical abundance levels and produce maps showing the geographical distribution of 71 elements determined on stream sediment samples (*Fig. A2.3*). In 2024, three provincial geochemical atlases were published based on a 20x20 km grid covering the Argentine provinces of Entre Ríos, Corrientes, and Misiones (*Figs. A2.4 & A2.5*). Chemical analyses were conducted at the Institute of Geophysical and Geochemical Exploration (IGGE) in Langfang, China, under a Cooperation Agreement between SEGEMAR and China Geological Survey. The following publications are available in the SEGEMAR digital repository:

Ferpozzi, L.H., Jara, A.S., Cabrera, R., Eguaburo, L.C., Turel, A.V., 2024. Atlas geoquímico de la Provincia de Misiones (Serie Contribuciones Técnicas. Geoquímica, N° 119). Buenos Aires,

Servicio Geológico Minero Argentino. Instituto de Geología y Recursos Minerales, 98 pp. ISSN 2618-5008; https://repositorio.segemar.gov.ar/handle/308849217/4490.

Ferpozzi, Luis Humberto, Eguaburo, Luis César, Jara, Ángel Sebastián, Turel, Andrea Vilma, González Ana Carolina y Larcher, Nicolás, 2024. Atlas Geoquímico de la Provincia de Corrientes, República Argentina. Serie Contribuciones Técnicas Geoquímica Nro. 121, 97pp. Buenos Aires, Servicio Geológico Minero Argentino. Instituto de Geología y Recursos Minerales, ISSN 2618-5008; https://repositorio.segemar.gov.ar/handle/308849217/4474.

Ferpozzi L.H., Turel A.V., Jara A.S., Cabrera, R., Eguaburo, L.C. y S. Gregorat. Atlas geoquímico de la provincia de Entre Ríos, República Argentina. Instituto de Geología y Recursos Minerales, Servicio Geológico Minero Argentino. Serie Contribuciones Técnicas Geoquímica N° 120, 98 pp. Buenos Aires, ISSN 2618-5008; https://repositorio.segemar.gov.ar/handle/308849217/4419.

Figure A2.3. Stream sediment sampling, Entre Ríos province.

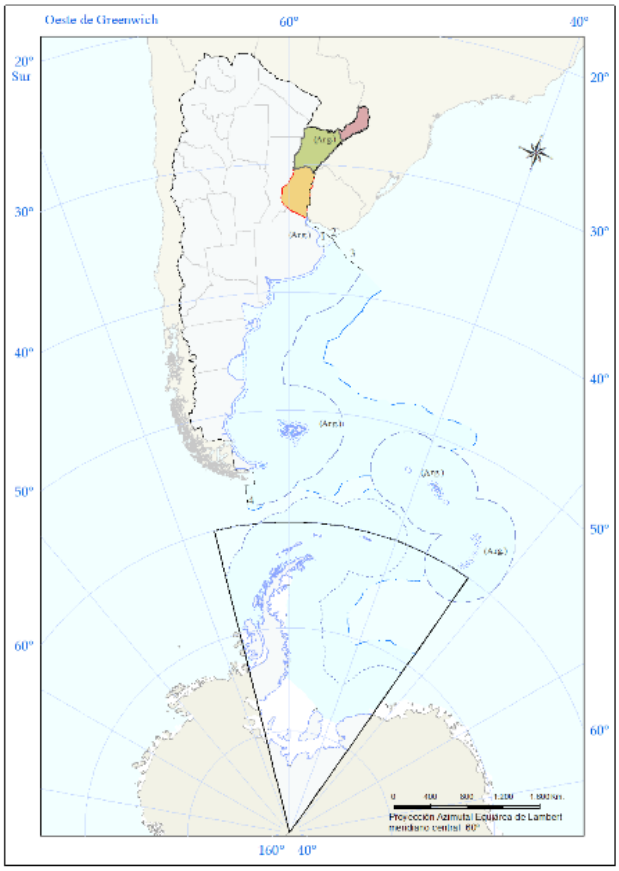


Figure A2.4. Location of the provinces of Entre Ríos, Corrientes and Misiones, Republic of Argentina.

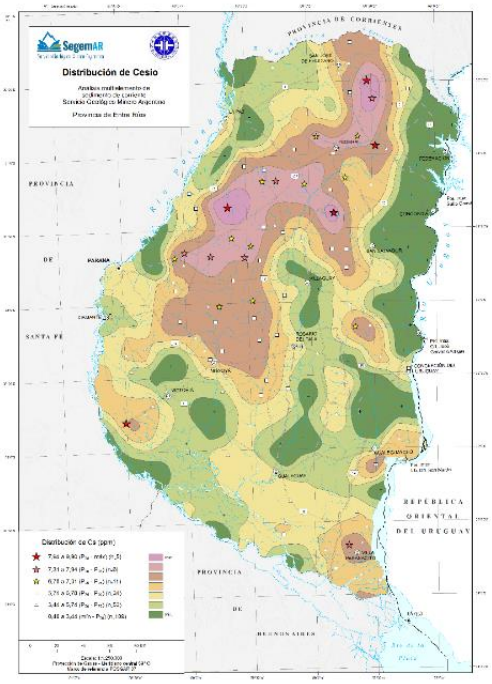


Figure A2.5. Caesium distribution map in samples of stream sediment. Geochemical Atlas of the Entre Ríos Province. Low-density geochemical sampling.

A2.3.3. 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)
- Rafel Mardones Parada (Project geologist; rafael.mardones@sernageomin.cl)
- Pablo Oliva Vicentelo (Project geologist; pablo.oliva@sernageomin.cl)
- Felipe Astudillo Wells (Project geologist; felipe.astudillo@sernageomin.cl)

General information

The Geochemical Map of Chile is a government programme conducted by the Geochemistry Unit of SERNAGEOMIN (Geological and Mining Survey of Chile) since 2011. This programme's objective is to promote Chile's sustainable growth by defining geochemical baselines and identifying mineral resources.

The Geochemistry Unit consists of 4 geologists (Fig. A2.6), 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 (Fig. A2.7).

Achievements and activities in 2024

During the year 2024, the following achievements and activities stand out:

- ***Publications:***

– *Geochemical database: Aguas Blancas Sheet / 17.000 km^2 / 787 sampling points (Fig. A2.8).*

– *Basin-scale geochemical study: Mataquito basin / 7.000 km^2 / 390 sampling points (Fig. A2.9).*

– *Manual: "Real-time generation of geochemical databases by using smartphones".*

Figure A2.6. Professionals of the unit of geochemistry: From left to right: Juan Pablo Lacassie (insert), Rafael Mardones, Felipe Astudillo and Pablo Oliva, during fieldwork in the Atacama Desert (March 2021). Photograph by Juan Pablo Lacassie.

- ***International meetings***

ASGMI-Webinar "*Sample preparation for geochemistry*": Joint presentation of INHGEOMIN (Honduras), SEGEMAR (Argentina), SGB (Brazil) and SERNAGEOMIN (Chile): "Sediment sample preparation" (November 2024 - refer to Section §6.3.4).

- ***National meetings:***

– *Seminar "II Conference on Strengthening Geospatial Information Management in Emergencies":* Presentation by Pablo Oliva: "Environmental geochemistry and mass removals: GIS structure, data and web applications", Arica, September 2024.

– *Seminar "Water for human consumption":* Presentation by Pablo Oliva: "Environmental geochemistry and mass removals: GIS structure, data and web applications", Arica, September 2024.

– *Seminar "From data to decisions: the power of information in integrated watershed management":* Presentation by Juan Lacassie: "Geochemistry and mineralogy of river sediments: contribution of SERNAGEOMIN to the understanding and management of Chile's basins". Santiago, October 2024.

- ***Ongoing projects:***

– *ASGMI- Project: "Geochemical Map of Iberoamerica"* (Fig. A2.10).

– *Chile (SERNAGEOMIN) - Honduras (INHGEOMIN) cooperation project:* Mission N°3 (Honduras; first steps of the Honduras Geochemical Map); Misión N°4 (Chile; capacitation in geology and metallogeny; Fig. A2.11).

– *International cooperation:* Cooperation agreement between SERNAGEOMIN (Chile) and the University of Münster (Germany) for the advanced mineralogical and geochemical study of sediment samples stored in SERNAGEOMIN.

– *Geochemistry of REE:* Southern Chile, Los Ríos Region / 18,500 km^2 / 408 sampling points / soil and sediment samples.

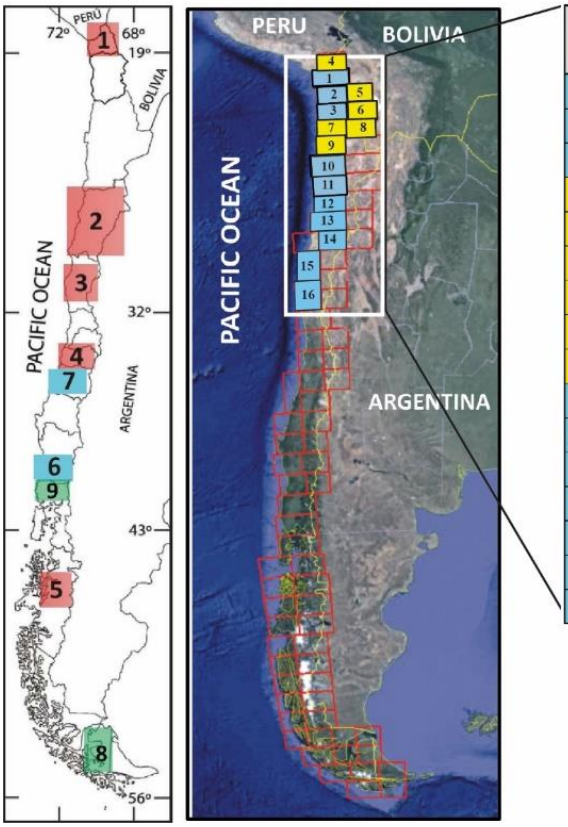
– *First geochemical web-map:* Vallenar Sheet / 13,163 km^2 / 597 sampling points / sediment samples.

- *Geochemical Atlas of Northern Chile:* 75,000 km^2 / Sampling: 85% completed / Sample preparation and analysis: 80% completed.
- *Antofagasta Sheet - Geochemical database*: 17,100 km^2 / Sampling: 100% / Sample preparation and analysis: 80 % completed.
- *Quillagua Sheet - Geochemical database*: 13,200 km^2 / Sampling: 80% / Sample preparation and analysis: 0% completed.
- *Urban soil geochemistry of Arica, northern Chile*: Regional resources financing / Project in preparation.

Personnel:

Juan Pablo Lacassie: Professor of the course "*Environmental Geochemistry*", Universidad Austral de Chile; Online short course: "*Environmental geochemistry and geochemical Maps*": Universidad Nacional Autonoma de Honduras. April 2024; Guiding teacher of 5 Thesis in geochemistry: Universidad Austral de Chile (2 Thesis); Universidad Andres Bello (2 Thesis); Universidad Central de Chile (1 Thesis).

Rafael Mardones: Guiding teacher of 1 Thesis in geochemistry, Universidad Austral de Chile.



Sheet (1:250,000)	Geochemistry		
	Sampling	Database	Map
(1) Arica	100%	Published	Published
(2) Pisagua	100%	Published	Published
(3) Iquique	100%	Published	Published
(4) Visviri	90%		
(5) Pisiga	10%		
(6) Collacagua	60%		
(7) Quillagua	60%		
(8) Ollagüe	40%		
(9) Tocopilla	5%		
(10) Antofagasta	100%	In prep.	
(11) Aguas Blancas	100%	Published	
(12) Taltal	100%	Published	
(13) El Salvador	100%	Published	
(14) Copiapó	100%	Published	
(15) Vallenar	100%	Published	In prep.
(16) La Serena	100%	Published	Published

Figure A2.7. ***Left:*** *Geochemical Map of Chile, fluvial basin scale. Progress status for the year 2024, including published studies (Pink areas): (1) Lluta and Azapa river basins; (2) Copiapó, Salado and Huasco river basins; (3) Elqui and Limarí river basins; (4) Rapel river basin; (5) Aysén river basin; recently published studies: (6) Valdivia river basin; (7) Mataquito river basin), and studies in progress: (8) Tierra del Fuego basin; (9) Bueno river basin).* ***Right:*** *Geochemical Map of Chile, 1:250,000 scale: Progress status for the year 2024. The limits of the 1:250,000 scale sheets (red boxes) are for reference only. Thus, the work areas correspond only to those included in Chilean territory.*

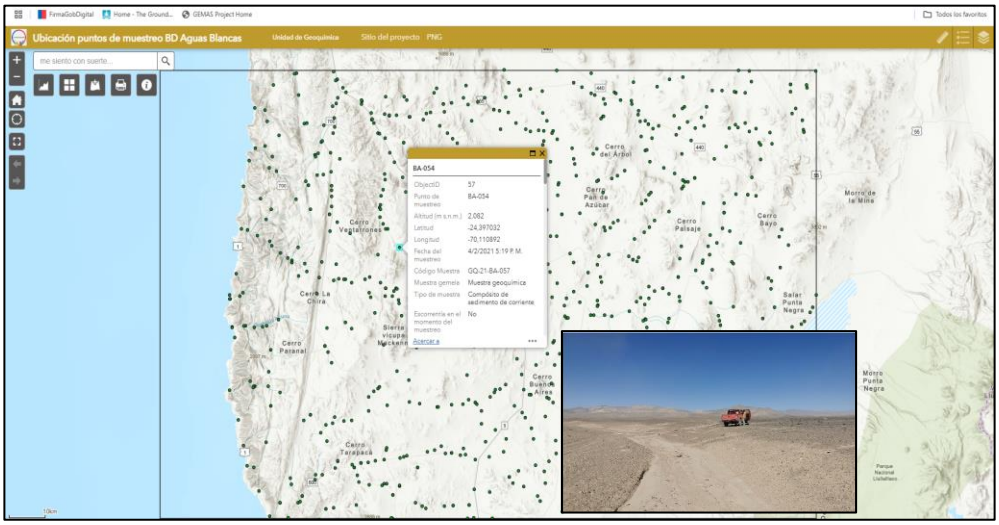


Figure A2.8. Geochemical Map of Chile, Aguas Blancas Sheet Geochemical database. Webmap that allows visualising the geochemical and field data, including field photographs (insert). Hyperlink: https://sernageomin.maps.arcgis.com/apps/webappviewer/index.html?id=fc133221dbbe4ec9be550e99cc9bcab8.

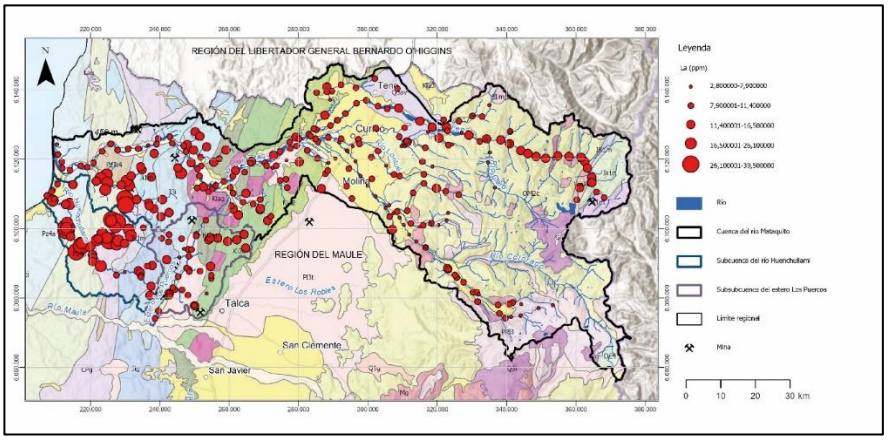


Figure A2.9. Geochemical Map of Chile, Geochemical study of Mataquito river basin (central Chile). Geographical distribution of the concentrations of La (ppm). The information is projected on the drainage network, the position of the mining sites, the main cities and the base geology at a scale of 1:1,000,000, taken from SERNAGEOMIN (2003).

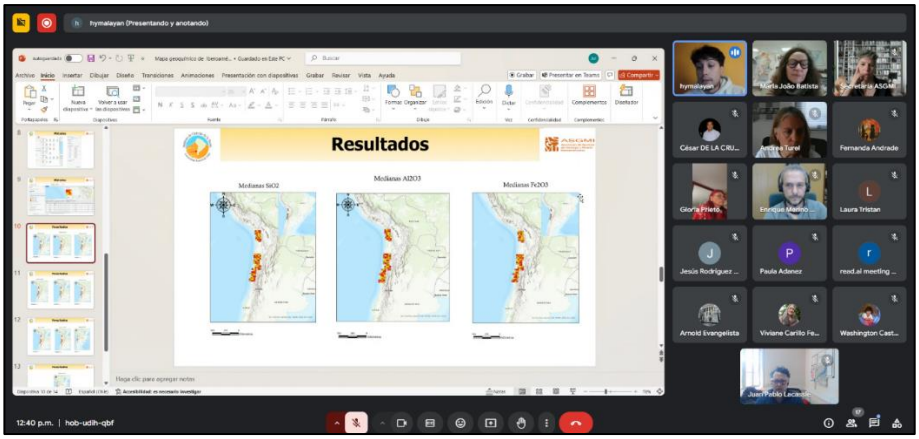


Figure A2.10. ASGMI Project: "Geochemical Map of Iberoamerica". Screenshot during the December ASGMI meeting. The first Chile's (SERNAGEOMIN) advances were presented.

Figure A2.11. Chile (SERNAGEOMIN) - Honduras (INHGEOMIN) cooperation project. First steps of the Geochemical Mapping Programme of Honduras. Field training was conducted in two streams in the San Juan Abajo sector of Choluteca (Quebrada San Juan and Río Calderas), Honduras. In this first stage, the use of digital forms using a smartphone and the sampling protocol are explained. From left to right: Miguel Martínez (INHGEOMIN), Rafael Mardones (SERNAGEOMIN) and Rori Padilla (INHGEOMIN).

A2.3.4. Cuba

Report by the specialists from the Institute of Geology and Paleontology/Geological Service of Cuba (IGP/SGC):

- Eng. Raynel Alberto Herrera Molina (Geologist Project Leader from the Department of Mineral Deposits, Institute of Geology and Palaeontology/ Geological Service of Cuba; raynel@igp.minem.cu)
- M.Sc. Jorge Luis Torres Zafra (Mineral Deposits Specialist, Institute of Geology and Palaeontology/ Geological Service of Cuba; zafra@igp.minem.cu)
- Dr. Xiomara Casañas Díaz (General Director of the Department of Mineral Deposits, Institute of Geology and Palaeontology/ Geological Service of Cuba; dprospeccion@igp.minem.cu)

The Institute of Geology and Palaeontology/Geological Service of Cuba (IGP/SGC), through a Collaboration Agreement with the China Geological Survey (CGS), has been carrying out multi-element and multi-purpose geochemical mapping work of global geochemistry relevance governed by a unique methodology from its projection to the publication of the resulting geochemical maps (see maps Figs. A2.12 to A2.16).

Sampling is carried out at three scales:

1) Global geochemical mapping (ultra-low density), by sampling 177 soil sample points from A and B horizons throughout the territory, distributed in a 40 x 40 km network, and samples analysed with a 76-element package;
2) National geochemical mapping: 1101 stream sediment sample points throughout the territory were sampled at a scale of 1:1,000,000, and samples were analysed with a 69-element package, and
3) Regional geochemical mapping in Camagüey by sampling 3001 stream sediment sample points at a scale of 1:100,000, and samples analysed with a 39-element package.

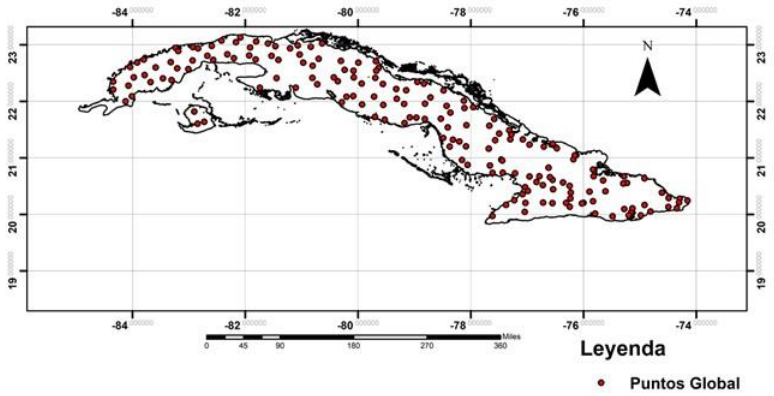


Figure A2.12. Global Level: 177 sampling points (40 x 40 km) of shallow and deep soil with 354 soil samples; 76 chemical elements were determined.

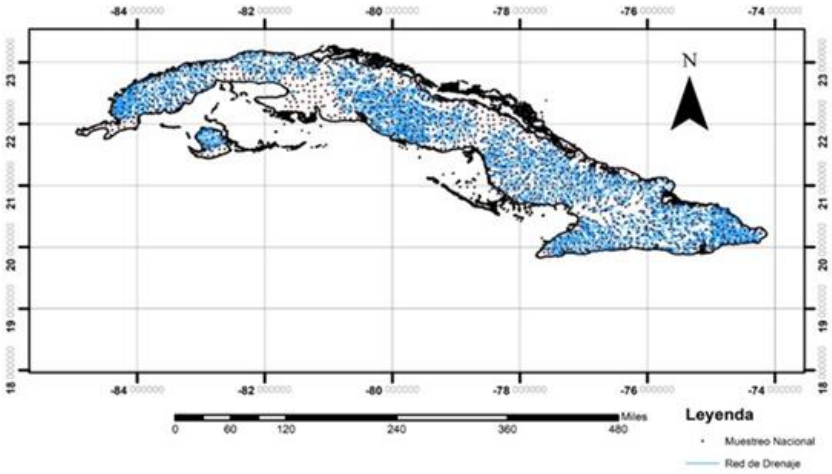


Figure A2.13. National Level: sampling points at a 1:1,000,000 scale where 1101 stream sediment samples will be taken. In total, 69 chemical elements will be determined.

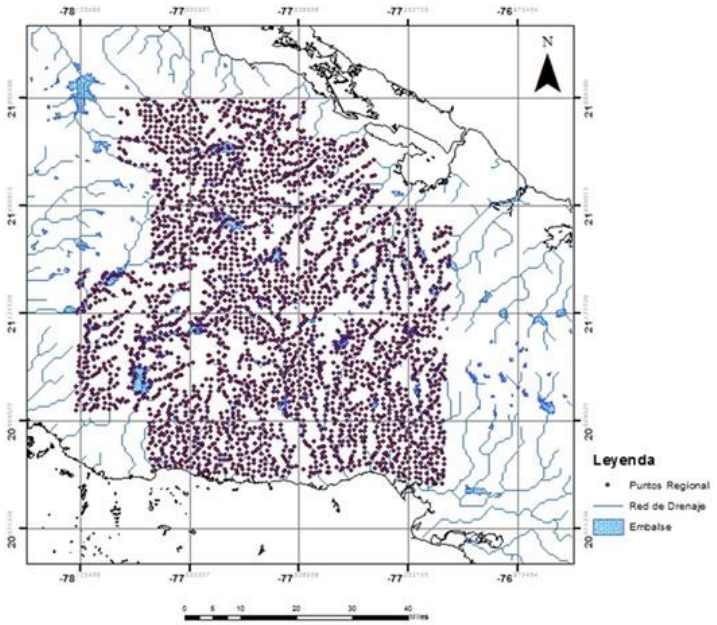


Figure A2.14. Regional Level: 3001 sampling points at a 1:100,000 scale in the Camagüey East area where 3001 stream sediment samples were taken. In total, 39 chemical elements were determined.

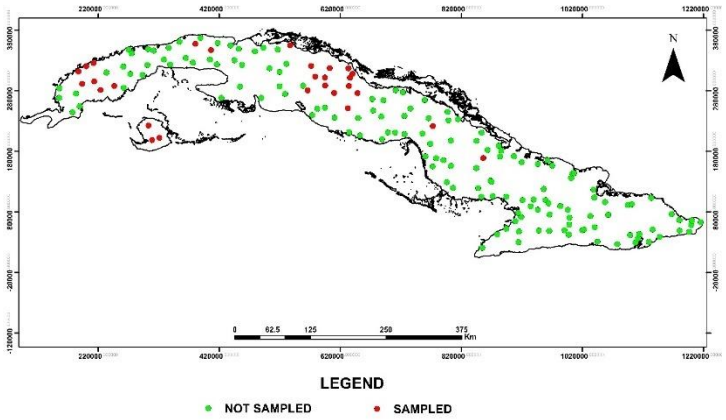


Figure A2.15. State of Global Geochemical Mapping in Cuba.

Currently, work is being carried out simultaneously on global and national scales. In total, 58 soil samples corresponding to horizons A and B have been collected at the global scale; while 192 stream sediment samples have been collected at the national scale.

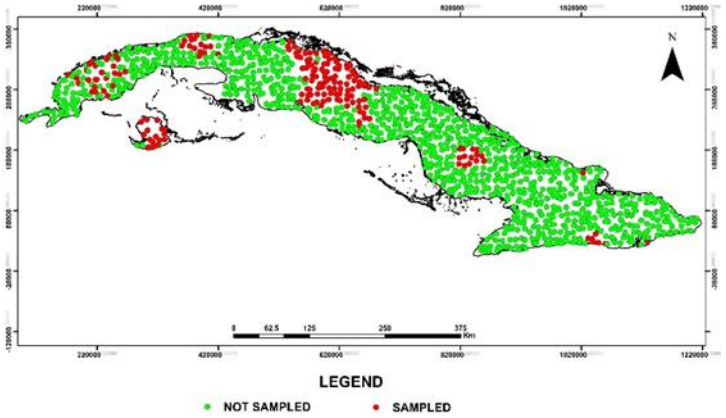


Figure A2.16. State of National Geochemical Cartography, Cuba.

The samples will be prepared in Cuban laboratories and analysed in China using equipment with lower detection limits and greater precision, such as X-ray Fluorescence (XRF) and Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES, among others). The results of the chemical analyses, their processing and interpretation will be carried out by both parties.

A group of samples has been sent to China for analysis. We have not yet received the analyses, but we are awaiting satisfactory results.

The results obtained through the execution of this project will contribute to the final preparation of the Cuba Geochemical Atlas for Global Geochemical Baselines, the Cuba National Geochemical Map and the Camagüey region chemical elemental maps. Despite having carried out many geochemical studies, especially during geological surveys and mineral prospecting work, this research is unprecedented for the geosciences in Cuba. These results will be of great importance for the country, as they will favour the knowledge of the geochemical composition of Cuba's soil, which responds to its geological constitution. The maps resulting from the study levels will be used in environmental research, in agriculture and in the search for mineral raw materials, three vital sectors for the development of our country.

A2.3.5. Ecuador

Report by: Mgs. Fernanda Dayana Andrade Mantilla (fernanda.andrade@geoenergia.gob.ec) and Ing. Pablo Ernesto Cobacango Flores (pablo.cobacango@geoenergia.gob.ec), Instituto de Investigación Geológico y Energético.

A2.3.5.1. General Information

The Government of Ecuador began Geochemical Prospecting work, with the United Nations Development Programme - Operation 5. To start with in 1966 the existence of several copper and zinc anomalies in streams to the south of the Yanuncay River were identified (NN.UU, 1972). However, exploration work officially began in 1970, subsequently, technical assistance was requested from the United Nations Programme for the extension of mining exploration of a new area, called Operation No. 8.

Systematic geochemical exploration with the United Nations Programme in Operation No. 8 began in March and ended in November 1970, marking the beginning of campaigns to collect geochemical information through the sampling of river sediments. This made way for the development of different projects that promoted research in the territory until today (Table A2.1).

Within the framework of an agreement signed between the Ecuadorian Mining Institute INEMIN, (ex-DGGM) and the company RTZ, a selection and reanalysis of the samples taken during the exploration campaigns of the United Nations projects, missions of UK technical assistance and cooperation with Belgium was carried out. The plasma spectrum (ICP) method was used for 29 elements; emphasising sampling in the surroundings of certain previously determined anomalies (Parambas and Morán rivers) and their projections. Exploration of the area west of Junín began. The database has 9,120 samples, which include some samples taken by the RTZ company (INEMIN, 1985), in addition to the collection of complementary information in specific areas (geophysics through the Induced Polarisation method) (CODIGEM-RTZ, 1992)

Subsequently, geochemical prospecting surveys, in regional drainage basins of the Western Cordillera by CODIGEM – British Geological Survey (BGS), were carried out within the frame of the PRODEMINCA project (Mining Development and Environmental Control Project) developed under its subcomponent 3.4 “Information Programme Cartographic and Geological” (PICG) which began in 1995 (BGS, 2000).

Since 2013, the National Institute for Geological, Mining and Metallurgical Research (INIGEMM), currently named the Geological and Energy Research Institute (IIGE), has been developing the “Geological Research and Availability of Occurrences of Mineral Resources in the Territory”. The Ecuadorian project aims to “Prepare the map of mineral occurrences and areas of geological mining interest of the Western and Royal Cordilleras and the Subandean Zone, through the processing of existing and new information, referring to Geology, Geochemistry and Geophysics”, supported by the activity of “Survey, Processing and Interpretation of Geochemistry data, in the Cordillera Real and the Subandean Zone”. Fieldwork started in 2014 and continues to date (Fig. A2.17) (Lomas, 2019).

In Ecuador, different geochemical prospecting campaigns have been carried out from 1968 to the present day, which are detailed in Table A2.1 (MERRNNR, 2020, pages 183−184).

Table A2.1. Details of Projects developed in Ecuador (see Fig. A2.17).

Year	*Detail*	*Project*	*Sector*	*Number of samples*
1970	Geochemical Data Survey begins in Ecuador	Programa de Desarrollo de las Naciones Unidas - Operación 5 y 8	Yacuncay y noroccidente de la Provincia del Azuay en los sectores de Fierro Urco y Chaucha	4585
1978	Geochemical Data collection	Dirección General de Geología y Minas con la colaboración de la Asistencia Técnica del Gobierno del Reino Unido	Parte de las Provincias de Tungurahua, Bolívar y Los Ríos	2562
1979	Geochemical Data collection	Convenio entre la Dirección General de Geología y Minas y la Comisión para el Desarrollo de las provincias del Sur (PREDESUR)	Provincia de Loja, Bolívar y El Oro	485
1984	Geochemical Data collection	Dirección General de Geología y Minas con la Asistencia Técnica del Gobierno de Bélgica-Proyecto Noroccidente	Provincia de Carchi, parte de las Provincias de Esmeraldas e Imbabura.	822
1985	Geochemical Data collection	Proyecto Junín ejecutado por el Instituto Ecuatoriano de Minería (INEMIN)	Junín, Provincia de Manabí	113
1986	Re-analysis of samples from past geochemical exploration campaigns.	Compañía RTZ (Consorcio Rio Tinto Zinc)	Ríos, Junín, Morán y Parambas	9120
1992	Geochemical Data collection	The Japan International Cooperation & Metal Mining Agency of Japan, realizaron estudios más detallados en Junín.	Junín, Provincia de Manabí	305
1998 - 2000	Geochemical Data collection	PRODEMINCA (Proyecto de Desarrollo Minero y Control Ambiental desarrollado por British Geological Survey (BGS))	Cordillera occidental	15175
2013	Geochemical Data collection	Proyecto Modelo Piloto para la determinación de Potencial Geológico- Mineralógico de las zonas Zaruma y Cariamanga escala 1: 100 000_SENESCYT	Hojas Geológicas escala 1: 100 000 Zaruma y Cariamanga	777
2014 - 2024	Geochemical Prospection	IIGE - Proyecto de Investigación Geológica y Disponibilidad de Ocurrencias de Recursos Minerales en el Territorio Ecuatoriano_IGTE	Cordillera Occidental, cordillera Real y Zona Subandina	15,295

Note: Description of Geochemical Prospecting campaigns carried out in Ecuador between 1970-2024 (NN.UU, 1972; MERRNNR, 2020; Maller E., 1971; San Martin H. y Elizalde L., 1978; PREDESUR, 1977; Aucott J. y Puig C., 1979; San Martin H., 1979; Aucott J. y Quevedo, L.PJ., 1979; Aucott, J.W., 1980; Cruz, 1980; Quevedo L., 1981; Williams M., 1997; Quevedo L.P.J., 1985; Quevedo, L.P.J., 1985; INEMIN, 1985; PRODEMINCA - BGS, 1997; JICA, 1992; BGS, 2000; Pilatasig, L., 2013; IIGE, 2024). ***Note:*** *For the references refer to the two published articles.*

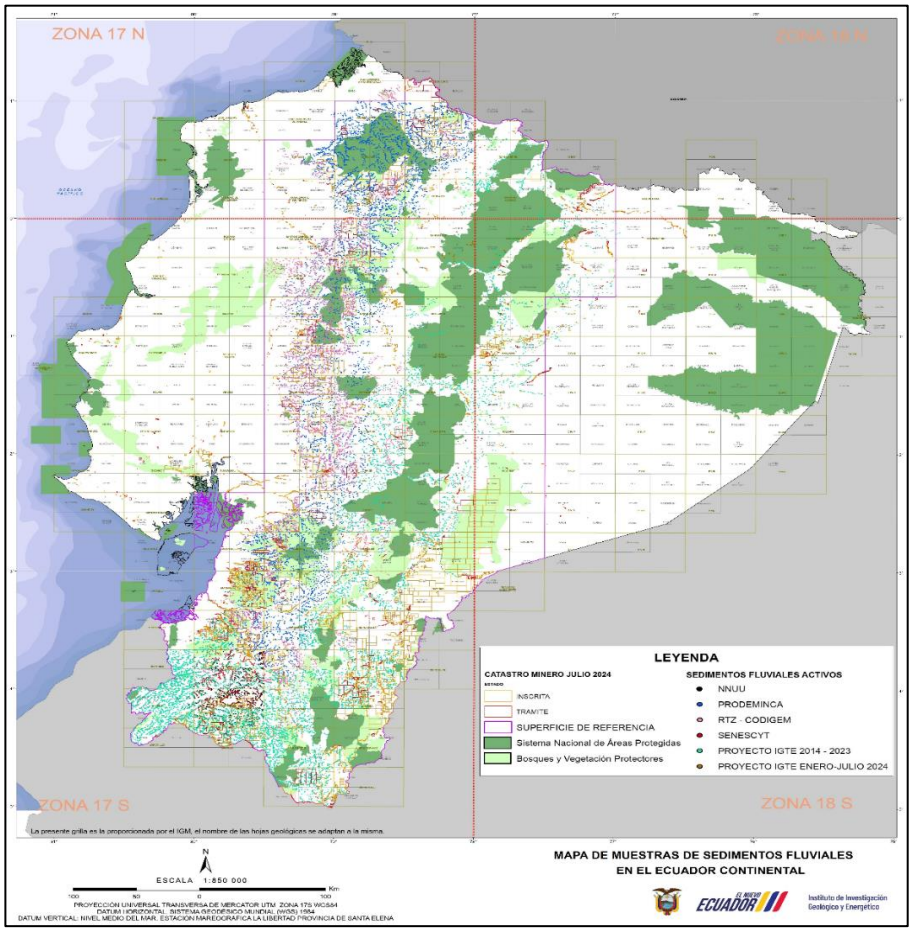


Figure A2.17. Map of historical Geochemical Prospecting campaigns (IIGE, 2024).

The information collected includes Geochemical Prospecting campaigns carried out in Ecuador from 1970 to the present. This work summarises the historical research, compiling information from several projects executed with different technical cooperations. However, the British Geological Survey (1998-2000) stands out among the main ones since the entire Cordillera Occidental was covered through the PRODEMINCA project, and 15,175 samples of active stream sediments were collected, setting a precedent in the historical trajectory in the search for mineral occurrences. Currently, the "Geological Investigation and Availability of Occurrences of Mineral Resources in Ecuadorian Territory" (IGTE) project is updating the geochemical information of the territory, specifically within the reference area that covers the Cordillera Real and the Subandean Zone, which includes an area of 140,932.69 km^2, for which it has taken existing information as a basis and it currently has a total of 15,295 stream sediment samples, collected with internationally standardised methodologies and applied by the PRODEMINCA Project. It is important to highlight that upon completion of its execution, the project will provide a database that will serve as a guide to explore possible new mineral deposits through mining exploration activities on a regional scale.

II. Ecuador – Active member of the Association of Ibero-American Geology and Mining Services - ASGMI

The Geochemistry Expert Group (GEG) was reactivated in 2019 to comply with the agreements reached at the XXIV General Assembly of ASGMI held in Salta (Argentina) in August 2018.

This group was created in previous phases of ASGMI to develop a common procedure for taking geochemical samples. This document serves as a guide for all ASGMI countries, especially

those that have not yet worked in this area. Portugal coordinates the group, which has the support of all member countries.

The Manual of Geochemical Methodologies of Ibero-American Countries-Geochemical Information for Society was completed in 2023 and is freely accessible by using the following hyperlink: https://asgmi.org/wp-content/uploads/2023/08/Manual-Metodologias-Geoquimicas-ASGMI.pdf.

For the year 2025, the group has planned to prepare the Geochemical Atlas of Latin America, which is currently under development and of which Ecuador will be a part with the information available (released) from the PRODEMINCA Project developed in the Western Cordillera, in addition to being part of the preparation of monographs (Manuals of technical content on the following elements: Sn-W, Au, Li-Ta-Nb).

The IIGE, as part of the ASGMI, has strengthened scientific, technical and informative knowledge, participating in:

- Monthly Technical Meetings (coordination and progress of the Manual of Geochemical Methodologies of Ibero-American Countries during 2019-2020).
- Participation in physical and virtual Workshops 2019-2024.
- Exhibitions of advances in Geochemistry in 2021 (virtual), 2022 (in-person), 2023 (virtual).
- Virtual workshop "Sample preparation, key stage to generate geochemical information" in 2024 (refer to Section §6.3.4).

III. Publications in indexed journals

- *Zumba, W.L., Mantilla, F.A., Flores, P.C., Freire, S.D.S., 2024.Geochemical re-interpretation of the Miocene Porphyry Cu-Mo-Au Metallogenetic Belt (Ecuador). GEO Latitud, 7(1), 1−18; https://geolatitud.geoenergia.gob.ec/ojs/ojs/index.php/GeoLatitud/article/view/155/129*.

Summary:

The Geological Investigation and Availability of Mineral Resources Occurrences in the Ecuadorian Territory Project has the objective of identifying mineral occurrences, through the processing of geochemical information from active river sediments. The present investigation shows the results of reinterpretation of geochemistry of active fluvial sediments in the "Miocene Cu-Mo-Au Porphyry" metallogenetic belt of Ecuador. These data allowed the identification of anomalous areas through spatial analysis of concentrations of precious metals, gold and silver, base metals copper and zinc; through an Exploratory Analysis of Spatial Data, where anomalous copper and zinc zones were identified that could be related to possible porphyries in the Western Cordillera that could be used as objectives for more detailed exploration campaigns.

- *Poster at the XI Geological Congress of Spain and article in Geo-Temas Magazine Vol. 20 (2024) "Geochemical prospecting, methodological experience in sampling active river sediments in Ecuador";* https://sge.usal.es/archivos/GEO_TEMAS/Geo_temas20.pdf.

Summary:

The Geological and Energy Research Institute (IIGE) aims to generate and promote knowledge in the field of geology and energy, through scientific research, technical assistance and specialized services for the responsible use of renewable and non-renewable resources, contributing to

decision-making for the benefit of society, which is why it is updating and completing the geological, geophysical and geochemical mapping of the Ecuadorian continental territory aimed at the lithological, mineralogical and structural characterization of the substrate rocky for the identification of mineral occurrences. This document aims to provide procedures for the selection of sampling sites, the collection of river sediment samples in first and second order drainages, as well as the sampling of heavy sediments from field-collected samples.

- *Article in the Magazine of the Research Institute of the Faculty of Geological, Mining, Metallurgical and Geographic Engineering – Peru: Mantilla, F.D.A. and Flores, P.E.C., 2024. Investigación histórica de las campañas de prospección geoquímica en el Ecuador (Historical Investigation of Geochemical Prospecting Campaigns in Ecuador), Rev. Inst. Investig. Fac. Minas Metal. Cienc. Geogr., 27(54), e27579; https://revistasinvestigacion.unmsm.edu.pe/index.php/iigeo/article/view/27579.*

Summary:

This research collects bibliographic information from Geochemical Prospecting campaigns carried out in Ecuador from 1970 to the present. This work summarizes the historical research, compiling information from several projects executed with different technical cooperation. However, the British Geological Survey (1998-2000) stands out among the main ones, since the entire Cordillera was covered through the PRODEMINCA project. Occidental and 15,175 samples of active river sediments were collected, marking a precedent in the historical trajectory of the search for mineral occurrences. Currently, the "Geological Investigation and Availability of Occurrences of Mineral Resources in Ecuadorian Territory" (IGTE) project is updating the geochemical information of the territory, specifically within the reference area that covers the Cordillera Real and the Subandean Zone, which includes an area of 140,932.69 km^2, for which it has taken existing information as a basis, it currently has a total of 15,178 sediment samples rivers, collected with internationally standardized methodologies and applied by the PRODEMINCA Project, it is important to highlight that upon completion of its execution, the project will provide a database that will serve as a guide to explore possible new mineral deposits through mining exploration activities on a regional scale.

A2.3.6. Peru

Report by: Luis Vargas Rodríguez (lvargas@ingemmet.gbo.pe), Igor Espinoza (iespinoza@ingemmet.gob.pe), Cesar De La Cruz (cdelacruz@ingemmet.gob.pe) (INGEMMET - Geological Mining and Metallurgical Institute of Peru).

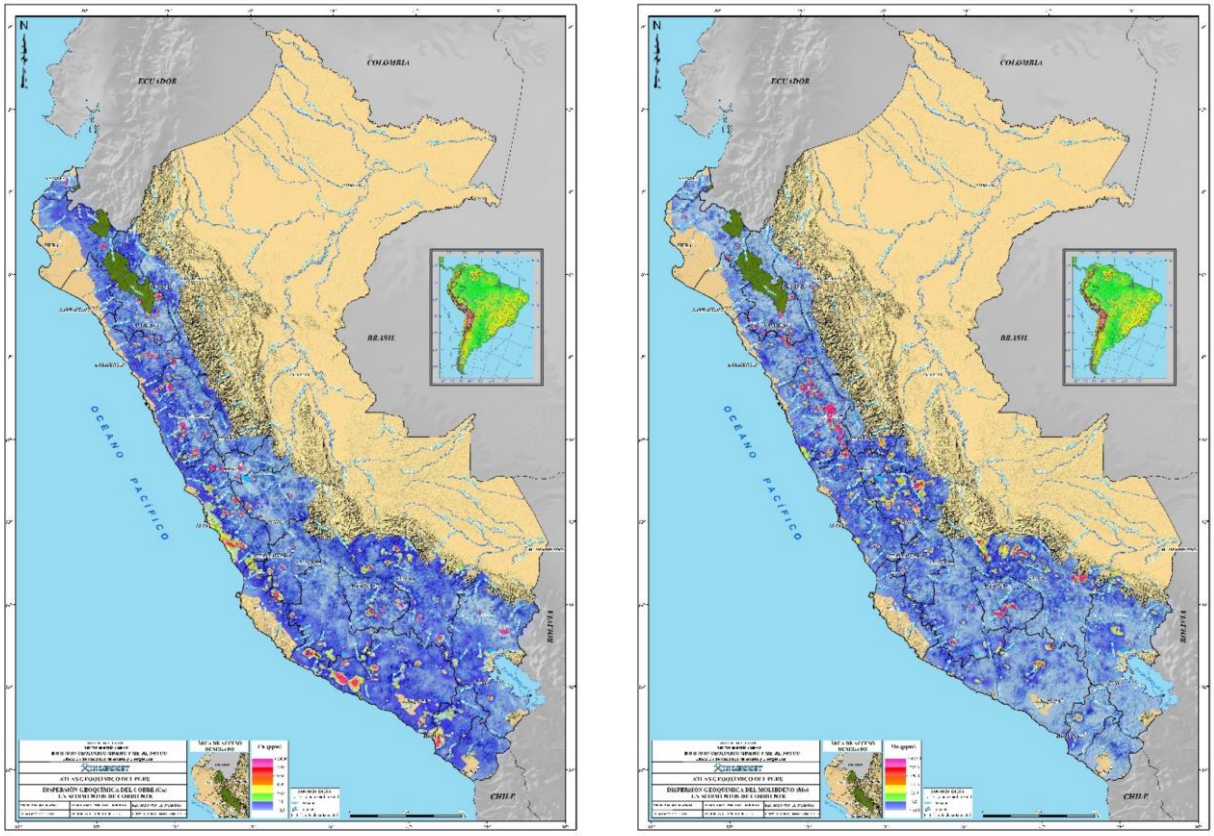
In relation to the operational activities carried out by the Geological Mining and Metallurgical Institute of Peru, the National Geochemistry Programme carries out studies and research on the behaviour of chemical elements in soils, stream sediments and rocks (Figs. A2.18 & A2.19).

During the years 2019 and 2023, the geochemical study of soil of the national territory was carried out on a global scale; with a sampling density of one sample per 6,400 km^2. A total of 386 soil samples were collected, between superficial and deep horizons, which were analysed in the laboratories of the Geological, Mining and Metallurgical Institute of Peru (INGEMMET) and the Institute of Geophysical and Geochemical Exploration (IGGE) of China Geological Survey. The results obtained are currently being processed, with the aim of completing the first geochemical baseline of soil in Peru, which can be compared with the different geochemical baselines worldwide.

As a result of the research carried out to date, a robust database is available, which offers regional geochemical information on 28,185 stream sediment samples. This information

corresponds to the geochemical abundances of the major elements and the main trace elements, among which Au, Ag, Cu, Mo, Pb, Zn, Cd, U, and the main lanthanide elements stand out.

Figure A2.18. Types of sampling carried out in the various studies of the National Geochemistry Programme: (a) Soil sampling; (b) Stream sediment sampling, and (c) Rock sampling.



(a) (b)

Figure A2.19. Distribution of (a) Cu and (b) Mo in stream sediment samples, Geochemical Atlas of Peru.

In addition, various studies have been developed, among which the Geochemical Atlas of Peru stands out. It contributes to the knowledge of the geochemistry of active current stream sediments throughout the Peruvian Orogen.

Since 2022, geochemical studies of rocks have been carried out in the Eastern Cordillera in central Peru. The analytical results of 600 rock chip samples are allowing us to expand knowledge about the geochemical behaviour of the main strategic and critical elements, in greatest demand in the nanotechnology industry, in addition to establishing their petromineralogical relationship with dispersion patterns in primary and secondary environments.

Geochemical information allows us to contribute to the sustainable use of mineral resources, under a focus on social and environmental responsibility.

It should be noted that the aforementioned database is freely accessible, from the GEOCATMIN platform by using the following hyperlink: http://metadatos.ingemmet.gob.pe:8080/geonetwork/srv/spa/catalog.search#/metadata/0cfea9d7-972c-4671-a4cf-73faf504d115.

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)

No report was sent from Armenia. However, results from different projects were reported in presentations delivered at the Joint Conference of ISEH, ICEPH & ISEG on Environment and Health, Galway, Ireland (refer to Section §6.4.3.2):

- *Identification of multi-element pollution hotspots and geochemical associations of PTE in urban dust (Yerevan, Armenia)* ─ Gevorg Tepanosyan*, Lilit Sahakyan.
- *Environmental Radiation Studies in Urban Environment: Case Study of Yerevan, Armenia* ─ Olga Belyaeva, Nona Movsisyan, Spartak Hovhannisyan.

A2.4.2. China

Reporters: Xueqiu Wang (wxueqiu@mail.cgs.gov.cn) and Zhou Jian (zjian@mail.cgs.gov.cn). No report was sent this year.

A2.4.3. India

Reporter: Pradip K. Govil (National Geophysical Research Institute, Hyderabad, India; govilpk@gmail.com). No report was sent this year.

A2.4.4. Japan

Report by: Atsuyuki Ohta, Geological Survey of Japan, AIST, Tsukuba.

Japan Geochemical Mapping project using soil substances

New geochemical maps of Japan are created by using 3,222 soil samples. The study of soil geochemical maps is published in Chikyukagaku, the domestic journal, and is in Japanese with an English abstract (https://doi.org/10.14934/chikyukagaku.57.247). The geochemical maps of 53 elements including As, Cd, and Hg and natural radiation and the histograms of element concentrations are available in the geochemical database (https://gbank.gsj.jp/geochemmap/dojo/dojo.html). Soil samples were collected from a depth of 0 to 20 cm (A-layer) at each site. Existing geochemical maps using stream sediments are considered

to correspond to those using soils collected from the deeper layer (C-layer), which are more strongly influenced by bedrock. Geochemical maps of soils and stream sediments are printed side by side. This makes them easier to compare.

The spatial distribution patterns of elements in soils are similar to those in stream sediments, which are essentially controlled by underlying geology and mineralisation zones (Fig. A2.20). Concentrations of Cu, Zn, Cd, Sb, Sn, Hg, Pb, and Bi in soils and stream sediments increase in urban areas (Fig. A2.21). Soils are systematically depleted of Na, Mg, Al, K, Ca, Rb, Sr, and Ba due to their dissolution during chemical weathering processes; highly concentrated in P, Cu, Cd, Sb, Hg, Pb, and Bi due to their immobilisation by humic substances, phosphorus adsorption by andosol, and anthropogenic contamination (Fig. A2.22).

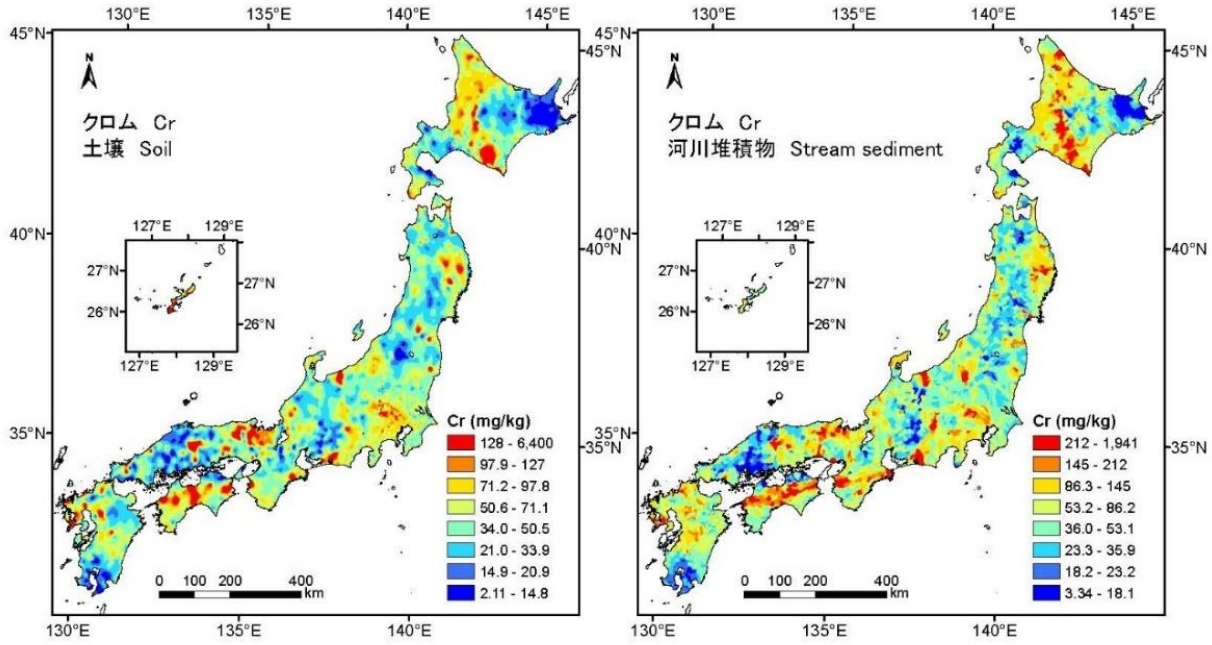


Figure A2.20. Geochemical maps of Cr in soil (A-layer) and stream sediment in Japan.

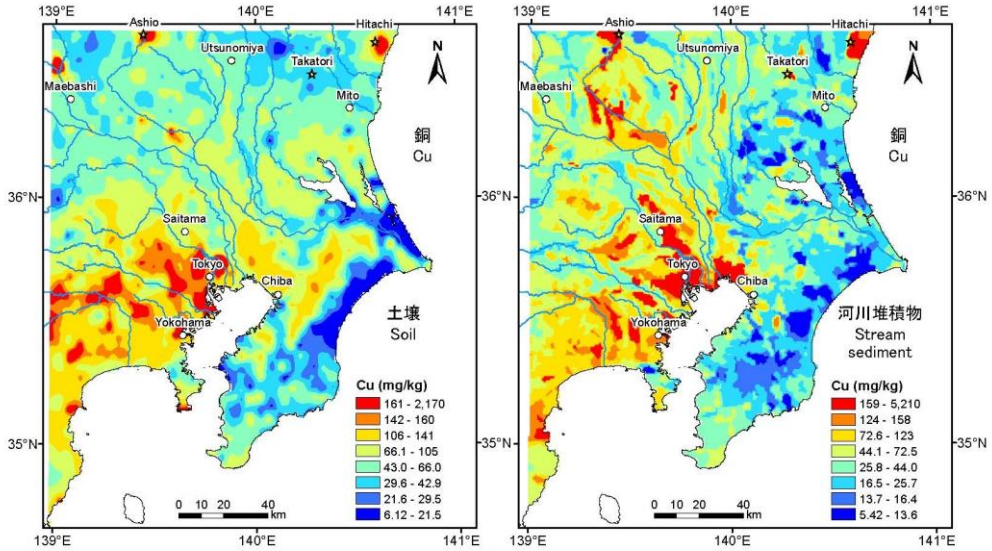


Figure A2.21. Geochemical maps of Cu in soil and stream sediment samples in the Kanto region, including Tokyo, which is the most densely populated metropolitan area in Japan. Stars and circles indicate metalliferous deposits and major cities, respectively.

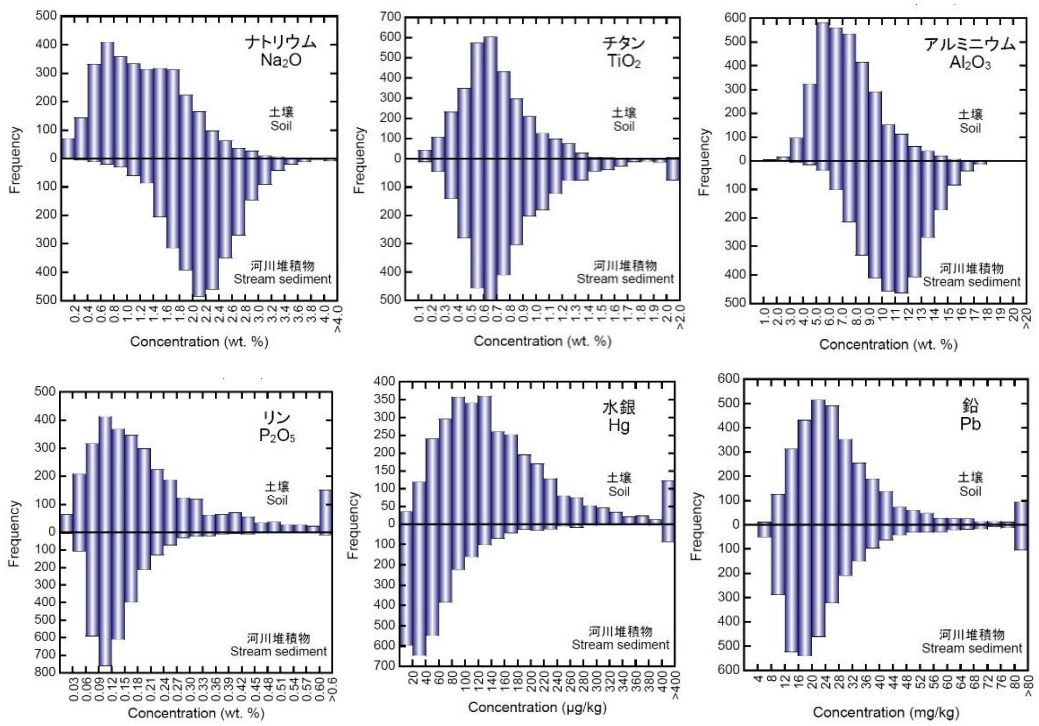


Figure A2.22. Histograms of concentrations of Na_2O, Al_2O_3, P_2O_5, TiO_2, Hg, and Pb in soil and stream sediment.

References

Ohta, A., Imai, N., TerashIma, S., TachIbana, Y., Okai, T., Manaka, M., Kubota, R., Nakamura, A. and Oyama, C., 2023. Geochemical Maps of Soil in Japan. Chikyukagaku Geochemistry)57, 247–278; https://doi.org/10.14934/chikyukagaku.57.247.

A2.5. AUSTRALASIA

A2.5.1. Australia

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

As part of the Levelled Geochemical Baseline of Australia project (funded as part of the Australian Governments Exploring for the Future program; https://www.eftf.ga.gov.au/) a national coverage of levelled surface geochemistry (soil, stream, and overbank sediment samples; Figure A2.23) for Australia has been released (Main and Champion, 2024). This release made use of data from Geoscience Australia and, at this stage, has not incorporated data from the state and territory geological surveys.

The goal of this data release is to: (1) provide a national coverage of surface geochemistry that can be used holistically without the fear of introduced statistical differences from the analysis; and (2) provide a central data set to which future surface sediment samples (soil, stream and overbank sediments) can be levelled to. To act as a starting point, the Levelled Geochemical Baseline of Australia made use of a large number of samples (~9000) from the 1970s – 1980s that were reanalysed and released in 2023 (Main *et al.*, 2023). In addition to these reanalysed surveys, the National Geochemical Survey of Australia (Caritat and Cooper, 2011) and the Northern Australia Geochemical Survey (Bastrakov *et al.*, 2018) were also included in the data release.

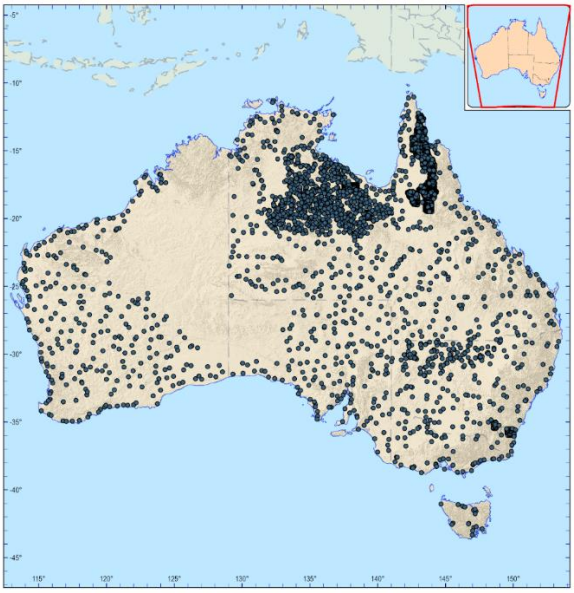


Figure A2.23. Map of locations for each of the data points included in the Levelled Geochemical Baseline of Australia data release.

References

Bastrakov, E.N., Main, P.T., Wygralak, A.S., Wilford, J., Czarnota, K. & Khan, M., 2018. Northern Australia Geochemical Survey data release 1: total (fine fraction) and MMI™ element contents. Record 2018/06. Geoscience Australia; https://ecat.ga.gov.au/geonetwork/srv/api/records/581b14c3-17a0-4ff4-a5ce-a28f5bc44721.

Caritat, P. de & Cooper, M., 2011. National Geochemical Survey of Australia: the geochemical Atlas of Australia, Record 2011/20 (2 volumes), Geoscience Australia, Canberra; https://www.ga.gov.au/about/projects/resources/national-geochemical-survey/atlas.

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.

Main, P., Champion, D.C., 2024. The Levelled Geochemical Baseline of Australia - Update 2024. GA Record 2024/48. Geoscience Australia, Canberra; https://dx.doi.org/10.26186/149683.

A2.5.2. New Zealand

Report by Mark Rattenbury (GNS Science; m.rattenbury@gns.cri.nz)

Through 2024, progress towards geochemical baselines in Aotearoa, New Zealand, has slowed considerably due to the re-focusing of science priorities, reduced funding and the departure of several key people involved in baseline work.

The Geochemical Atlas of Aotearoa New Zealand (Martin *et al.*, 2023) reported last year now has the underlying soil geochemistry data available through a downloadable structured text file and GIS inverse distance weighted interpolation grids for 65 elements analysed by aqua regia digest ICPMS method. The links to the national data are available through a metadata record in GNS Science's Dataset Catalogue: https://data.gns.cri.nz/metadata/srv/eng/catalog.search#/metadata/aa63b5e1-0ea1-4f8d-b717-9b4798861267.

A third New Zealand city, Wellington, now has a completed geochemical baseline study, reported as a Geochemical Atlas of Wellington (Morgenstern *et al.*, 2024):

Morgenstern, R., Martin, A.P., Turnbull, R.E., Norton, K., Rattenbury, M.S., Rogers, K.M., 2024. Urban Geochemical Atlas of Wellington, New Zealand. Lower Hutt (NZ). GNS Science, 128 pp. (GNS Science report; 2024/01); *https://doi.org/10.21420/8adh-f354*.

The Wellington Geochemical Atlas shows the abundance and variability of element concentrations within surficial soil material across the study area. Sampling was undertaken between December 2022 and April 2023 at 151 sites highly urbanised land (domestic and commercial properties) was sampled, as well as a variety of other, more natural land use types (native regenerating park, native park, exotic park, exotic forest, agricultural pasture) for comparison. At each site, two samples were collected using a hand auger: the upper O-depth (0–2 cm) and a shallow A-depth (2–20 cm). Several deeper B-depth (50–70 cm) samples were also collected for statistical analysis. Samples were dried, sieved to <2 mm and split into 15 g sample sizes, before being analysed for a suite of 65 elements using aqua regia digestion and Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

The Wellington data are available in two forms; a structured text file of element concentrations for all depths sampled (with sample locations collapsed to StatisticsNZ 2024 meshblocks to protect privacy) and a zipped ArcGIS geodatabase of Inverse Distance Weighted (IDW) grids for each of the 65 elements. The links to the Wellington data are available through a metadata record in GNS Science's Dataset Catalogue: https://data.gns.cri.nz/metadata/srv/eng/catalog.search#/metadata/20c19f95-4079-4fdf-a5a8-ed6ecbc6b727.

Articles, papers, atlases and books

Rogers, K.M., Morgenstern, R., Rattenbury, M.S., Norton, K.P., Doogue, C., Kah, M., Sari, S., Turnbull, R.E., Martin, A.P., 2024 (in review). A comparative study of human activities and climate effects on heavy metal and carbon sequestration in Wellington soils and other New Zealand urban soils. Submitted to Applied Geochemistry.

Martin, A.P., Rattenbury, M.S., Roudier, P., Cavanagh, J., Turnbull, R.E., Rogers, K.M., Vandergoes, M.J., Reyes, L., Gard, H.J.L., Richardson, S.J., Clarkson, B.R., Kah, M. (in preparation). National Geochemical Baseline Soil Survey of Aotearoa New Zealand. To be submitted to the Geochemistry: Exploration, Environment, Analysis special issue.

Oral and poster presentations

Rattenbury, M.S., Martin, A.P., Morgenstern, R., Rogers, K.M., Turnbull, R.E., 2024. Soil geochemical mapping of the Aotearoa New Zealand convergent margin. Fourth Arthur Darnley Symposium, International Geological Congress, Busan 2024.

Morgenstern, R., Martin, A.P., Turnbull, R.E., Doogue, C., Norton, K., Rattenbury, M.S., Rogers, K.M., 2024. A geochemical baseline survey of urban soils in Wellington. 1 p. In: International Applied Geochemistry Symposium, 30th edition, 14-18 October 2024, Adelaide. Adelaide, S. Aust.: Association of Applied Geochemistry.

A2.6. EUROPE

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

This report was prepared by: Chair Philippe Négrel (BRGM, France; p.negrel@brgm.fr), Deputy Chair Anna Ladenberger (SGU, Sweden; anna.ladenberger@sgu.se), Deputy Chair Jasper Griffioen (TNO, The Netherlands; jasper.griffioen@tno.nl)

Activities of EGS GEG in 2024

The activities of the EuroGeoSurveys Geochemistry Expert Group in 2024 were:

- Collaboration with the EU Soil Observatory (EUSO). EGS-GEG members' participation in the Working Groups (WG) is considered essential for policy, and GEG delegated their members to different Working Groups. The expert group advises the European Commission and provides expertise on implementing the actions of the Soil Monitoring Law.
- GEG members are active in national working groups which advise national Governments on the new Soil Monitoring Law.
- Collaboration with the extended expert group on the implementation of the EU Soil Monitoring Law for the Commission's Directorate-General for Environment (DG ENV). Philippe Négrel represents EGS-GEG.
- Contributing to the Strategic Research and Innovation Agenda (SRIA) of EuroGeoSurveys.
- GEG has close collaboration with the IUGS Commission on Global Geochemical Baselines. Implementation of the "*IUGS Manual of Standard Methods for the Establishment of the Global Geochemical Reference Network*" is an ongoing work.
- Scientific manuscripts of the GEMAS results have been published and are also in preparation (see below).
- Strategic publications with EGS have been published (see below).
- Participated in various tasks in the Geological Service for Europe project (GSEU).
- GEG members (Martin Gabersek, Timo Tarvainen, Jaana Jarva, Gevorg Tepanosyan, Alecos Demetriades) participated in the joint Conference of ISEH, ISEPH & ISEG on Environment and Health in Galway (Ireland) 11-18 August 2024 (refer to Section §6.4.3).
- Co-organisation and participation in a session '*Challenges and Opportunities of Global-Scale Geochemical Mapping (4th Arthur Darnley Symposium)*' at the 37 IGC in Busan, Republic of Korea (25-31 August 2024 – refer to Section §6.4.4.1).
- Anna Ladenberger (GEG deputy chair) co-chaired the joint session on Forensic and Medical Geology at the 37 IGC in Busan, which consisted of two parts: (i) Forensic Geology: Illegal Mining and Associated Crimes in the Global Minerals and Metals Supply Chain, co-chaired by Laurance Donnelly (Initiative on Forensic Geology chair), and (ii) Medical Geology in Honour of Professor Olle Selinus (Special Session), co-chaired by Hassina Mouri (refer to Section §6.4.4.3).
- Co-organisation of the 3-day workshop on the IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network (30-31/8/ & 1/9/2024) at the 37 IGC in Busan, Republic of Korea, co-sponsored by the International Union of Geological Sciences and the Association of Applied Geochemistry. Anna Ladenberger (GEG deputy Chair) and Maria João Batista (ASGMI-GEG Chair) co-chaired the session (refer to Section §6.4.4.1.3).

- EGS-GEG joint autumn meeting with IUGS-CGGB and ASGMI-GEG, from 19 to 21/09/2024 in the Czech Geological Survey, Prague, Czech Republic (23 participants in person). During the meeting, the group discussed future projects, GEMAS sample management, and valorisation of GEMAS data. July Hollis joined the meeting with the presentation of EuroGeoSurveys' Strategic Direction Updates. An important part of the meeting was the scientific presentations from EGS-GEG, ASGMI-GEG and local hosts and the celebration of the GEMAS 10th Anniversary with Clemens Reimann (former GEG chair and the GEMAS project leader) as a distinguished guest (refer to Appendix 1).
- IUGS-CGGB & GEG members took part in FAO's Global Soil Symposium (Global Symposium on Soil Information and Data; Hybrid event, September 25-28, 2024 - Nanjing, China). Presentations were delivered by GEG members: Anna Ladenberger, Maria João Batista, Paula Adánez-Sanjuan and Alecos Demetriades (retired GEG deputy chair) – refer to Section §6.4.5.
- GEG members (Philippe Négrel) participated in the European Mission Soil Week (12–13 November 2024 - Brussels).

Participation in projects and proposals

- GEG members were active (or will be active) in PANAFGEO2, SCRREEN2, EURAD, European Partnership, LIFE IP restart, EU-WaterRes and FUTURAM. FUTURAM is a Horizon project which has close collaboration with the WP2 of the GSEU.
- One of the biggest projects is GSEU (Geological Service for Europe). Many EGS-GEG members are involved in various work packages but not GEG itself. Geochemistry topics and soil issues have been included in the new Strategic Research and Innovation Agenda (SRIA) document which is still under preparation.
- The preparation of a Soil Factsheet together with the EGS secretariat.
- GEMAS data are available on the EGDI (European Geological Data Infrastructure) website: (https://data.geus.dk/egdi/?mapname=egdi_new_structure#baslay=baseMapGEUS&extent=138854.01929260464,1796730,5948345.980707396,4619780&layers=gemas_ap_aquaregiaxrf) and the discussion on improving the viewer are ongoing.
- GEMAS data are available from the BGR product centre: all maps can be downloaded in various file formats (https://geoportal.bgr.de/mapapps/resources/apps/geoportal/index.html?lang=en#/search?term=%24iso_hierachyLevelName_facet%3AGeochemie&core).
- Broad advisory work and consultations on the EU Soil Directive (Soil Monitoring Law). Both at the EU Commission level and at the national level.

Articles, papers, atlases and books

(a) GEMAS project publications

- GEMAS overview of publications, current status and latest ones: phosphorus (published), boron (published), silica, aluminium-iron and climate change (under internal review); see below:
    - Négrel, Ph., Ladenberger, A., Reimann, C., Birke, M., Demetriades, A., Sadeghi, M. and The GEMAS Project Team, 2024. GEMAS: Phosphorus in European agricultural soil - sources versus sinks at the continental-scale - the geological perspective. Science

of The Total Environment, 930,172524; https://doi.org/10.1016/j.scitotenv.2024.172524.

- Négrel, Ph., Ladenberger, A., Demetriades, A., Reimann, C., Birke, M., Sadeghi, M. and The GEMAS Project Team, 2024. GEMAS: Boron geochemical proxy of weathering recorded by European agricultural soil. Journal of Geochemical Exploration, 267, 107618; https://doi.org/10.1016/j.gexplo.2024.107618.
- Négrel, Ph., Ladenberger, A., Reimann, C., Birke, M., Demetriades, A., Sadeghi, M. and The GEMAS Project Team, 2025. The silica-aluminum-iron triptych, the geology and the composition of European soils: facts versus concepts at the continental scale (Under internal review).

(b) Publications with a strategic objective

Hollis, J.A., Calcagno, P., Bertrand, G., de Oliveira, D., Négrel, Ph., Diaz Martinez, E., La Vigna, F., Poyiadji, E., Tonne, N., van Heteren, S., Dakin, N., Hinsby, K., van Der Keur, P., Capova, D., Pizzocolo, F., 2024. A Geological Service for Europe – building trust through collaboration. European Geologist, 57; https://doi.org/10.5281/zenodo.12205679.

Klaus H., Négrel, P., Oliveira, D. de, Barros, R., Venvik, G., Ladenberger, A., Griffioen, J., Piessens, K., Calcagno, P, Götzl, G., Broers, H.P., Gourcy, L., Heteren, S. van, Hollis, J., Poyiadji, E., Čápová, D., Tulstrup, J., 2024. Mapping and Understanding Earth: Open access to digital geoscience data and knowledge supports societal needs. International Journal of Applied Earth Observation and Geoinformation, 130; https://doi.org/10.1016/j.jag.2024.103835.

(c) In memoriam

Zhang, Ch., Ladenberger, A., Centeno, J., Finkelman, R.B., Mouri, H., 2024. Medical Geology: A tribute to Olle Selinus (2043-2023). Applied Geochemistry, 164, 105955; https://doi.org/10.1016/j.apgeochem.2024.105955.

A2.7. MIDDLE EAST

A2.7.1. Saudi Arabia

Report by: Ibrahim Osman Abdella (Othman.I@sgs.gov.sa) (Technical Advisor/Geochemist, Saudi Geological Survey), Mazen B. Balkheyour (Senior Geochemist, Saudi Geological Survey), and Wadee A. Kashghari (Owner and Director of the Regional Geological Program (RGP), Saudi Geological Survey).

High-Resolution Geochemical Survey of the Arabian Shield (GSAS), Saudi Arabia

The Geochemical Survey of the Arabian Shield (GSAS) project is implemented by the China Geological Survey (CGS) under the direction of the Saudi Geological Survey (SGS), with support from technical partners, including experienced geochemists from International Geoscience Services (IGS) Ltd and the Geological Survey of Finland (GTK) – see Figure A2.24.

This ambitious geochemical survey covers an expansive area of approximately 600,000 square kilometres across the Arabian Shield and has reached a significant milestone with the successful collection of 90,872 stream sediment samples. A systematic and unified sampling methodology has been adopted across the diverse landscapes of the Arabian Shield, encompassing mountainous terrains, flat plains, sabkhahs, relatively unweathered recent harrats (basaltic lavas), and nafuds

(sand dune areas). Samples have been collected at a density of one per 6.25 square kilometres, making this survey one of the most comprehensive and detailed of its kind.

To date, 80% of the collected samples have been chemically analysed in CGS laboratories in China, covering 76 elements along with Loss on Ignition (LOI). These analyses have undergone rigorous quality control processes in collaboration with CGS, IGS-GTK, and SGS to ensure accuracy and reliability.

The project has advanced considerably, with statistical analyses and geochemical mapping—both single- and multi-element—successfully completed for 10 quadrangles (each measuring 1½° x 1°).

Looking ahead, the project will continue to focus on conducting detailed statistical evaluations, generating high-resolution geochemical maps, and preparing comprehensive technical reports for all 51 quadrangles that comprise the Arabian Shield. The initiative is on track for completion in May 2027, culminating in the publication of the Geochemical Atlas of the Kingdom of Saudi Arabia — a landmark achievement in geoscientific research and resource exploration.

Figure A2.24. CGS and SGS geochemists during the stream-sediment sampling campaign for the GSAS Project.