2025
ANNUAL REPORT

of the

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES
COMMISSION
ON
GLOBAL GEOCHEMICAL BASELINES

February 2026

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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 brevity, it will henceforth be referred to as either CGGB or the 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 the IUGS cooperative enterprise. This first phase 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 its cover colour).

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' (TG-GGB) 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, discussed the proposal of Dr. José P. Calvo (Secretary-General) for the "*creation of a new Commission on Global-scale Geochemistry by upgrading the current Global Geochemical Baseline Task Group, which could provide substantial support to the RFG Initiative*" (see p.10-11 of the Minutes: https://98ca4554-1361-4fb1-a4d8-a1bb16d032e6.filesusr.com/ugd/f1fc07_a7026713000b4d2baa13ea9985c3d5ef.pdf?index=true).
- At the 69th siting of the IUGS-EC (18-19 January 2016), Dr. José P. Calvo (Secretary-General) repeated the necessity for the Task Group's upgrade to Commission with the following supporting statement that "*there is opportunity for Geochemical Baselines to collaborate with the IUGS Initiative on RFG and other projects, such as One Geology, GEOSS, Future Earth-ICSU, and Joint Task Group on Isotopes*" (see p.16 of the Minutes: https://98ca4554-1361-4fb1-a4d8-a1bb16d032e6.filesusr.com/ugd/f1fc07_c475e314f1af47eaa1480cb6d536d9a2.pdf).
- The proposal for upgrading the Task Group to an IUGS Commission was reaffirmed at the 70th sitting of the IUGS-EC (26-27 August 2016) in Cape Town, South Africa (see p.14 of the Minutes: https://98ca4554-1361-4fb1-a4d8-a1bb16d032e6.filesusr.com/ugd/f1fc07_5dfa1d19dbc547a1a9a210e61b71a55a.pdf?index=true).
- At the 4th Ordinary Session of the IUGS Council on the 31st of August 2016, Dr. José P. Calvo's (Secretary-General) "*introduced that the IUGS Commission on Global Geochemical Baselines built on the previous work of the IUGS Task Group on Global Geochemical Baselines (TGGGB) (1997-2016). The objectives of the proposed new Commission will be to promote and facilitate the implementation of harmonized sampling, sample preparation, quality control, and analytical protocols in geochemical*

mapping programmes. The new Commission will collaborate closely with the UNESCO International Centre on Global-Scale Geochemistry" (see p.33 of the Minutes: https://98ca4554-1361-4fb1-a4d8-a1bb16d032e6.filesusr.com/ugd/f1fc07_b95cdd3f83ae4e45a0f980239926b644.pdf).

- Finally, the IUGS President, Professor Roland Oberhänsli, proposed the "*Motion to ratify the new IUGS Commission on Global Geochemical Baselines and its Officers*", which was unanimously approved by the IUGS Councillors at the Fourth Ordinary Session of the IUGS Council meeting in Cape Town (South Africa) on the 31st of August 2016.

2. OVERALL OBJECTIVES

The mission of the Commission is to:

(i) Develop a Manual of Standard Methods for the Global Geochemical Reference Network project to facilitate the implementation of harmonised sampling, sample preparation, quality control, and analytical protocols in geochemical mapping programmes [the IUGS Manual of Standard Methods was published in 2022].

(ii) Establish a global Geochemical Terrestrial Network (GTN) similar to a geodetic network for levelling existing databases (prime objective) [the GTN was established in 2022 with the assistance of Robert G. Garrett (Geological Survey of Canada), and the report by He, J. & Geng, X., 2022. R-scripts for Generation of 5, 8 and 16 Random Sampling Points Within Predefined Rectangles].

(iii) Prepare a global geochemical database and its representation in map form (long-term objective), and

(iv) Document the concentration and distribution of chemical elements and species in the Earth's near-surface environment (long-term objective).

Items (iii) and (iv) of the Commission's mission: 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 implement the standards for global-scale geochemical mapping, as described in the IUGS Manual of Standard Methods. The Commission also promotes and facilitates the implementation of harmonised protocols for geochemical sample collection, preparation, quality control, and analysis 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 and quality

control 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 directly relates to all of these objectives by establishing a land-surface global geochemical reference network and providing multi-sample media and multi-element baseline data for a wide variety of environmental and natural resource applications (Darnley *et al.*, 1995). The project is also consistent with:

- The strategic plan published by the IUGS Strategic Planning Committee (2000).
- The International Year of Planet Earth (2007-2009) of *'Earth Sciences for Society'*. (www.yearofplanetearth.org/), 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 on page 9 of the IUGS-CGGB 2024 report shows how the UN Sustainable Development Goals are implemented in Chile with respect to information and results generated by applied geochemical projects. Similarly, such Tables can be compiled for all countries carrying out applied geochemical projects.

4. STRUCTURE AND ORGANISATION

The Commission is led by a Steering Committee that coordinates the activities of four Technical Committees and the contributions of 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 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-Sanjuán, *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, Hellenic Republic

Deputy Chair: Iván Martín-Méndez (Spain)

Supervises the development and coordination of 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 Commission'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
Forbes Mugumbate, Zimbabwe Geological Survey, Zimbabwe
Ernest Tafumanei Mugandani, Zimbabwe Geological Survey, Zimbabwe

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
Sofía del Pilar Mendoza, SGM, Pachuca de Soto, Hidalgo, Mexico
Saúl Peña Coronado, 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 (retired)
Daliane Bandeira Eberhardt, 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)
Juanita Sierra Salamanca, Servicio Geológico Colombiano, Bogotá, Colombia
Raynel Alberto Herrera Molina, Instituto de Geología y Paleontología (IGP), Cuba
Fernanda Andrade, Instituto de Investigación Geológico y Energético (Ecuador)
Cesar De la Cruz Poma, Instituto Geológico, Minero y Metalúrgico (INGEMMET), Peru

4.6.4. Asia (East)

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

4.6.5. Australasia

Philip Main, Geoscience Australia, Canberra, Australia
Mark Rattenbury, Earth Sciences New Zealand, Avalon, Lower Hutt, New Zealand

4.6.6. Europe

Philippe Négrel, Bureau de Recherches Géologiques et Minières (BRGM), 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 (retired)
Ashvin Wickramasooriya, University of Peradeniya, Peradeniya, 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 clearly specified in the Statutes of the Centre, which were unanimously approved by the Governing Council on the 16th 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 unusual 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 UNESCO-ICGG management has neither consulted nor 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 and the Institute of Geophysical and Geochemical Exploration 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 "*Meeting with UNESCO-ICGG Executive Director*" of the IUGS-CGGB 2024 report and pages 25−28. The aforementioned statement clearly explains why the International Councillors, who were all Commission members, were never consulted.

While preparing the Commission's annual report, the UNESCO ICGG was contacted several times to request input about its activities during 2025, but to no avail.

The reason is most likely explained by the **New Wording of Article 7**, approved at the First Session of the Second Term of the ICGG Governing Board and Academic Committee, which was held in Langfang (P.R. China) between the 9th and 10th December 2025, *i.e.*:

"*The functions of the Centre shall be to:*

1) *Standardize methods and guidelines for global geochemical baselines and geochemical observation networks to provide reference data accompanying maps for monitoring future chemical changes of the Earth's pedosphere;*
2) *Certify baselines of chemical parameters in soils for green land use and sustainable agriculture;*

3) *Implement global geochemical baselines programs for securing funds, managing and coordinating these activities according to scientific guidelines determined by the ICGG's scientific committee, cooperating with external advisory experts;*
4) *Transfer global-scale geochemical methods to developing countries and to facilitate capacity building in these countries in application of geochemical databases and maps to mineral resource investigations, global climate change studies, and research on environmental effects of agricultural practices, etc.*"

With this change, the UNESCO-ICGG management removed the clauses of the 2018 Article 7 (see above) that did not conform to its aims, and it now has complete independence. Of course, it was never explained to the new Governing Board Councillors which articles were revised, and the reasons for their revision.

It will indeed be interesting if the UNESCO-ICGG management will ever activate Article 8, which states that "*The Centre shall pursue the above objectives and functions in **close cooperation** with the Ecology and Earth Sciences Section of the Natural Sciences Sector of UNESCO and the Commission on Global Geochemical Baselines of the International Union of Geological Sciences (IUGS)*".

Another very interesting development is that the UNESCO-ICGG management removed from the Download webpage (http://www.globalgeochemistry.com/en) its first and only Newsletter, published in 2017, and the two sets of Chinese geochemical data, *i.e.*, the EGMON top- and bottom-soil geochemical data sets and the China Geochemical Baselines data set. The question is: *What are the reasons for their removal when the UNESCO-ICGG wishes to manage geochemical data sets from other countries?*

5.2. Interface with other International Organisations

The interface with other international organisations is reported in the Commission's 2024 Annual Report, Section §5, on pages 12 to 13. Any collaboration with the same organisations or new ones are 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 2025

6.1. 81st IUGS Executive Committee Meeting

The 81st IUGS Executive Committee (EC) meeting was held in Paris (France) from Monday, 17th to 20th March 2025. Alecos Demetriades, Commission's Chair, presented on Monday, 17th of March 2024, the CGGB 2024 activities report at the open session of the 81st IUGS EC meeting (Figure 1). The original Microsoft® PowerPoint presentation can be downloaded from the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=XZ6x0K5ZTl7DFumRr0u45K8Tbm8Seu1i60tk.

The report included:

1) A short comment about the CGGB's mission and implementation.
2) Promotion of the IUGS Manual of Standard Methods at conferences.
3) Expectations and plans for 2025.
4) Reference to the four CGGB publications (see https://www.globalgeochemicalbaselines.eu/content/91/publications-/).
5) Budget request, and
6) Motivation for 2025.

Figure 1. Photograph of the 81st IUGS-Executive Committee meeting in Paris. Photograph by Chaosheng Zhang.

6.2. Annual Joint Business Meeting

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

The event took place over three days (9–11 October 2025) in a hybrid format and was hosted by the Geological Survey of the Netherlands (TNO) at the Science Park in Utrecht (Princetonlaan 8, NL-3508 TA). In total, 24 participants from across Europe attended in person, while another 8 joined online.

The first day focused on reviewing the work carried out by IUGS-CGGB, EGS-GEG, and ASGMI-GEG over the past year, outlining plans for the coming year, and exploring opportunities for future collaboration. IUGS-CGGB presented its 2025 activities, highlighting in particular the four-day Goldschmidt Workshop and the scientific session titled *"Multi-scale Geochemical Mapping for Mineral Resource Management."* Looking ahead, one of the main priorities discussed was the organisation of a workshop in Latin America, where participants will receive hands-on training in the methods and procedures described in the IUGS Manual of Standard Methods, including practical exercises and fieldwork.

The second day was dedicated to presentations from various geological surveys showcasing their geochemical research. These talks demonstrated the wide range of applications of geochemistry and reinforced its importance within the earth sciences. Topics included environmental assessments and risk analysis, recovery of raw materials from mining and urban waste, the role of geochemistry in studying extreme events, and its use in mineral exploration —

especially regarding critical raw materials. All presentations have been made available in a dedicated pCloud folder.

On the final day, participants visited Marker Wadden, an artificial island that represents the first phase of a major ecological restoration project in one of western Europe's largest freshwater lakes.

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 submit concise monthly reports on their activities. The Commission has responded when having any vital news to transmit. Its 2025 contributions were published in the following nine E-Bulletins:

- IUGS E-Bulletin No. 212-213 – January-February 2025 (p.5)
- IUGS E-Bulletin No. 214-215 – March-April 2025 (p.5−6)
- IUGS E-Bulletin No. 217 – June 2025 (p.5)
- IUGS E-Bulletin No. 218 – July 2025 (p.3−4)
- IUGS E-Bulletin No. 219 – August 2025 (p.4-5)
- IUGS E-Bulletin No. 220 – September 2025 (p.6)
- IUGS E-Bulletin No. 221 – October 2025 (p.9−10)
- IUGS E-Bulletin No. 222 – November 2025 (p.5)
- IUGS E-Bulletin No. 223 – December 2025 (p.2−3)

It is noted that the Commission's May 2025 article is not included in E-Bulletin No. 216.

The Commission would like to acknowledge Farnoosh Farjandi and Zhao Weijun for their excellent communication skills.

6.3.2. Field Workshop for MSc Students studying at the University of Athens

At the request of Prof. Ariadne Argyraki (Commission's Public Relations Officer), on Saturday, 22 February 2025, eight MSc candidates from the "*Mineral Resources, Petrology, and Environmental Management*" programme at the National and Kapodistrian University of Athens participated in an intensive, full-day field workshop (Figure 2). The session was organised and supervised by Alecos Demetriades (CGGB Chair), providing students with a valuable opportunity to acquire practical competence in geochemical sampling methodologies, as described in the IUGS Manual of Standard Methods.

Throughout the workshop, all field procedures specified in the IUGS Manual of Standard Methods were demonstrated. Participants practised a range of sampling techniques, including the collection of rock and residual soil samples, soil sampling for mineral exploration purposes, and the acquisition of stream water and stream sediment samples (both dry and wet). These activities were conducted at strategically selected sites within the University of Athens campus and in a northern suburb of Athens.

In addition to technical training, the workshop emphasised best practices in field sampling, such as accurate coding and labelling, rigorous selection of sampling locations, and the use of appropriate materials to minimise contamination risks. Students also engaged in discussions regarding the critical importance of precise sampling procedures for ensuring data reliability, reinforcing the connection between methodological rigour and high-quality geochemical analyses.

This practical training experience served as an invaluable educational component, effectively bridging theoretical instruction with real-world application and preparing students for future professional responsibilities in mineral exploration and environmental geochemistry.

(a) *(b)*

(c) *(d)*

Figure 2. Alecos Demetriades during the workshop (a) with the field sampling sheet, (b) taking the topsoil sample, (c) with some students, and (d) taking the stream sediment sample.

6.3.3. Webinar: Generating Geochemical Information for Society: Sample Analysis

The Geochemistry Expert Group of the Ibero-American Association of Geological and Mining Surveys (ASGMI-GEG) held the third webinar in its series *"Geochemical Information for Social Service"* (Figure 3). This edition, titled *"Generating Geochemical Information for Society: Sample Analysis,"* took place on 12–13 November 2025 and was coordinated by the Geological Survey of Ecuador.

The event brought together more than 86 participants and included contributions from internationally recognised specialists, as well as experts in geochemical sample analysis from Latin America, Spain, and Portugal. Among the invited speakers were Alecos Demetriades (Chair of the IUGS Commission on Global Geochemical Baselines), Anna Ladenberger (Senior Geochemist at the Geological Survey of Sweden and member of the CGGB Steering Committee), Philippe Négrel (Chair of the EuroGeoSurveys Geochemistry Expert Group), and Jinfeng Bai (Laboratory Director at the Institute of Geophysical and Geochemical Exploration, Langfang, P.R. China). Although David Cohen (IUGS Treasurer) was unable to attend the live session, he provided his presentation together with detailed notes. All presentations have been made available through a dedicated pCloud folder. The webinar presentations are also available on YouTube in two parts, Day 1 and Day 2. Gracia Olivenza (General Secretary of ASGMI), Virginia Luengo (Gestión de Proyectos ASGMI), and Fernanda Andrade (Conference Moderator, Representante del Ecuador, Instituto de Investigación Geológico y Energético) are thanked for organising the webinar.

Figure 3. Logo of the ASGMI-GEG webinar "Generating Geochemical Information for Society: Sample Analysis" designed by Tatiana Cárdenas Prieto (daughter of Gloria Prieto, Advisory Panel Councillor of the IUGS-CGGB Steering Committee).

The webinar served as an important platform for applied geochemists to exchange technical knowledge on analytical quality control, laboratory methodologies, instrumental techniques, and standardised procedures. It also provided an overview of the analytical infrastructure currently available in the Latin American and Caribbean region. Discussions underscored the critical importance of generating robust, high-quality geochemical data to support a wide range of applications, including the development of global geochemical baselines, mineral resource evaluation, environmental and public health studies, and broader initiatives aligned with the United Nations sustainable development goals.

6.3.4. Podcast: GeOCHemISTea

Alecos Demetriades (CGGB chair) joined the GeOCHemISTea podcast organised by Sam Scher (member of the Association of Applied Geochemists), an applied geochemist based in Washinghton, D.C. (Figure 4). In her podcast, she connects with applied geochemists from around the world to share their experiences, insights and stories from the field.

Figure 4. Logo of the GeOCHemISTea podcast.

Alecos unpacked the philosophy of the Global Geochemical Reference Network, and other relevant issues, such as harmonised sampling, quality control procedures, *etc.*, under the general title "Geochemistry without Borders".

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 disseminating information about their activities to all CGGB members. During 2025, the Commission circulated information for the following virtual events:

- ✓ 23rd January 2025. *Hyperspectral Core analysis at the Geological Survey of Ireland*; EuroGeoSurveys Geological Mapping & Modelling Expert Group, by Russell Rogers, bedrock geologist in the Geological Mapping Programme of Geological Survey Ireland. https://www.youtube.com/watch?v=lHsXwZdiqV8.
- ✓ 24th January 2025. *First comprehensive study of the state of environmental pollution in Region Lagunera, Mexico and its possible impacts on human health*. By Ofelia Morton, Researcher at the Institute of Geophysics at UNAM. A SEGH Live Fellows seminar.
- ✓ 28th March 2025. *The FOREGS multi-media geochemical atlas*. By Alecos Demetriades (CGGB Chair). A SEGH Live Fellows seminar (available on YouTube).
- ✓ 7th May 2025. *How to write a scientific paper*. By Dr Thomas von Larcher, Senior Editor of Springer Nature. This was a series of useful lectures, and CGGB members were asked to register.
- ✓ 22nd September 2025. *Seminar Forensic Geology-IUGS IFG* by Rob Fitzpatrick.
- ✓ 25th September 2025. Webinar on "*Prenatal Exposure to Arsenic in Drinking Water and Type 1 Diabetes in a Nationwide Population-based Cohort of Danish Children*". By Thoranna Gilbertsdottir, IMGA ECR.
- ✓ 10th October 2025. *Writing scientific papers for journal publication*. By Michael Watts, Head of Inorganic Geochemistry, British Geological Survey. A SEGH Live Fellows seminar (available on YouTube).
- ✓ 3rd – 7th November 2025. Sixth Meeting of the Conference of the Parties to the Minamata Convention on Mercury (COP-6).
- ✓ 24-29th November 2025. *4th International Student Conference on Medical Geology and Environmental Health*.
- ✓ 5th December 2025. *Hidden in Plain Sight: How the toxic metal lead continues to impact our communities and what we can do about it*. By Jane Entwistle, Professor of Environmental Geochemistry and Health, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, United Kingdom. A SEGH Live Fellows seminar (available on YouTube).
- ✓ 10th December 2025. *WEBINAR organised by the EUSO TW on soil monitoring*. The updated *in-situ* soil sampling protocol for the next LUCAS survey. Since this protocol is complex and difficult to apply, based on the Commission's expertise, a Zoom discussion was organised with the members who attended the workshop. It was decided for Paula Adánez Sanjuán (CGGB Scientific Secretary) to send the following message to the EUSO soil scientists (sent on 18/12/2025):

"I am writing on behalf of the Commission on Global Geochemical Baselines, as well as the EGS Expert Group on Geochemistry. Following a recent discussion that arose after last week's EUSO webinar on LUCAS sampling protocols, we would like to share our impressions.
We would like to share the link to the *International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*, published by the Commission in 2022.

https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2022_Manual_of_Standard_Methods_for_Establishing_the_GGRN.pdf
Chapter 3.2, *"Residual Soil and Humus Sampling"*, provides a comprehensive and well-established overview of best practices for residual soil sampling. As can be seen, this chapter was prepared by 13 experts in soil geochemistry and reviewed by soil scientists. It represents a broadly agreed contribution that also takes into account the 28 soil types of the Harmonised World Soil Database (HWSD).

For these reasons, we believe that the sampling approach described in this document is more practical and reliable, particularly from both an operational and scientific perspective, and we would therefore recommend its use as a reference."

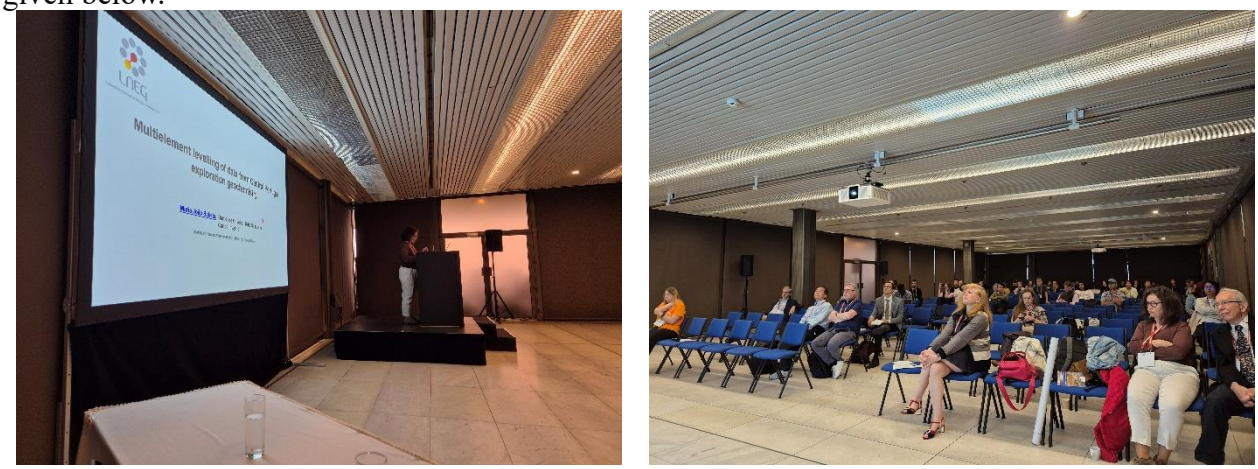
6.4.2. Goldschmidt Conference (2025) Prague (Czech Republic)

The Goldschmidt Conference is held every two years in Europe. This year was in Prague (Czech Republic), and the venue was the Prague Congress Centre.

6.4.2.1. Session on Multiscale Geochemical Mapping and Mineral Resources

The IUGS Commission on Global Geochemical Baselines (CGGB) organised a session entitled "05j-Multi-scale Geochemical Mapping for Mineral Resource Management" under Theme 05 "Earth Resources and Energy" at the Goldschmidt 2025 Conference. The session was convened and chaired by Maria João Batista (CGGB Deputy-Chair) and Paula Adánez Sanjuán (CGGB Scientific Secretary). The main topic of the session was geochemical mapping as an essential tool for any study of Earth's surface, regardless of scale. The keynote lecture "*Systematic Phased Geochemical Mapping Surveys for Mineral Exploration*" was delivered by Alecos Demetriades (CGGB Chair; the original Microsoft® PowerPoint presentation can be downloaded from: https://u.pcloud.link/publink/show?code=XZPSjl5ZI4Q8jws0tqkcqBRaM8KFT0lg8sfX.

The session took place on the morning of July 9th, and was attended by around 50 people. Eleven presentations on different themes were delivered orally (Figure 5). The presentations are given below.



(a) (b)

Figure 5. (a) Maria João Batista (CGGB Deputy-chair) delivering a presentation (b) Attendants of the Session.

6.4.2.1.1. Oral presentations

1) [Keynote] Alecos Demetriades: *Systematic Phased Geochemical Mapping Surveys for Mineral Exploration*.
2) **Olga Filimonova**, Sarah-Jane Barnes, Oier Bikondoa, Jacopo Orsilli and Didier Wermeille: *The state of Pd in pentlandite from Norilsk and Lac-des-Îles ores*.
3) Martiya Sadeghi, Patrick Casey, **Prof. John Carranza** and Edward P. Lynch: *Exploration Targeting for Pegmatite-hosted Lithium Mineralization in Västernorrland Region, Sweden, by Multivariate Analysis of Till Geochemical Data*.

4) **Maria João Batista**, Daniel de Oliveira, Rute Salgueiro and Carlos Inverno: *Multielement levelling of data from Central Portugal exploration geochemistry*.
5) **Tobias Bamforth**, Heta Lampinen, Leah Lynham, Nathan Reid, Robert Thorne, Mario Iglesias-Martinez, Joël Brugger and Fang Xia: *Defining Regolith-Hosted REE Deposits Using Multivariate Geochemical Analyses*.
6) **Botond G. Gereczi**, Viktor Bertrandsson Erlandsson, Vasilios Melfos and Gabriella B. Kiss: *Enrichment conditions of critical raw materials in sphalerite from VMS-type ore deposits – opportunities for more cost-effective and sustainable metal extraction*.
7) **Ray Scanlon**, Victoria Lowe, Eoin McGrath and Koen Verbruggen: *CRM hotspot mapping of Irish geochemical soil datasets to locate potential Volcanic Hosted Massive Sulphide mineralisation*.
8) Mario Iglesias-Martinez, Heta Lampinen, Ruixue Wang, Yoram Teitler, Louise Schoneveld, Kalimuthu Rajendran, Alok Porwal and **Erick Ramanaidou**: *Multiscale analysis of Lithium-rich pegmatites in Rajasthan (India)*.
9) **Heileen Hsu-Kim**, Zehao Jin and James C. Hower: *National Inventory of Coal Ash Quality in Reserve at Major Electric Power Facilities in the United States*.
10) **Mizuki Ishida**, Kentaro Nakamura, Sam J. Hammond, Frances E. Jenner, Masataka Aizawa, Takahiro Hosono, Prof. Ryuichi Shinjo, Hikaru Iwamori, Yasuhiro Kato and Jamie Wilkinson: *Role of slab bending in the epithermal gold mineralization of South Kyushu, Japan*.
11) **Sophie Graul**, Vincent Monchal, Remi Rateau, Lauri Joosu, Mawo Ndiaye, Paul Guyett and Rutt Hints: *LA-ICP-MS imaging and semi-quantification: Unlocking the REE potential of low-grade sedimentary ores, application to Estonian phosphorites*.

6.4.2.1.2. Poster presentations

The following works were presented as posters:

1) **Jennifer S. Cann**, Daniel D. Gregory and Evan Hastie: *Trace element geochemistry of pyrite from orogenic gold deposits of the Abitibi greenstone belt*.
2) **Efstratios Kelepertzis**, Artemios Roussos, Zacharenia Kypritidou, Epaminondas Aivatzidis, Christos Drougas, Emmanuel Vassilakis, Panagiotis Voudouris and Nikolaos Zouros: *Lithological controls on soil geochemistry in Lesvos island, Greece*.
3) **Ivan Martin Mendez** and Pablo Martín-Páez: *Critical Raw Materials distribution in residual soils of Iberian Pyrite Belt (Spain)*.
4) Marta Sánchez-García, **Paula Adánez Sanjuan** and Concepcion Fernandez-Leyva: *Rare Earth Elements distribution patterns in stream sediments in Southeast Spain*.
5) **Shaun L.L. Barker**, Brian McNulty, Matthew Manor, Cassady Harraden and Maxwell Porter: *Use of large multi-digest lithogeochemical datasets for mapping lithology and alteration in porphyry copper deposits*.
6) **Walid Salama**, Robert Thorne and Ravi Anand: *Indicator minerals, interface sampling and sulfur isotopes for vectoring the Nova-Bollinger Ni-Cu-Co sulfides, Western Australia*.
7) **Nikola Denisova**, Kate E L Rubingh, Mana Rahimi and Shaun L.L. Barker: *Preservation of paleosurfaces in Jurassic-age rocks of the Golden Triangle, British Columbia, Canada - evidence from the world-class Treaty Creek Au camp*.
8) **Nyah Bay**, Mohammad Parsa and Andrei Swidinsky: *Integrating Geoscience Text Data into Mineral Prospectivity Mapping Using BERT-Based Natural Language Processing*.
9) **Ms. Ilham M'hamdi Alaoui,** Ahmed Akhssas, Anas Bahi, Hassan Ibouh, Nour Eddine Berkat, Saloua Mnissar Himyari and Hicham Khebbi: *Geostructural Framework of the Alma Inlier (Western Anti-Atlas, Morocco) Revealed by Combined Remote Sensing and Airborne Geophysical Methods*.

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

The Commission compiled a comprehensive Manual of Standard Methods, which, after approval by the IUGS Executive Committee and a foreword signed by three IUGS Presidents, was published as the official IUGS publication for 2022 marking its 60th anniversary. 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 IUGS Manual, in addition to their use for establishing the Global Geochemical Reference Network, can be applied to 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, a two-day event 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 determined that at least two days for lectures and hands-on exercises were required, and one day in the field.

The second workshop was co-sponsored by the International Union of Geological Sciences and the Association of Applied Geochemists, and both entities are thanked for their generosity. It was held in Busan (South Korea) during the 37th International Geological Congress, with two days of lectures (30-31 August 2024) and the last day (1 September 2024) was devoted to field training. Professor Hassina Mouri (current IUGS President) also participated in the field course.

The Prague 2025 workshop was the third organised by the CGGB. This time it was a four-day workshop from the 2nd to the 5th of July and was titled "*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'*". Three days were devoted to lectures and practical exercises (Table 1), while the fourth and last day comprised a field training course on the outskirts of Prague. The workshop was attended by 24 earth scientists from Africa, N. & S. America, Asia, Europe, and the Middle East (Figure 6). The workshop was sponsored by IUGS and held in the lecture room of the Czech Geological Survey (CGS) with the approval of its Director Dr. Zdenek Venera.

The workshop tutors were Alecos Demetriades, Maria João Batista, Paula Adánez-Sanjuán and Iván Martín-Méndez, with interventions in the form of short, interesting tutorial lectures on isotopes by John Hora and Eva Martinková (Czech Geological Survey).

Table 1. Prague 2025 workshop schedule.

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

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 using Golden Software's Grapher™
- ANOVA-RANOVA (Vassiliades, 2022)
- Quality Control – The Cyprus Soil Geochemical Atlas study (David Cohen)

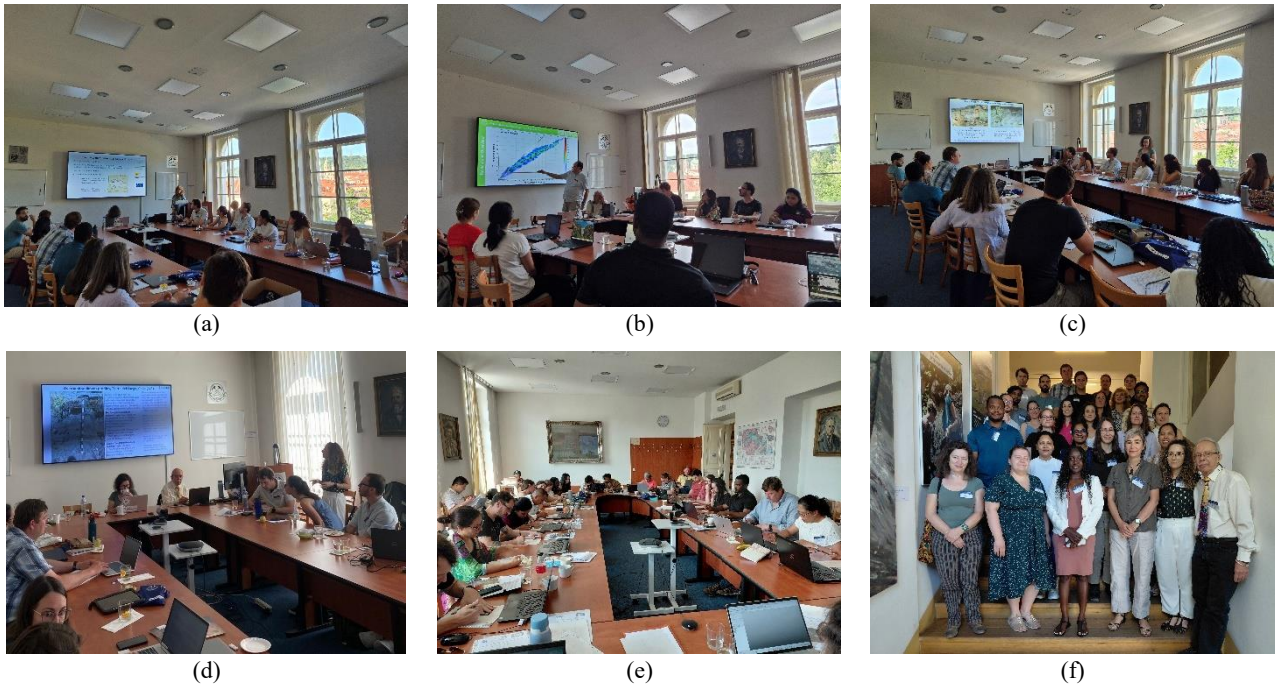
Data Conditioning Methods: Generating Time-Independent Geochemical Data

- Levelling exercise

Data management and Map Production

- Map plotting exercise with Golden Software's Surfer™ using the FOREGS data set

Interpretation and Usage of European Multinational and Continental-scale Geochemical Data Sets
Global to Local-scale Geochemical Surveys



(a) (b) (c)

(d) (e) (f)

Figure 6. (a) Workshop participants during the welcoming introduction by Dr. Anna Vymazalová, Deputy Director of the Czech Geological Survey; (b) John Hora, (c) Maria João Batista, and (d) Paula Adánez-Sanjuán delivering their lectures; (e) Workshop participants doing a hands-on exercise, and (f) group photograph.

During the field training course in the outskirts of Prague, practical sampling methods were demonstrated to the workshop participants (Figure 7). Stream water, stream sediment, overbank sediment, and rock sampling were demonstrated; soil sampling was explained at an exposed section. The sampling videos recorded by Szimona Zarzsevszkij, who is thanked, can be downloaded by using the following pCloud hyperlink: https://u.pcloud.link/publink/show?code=kZDOjl5ZzlHXOJH4bHB054UeGK8m3QlpSVWV.

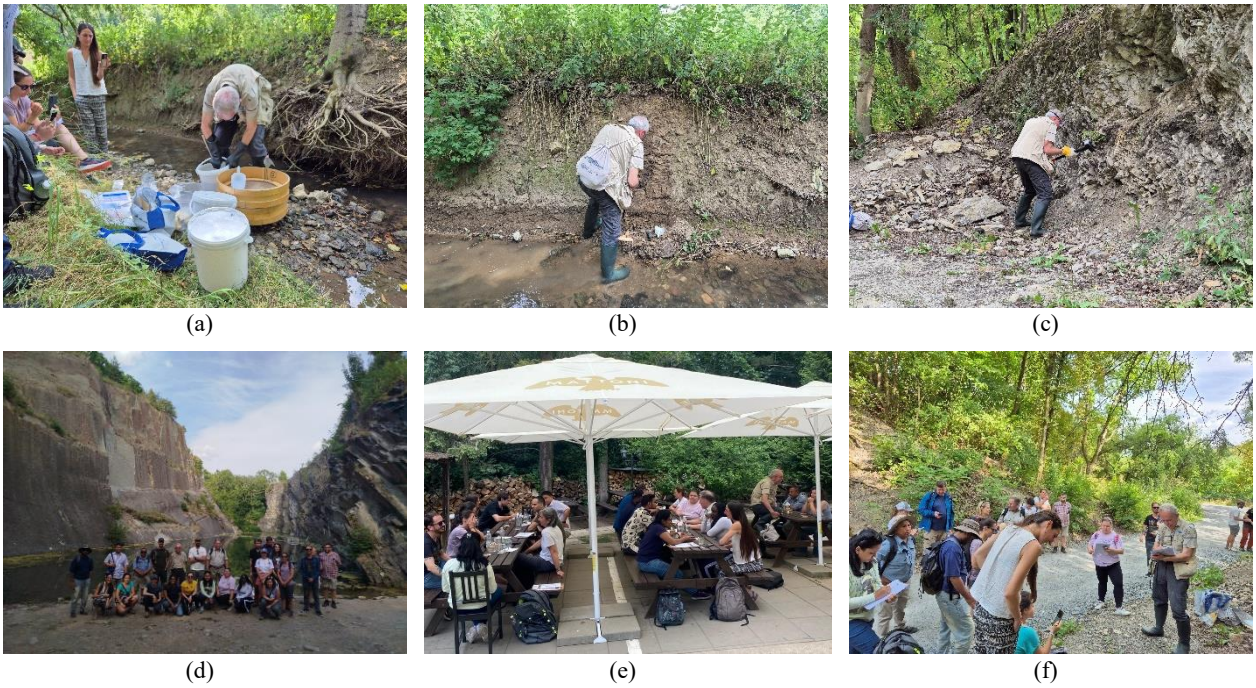


Figure 7. Alecos Demetriades taking (a) the stream sediment, (b) overbank sediment and (c) rock samples; (d) Group photograph, (e) Workshop participants and tutors during lunch time, and (f) Alecos with the Workshop participants at the rock sampling site, recording field observations.

The CGGB would particularly like to thank Michal Poňavič, Dalibor Mašek, and the Deputy Director Dr. Anna Vymazalová, for their help in organising the workshop and field training course. Also, the assistance during the workshop of two students, Jan Mráček and Ondra Cenek, and Mrs. Darja Skacelova, the CGS Secretary. Finally, Ing. Tereza Grabmüllerová (Head of the Czech Geological Survey Central Laboratory) is thanked for the analysis of the collected samples by hot *aqua regia* and ICP-OES finish, and total concentrations by WD-XRF.

Since there is already plenty of material publicly available on the Commission's website for anyone who needs it for lectures, it was decided not to make available the Workshop material, since we strongly believe that it is important to offer a certain level of "*exclusivity*" to those who make the effort to attend the course in person.

6.4.2.3. Comments by professionals and students about the workshop

The participants considered the workshop "*Excellent*" (Table 2). In Table 3, with specific questions as to which part of the workshop they found most interesting and which part the least interesting, the participants gave different answers depending on their interests:

- The sampling lectures need to be streamlined to avoid repetition of common parts.
- More time is needed for the hands-on exercises and the use of their own data sets, and
- To incorporate interactive quizzes.

The comments in Table 4 on their suggestions for improvement essentially support what we already knew: the workshop lectures and, especially, the hands-on exercises were very difficult to elaborate on in the required detail within the three-day time limit. However, there were good suggestions for improvement, namely:

- Getting acquainted with the IUGS Manual of Standard Methods before the workshop;
- A lecture on soil-forming processes;

- Providing actual problems to solve collaboratively – here, it is suggested that the participants are divided into groups;
- More time needed for using the software, and
- Longer field training course so that all participants could use the sampling techniques.

Sampling methods were emphasised as they are the most important in any geochemical mapping survey, followed by sample preparation and quality control. Indeed, more time should be devoted to hands-on exercises, and they should be spread across all days. However, we informed the participants that they should try all the exercises upon returning home and that any questions they may have could be answered electronically or virtually. The overbank sediment and rock samples collected during the field training course were analysed by the Czech Geological Survey, and the data were sent to the participants for processing.

Something that is repeated in the comments is studying the IUGS Manual of Standard Methods before the course. All participants were asked to do so, but only a few did.

Table 2. The questionnaire concerns the quality of the workshop, and in total, 17 participants answered the questions.

Questions	Rating 5 = Excellent to 1 = Poor
How would you rate the quality of the workshop lectures?	**5** (n=9); **4** (n=8)
How would you rate the quality of the workshop exercises?	**5** (n=8); **4** (n=8); **3** (n=1)
How would you rate the quality of the workshop material in the USB memory stick?	**5** (n=17)
How would you rate your experience during the field course? (please answer only if you followed the field course)	**5** (n=7); **4** (n=7); **3** (n=2)

Table 3. The questionnaire concerns the parts of the workshop that were most and least interesting to the participants. All 17 participants provided comments.

Please provide your general comments. Which part of the workshop did you find most interesting, and which part was least interesting?
Most interesting were the exercises with Grapher and Surfer.
This was one of the best workshops I have ever participated in. I have already started to use the materials I received from the workshop. They are very useful. I would like to give special thanks to Dr. Alecos, Dr. Maria, and all the involved experts who arranged this wonderful workshop. I am over-satisfied with my time spent in the workshop.
All the classes were interesting.
All topics covered were interesting and very useful to my work.
The field trip was great because we got to know how to apply the sampling methods in real life. Need more of those.
The workshop covered highly relevant topics in geochemical sampling for both environmental and mineral exploration, as well as the important initiative to establish a global geochemical reference network. I genuinely enjoyed all the topics (QA/QC and levelling were my favourites) presented and didn't find any of them uninteresting. However, the sampling section could benefit from improvements to reduce repetition — such as repeated explanations on how to take photos or label samples — and to make it more engaging. Incorporating interactive elements such as quizzes and hands-on activities could help reinforce key concepts and emphasise the importance of obtaining a representative, uncontaminated sample at each site.
For me, everything was interesting! Only there was a lack of main power connection, and the internet connection was slow and not stable. This has to do with the location. The services and support were super. More support for Basics and practice in case that no digital information / Communications are working / Available. You should be able to handle any situation. Use a pencil and drawings.
The workshop was very interesting and educational. I find it difficult to say which part was the most fascinating.
Thank you for this workshop. It was very useful and interesting. In 4 days, the organisers managed to tell everything - from sampling to quality control of analytical studies. And also practical work. It's incredible. Of course, I would like more time for practical exercises, but given the limited time, this is impossible to organise.

Please provide your general comments. Which part of the workshop did you find most interesting, and which part was least interesting?
The workshop was really interesting and well-documented. There were some repetitions in the lectures that maybe could have been avoided. I would also have liked to get more precise examples of rock sampling and processing. I found that the stream water section was very clearly explained, but the rock section could have been a bit more detailed. Other than that, it was absolutely fantastic!
I really liked the dedication of Alecos and the other presenters, and the whole workshop was interesting and very well organised, both the theoretical days and the field trip. There were some overlaps between the presentations of the sampling methods, but it is clear why. The material provided on the USB stick is great and highly appreciated! It was also good to try some new software programs.
The workshop was well-prepared and highly informative. Sharing knowledge of best-practice sampling techniques in geochemistry is of profound importance, as it helps build a coherent, reliable geochemical database across diverse projects worldwide. The workshop addressed many critical issues in depth, showcasing the remarkable expertise and proficiency of the lecturers. It was an absolute pleasure to participate. Several parts of the workshop were particularly interesting and profoundly relevant to my work — for example, the sessions on stream sediment sampling and data levelling.
All the sessions of the workshop were very interesting. I'm happy for the opportunity to have learned firsthand.
The workshop was very interesting and thorough. Alecos did a fantastic job. It was very interesting and useful to hear about the proper standardised techniques for sampling, and learn about the various software.
I enjoyed the workshop in general, especially the field sampling day. I think everything regarding sampling was well explained in the theoretical sessions, so it was easy and useful to apply in the field. It was helpful to see Alecos making decisions on the spot and to try some of the procedures ourselves. Regarding the theoretical sessions, I found them interesting and informative. I liked how they went over the whole process. Even though I was familiar with a lot of it, I appreciated going through it. However, I found some parts a bit repetitive, and I would have liked a bit more dedication to the practical data-handling exercises. Maybe even trying some with our own data. Overall, I am happy I attended the workshop, and I would recommend it to anyone in the field, as it provides a very clear view of how to properly organise and execute the entire process so that the information is reliable and comparable. It was also a very nice opportunity to meet interesting people from all over the world, and the Czech Geological Survey (CGS) was very comfortable and welcoming. I also liked the sessions about isotopes given by CGS scientists.
The QC part is, I believe, the most interesting and vital for geochemistry in general. We plan to add several methodologies to our work at SGU. Some of the exercises, like creating a topographical map, were uninteresting to me, but I see the value for people from regions that lack 1m lidar elevation data, as we have in Sweden.
The hands-on exercises provided a valuable learning experience.

Table 4. The questionnaire concerns suggestions for improving the workshop. It is noted that four participants did not provide any suggestions.

Suggestions for improvement
No suggestions. Every part of the workshop was well organised.
I suggest including one additional day for the exercises.
The course should be disseminated in South America.
A longer field trip, showing all the different types of sampling processes. Dedicated days to learn, manage, and use the software.
The workshop relies predominantly on passive learning methods, mainly through lectures, with most exercises scheduled at the end of the second and third days. I believe that increasing interaction between participants and instructors throughout the workshop — such as incorporating more hands-on exercises daily — would enhance each attendee's learning curve. At first glance, the manual may seem extensive, but it doesn't take long to read. Therefore, it could be recommended — or even required — to read three or four key chapters in advance (not all of it). This would provide participants with a solid foundation and a clearer understanding of the workshop's objectives and content. Rather than focusing on showing soil profiles, it might be more beneficial to include a lecture on soil-forming processes. As geologists, we often have limited exposure to surface and pedogenetic processes, yet these are crucial to understanding the behaviour and mobility of metals and contaminants in the environment.

A little more information on how the course navigates through and uses the Documentation, like directories and files (*e.g.*, a workshop workflow).
At this point, I don't have any specific recommendations for enhancing the workshop.
In the field work, the participants could be grouped and make them try the different sampling methods; maybe one group one or two methods, in case of a shortage of time.
I would like to suggest allocating more time to practical exercises by slightly reducing the duration of lectures. Some lecture segments were somewhat repetitive, and the time saved could be better used for hands-on activities. I believe the exercises could be further enhanced by incorporating more interactive elements — *for example*, presenting a problem for participant groups to solve collaboratively, followed by a group discussion.
There was not enough to do on the field trip for the large group. It involved a lot of standing and watching. Ideally, the course could be a little broader in its coverage of geochemical techniques and mapping, and less focused on the global map specifically. Instead of being focused on the global map, use it as an example to explain the concepts.
I'd have appreciated a bit more time on the exercises dealing with data or the maps. I think it would be very useful to even use our own data sets. Of course, the time is a problem with this suggestion, but maybe some of the theory could be reorganised because there were some repetitions in the content.
I felt that some lectures should be simply required reading before the workshop, or after. This would allow more time for exercises, which I think are the most rewarding part. Also, the field demonstrations should be reworked to have everyone participating. Divide people up into groups, have all groups complete the sampling, and then run the analyses for each sample from each group, and then compare the results. Perhaps interesting discussions can be had later.
Additionally, a practical session on mapping geochemical data for individual elements using Surfer software would be highly beneficial.

6.4.3. Invited lecture at the Iberian Geochemistry Congress (Azores, Portugal)

Every two years, applied geochemists from various Portuguese and Spanish scientific institutions, including universities, organise the Iberian Geochemistry Congress, which alternates between Portugal and Spain. This year, the 14th Iberian Geochemistry Congress (*XIV CONGRESSO IBÉRICO DE GEOQUÍMICA:"Geoquímica: novos desafios, novas soluções"*) took place from 8 to 12 September on the island of São Miguel in the Azores, Portugal, an unrivalled setting due to its volcanic landscapes of great geological interest. The Congress was organised by the Universidade dos Açores, the Instituto de Investigação em Vulcanologia e Avaliação De Riscos, and the Fundaçao para a Ciência e a Tecnologia. The first three days were devoted to scientific sessions, while the last two days to field trips.

The Commission on Global Geochemical Baselines was represented by Paula Adánez Sanjuán, CGGB Scientific Secretary, who delivered an invited plenary lecture (Figure 8). The title of the lecture was *"La Geoquímica sin fronteras: Claves para establecer una Red Global de Referencia" (Geochemistry without borders: keys to establishing a global reference network*), where she presented the history of the Commission and its IUGS-Manual of Standard Methods, aimed at achieving a global and harmonised geochemical database.

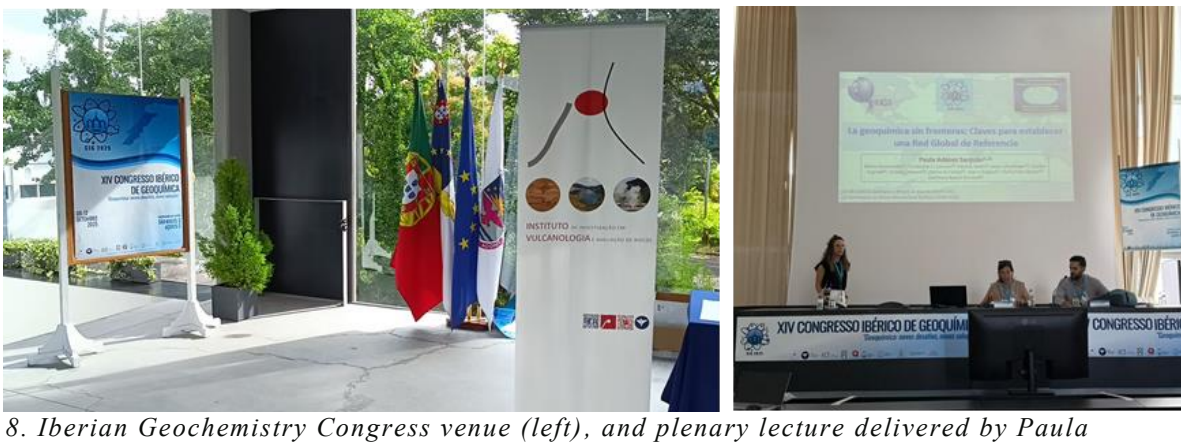


Figure 8. Iberian Geochemistry Congress venue (left), and plenary lecture delivered by Paula Adánez-Sanjuán (right), Commission Scientific Secretary.

We would like to express our sincere gratitude to the organisers for giving us the opportunity to spread our message and reach more applied geochemists, who showed great interest in the proposed harmonised procedures.

6.4.4. Lecture at the 5th International Professional Geology Conference (IPGC)

On 5 November, Iván Martín delivered a presentation on the IUGS Manual of Standard Methods during the 5th International Professional Geology Conference (IPGC), which took place in the Spanish city of Zaragoza (Figure 9).

Figure 9. 5th International Professional Geological Conference with Iván Martín (Deputy Chair of CGGB's Sampling Committee) in front of the poster(left), and the picture on the right is Iván delivering the presentation about the IUGS Manual of Standard Methods.

6.4.5. Lecture at the 4th International Student Conference on Medical Geology and Environmental Health

IUGS and CGGB supported the South Asia edition of the virtual 4th International Student Conference on Medical Geology and Environmental Health, which was coordinated by the Rashtrasant Tukadoji Maharaj Nagpur University in India from 24 to 29 November 2025 (Figure 10). The session chairs were very pleased with the excellent oral and poster presentations of the postgraduate students. The CGGB Chair delivered a workshop lecture with the title "*Preparing manuscripts for publication in International Journals: Instructions for young researchers*".

The conference videos can be downloaded by using the following hyperlink: https://drive.google.com/drive/folders/1-l3YhahARJil-ucJFRRSEEWs7jL1Vknt.

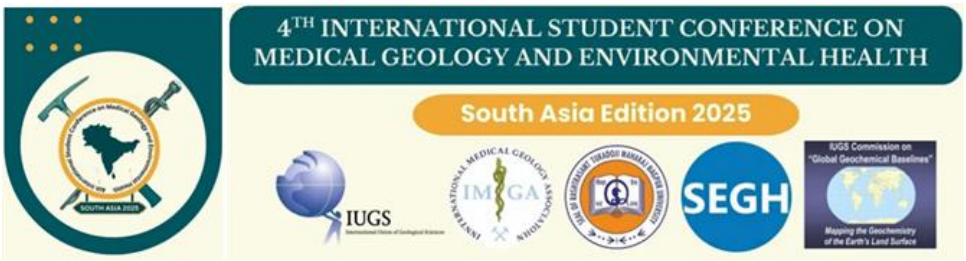


Figure 10. Logos of the 4th International Student Conference and supporting organisations.

6.4.6. Display of IUGS Manual of Standard Methods at the EGU 2025 conference in Vienna

The "International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network" was displayed in the International Union of Geological Sciences booth at the EGU General Assembly 2025 conference in Vienna from April 27 to May 2, 2025 (Figure 11).

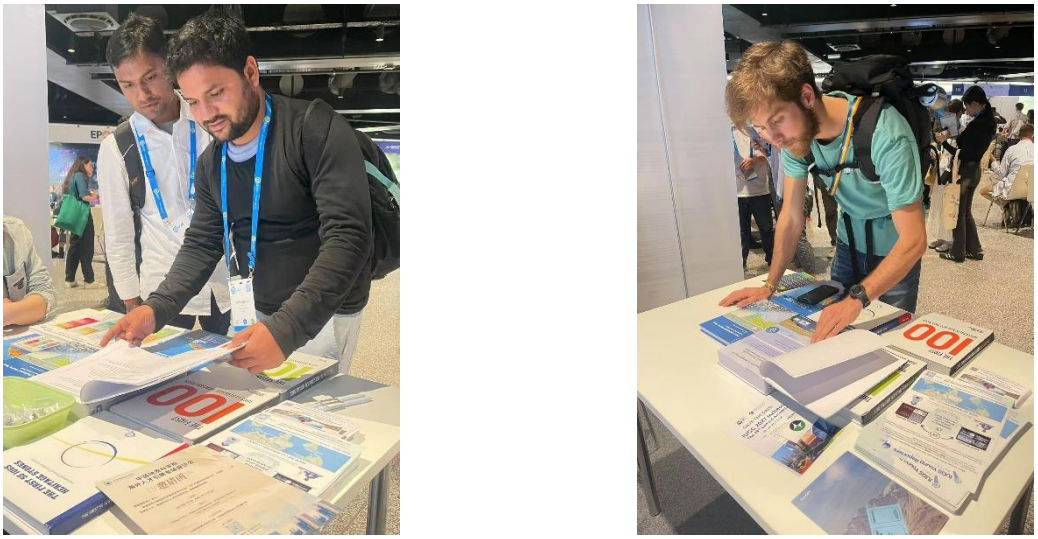
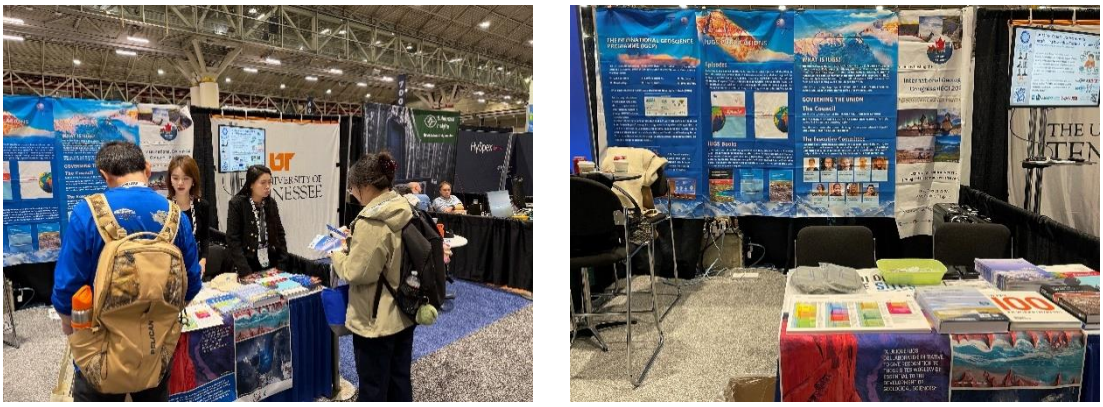


Figure 11. EGU General Assembly 2025 conference participants looking with interest at the IUGS Manual of Standard Geochemical Methods. Photographs by Mrs. Shi Xiehang (IUGS Secretariat staff member).

6.4.7. Display of IUGS Manual of Standard Methods at the AGU25 annual meeting

The International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network was displayed in the IUGS booth at the American Geophysical Union's 2025 annual meeting (AGU25) in New Orleans, U.S.A. (15-19 December 2025; see Figure 12). The AGU annual meeting attracts more than 20,000 participants from around the world; it is considered the largest annual gathering of earth and space scientists, educators, policymakers and communicators.



(a) (b)

Figure 12. (a) IUGS booth in which the IUGS Manual of Standard Methods was displayed at the front row of the desk (third item from the right) and (b) the second item from the left. Photographs by Mrs. Mu Langfeng (IUGS Secretariat staff member). The CGGB Steering Committee would like to acknowledge the excellent collaboration with the staff of the IUGS Secretariat Office.

The display of the IUGS Manual of Standard Methods at two big global annual scientific events, the EGU General Assembly in Vienna (Austria) in the spring, and the AGU annual meeting in the U.S.A. in the winter, helps its widespread distribution enormously.

6.4.8. IUGS Manual of Standard Methods reaches a wider audience

On 24 September 2025, the CGGB Chair received the following message from Jennifer Angel-Amaya, a Colombian geologist who is doing her Ph.D. at Columbia University (Lamont-Doherty Earth Observatory). Her comments were: "*I recently came across the 'Manual of Standard Methods for Establishing the Global Geochemical Reference Network', which you edited. It has*

become a key reference for my work on the Amazon project, where I am conducting a paired watershed comparison between a watershed impacted by gold mining and one that is not." Jennifer's work in the Amazon was featured in a 2024 National Geographic article by Hicks Wogan (https://www.nationalgeographic.com/environment/article/amazon-river-basin-mercury-jennifer-angel-amaya).

It is concluded that the IUGS Manual is reaching scientists outside our applied geochemistry community. The promotion of the IUGS Manual of Standard Methods at two big international conferences, EGU in Vienna, and the AGU annual meeting in the U.S.A., on the IUGS exhibition desk by the IUGS Secretariat staff is helping a lot, and for this, the CGGB Steering Committee extends its gratitude. Further, the uploading to the Zenodo website is also assisting considerably in its wider distribution.

6.5. E-books and publications

6.5.1. Applied Geochemistry - The How and Why

Demetriades, A., 2025. ***Applied Geochemistry - The How and Why***. Chapter 8.1 In: A. Shahar (Editor), Volume 8, How we Know, In: A. Anbar and D. Weis (Editors-in-Chief), Treatise on Geochemistry, 3rd Edition, Elsevier, 8, 1−72; https://doi.org/10.1016/B978-0-323-99762-1.00004-8.

The new publication extensively refers to the chapters of the "*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*". These two publications provide university teachers and early-career researchers in applied geochemistry with important tools to plan their studies and surveys effectively.

David B. Smith (United States Geological Survey, and Commission Steering Committee member) reviewed the chapter, and his expert comments are: "*Alecos Demetriades has undertaken a very difficult task. In less than 100 pages, he is outlining principles of applied geochemistry that other authors have used entire textbooks to explain and discuss. The chapter is well-written, well-organized, and well-referenced. The figures are all very good and the captions describe the figures adequately. I think the chapter will be useful, in particular, to early-career applied geochemists who are undertaking geochemical surveys in support of mineral exploration or environmental investigations*."

The pre-publication chapter, together with the supplementary material, was given to Professor Ariadne Argyraki, who is a professor of geochemistry at the National and Kapodistrian University of Athens, for use in her teaching. Below are her comments after using the chapter during 2024: "*Dr Alecos Demetriades' chapter on the 'How and Why of Applied Geochemistry' in the Treatise on Geochemistry has been an invaluable resource for my teaching as a Professor of Geochemistry at the National and Kapodistrian University of Athens. By providing a comprehensive framework for planning and implementing geochemical surveys, this chapter equips educators with practical examples and hands-on exercises from the Supplementary material to enhance student learning. The structured approach outlined in the chapter —ranging from orientation surveys to large-scale geochemical mapping — enabled my teaching about mineral exploration and environmental investigations effectively in multiple courses that I teach at both first-degree and post-graduate studies, i.e., environmental geochemistry, analytical geochemistry, and geochemical exploration methods. The emphasis on quality assurance, data analysis techniques, and 2D/3D map plotting is particularly beneficial for designing advanced coursework and research projects. Moreover, the chapter's guidelines for organizing geochemical projects offer a practical roadmap for students aiming to apply these methods in real-world scenarios, making it an essential teaching tool in applied geochemistry education. I hope that other professors will also consider it. However, it is a*

pity that our university does not provide access to the Treatise anymore. I hope this will change in the future."

6.5.2. Tutorial for making topographical maps with modern digital tools

In the IUGS E-Bulletin No. 208-209 (August-September 2024), a concise report was given about the successful 3-day workshop at the 37th IGC in Busan (South Korea) on the methods described in the "*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*". Acting on the request not only of these particular workshop participants but also of earlier ones, the CGGB decided to publish useful tutorials for university teachers, early-career researchers in applied geochemistry, and professionals.

The first tutorial should be of interest not only to applied geochemists but also to any earth scientist working in areas without topographical maps. This was the case in South Korea during the planning stage of the field training workshop. Google Earth Pro was used to locate an area near Busan, but due to the dense forest, the topography was not so clear. A topographical map was needed, and the only way to make one was to find available digital tools for plotting it. The digital tools used are Google Earth Pro and GPS Visualizer for digitising points within the work area and extracting altitude for each digitised point, respectively, while Golden Software's Surfer™ is used to plot the topographical map (Figure 13). Of course, any other map plotting software can be used.

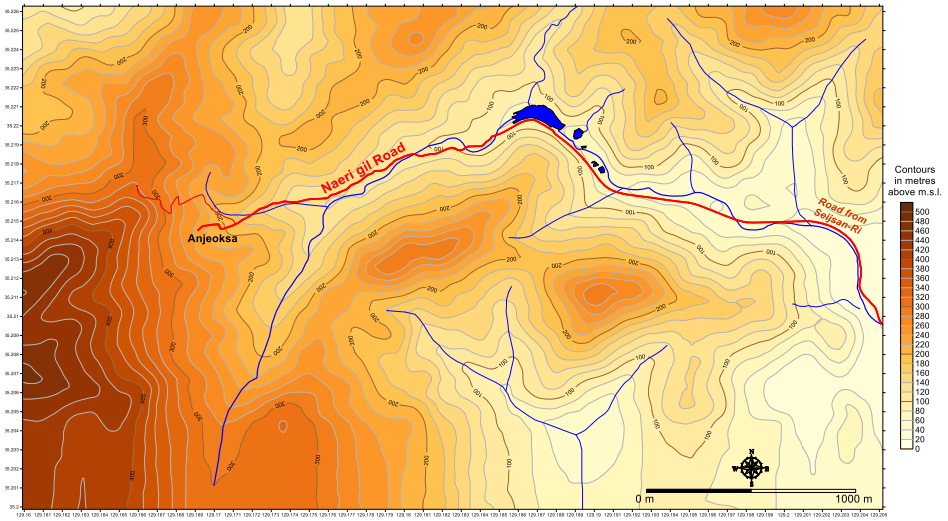
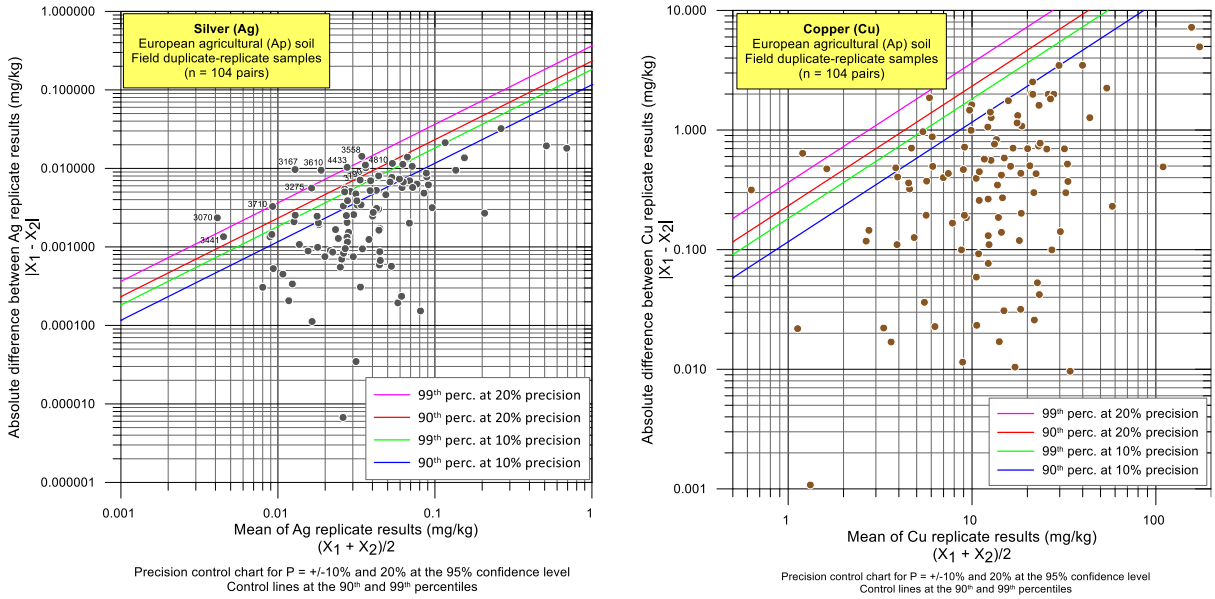


Figure 13. Digital topographical map of the Busan field course area, South Korea. Instructions for plotting the map are given by Demetriades, A., 2025. Tutorial: Making Digital Topographical Maps. *International Union of Geological Sciences, Commission on Global Geochemical Baselines, Tutorial Publication No. 1, 40 pp., 57 figures, Supplementary material. The map was plotted with Golden Software's Surfer™.*

6.5.3. Tutorial for plotting analytical precision charts

Thompson and Howarth developed a graphical method in the 1970s for the visual estimation of analytical precision even for a single duplicate-replicate pair of samples. The mean of the field-duplicate-replicate analytical results for each sample pair is plotted against the corresponding absolute difference.

Digital log-log and linear templates for Thompson and Howarth charts are provided, along with control lines at the 90th and 99th percentiles for 10% and 20% precision at the 95% confidence level. These templates were generated using Golden Software's Grapher™ (version 25). Instructions are provided for preparing the input replicate data set and plotting the results. Worked examples and the interpretation of the plotted results are also included (Figure 14).



(a) (b)

Figure 14. (a) The Ag field duplicate-replicate analytical results indicate that the data are judged to be consistent with a precision of ±20% at the 95% confidence level; (b) the Cu field duplicate-replicate analytical results are judged to be consistent with a precision of ±10% at the 95% confidence level. Thompson and Howarth charts were plotted with Golden Software's Grapher™ v.25.

This comprehensive tutorial aims to enhance the understanding and application of analytical precision assessment in applied geochemical surveys, making it a valuable resource for practitioners in the field, as well as for university students and early-career researchers.

Demetriades, A. and Argyraki, A., 2025. *Tutorial: Analytical Precision - Plotting Thompson and Howarth Charts*. International Union of Geological Sciences, Commission on Global Geochemical Baselines, Tutorial Publication No. 2, 28 pp.; https://doi.org/10.5281/zenodo.15557648. Supplementary material.

6.5.4. Revision and translation of ROBCOOP4A tutorial

Program ROBCOOP4A (balanced robust ANOVA) is being translated into Spanish by Paula Adánez-Sanjuán (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 2025 and the English, Spanish and Hellenic versions published. However, due to technical problems, it is hoped that this work will be completed in 2026.

6.5.5. Publication in Explore

An article with the title "*Review of the workshop on global- to regional-scale geochemical mapping*" was published in EXPLORE No. 206 (p.20−25), the newsletter of the Association of Applied Geochemists, which cosponsored, together with the IUGS, the three-day workshop "*Global-to-Regional-Scale Geochemical Mapping*" held from 30 August to 1 September 2024 on the occasion of the 37th International Geological Congress (IGC) in Busan, Republic of Korea.

6.6. Commission's website

The Commission's website is updated regularly.

6.6.1. Google Analytics statistics

Table 5 shows the number of 2025 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 15 shows pictorial statistics of the users from the 10 top (a) countries, and (b) cities; (c) 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 5. Google Analytics table of web page users from January 1st to December 31st, 2025.

Page title and screen class	***Views***	***Active users***
Total	14,686	4965
Home web page	8223	2350
IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network	811	551
GTN 160x160 km	718	618
Members	555	384
Publications	367	155
Tutorial: Making a topographical map	239	144
Annual Reports	207	95
History	180	74
Conferences	179	88
Steering Committee	173	112
Global or Geochemical Reference Network	129	102
Results & Database	126	88
Sampling Design	92	67
Current Work	86	70
Workshops	79	48
Committees	79	55
Regional officers	77	71
GTN 160x160 km files	77	63
Recent Publications	56	42
GMN 160 x 160 km	55	35
Organisation	54	37
Duplicate Field Sampling	54	51
Levelling of existing data	54	41
Sample preparation	49	47
Links	47	41
Site Location and Sampling Media	45	41
Black Soil Project Manual	44	31
Selecting Sampling Sites	44	48
Map presentation	43	47

Page title and screen class	*Views*	*Active users*
E-book Program ROBCOOP 4A for estimation of classical & robust ANOVA	39	26
Webinars	35	24
Laboratory Arrangements	34	33
Sample Quantities	27	25
Chapter files: Word text; Original figures; Microsoft® PowerPoint presentations	27	25
eBook: R-scripts for Generation of 5, 8 and 16 Random Sampling Points	24	19
Field methods for Regional Surveys	23	24

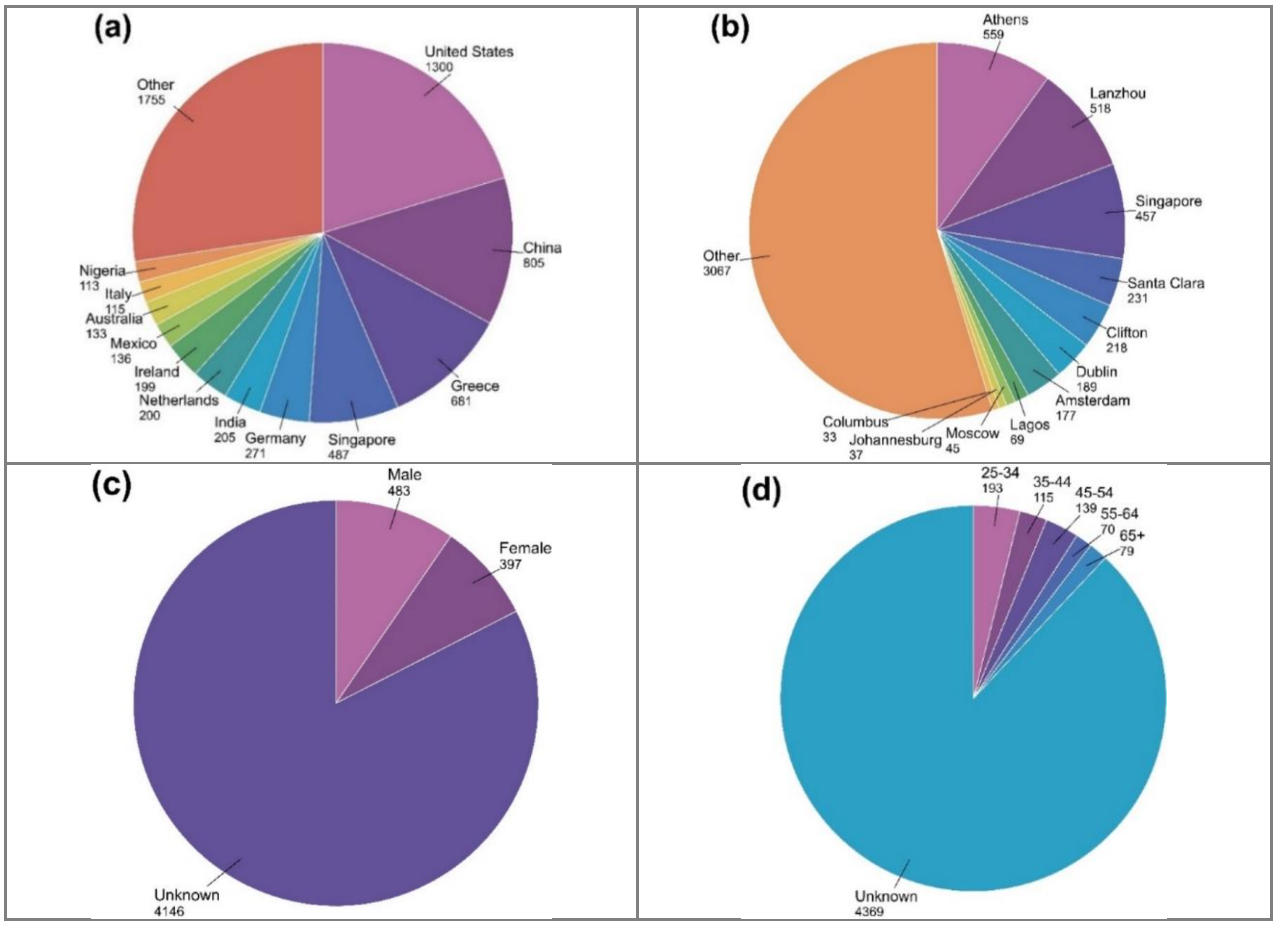


Figure 15. Shows Google Analytics statistics from the 1st of January to the 31st of December 2025 in the form of pie charts:- (a) the top 10 countries of users (6400 users in 2025); (b) the top 12 city users (total 199 cities); (c) age class users, and (d) gender class users. The global distribution of 6400 users in 2025 is higher than the 3846 users in 2024. The number of countries has changed considerably from 73 in 2021 to 145 in 2025. The pie charts were plotted with Golden Software's Grapher™ version 27.

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 6, the number of downloads for each publication is given, along with the date it was uploaded to the Zenodo website. Considering the applied geochemistry community's relative smallness, the number of downloads per publication is considered satisfactory. As expected, the IUGS Manual of Standard Methods has more downloads: compared to 2023, there are an additional 172 downloads in 2024 and 268 in 2025, making a grand total of 682 downloads. Of course, in 2025, there are additional downloads for all publications (Table 6). Apart from the downloads of the IUGS Manual of Standard Methods from

the Zenodo website, there were 267 downloads from the two Commission's website Publication pages, making a grand total of 949 downloads.

Table 6. Zenodo DOI download statistics for the four Commission publications from the date they were uploaded until the 31st of December 2025.

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	261
International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network	9/11/2022	682
R-scripts for Generation of 5, 8 and 16 Random Sampling Points Within Predefined Rectangles	9/11/2022	161
Program ROBCOOP4A for Estimation of Balanced Classical and Robust Analysis of Variance: Instructions for Use and Source Code	9/11/2022	147
Tutorial: Making Digital Topographical Maps	19/2/2025	93
Tutorial: Analytical Precision – Plotting Thompson and Howarth Charts	6/6/2025	42

6.7. Work of Commission's Committees

6.7.1. Sampling, Analytical & Data Management Committees

In 2025, representatives of the Sampling, Analytical, and Data Management Committees participated in the four-day workshop organised on the occasion of the Goldschmidt conference in Prague, Czech Republic (see Section §6.4.2.2). Apart from the workshop lectures, they answered questions and gave advice to the 24 participants 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 2026, subject to the personal situation 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 continuing to explore a few options for obtaining sponsorships. Discussions have already started with a Hellenic mining company and a non-profit company and will continue in 2026.

In 2025, 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 the 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). In 2025, the Facebook CGGB followers are slightly lower than in 2024, reaching 771 (-5), and the number of subscribers to CGGB's YouTube

channel is 16, the same as in 2024. Regarding, Twitter (now X), 3 followers were lost compared to 2024, and the number in 2025 was 140 (-3). In July 2023, the Commission began its presence on LinkedIn (@IUGS_CGGB), reaching 122 followers by the 31st of December 2025, an increase of 26 followers compared to last year.

6.8. Assistance to Members and Workshop Participants

Assistance was provided to a colleague from the Geological Survey of Iran, since samples were collected according to the GTN sampling scheme.

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.

7. REGIONAL REPORTS

Regional reports were provided from Africa (Africa, PanAfGeo+), America-North (Mexico), America-South (ASGMI Geochemistry Expert Group, Chile, Colombia, Cuba, Peru), Asia (Armenia), Australasia (Australia), Europe (EuroGeoSurveys Geochemistry Expert Group, Romania). These reports are in Appendix 2: Regional Reports, and all reporting colleagues are thanked for their input, as they provided useful reports on the geochemical surveys carried out in their countries.

8. NEW MEMBERS

In 2025, the Commission made 28 new members from Albania (1), Austria (1), Brazil (1), Canada (1), China (1), Czech Republic (4), Egypt (1), Germany (4), Hungary (1), India (3), Iran (1), Namibia (1), Nigeria (1), Norway (1), Peru (1), Sweden (3), Ukraine (1), and United States of America (1). Although some members retire and do not send a contact E-mail address, the number of members is growing year by year. In total, the Commission has 297 members in 78 countries (see Members list on the Commission's web page, and their countries are shown in Figure 16.

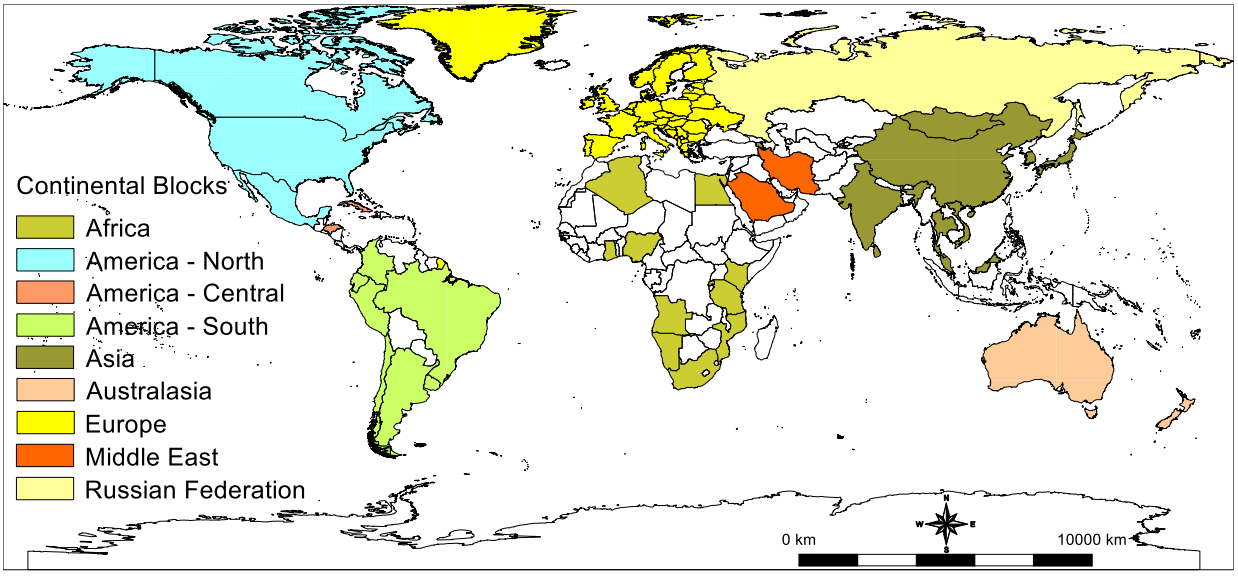


Figure 16. Map showing countries with Commission members. The different colours represent continental blocks. The Russian Federation has its own colour because it spans two continents: Europe and Asia. Map plotted with Golden Software's MapViewer™ v8.

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; US$15,000 for 2024, and US$22,000 for 2025.

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 2025 FUNDING ALLOCATION

Table 7 shows the use of US$22,000 allocated in 2025, together with the outstanding balance of US$274.81 from the 2024 funding allocation, and the remaining amount of the 2024 contribution from the Association of Applied Geochemists of US$3630.84, making a grand total of US$25,905.65.

Table 7. Expenses incurred during 2025.

Breakdown of expenses	Number of participants	TOTAL (USD)	IUGS Support (USD)	IUGS support (in %)	Other contributing sources
A. Goldschmidt 2025: Preconference workshop (2-5 July 2025) and conference (6-11 July 2025)					
A.1. Travel	4	2,080.12	1,500.33	72%	LNEG, Portugal
A.2. Accommodation	4	5,661.24	1,294.04	23%	LNEG, Portugal
A.3. Registration and abstract fees	4	2,880.08	2,084.24	72%	LNEG, Portugal
A.4. Daily allowance	4	3,384.98	1,921.02	57%	LNEG, Portugal
A.5. Other costs (*e.g.*, Bank transfer charges $9.19 CGGB; $129.93 LNEG)	3	139.12	9.19	7%	LNEG, Portugal
B. Goldschmidt 2025: Four-day Preconference workshop (2-5 July 2025)					
B.1. Travel (sponsored 4 participants)	4	2,908.13	2,908.13	100%	
B.2. Accommodation (sponsored 4 participants)	4	2,423.15	2,423.15	100%	
B.3. Registration fees	There were no registration fees because the pre-conference 4-day workshop was organised at the premises of the Czech Geological Survey				
B.4. Daily allowance (sponsored 4 participants)	4	1,369.67	1,369.67	100%	
B.5. Other costs: Bank transfer charges	4	126.92	126.92	100%	
B.6. Workshop Organisation expenses paid to Czech Geological Survey and meals (27 participants and 5 tutors for 4 days)	32	8,898.11	8,898.11	100%	
C. 14th Iberian Geochemistry Congress - "*Geoquímica: novos desafios, novas soluções*", São Miguel, Azores, Portugal (8-12/9/2025)					
C.1. All expenses (Travel, Accommodation, Daily allowance, Registration fees)	1	1772.62	0.00	0%	I.G.M.E., Spain
D. 5th International Professional Geology Conference (IPGC), Zaragoza, Spain (5/11/2025)					
D.1. Registration fee and return train fare Madrid-Zaragossa	1	312.20	0.00	0%	I.G.M.E., Spain
E. Name of the meeting: Joint annual meeting of IUGS-CGGB, EGS-GEG & ASGMI-GEG, Utrecht (9-11 November, 2025)					
E.1. Travel	2	928.56	928.56	100%	
E.2. Accommodation	2	1,552.70	751.92	48%	I.G.M.E., Spain

Breakdown of expenses	Number of participants	TOTAL (USD)	IUGS Support (USD)	IUGS support (in %)	Other contributing sources
E.3. Other costs (specify the type of cost, insert rows if needed): Daily allowance	2	673.65	673.65	100%	
E.4. Travel, Accommodation & Daily allowance	1	1,959.26	0.00	0%	I.G.M.E., Spain
D. Other costs					
D.1. Papers by other researchers from the group (2 papers and 2 tutorials)	4	0.00	0.00	0%	
D.2. Dissemination/outreach/website (insert rows for each item if needed): Annual website hosting fee		341.08	341.08	100%	
D.3. Other costs: Zoom annual fee		222.97	222.97	100%	
TOTAL EXPENDITURE			**25,452.98**	*	

* The IUGS Funding allocation for 2025 was 22,000 USD.
The excess amount of 3,452 USD was paid by the carried-over balance from 2024, which comes mostly from the sponsorship amount of the Association of Applied Geochemists. Presently, the available balance in the CGGB bank account is 452.67 USD, which is carried forward to 2026.

11. FUNDING REQUEST FROM IUGS FOR 2026-2027

11.1. Planned 2026 activities requiring no funds from IUGS

Although no funds are requested for the activities described below, it should be stressed that the Commission members, 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 around the world contributing to this work is between 30 and 50 person-months, with an estimated cost of over 100,000 US$.

The main Commission activities in 2026 that require no funds are:

- Writing short articles about the monthly work performed to be published in the IUGS E-Bulletin.
- Providing assistance and information to requests from different geological surveys and individuals, especially participants in past workshops.
- 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.
- Looking for sponsors for the preparation of reference materials, and funding workshops.
- Organisation of 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 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 2026).

- Organisation of webinars on quality control methods and statistical data processing, including Compositional Data Analysis.
- Updating the Commission's website.
- 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 2026.
- 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 for deleting 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 (according to the information, this work will be completed in 2026).
- Assisting in the organisation of student virtual conferences, *e.g.*, (i) 3rd International Student Conference on Medical Geology & Environmental Health - Europe 2024, and (ii) 4th International Student Conference on Medical Geology & Environmental Health - South Asia Edition 2025. A similar workshop is currently being discussed for Oceania.
- Writing tutorials explaining step-by-step different procedures in applied geochemistry, which are helpful not only to early-career researchers but also to academics and professionals.
- Enrich the content of the Commission's YouTube channel with short educational videos produced during CGGB workshop activities.
- 16th Quadrennial IAGOD Symposium, 30 August - 2 September 2026, Porto, Portugal. Session 17 "*Geochemical Vectoring and Statistical Interpretation for the Discovery of Critical Raw Materials*" is chaired by Martiya Sadeghi (a CGGB member from the Geological Survey of Sweden)
- The CGGB is participating in the IGC 2028 International Advisory Committee due to its interest in organising the 5th Arthur Darnley Symposium and a five-day physical workshop in Calgary.

11.2. Planned 2026-2027 activities requiring IUGS funding

The following planned activities in 2026 and the first quarter of 2027 require IUGS funding:

- Continued promotion of the *IUGS Manual of Standard Methods* and all the materials published by the Commission.
- Training young researchers in applied geochemical methods, including sampling techniques, through physical workshops:-

- ❖ A one-day field-training workshop in Athens in January-February 2026 for M.Sc. students in the "*Environmental Monitoring and Sustainability*" course of the National and Kapodistrian University of Athens, Hellenic Republic.
- ❖ Two five- to six-day physical workshops are planned for 2026. The first in South Asia and Indonesia (Brunei), and the second in Latin America and the Caribbean (Dominican Republic).

- Organising sessions and workshops at international conferences, when such opportunities arise.
- Organisation and participation in the joint annual meeting of IUGS-CGGB, EGS-GEG and ASGMI-GEG in Espoo (Finland) in October 2026.
- Participation in the 2027 annual EC meeting.

Planned publications on research to be supported by IUGS funds if necessary:

- Tutorial for levelling geochemical data sets.
- Instruction Manual for the use of the Merge program (merging two data files).
- Instruction Manual for the use of the Random Sites executable program.
- Spanish version for the use of the ROBCOOP4A program.
- Instruction Manual for the use of the Cluster Analysis program.
- Instruction Manual for the use of the Factor Analysis program.
- European black soil geochemistry (publication to be submitted to Episodes).

It should be mentioned that in the 2026 budget (Table 8), 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 8. Estimated expenses for 2026 and the first quarter of 2027.

Breakdown of expenses	Number of participants	TOTAL (USD)	IUGS Support (USD)	IUGS support (in %)	Other contributing sources
A. ASGMI five- to six-day physical workshop in the Dominican Republic					
A.1. Travel - CGGB Tutors	7	11,000	11,000	100%	
A.1b. Travel - ASGMI applied geochemists	10	8,000	8,000	100%	
A.2. Accommodation for Tutors (Sponsored by the Geological Survey of the Dominican Republic - GSDR): 7 Tutors x 8 days x 100 USD/day	7	5,600	0	0%	GSDR
A.2b. Accommodation for ASGMI applied geochemists (Sponsored by the Geological Survey of the Dominican Republic - GSDR): 10 ASGMI Applied Geochemists x 6 days x 100 USD/day	10	6,000	0	0%	GSDR
A.3. Daily allowance of IUGS-CGGB tutors (7 Tutors x 55 USD/day x 9 days)	7	3,465	3,465	100%	
A.4. Other expenses (memory sticks with the Workshop material and printing of attendance certificates)		500	500	100%	
B. South Asia-Indonesia five- to six-day physical workshop in Brunei					
B.1. Travel - CGGB Tutors (Sponsored by the Universiti Brunei Darussalam -UBD)	5	6,000	0	0%	UBD

Breakdown of expenses	Number of participants	TOTAL (USD)	IUGS Support (USD)	IUGS support (in %)	Other contributing sources
B.2. Accommodation (Sponsored by the Universiti Brunei Darussalam - UBD)	5	4,000	0	0%	UBD
B.3. Daily allowance (5 Tutors x 55 USD x 9 days)	5	2,475	2,475	100%	
B.4. Other expenses (memory sticks with the Workshop material and printing of attendance certificates)		500	500	100%	
C. Joint annual meeting of IUGS-CGGB, EGS-GEG & ASGMI-GEG, Espoo, Finland (8-10 October 2026)					
C.1. Travel	2	1,400	1,400	100%	
C.2. Accommodation (2 persons x 4 nights x 150 USD/night)	2	1,200	1,200	100%	
C.3. Daily allowance (2 persons x 4 days x 55 USD/day)	2	440	440	100%	
D. Reporting at the Open session of the Annual EC meeting in 2027					
D.1. Travel	1	1,000	1,000	100%	
D.2. Accommodation	1	450	450	100%	
D.3. Daily allowance (1 person x 3 days x 55 USD/day)	1	165	165	100%	
E.3. Annual website hosting fee		350	350	100%	
F. Other costs - Zoom annual fee		250	250	100%	
TOTAL REQUESTED BUDGET FOR 2026			**31,195**		

The comparatively high allocation funding request is due to the ASGMI physical workshop in the Dominican Republic. While the local Geological Survey will host all the workshop participants, funding is required for the return airfares of South American colleagues. At the five-to six-day workshop, 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. In the classes, apart from the practical theoretical lectures, there will be hands-on-exercises.

The Commission anticipates that the IUGS EC will be more generous with its 2026 funding allocation, as we are not certain whether sponsorship will be available or whether 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 above the requested annual funding allocation. The reason is that 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 with setting up standards for their geoscientific discipline. Therefore, the Commission is mandated to establish standards for 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 appropriate to begin developing its own analytical reference materials. The Commission has the expertise and the laboratory to produce these reference materials. It is planned to contact private mining companies and professional associations in applied geochemistry for sponsorship. In this venture, the support of the IUGS EC will most likely be needed, with a cover letter stressing the importance of developing 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-/.

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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-/.

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APPENDIX 1. IUGS-CGGB ANNUAL BUSINESS MEETING

Minutes of the joint meeting of
IUGS-CGGB, EGS-GEG, ASGMI-GEG
09-11/10/2025

List of participants (in person)

Irena de Séjournet	Belgium, EGS
Julie Erban Kočergina	Czechia
Birgitte Hansen	Denmark
Rasmus Jakobsen	Denmark
Jaana Jarva	Finland
Philippe Negrel	France
Alecos Demetriades	Hellenic Republic
Alexandros Liakopoulos	Hellenic Republic
Chaozheng Zhang	Ireland
Ray Scanlon	Ireland
Pooria Ebrahimi	Italy
Belinda Flem	Norway
Mateja Gosar	Slovenia

Martin Gaberšek	Slovenia
Paula Adánez Sanjuan	Spain
Iván Martín Mendez	Spain
Martiya Sadeghi	Sweden
Patrick Casey	Sweden
Jasper Griffioen	The Netherlands
Joris J. Dijkstra	The Netherlands
Laura J. Wasch	The Netherlands
Frances C. Versluis	The Netherlands
Mathijs E. Kuiper	The Netherlands
Pim W.G. van Geffen	The Netherlands
Frances Versluis	The Netherlands

List of participants (online)

Gevorg Tepanosyan	Armenia
David Cohen	Australia
Gloria Prieto	Colombia
Hatakka Tarja	Finland
Panagiotis Papazotos	Hellenic Republic

Stefano Albanese	Italy
Frank Murphy	Ireland
Maria João Batista	Portugal
George Morris	Sweden
Anna Ladenberger	Sweden

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=kZkFB95ZMQvJvzG7wXpkdk61HeXVWbLdAuV7

1st Day, Thursday, 9th October 2025, 09.30-17.00 (CET)

09.30-10.00: Registration and coffee
10.00-10.05: Welcome by Mrs. Yvonne Schavemaker (TNO Department Head) on behalf of Mrs. Tirza van Daalen, Director of TNO
10.05-10.10: Welcome by Alecos Demetriades (AD), IUGS-CGGB Chair 2024-2028
10.10-10.15: Welcome by Philippe Négrel (PN), EGS-GEG Chairperson 2018-2026
10.15-10.20: Welcome by Iván Martín (IM) on behalf of ASGMI Chair Maria João Batista
10.20-10.45: Round table self-introduction
10.45: Organisation arrangements – Jasper Griffioen (JG)

10.45-11.00: Coffee break

Business meeting:

(01) 11.00-11.20: IUGS-CGGB 2024-2025 activities report (AD)

At present, the Commission has 274 members in 78 countries.
The biggest milestone was the IUGS Manual of Standard Methods, which began in 2007 and, by 2020, had gone through several phases to reach its current final form. It was published in 2022, during the IUGS's 60th Anniversary. The Global Terrestrial Network (GTN) design for the future development of the harmonised database to document the distribution of the elements was finalised.
Other publications: Blue Book, and FOREGS Geochemical Atlas of Europe.
Tutorials: Two new tutorials were written this year; one of them was published in February with 89 downloads, and the second had 30 downloads.
Statistics of the downloads: a big difference between the IUGS Manual Standard Methods downloads and other specialised publications and programs, which is very encouraging
The monthly activities of the IUGS-CGGB are published in the IUGS E-Bulletin and in the Commision's Annual Report.
News about the use of the IUGS Manual of Standard Methods, for example, by a researcher at Columbia University (the manual is a key reference in her work in the Amazon River).

(02) 11.20-11.40: EGS-GEG 2024-2025 activities report (PN)

The Expert Group has a total of 63 members representing 32 countries, as well as more than 40 external co-workers, the majority of whom participate in the strategic EGS groups.
Activities:

- Development of GEMAS data viewer on the EGDI platform.
- GEG Contribution to EGS strategy documents.
- Publication of EGS factsheet on soil.
- Continued collaboration in EUSO, which is a direct response to the EU soil strategy (Working groups launched in 2021 and participation in European Mission Soil Week in November).
- EU enlarged soil expert group with stakeholders from the business world and professionals.
- Collaboration: with IUGS-CGGB and participation in ASGMI webinars.
- The Group published 2 more papers, 1 under review, 1 under internal review, 1 under internal reading.
- Participation in the Goldschmidt Conference in Prague.

- Participation in PanAfGeo project.

(03) 11.40-12.00: ASGMI-GEG activities report (IM)

More than 30 people are members of the group.

Activities:

- Geochemical Atlas of Latin America and the Caribbean with available data in the countries (stream sediments, median of the data within the reference network (40x40)). Some examples from Chile and Argentina were presented.
- Presentation and poster at the IUGS Congress in Busan and the Iberian Geochemistry Congress.
- Webinars online, last year about sample preparation, in November 2024, and translation in 3 languages (English, Portuguese, Spanish).
- Maria João Batista gave a talk to members (but not only) about Data Treatment.

(04) 12.00-12.20: 2024-2025 conferences and workshops (Paula Adánez Sanjuán (PAS) & AD)

Summary of the conferences and workshops:

Participation in the FAO's Global Symposium on soil Information and Data, in the ASGMI webinar "Sample Preparation: Key Stage to Generate Geochemical Information" and in the "14th Iberian Geochemistry Congress (XIV CONGRESSO IBÉRICO DE GEOQUÍMICA: "Geoquímica: novos desafios, novas soluções)".

Organisation of the "*Hands-on Field Workshop for M.Sc. Students studying at the University of Athens, Hellenic Republic*". A four-day preconference workshop and organisation of a session: "*05j-Multi-scale Geochemical Mapping for Mineral Resource Management*" under Theme 05 "*Earth Resources and Energy*" within the Goldschmidt Conference 2025 in Prague, Czech Republic.

(05) 12.20-12.40: Update from the EuroGeoSurveys (Irena de Séjournet, EuroGeoSurveys)

Irena de Séjournet and Marina Cabidoche are now in charge of different expert groups due to their growing numbers.

Development of a Geological Service for Europe (2027):

- Basis provided by our EGS strategy (2023): 3 pillars (support decision making, *etc.*).
- Summary of timeline for publication of strategic documents + 2026 GSE full proposal.
- GSE will provide benefits at both European and national levels.
- SRIA scientific base of a GSE.
- Key policy developments.
- EuroGeoSurveys strategic direction. One position paper in preparation.

Others:

- Current projects (EMODNET, GSEU, Africa MaVal, SCRREEN...)
- Project proposals: Raw Materials Partnership (RAMP), Exploration Information System (EIS2), Natural Hydrogen Tender, CO2site.
- Factsheets: Geoheritage, Radon, Soil, EGDI (60 in preparation) available on the EGS website.

Issues affecting GEG:

Soil Monitoring Law update: next steps, linguistic corrections, translation, *etc.* Key discussion in Annex I: soil criteria details, which will include 3 types of indicators.

GEG meeting of the Soil Expert Group: big discussion about the archive of samples, which can be sent to JRC facilities across the EU (where LUCAS samples are stored). Funding the archiving of the GEMAS project (law lacks procedures for research projects) requires further discussion.

Discussion:
AD: Comments nobody wants the samples archived in the JRC; we do not know the quality of their analyses, *etc.*). We want collaboration, but in an equal way. They don't conduct quality control properly. They have not produced quality control reports.
MS: LUCAS project was funded by the EU Statistical Service; the data should be released within 5 years?
PN: There are a few public data sets and maps (Samples with Eurostat).
AD: Problem with the sampling; checking of the sample sites in Lithuania by Virgilija Gregorauskiene commented that she would not collect samples from the LUCAS sites.
MS: EGDI for storing the data; why do the LUCAS data not appear in the EGDI platform? *For example*, people cannot judge the quality of released data sets.

Action 2: Irena de Séjournet (**IS**) proposes exploring LIFE projects to invigorate the GEG.

Future:
- EC and JRC are leading various actions involving the Soil Expert Group.
- Upcoming calls in 2026 will have a limited budget, but in 2027 will increase again.
- Water resilience strategy: EU has strong and significant water legislation.
- Julie Hollis has been re-elected as Secretary General (+ 2 new members).

AD: Who is the link of the expert group?
PN: Marina and Philippe (Soil Expert Group is a European Commission Expert group).
AL: Soil Directive: message from the Swedish Government that the Directive will be voted on in the European Parliament. All member states will have 3 years to enforce these procedures. Expected to be more like LUCAS sampling.

(06) 12.40-13.00: GEG recent and under internal review publications (PN)
- Interactions with the JRC on the topic of soil contamination.
- 3 special issues under preparation, 3 publications (phosphorus, medical, boron)+ collaboration with EUSO. Strategic documents and papers, 1 paper under internal review, 1 under internal reading
- This year 2025: 2 papers and 1 paper under external review; paper under internal reading + papers in congress, Special issues of journals.

AD: Commented that it is a problem to have writers from the universities who think that the data are theirs, and do not appreciate that they were generated by public funds; they have a totally different way of thinking.

Improvised discussion out of the presentation:
MS: Very nice papers in the past, but what is the situation of the EGS-GEG? MMRR EG has many projects in common, related to the critical raw materials, *etc.*
AL: There are very few geochemical groups that form independent groups in the surveys. We are in between, and this is one reason, and the second is the GSEU. We contributed to geochemical projects, but they were removed from the final proposal. This is a direct consequence. In smaller groups, we collaborate.
MJB is involved in PanAfGeo project and is responsible for mineral resources, and exploration, which is at the moment the hot topic; geochemistry cannot be financed by itself. In the old days, the Portuguese Survey financed geochemical survey projects. Nowadays, a final goal is needed; geochemistry must be applied for something.
AL: In Sweden, all geochemists are in mineral resources. She suggested environmental geochemistry projects, but her direct bosses are not interested in environmental issues.

AD: If we study the FOREGS and GEMAS atlases for mineral exploration, we can find targets even in low-sampling-density surveys.
AL: Not all the countries have geochemical maps (Denmark) at a national scale, GEMAS, for example, is not attractive for mineral exploration.
MJB: In Portugal, they have an atlas of sediments and soils, but it is not appropriate for mineral resources; they have a 3-phase National Exploration Programme in which geochemical exploration is included. However, the Ministry does not want problems with people and don't want people picking the samples, because society in general is against mining. European future of the Group is to find a project where we can apply.
IS: Quite strategic and a document with the forces of each country.
AL: National Exploration Projects. National services are obliged to do it, and this can open a window to pilot projects.
IS: Discuss how to prepare and how the countries are preparing them. New European Commission meeting in March.
MS: Meetings with the Ministry. The programme is going to be a big deal; we have to see common activities between the countries.
AD: This is very important and EC must know that we are interested. Money for meetings is very important.

Action 3: To compile a document with input from colleagues from each country regarding activities and research areas where geochemistry is applied. That way, we could have a real understanding of the Group's strengths.

13.00-14.00: Lunch break

(07) 14.00-14.20: IUGS-CGGB, FOREGS, EGG & GEMAS publications; EGS-GEMAS website; GEMAS map viewer at BGR, GEMAS & FOREGS sample archive at BGS; GEMAS Ap standard at GSRS (AD, PN, Paolo Valera, Sebastian Pfleiderer, Uwe Rauch, Manfred Birke, Dennis Krämer, Louis Ander, Henrietta Soltysova & Katarina Boksanska)

AD: Summary of publications of the projects. Reminder to send the publications we publish to add to the list. Whatever publication is related to the project.
MS says that not all the papers are open access.
AD: Thematic volume on factor analysis to commemorate Prof. Simon Pirc. There are chapters in the second volume of the FOREGS Geochemical Atlas, which can be suitably modified. Proposal that we publish these chapters in a Thematic special issue (if Martiya and Pooria accept).
Martiya Sadeghi (MS): For a special issue, several papers are needed. How many papers would be related to this topic?
AD: A volunteer is needed to manage the GEMAS website in collaboration with Paolo Valera. The procedure is as follows: **AD** compiles the information and sends it to Paolo Valera, who writes the scripts and then uploads the new information to the website. The BGR Geoportal can be accessed by different hyperlinks. There is also the Geochemical Atlas of Germany. We must thank Manfred Birke and Uwe Rauch for all the work.
AD: Problem that needs urgent attention: The archive of reference samples stored in Slovakia must be moved to BGS for permanent storage. In total, 11,040 bottles must be transported to the BGS.

Action 4: Special Issue in Journal of Exploration Geochemistry on Factor Analysis to commemorate Prof. Simon Pirc.

(08) 14.20-14.30: ***International Conference on Environmental Geochemistry and Health (SEGH2026) in Ljubljana*** **(Martin Gaberšek & Mateja Gosar)**

Organisers: Geological Survey of Slovenia in collaboration with the University of Ljubljana and Slovenian Geological Society. It will take place from 13–17 July 2026.
Main conference themes: mostly health issues with organic and inorganic geochemistry, extreme weather events, emerging technologies, toxicology, forensic geology, *etc.* There will be a field trip to Idrija mining geopark.

(09) 14.30-15.00: Discussion about next year's activities:

(9A) IUGS-CGGB (AD)

Workshops: Promote the IUGS Manual of Standard Methods. After the successful organisation of workshops in Athens, Busan, and Prague, other workshops are planned in Latin America and South-east Asia. Review paper about the Manual to be published in Episodes.
Funding: We are now studying how to fund all these activities, including looking for sponsors.
Publications: Revision of the Blue Book by removing the contradictory parts; Publication of Tutorials, Publication of a Manual on new analytical methods for compounds and isotopes (PFAS, radiogenic and stable isotopes, *etc.*).
Analytical Committee: The retired members in charge are not active any longer. We need new people for the analytical committee (**AD** had thought of Belinda Flem and Flor de Maria) and for the sampling Committee (Ivan Martin will take over the Chair as of 2026). **MJB** will be the Chair of IUGS-CGGB from 2028-2032.
Belinda Flem (BF): Asked about the Chinese Centre, and
AD commented that they don't reply, and as far as we know, they are doing nothing. They are still under the UNESCO umbrella.

(9B) EGS-GEG (PN)

GEG focuses on geochemistry and delivers geochemical knowledge, services and products (Environmental, mineral exploration, renewable energy, water resources, forestry, geomedicine, natural background, *etc.*).
One problem: Geochemistry is expensive, but many areas rely on basic geochemistry.
Goal to set a standardised database for Europe on different media (agriculture, groundwater, urban soil) / worth noting that the GEG's main focus is currently on soil.

- Strategy: publications, external actions, reinforcing dynamics...
- Publications: a small part of the group is involved; each year, there is little evolution. **IS**: Some groups are more scientifically oriented.
- EUSO working groups (pollution, data integration, …)
- What should be improved: a list in 2018 summarising what can be done
- Contribution with other groups because geochemistry is needed in geothermal water, urban status of contaminants, groundwater...
- Some people seem not interested in being part of the group. There are like sixty people, but only a small part of the group are active participants.

IS: People prefer to be part of bigger groups. In each Expert Group, the situation is roughly the same: 20 more participants, 20 who only follow, and 20 who don't have a real interest.
AL: The recruitment to the EGS expert groups is not well established. Not everyone who is most active becomes a member. Also, this is not a prioritised activity for most people. Maybe there should be an incentive, such as an extra salary, but this is not the case.
IS: Not everyone in the geological surveys is aware of EGS groups and what they are doing; there may be young people who could be interested, and they don't know about their existence.
MJB: Comments on the activity of the group, compared to the ASGMI group, what is being done is more or less what was done in Europe years ago. At the beginning of the monthly virtual meetings, there was little interaction – most people weren't talking. Gradually, this situation has

changed, and there are now good discussions. What is needed is continuous work to establish a coherent group. One meeting per year is not enough. There has to be constant contact and engagement.
JG: Reinforcing the GEG dynamics: reenergise, taking GEE Geoenergy Group as an example, pick 3-5 topics with a respective chair: topics can be:

- EU policy
- Groundwater
- Soil
- Mineral resources
- Geothermal energy, energy storage.

This could be linked with the need to be more interactive: Geothermal water, urban status of contaminants, and groundwater.

Action 5: To divide the GEG in several, more specialised fields and increase the frequency of meetings in order to be more dynamic.

(9C) ASGMI-GEG (IM)

- To continue with the geochemical map of Latin America and the Caribbean. To use a 40x40 grid and the stream sediment as a sampling medium. Examples of sample points that will be included, and also the metadata. Example of Argentina. We will use the map of mineral resources and the tectonic map for reference.
- Translation of the IUGS Manual of Standard Methods into Spanish.
- Next webinar series will be held in November (sampling analysis).
- Workshop next year of the CGGB in Latin-American (Dominican Republic).

MJB: We don't know to what extent the results will be; maybe just for a few elements, and we will level the data when it is possible.

15.00-15.30: Coffee break

(10) 15.30-17.10: Discussion of pan-European project proposals, *e.g.*, Urban Geochemistry, Mineral Exploration, *etc.*, and any other issues related to EGS-GEG, IUGS-CGGB and ASGMI-GEG (PN, JG, AD, PAS, IM, and remote Anna Ladenberger, Maria João Batista)
(This was discussed throughout the previous presentations)

General Session – Part 1:

(11) 17.10-17.30: *Vanadium and chromium trace metals in agricultural soil at the European continental scale: weathering, redox proxies and low-density geochemical mapping* − PN

FINAL DISCUSSION TIME
Chaosheng: Medical geology event. COST on medical geology, he wants to invite this group.
AL: Those who attended Goldschmidt2025?
AD: Participated in a virtual meeting of the European Association of Geochemistry (EAG), where the next conference in Montreal was discussed. We should not participate in Goldschmidt 2026 due to the cost and, more importantly, our own workshop plans. Only if the EAG provides the financial support needed can we organise a workshop in Montreal.
AL: UNESCO Chinese Centre, Anna informed the participants that she had been invited to the Advisory Board but hadn't heard from them for months until a few weeks ago. They have a meeting in December, and she is invited; she asked for a list of the rest of the Advisory Board. The Centre is renewed.

AD and **BF** informed everybody that the Centre never consulted the international Councillors during its first term under UNESCO (refer to Section §5.1).

Proposal: Anna Ladenberger should be the new Chair of the EGS-GEG. The proposal was seconded by **MJB**, and the in-person members supported it.

IS: There are EGS rules for appointing a Chair and Deputy Chair. 1. Anyone can express interest and they should have the support of their Geological Survey Directors (or national delegate). 2. EXCOM has to approve it.

IS: Chair and Deputy Chair, there are no vice-chairs. In total, they serve for two periods of 4 years; there are no rules regarding Deputy Chairs.

2nd Day, Friday, 10th October 2025, 09.00-17.30
Presentations from IUGS-CGGB, EGS-GEG, ASGMI-GEG, and local hosts (20 minutes each, *i.e.*, 15-minute presentation plus 5 minutes for questions, *each presenter is expected to share her/his original Microsoft® PowerPoint presentation*). The original Microsoft® PowerPoint presentations are available from a dedicated pCloud folder: https://u.pcloud.link/publink/show?code=kZkFB95ZMQvJvzG7wXpkdk61HeXVWbLdAuV7.

09.00: Organisation arrangements by JG
09.05: Presentation Moderators - PN & JG

General Session – Part 2:

(12) 09.10-09.30: *Agricultural soil challenges in Norway* – Belinda Flem
(13) 09.30-09.50: *EU Soil Monitoring Law and Opportunities for Medical Geology* – Chaosheng Zhang
(14) 09.50-10.10: *Introducing EIS Toolkit and its applications for geochemical vectoring and Statistical Interpretation using examples related to lithium* – Martiya Sadeghi
(15) 10.10-10.30: *Demonstration of EIS tools in target generation for REE* – Patrick Casey

10.30-11.00: Coffee break

(16) 11.00-11.20: *The geochemical significance of "novel anthropogenic materials" in the Dutch subsurface: Industrial wastes and by-products* – Joris J. Dijkstra
(17) 11.20-11.40: *Geochemical composition of three types of dust in the vicinity of a cement plant in Slovenia* – Mateja Gosar (MG) and Martin Gaberšek
(18) 11.40-12.00: *Hydrogeological study methods for induced bank filtration* – Jaana Jarva
(19) 12.00-12.20: *Detecting hydrogeochemical signatures through compositional data analysis (CoDA) in Campi Flegrei volcanic aquifer, southern Italy* – Pooria Ebrahimi
(20) 12.20-12.40: Part 1 – *Geochemical Exploration in primary and secondary Resources (ongoing projects at IGME- CSIC)* – IM
(21) 12.40-13.00: Part 2 – *Geochemical Exploration in primary and secondary Resources (ongoing projects at IGME- CSIC)* – PAS

13.00-14.00: Lunch break

(22) 14.00-14.20: *Ongoing Projects of the Geochemistry and Environment Department, HSGME* – Alexandros Liakopoulos
(23) 14.20-14.40: *Project ExtremEarth* – Martin Gaberšek & MG
(24) 14.40-15.00: *Updates from the Irish Tellus Programme* – Ray Scanlon
(25) 15.00-15.20: *Nitrate in Danish groundwater – trends and new approaches* – Birgitte Hansen
(26) 15.20-15.40: *Geochemistry and the Public — Examples from the Czech Geological Survey* – Julie Erban Kočergina

(27) 15.40-16.00: *Needle in a Haystack: Finding CRM Potential in the Netherlands* − presented on behalf of the Netherlands Materials Observatory by Pim van Geffen

16.00-16.30: Coffee break

16.50-17.30: Conclusions, meeting closes
Final Comments about the procedure to elect the new Chair:
IS: Procedure to elect the chair: First, the Chairperson must be selected, then approval of the National Delegate, the Deputy Chair.
JG: They will talk about this issue in the coming months. If anyone is interested, send an email to the Board.
IS: Chairs must be part of the Expert Group. Julie Hollis (EGS Secretary General) sends an email for expression of interest, and any person who is interested must be supported by their National Delegate. Then the final approval.

3rd Day, Saturday, 11th October 2025, EXCURSION (All day) –
Meeting at **08:15** at a bus station near Utrecht railway station, and return at 18:00. The Marker Wadden islands in the middle of Lake Markermeer were visited.

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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)

Summary

Activities related to the Africa Geochemical Database (AGD) programme during 2024–2025 have involved national geological surveys, such as those undertaken by the Nigeria Geological Survey Agency (NGSA), which has expanded geochemical baseline data for mineral exploration and land-use planning. Continental efforts under the International Union of Geological Sciences (IUGS) have included the creation of harmonised African geochemical databases, with a focus on developing robust methodologies (using analytical techniques such as XRF and ICP-MS) for defining natural element levels in soils and sediments to track contamination and support sustainable resource management across diverse geological terrains. By leveraging AI/digital platforms (Global Geochemical Baselines), new data from Angola and Nigeria were integrated, and prospectivity maps for critical minerals were produced. Other key activities include capacity building and the application of elemental distribution maps for health, environmental, and mining assessments.

A Description of Key Highlights in AGD Progress During 2024–2025

- **Digital Geochemical Atlases:** Prospectivity maps and data sets for resource assessment were produced during the period under review (2024–2025), marking a significant increase in AGD activities compared with the previous two years. These developments motivated the inauguration of new infrastructure and the acquisition of additional projects, *e.g.*, the Namibia Geochemistry Laboratory, launched in Walvis Bay (Namibia) in September 2025 to provide analytical services for the mining industry.
- **Digital Platforms and Tools:** Through the "Digital Chemical Earth" system, the period 2024–2025 saw continuous updates to platforms for the visual analysis of geochemical data across geological units.
- Under **Earth Observations (GEO) Initiatives**, focused on global baseline networks and data sharing, the PanAfGeo+ Programme Implementation is well underway. The third phase of this project commenced in 2024 and will run until 2029, building on the successes of the PanAfGeo-1 and PanAfGeo-2 programmes implemented in previous years. GeoZS is an important partner in the PanAfGeo+ project, which will also run until 2029. PanAfGeo+ has enabled long-term human and institutional capacity building and the development of a training network that fosters collaboration and knowledge sharing beyond the project's duration.
- Under the **MOU between the USGS and the Angola Geological Institute (IGEO)**, established in November 2023, a project was initiated in October 2024 to evaluate Angola's critical mineral resources. This project aims to compile, analyse, and interpret newly acquired geological, geochemical, geophysical, and spectroscopic data to produce prospectivity maps for selected critical mineral deposit types (such as rare earth elements, REEs), thereby attracting investment and aligning with Angola's mining strategy.
- **Ongoing studies in Nigeria** actively use stream-sediment samples to create baseline environmental data, map toxic-element contamination, and identify mineral potential—particularly for gold (Au), rare earth elements (REEs), base metals (Pb, Zn, Cu), and precious metals. These studies leverage geochemical anomalies in regions such as the West-Central Nigeria Pan-African Belt to support mineral exploration and environmental management (see

Ngozi-Chika and Mhlongo, 2025). The NGSA identified specific areas for proposed geochemical data acquisition in its 2024 plans, in collaboration with international partners. Studies focus on distinguishing natural variations from anthropogenic impacts, using statistical methods such as PCA to pinpoint anomalies for resource assessment and baseline environmental health.

- **Geochemical exploration in Cameroon** centred on the use of stream-sediment geochemistry to assess pollution risks in aquatic ecosystems during the period under review (see, *e.g.*, Afahnwie *et al.*, 2025).
- **Research efforts in 2024 and 2025** continued to develop methodologies for using existing hydrogeological and lithological data from databases to improve geological maps in highly weathered regions of Sub-Saharan Africa (see, *e.g.*, Ouangaré *et al.*, 2024).
- **Data Compilation and Standardisation:** Harmonisation efforts continue to make diverse national data sets consistent and comparable (*e.g.*, Nigeria's stream-sediment data, Angola's new datasets).
- **Republic Tamnyar, 295B:** This refers to a legend/interpretation associated with an alternative proposal put forward in 2024 by the NGSA for geochemical data originally proposed by "China org". This alternative describes geochemical cell 295B (part of the Tamnyar region in Taraba State, Nigeria), contrasting it with a previous proposal documented in an NGSA dossier and related to mineral-resource exploration and environmental baseline data. The NGSA's alternative proposal for the "Republic Tamnyar 295B legend" for a specific geological-mapping project is considered highly significant.
- **Geospatial Layers:** During the period under review (2024–2025), the USGS continued updating geodatabases with mineral facilities, exploration sites, and infrastructure (ports, power, roads) across Africa.
- **Consolidation of European and African geological survey networks** continued, enhancing data-sharing and management protocols. National and regional geoscientific institutions were also strengthened through training in geoscientific information management and the expansion of geological-mapping and mineral-resource assessments.
- **Training courses relevant to the AGD** during 2024–2025 included programmes from organisations such as the AGATE project (short courses in mineral exploration in Senegal and Togo), the European Association of Geochemistry (EAG) summer schools (Uganda), and institutions such as Wits University (South Africa) offering degree programmes. The Royal Society of Chemistry also planned GC-MS (Gas Chromatography–Mass Spectrometry) training in Kenya, highlighting opportunities in Applied Geochemistry, Mineral Resources, and Environmental Studies.

Conclusion

The importance of a complete AGD is underscored by its main applications in Environmental Health (baseline mapping for health assessments, urban contamination, and agriculture) and Mineral Exploration (identifying new deposits of base metals, REEs, and precious metals).

A notable increase in efforts to achieve a complete AGD was observed during the period under review (2024–2025), led by several national geological surveys (Angola, Namibia, Nigeria, among others). There was also a clear desire to harmonise sampling (stream-sediment, soil, rock, and water samples), analytical methods and technologies (mainly ICP-MS, XRF, AAS), and mapping techniques (GIS, geochemical-anomaly delineation, multivariate statistics). However, the methodologies used in these applications still differ, to varying degrees, from those recommended by Darnley *et al.* (1995). Despite the progress made during 2024–2025, many challenges in compiling the AGD unfortunately remain.

References

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A2.1.2. PanAfGeo-2 project in Africa

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

Members of the CGGB-IUGS (Maria João Batista and Cátia Prazeres) participated in the last WPB-PanAfGeo2 seminar, held in Entebbe at the Geological Survey Department of the Ministry of Energy and Mineral Development. During the event, the team delivered presentations on the work carried out in the training, which also included exploration geochemistry.

In June 2025, the third phase of the PanAfGeo project, called PanAfGeo+, started in Dar es Salaam, Tanzania. This new phase includes training activities and exploration studies in selected countries, referred to as “country windows”.

Figure A2.1.2.1. Kickoff meeting of PanAfGeo+, Dar Es Salam, Tanzania.

Members of the EGS-GEG are involved in both training and country windows and have conducted visits to Uganda, Zambia, and Tanzania. The good practices outlined in the IUGS

Manual of Standard Methods are being introduced in the training and applied in the development of work within these country windows.

A2.2. AMERICA, NORTH

A2.2.1. Mexico

Report by Flor de Maria Harp Iturribarría (florh@sgm.gob.mx), Saúl Peña Coronado (saulpena@sgm.gob.mx) and Sofia del Pilar Mendoza Castillo (sofiamendoza@sgm.gob.mx), Mexican Geological Survey (SGM), Pachuca de Soto, Hidalgo, Mexico.

The Mexican Geological Survey (Servicio Geológico Mexicano, SGM) has continued to develop multi-element and multi-purpose geochemical mapping activities of global geochemical relevance, fully aligned with the methodological principles promoted by the IUGS Commission on Global Geochemical Baselines.

Soil geochemistry

During 2025, progress was made on baseline and geochemical-anomaly studies using the national database of soil geochemical element concentrations across the Mexican territory. As part of this programme, sampling protocols aligned with the North American Soil Geochemical Landscapes Project were applied. Samples were collected from four soil horizons (0–5 cm, A, B, and C) at a grid spacing of 10 × 10 km.

The work included:

- Field and laboratory quality control
- Processing and interpretation of geochemical data
- Statistical analysis aimed at anomaly identification
- Integration with existing geological mapping

The objective is to use soil geochemistry as a complementary tool for the prospecting of critical minerals in the Central–Northern region of Mexico. Results are currently being processed; however, preliminary analyses indicate that the methodology is useful for supporting geological evaluation in areas where mineralisation associated with critical elements is inferred.

Active stream-sediment geochemistry

The SGM continues to systematically produce geochemical maps based on the analysis of active stream-sediment samples. These maps present the results and primary interpretation of elemental concentrations in samples collected under SGM's methodology, which is compatible with internationally used approaches.

Sampling design

Sampling density depends on the mapping scale:

- 1:50 000: up to 210 samples (~1 sample per 5 km²)
- 1:250 000: up to 660 samples (~1 sample per 40 km²)

Site selection considers hydrology, topography, and accessibility, prioritising uniform sampling conditions, particularly during the dry season.

Methodology

Samples are dried at 60°C, sieved to <80 mesh, packaged in kraft paper bags, and sealed in plastic to prevent contamination. A total of 32 elements are analysed per sample using ICP, except for gold, which is determined by fire assay (gravimetric or atomic absorption finish depending on concentration). Results are reported in mg/kg (ppm), except for Fe, Al, Ca, and Mg, which are reported in per cent. Gold, tellurium, and selenium concentrations are converted to µg/kg (ppb) for presentation in the final geochemical maps.

Geochemical map production

During 2025, 41 maps were surveyed in the field, and 43 maps were edited, incorporating:

- Percentile-based statistical calculations
- Contrast relative to mean values
- Consistency with geological and mineralisation models

The objective of the geochemical maps developed by the SGM is to provide a tool to support mineral-deposit prospecting through the statistical analysis and interpretation of sampling data, in combination with the geological context provided by geological–mining maps.

Active stream-sediment geochemical maps are available in digital format at scales of 1:250 000 and 1:50 000, one per element, together with associated databases and technical reports. This information can be consulted through the SGM web viewer (https://www.sgm.gob.mx/GeoInfoMexGobMx/#) and is also available for acquisition by map sheet in shapefile and Excel formats.

A2.2.2. United States of America

Report by David Smith (dbsmith13@gmail.com)

Regarding regional-scale geochemical mapping, no activities have been reported in North America.

A2.3. AMERICA, SOUTH

A2.3.1. ASGMI Geochemistry Expert Group

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

In 2025, the Geochemistry Expert Group of ASGMI continued to include metadata in the database to produce the Geochemical Atlas of Latin America. The challenge for this Expert Group is to include as many campaigns as possible in this phase, along with the metadata. These campaigns are compatible in terms of both space and methodology at the country level, and will move to the continental scale in the next phase.

The Expert Group participated in conferences such as:

- The Iberian Geochemical Congress in the Azores, Portugal;
- The 5th International Professional Geology Congress (IPGC) in Zaragoza, Spain, and
- The joint annual meeting of the IUGS-CGGB, EGS-GEG and ASGMI-GEG at the Geological Survey of the Netherlands (TNO).

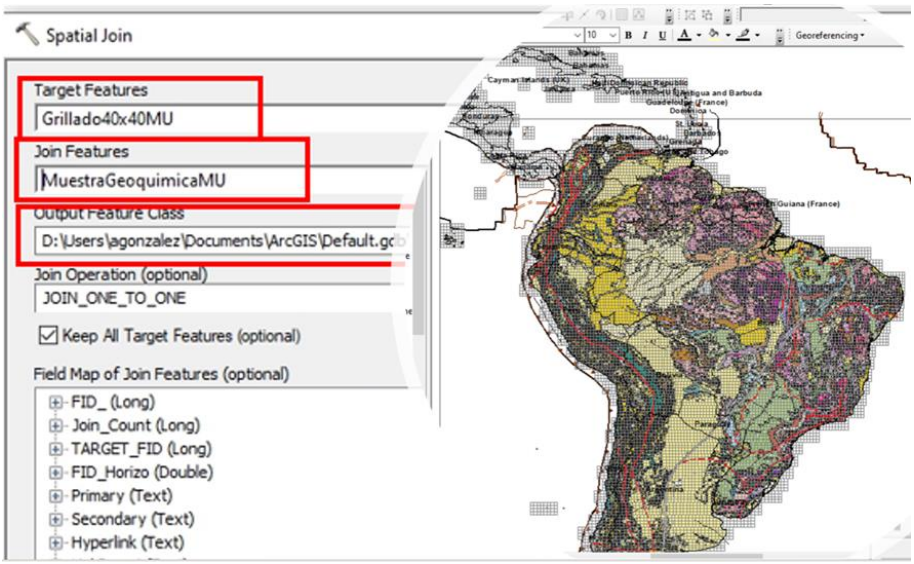

Figure A2.3.1.1. Image of the work in progress for the Geochemical Atlas of Latin America and the Caribbean.

On the 12th and 13th of November 2025, the ASGMI Geochemistry Expert Group organised its third webinar entitled *'Sample Analysis'* as part of the *'Geochemical Information for Society'* series, organised by Ecuador under the ASGMI Geochemistry Expert Group. This provided an opportunity for laboratory staff from geological survey laboratories and members of other international geochemistry groups, such as IUGS-CGGB and EGS-GEG, to exchange experiences. All the original Microsoft® PowerPoint presentations are available from a dedicated pCloud folder by using the following hyperlink: https://u.pcloud.link/publink/show?code=kZSVRg5Z27kdH9CAhGLlsLQX34X9bSjtFJFk.

A2.3.2. Argentina

Report by Andrea V. Turel (SEGEMAR) (andrea.turel@segemar.gov.ar)
No activities reported this year.

A2.3.3. Brazil

Report by professionals of the Geological Survey of Brazil (CPRM - Serviço Geológico do Brasil):

- Daliane Bandeira Eberhardt daliane.eberhardt@sgb.gov.br
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Characterisation of the data in the Latin American countries

Geology and Mineral Resources

Brazil forms part of the extensive continental area known as the South American Platform, which has remained relatively stable since the Mesozoic era. Its geological evolution is characterised by a polycyclic history stretching from the Eoarchean to the Caenozoic era. The crystalline basement formed through successive episodes of crustal accretion, reworking and stabilisation. The Amazonian and São Francisco cratons host some of the continent's oldest rocks.

Brazil's geological framework developed alongside the assembly and breakup cycles of the Columbia, Rodinia, Gondwana and Pangaea supercontinents. These cycles influenced the formation of mobile belts, sedimentary basins, magmatic activity and metamorphic events, particularly during the Neoproterozoic Brasiliano Cycle when crustal reworking was more prevalent than the formation of new crust.

From the Archaean to the Palaeoproterozoic era, greenstone belts and mafic–ultramafic complexes played a pivotal role in metallogenesis. These formations hosted substantial deposits of gold, iron, manganese, chromite, nickel, copper, and platinum group elements, particularly in the Carajás Mineral Province and the Quadrilátero Ferrífero region. During the Palaeoproterozoic era, metallogenetic diversification intensified, resulting in the formation of gold, Lake Superior-type iron and manganese deposits, as well as tin, copper, lead, zinc and diamond deposits. These were associated with intracontinental rifting, anorogenic granites and volcanic-sedimentary sequences.

During the Mesoproterozoic era, mineralisation was more limited, but included tin-bearing granites, volcanogenic massive sulphide deposits and diamond-bearing conglomerates. During the Neoproterozoic era, the Brasiliano fold belts and related platform covers generated significant deposits of phosphate, zinc, lead, copper, gold, graphite, tungsten and other minerals related to intrusions and structural control (shear zones).

During the Palaeozoic era, the stabilisation of the continental shelf led to the formation of large intracratonic sedimentary basins, such as the Paraná, Parnaíba and Amazon basins. These basins are associated with coal, evaporites, oolitic iron and copper deposits. The breakup of Gondwana and the opening of the South Atlantic during the Mesozoic era triggered extensive basaltic and alkaline–carbonatite magmatism. This resulted in the mineralisation of apatite, niobium, titanium, rare earth elements, diamonds, fluorite and gemstones.

During the Caenozoic, lateritic weathering and mechanical concentration processes formed important bauxite, kaolin, nickel, iron, gold, and heavy-mineral placer deposits in continental and coastal environments. Together, these events emphasise the close relationship between Brazil’s geotectonic evolution and its exceptional mineral diversity and resource potential throughout geological time.

Geochemistry (geochemical coverage of stream sediments, main analytical methods, density of sampling in the different campaigns, objective of the studies)

The global demand for critical and strategic minerals is intensifying due to the energy transition and technological development. This intensifying demand is creating a greater need for reliable geoscientific information to support mineral exploration and territorial planning. As easily accessible resources become scarcer, it is essential to strengthen national geochemical knowledge to identify new exploration targets, reduce geological uncertainty, and improve environmental and land-use decision-making.

Geochemistry plays a fundamental role in this context by providing systematic information on the spatial distribution of chemical elements at regional and local scales. These data support a wide range of applications, including:

i. Regional geological and metallogenetic mapping;
ii. Mineral prospectivity and favorability modelling;
iii. Identification of geochemical anomalies associated with critical and strategic minerals;
iv. Environmental baseline characterisation and monitoring;
v. Soil and sediment quality assessment;
vi. Support for hydrogeological and land-use studies, and
vii. Territorial planning and sustainable resource management.

To consolidate and expand this information infrastructure, the Geological Survey of Brazil (SGB-CPRM) has established the Geochemical Survey Expansion, Recovery and Dissemination Programme, aiming to recover, update and standardise the national geochemical database and disseminate it. The programme involves digitising historical sample collections and analytical results, incorporating new surveys and expanding territorial coverage to include all metallogenetic provinces. Georeferenced data and maps are being made publicly available through the Institutional Repository of Geosciences (RIGeo) and the SGB-CPRM Geoportal.

Since its establishment in 1969, the Mineral Resources Research Company (CPRM), now known as the Geological Survey of Brazil (Serviço Geológico do Brasil – SGB), has played a pivotal role in systematising geological knowledge nationwide (Almeida *et al.*, 2024). This support has encompassed geological mapping, geochemical surveys, and mineral and environmental research projects. A central component of these activities has been the chemical analysis of geological samples (rocks, soils, and stream sediments), which provides essential data for geochemical characterisation and geological interpretation in a wide range of projects.

The history of chemical analysis within the Geological Survey of Brazil projects reflects an increasing level of institutional autonomy and integration with specialised external laboratories. This began in the 1990s with the integration of laboratories such as ACME (see Table A2.3.3.1), followed by the consolidation of the internal LAMIN Network (see Table A2.3.3.2), which is currently specialised in mineral water analyses. Collaboration with Brazilian private laboratories such as SGS GEOSOL (see Table A2.3.3.3) has also been established since the 2000s. Standardising digestion methods, instrumental techniques, and analytical packages has greatly helped develop a robust national geochemical database that supports geological mapping, mineral resource assessment, and scientific research in Brazil.

Table A2.3.3.1. Analytical methods used in geochemical analyses – ACME Analytical Laboratories Ltd.

Method	Digestion / Sample Preparation	Analytical Technique	Main Elements Determined
1DX, 1EX, AQ200	Multi-acid digestion	ICP-MS	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Ga, Hf, Hg, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr
1DX	Multi-acid digestion	ICP-OES	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Pd, Pt, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr
LF200	Lithium tetraborate fusion	ICP-OES / ICP-MS	Al_2O_3, Ba, Be, CaO, Ce, Co, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe_2O_3, Ga, Gd, Hf, Ho, K_2O, La, Lu, MgO, MnO, Na_2O, Nb, Nd, Ni, P_2O_5, LOI, Pr, Rb, Sc, SiO_2, Sm, Sn, Total, Sr, Ta, Tb, Th, TiO_2, Tm, U, V, W, Y, Yb, Zn, Zr
1DX, 2A Leco, 2A12, TC000	Induction combustion	Infrared	Total C, Organic C, S
G806, G818	Acid digestion and titration	Not applicable	Fe, FeO
AQ250	Hot aqua regia digestion	ICP-MS	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, S, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
1F	Hot aqua regia digestion	ICP-OES / ICP-MS	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Pb, Pd, Pr, Pt, Rb, Re, S, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
FAA / G608	Fire assay	Atomic absorption spectrometry	Ag, Au, Pd, Pt
XRF	Lithium metaborate fusion	X-ray fluorescence	Ag, Al, Al_2O_3, As, Au, B, Ba, Be, Bi, Ca, CaO, Cd, Ce, Co, Cr, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe, Fe_2O_3, Ga, Gd, Ge, Hf, Hg, Ho, In, K, K_2O, La, Li, Lu, Mg, MgO, Mn, MnO, Mo, Na, Na_2O, Nb, Nb_2O_5, Nd, Ni, P, P_2O_5, LOI, Pb, Pr, Pt, Rb, Re, S, Sb, Sc, Se, SiO_2, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, TiO_2, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
P-XRF	Pressed pellet	X-ray fluorescence	Ba, Nb, Rb, Sr, Y, Zr
4A–4B	Lithium metaborate fusion	ICP-OES / ICP-MS	Ag, Al_2O_3, As, Au, Ba, Be, CaO, Ce, Co, Cr_2O_3, Cs, Dy, Er, Eu, Fe_2O_3, Ga, Gd, Hf, Ho, K_2O, La, Lu, MgO, MnO, Na_2O, Nb, Nd, Ni, P_2O_5, LOI, Pr, Rb, Sc, SiO_2, Sm, Sn, Total, Sr, Ta, Tb, Th, TiO_2, Tm, U, V, W, Y, Yb, Zr

Since its inception, the programme has made significant progress in data consistency, releasing 188 geochemical projects by November 2025. A total of 162,031 samples are now available for download via the Geoquímica portal (https://geoportal.sgb.gov.br/geoquimica/). The database includes rock, stream sediment, soil, panned concentrate, gold grain and drill-hole data, representing a substantial advance in the integration and standardisation of national geochemical information (see Fig. A2.3.3.1). This consolidated database enables new geological interpretations and improves the efficiency with which areas favourable to the occurrence of critical and strategic minerals can be identified.

In parallel, a wide range of geochemical studies has been published over the last five years, including geochemical atlases, thematic and regional prospecting reports, and integrated geological, geophysical and geochemical studies. These studies emphasise the generation of multi-element anomaly maps, the definition of anomaly thresholds, the application of exploratory statistics and the use of GIS-based 2D and 3D modelling to improve target definition. Methodological advances, such as studies on the effects of grain size in stream sediments, have

contributed to more robust interpretations by reducing analytical bias and minimising false anomalies. Thematic projects focusing on lithium and pegmatite potential further demonstrate the importance of a regional geochemical survey with a high sampling density (1 sample/10 km²) and high-quality chemical analysis for identifying prospective areas.

Table A2.3.3.2 – Analytical methods used in geochemical analyses of rock, soil and sediment samples - LAMIN Network.

Analytical Method	Digestion / Preparation	Analytical Technique	Main Elements Determined
AA	Multi-acid Digestion	Atomic Absorption Spectrometry (AAS)	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sr, Ti, V, Zn
AA	Cold EDTA Digestion	Atomic Absorption Spectrometry (AAS)	Ba, Be, Cd, Co, Cu, Fe, Li, Mn, Ni, Pb, Zn
AA	H_3PO_4 Digestion	Atomic Absorption Spectrometry (AAS)	Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, V, Zn
AA	HBr–Br Digestion	Atomic Absorption Spectrometry (AAS)	As, Au, Cd, Co, Cr, Cu, Fe, Hg, Ni, Pb, Sb, Se, Tl, Zn
AA	Hot HBr–Br Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Cu, Hg, Li, Mo, Pb, Sb, Zn
AA	Cold Dilute HCl Digestion	Atomic Absorption Spectrometry (AAS)	Cd, Co, Cu, Fe, Li, Mn, Ni, Pb, Zn
AA	HNO_3 Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Ba, Bi, Cd, Co, Cr, Cu, Fe, K, La, Li, Mn, Mo, Na, Ni, Pb, Sb, Sn, V, Zn
AA	Hot HNO_3 Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Ba, Bi, Cd, Co, Cr, Cu, Fe, K, La, Li, Mn, Mo, Na, Ni, Pb, Sb, Sn, V, Zn, Zr
AA	Partial Hot HNO_3 Digestion for Silicates	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Ba, Bi, Cd, Co, Cr, Cu, Fe, K, La, Li, Mn, Mo, Na, Ni, Pb, Sb, Sn, V, Zn
AA	Total Digestion (HNO_3–HF–HCl–$HClO_4$) for Silicates	Atomic Absorption Spectrometry (AAS)	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Sr, Ti, V, Zn
AA	Reverse Aqua Regia Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn
AA	Hot Aqua Regia Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Ba, Bi, Cd, Co, Cr, Cu, Fe, K, La, Li, Mn, Mo, Na, Ni, Pb, Sb, Sn, V, Zn
AA	Partial Hot Aqua Regia Digestion for Silicates	Atomic Absorption Spectrometry (AAS)	Ag, As, Au, Ba, Bi, Cd, Co, Cr, Cu, Fe, K, La, Li, Mn, Mo, Na, Ni, Pb, Sb, Sn, V, Zn
AA	Strong Acid Digestion (HNO_3–HCl)	Atomic Absorption Spectrometry (AAS)	Ag, Al, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Zn
AA	Strong Acid Digestion (HNO_3–HCl–HF)	Atomic Absorption Spectrometry (AAS)	Ag, Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Zn
AA	Strong Acid Digestion (HNO_3–HF–HCl–$HClO_4$)	Atomic Absorption Spectrometry (AAS)	Ba, Cr, Sn
AA	Acid Fusion	Atomic Absorption Spectrometry (AAS)	Al, Cd, Co, Cu, Fe, Mn, Mo, Nb, Ni, Pb, Sn, Ta, Ti, Zn, Zr
AA	Fusion, Cupellation and Acid Digestion	Atomic Absorption Spectrometry (AAS)	As, Au, Be, F, Pd, Pt, Sb, Sr
AA	Not applicable – Semi-quantitative Analysis	Atomic Absorption Spectrometry (AAS)	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, La, Li, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Se, Sn, Sr, Ti, Tl, V, W, Y, Zn, Zr
AA	KI Sublimation	Atomic Absorption Spectrometry (AAS)	As, Au, Bi, Hg, Sb, Se, Te, Tl
AAGH	Hot Aqua Regia Digestion	Hydride Generation AAS	Bi, Sb
COL	HBr–Br Digestion	Colorimetry	SiO_2
COL	Not applicable – Semi-quantitative Analysis	Colorimetry	As, P, Sb
—	Inductive Combustion	Infrared Detection	Elemental C, S
EE	Strong Acid Digestion (HNO_3–HCl–HF)	Optical Emission Spectrography	Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Dy, Fe, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Rh, Sb, Sc, Sn, Sr, Ti, V, Zn, Zr
EE	Fusion, Cupellation and Acid Digestion	Optical Emission Spectrography	As, Au, Be, F, Pd, Pt, Sb, Sr
EE	Not applicable – Quantitative Analysis	Optical Emission Spectrography	Ga, Sc, Pt, Pd, Rh, Rb, Sr, Sn, Nb, Zr, La, Y
EE	Not applicable – Semi-quantitative Analysis	Optical Emission Spectrography	Al, Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cl, Cr, Cu, F, Fe, Ga, Ge, Hf, In, La, Li, Mg, Mn, Mo, Na, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Ta, Ti, V, W, Y, Yb, Zn, Zr
EFRX	Pressed Pellet	X-ray Fluorescence (XRF)	Ba, Nb, Rb, SiO_2_L, Sr, Y, Zr
EIE	Partial Cold Dilute HCl Digestion	Ion-Selective Electrode	F
EIE	Total Alkaline Fusion	Ion-Selective Electrode	Be, F, Sr
EIE	Not applicable – Semi-quantitative Analysis	Ion-Selective Electrode	F
FAA	Fire Assay	Atomic Absorption Spectrometry (AAS)	Au
FL	Not applicable	Fluorimetry	U
FRX	Lithium Metaborate Fusion	X-ray Fluorescence (XRF)	Ag, Al, Al_2O_3, As, Au, B, Ba, BaO, Be, Bi, CO_2, Ca, CaO, Cd, Ce, Co, Cr, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe, Fe_2O_3, FeO, Ga, Gd, Ge, Hf, Hg, Ho, In, K, K_2O, La, Li, Lu, Mg, MgO, Mn, MnO, Mo, Na, Na_2O, Nb, Nb_2O_5, Nd, Ni, P, P_2O_5, PF, Pb, Pr, Pt, Rb, Re, S, Sb, Sc, Se, SiO_2, Sm, Sn, Sr, SrO, Ta, Tb, Te, Th, Ti, TiO_2, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
FRX	Lithium Tetraborate Fusion	X-ray Fluorescence (XRF)	Ag, Al, Al_2O_3, As, Au, B, Ba, Be, Bi, Ca, CaO, Cd, Ce, Co, Cr, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe, Fe_2O_3, FeO, Ga, Gd, Ge, Hf, Hg, Ho, In, K, K_2O, La, Li, Lu, Mg, MgO, Mn, MnO, Mo, Na, Na_2O, Nb, Nb_2O_5, Nd, Ni, P, P_2O_5, PF, Pb, Pr, Pt, Rb, Re, S, Sb, Sc, Se, SiO_2, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, TiO_2, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
GRAV	Hot Aqua Regia Digestion	Gravimetry	As, Bi, Sb
ICP/OES	Sodium Carbonate Fusion	Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)	B, Be, Ca, Co, Cu, Fe, La, Li, Mg, Mn, Ni, P, Pb, Sc, Sr, Ti, V, W, Y, Zn
ICP/OES	Lithium Metaborate Fusion	Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)	Ba, Mo, P, S, V, W
Qualitative Mineralogy	Not applicable	Hand Lens	—
Quantitative Mineralogy	Not applicable	Hand Lens	—
Semi-quantitative Mineralogy	Not applicable	Hand Lens	—
UV	Partial Digestion / Acid Fusion	UV–Visible Spectrophotometry	P
VOL	Not applicable	Volumetry	CaO, FeO, MgO

Table A2.3.3.3 – Analytical methods used in geochemical analyses of rock, soil and sediment samples - SGS-GEOSOL® Analytical Laboratories.

Analytical Method	Digestion / Preparation	Analytical Technique	Main Elements Determined
AAS19V	Hot Aqua Regia Digestion	Atomic Absorption Spectrometry (AAS)	Au
AAS40B	Multi-acid Digestion	Atomic Absorption Spectrometry (AAS)	Ag, As, Bi, Cd, Co, Cr, Cu, Fe, K, Li, Mn, Mo, Na, Ni, Pb, V, Zn
AAS41B	Multi-acid Digestion	Atomic Absorption Spectrometry (AAS)	Bi, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, V, Zn
CLA08V	Caustic Fusion (NaOH) and Hydrochloric Acid	ICP-OES / AAS	Al_2O_3_Ap, SiO_2_Re
CLA70C	Acid Digestion and Titration	Not applicable	FeO
CLA80C	Acid Digestion and Titration	Not applicable	FeO
CSA02V	Resistive or Inductive Combustion	Infrared	CO_2, organic C
CSA03V	Acid Digestion and Filtration	Infrared	*TOC = Total Organic Carbon by combustion, organic C
CSA05V	Acid Digestion and Muffle Furnace Calcination	Infrared	graphitic C
CSA17V	Inductive Combustion	Infrared	elemental C, S
CSA20V	Acid Digestion, Filtration and Inductive Combustion	Infrared	carbonate C, elemental C, organic C
FAA303	Fusion, Cupellation and Acid Digestion	Atomic Absorption Spectrometry (AAS)	Au
FAA313	Fire Assay	Atomic Absorption Spectrometry (AAS)	Au, Au1, Au2
FAI313	Fire Assay	ICP-OES	Au, Pd, Pt
FAA505	Fusion, Cupellation and Acid Digestion	Atomic Absorption Spectrometry (AAS)	Au, Pd, Pt
FAI515	Fusion, Cupellation and Acid Digestion	ICP-OES	Au, Au1, Au2, Pd, Pt
GC_ICP40BGR	Multi-acid Digestion	ICP-OES and Ash Determination	Ag, Al, As, Ba, Be, Bi, Ca, Cd, ash, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Ni, P, PF, Pb, S, Sb, Sc, Se, Sn, Sr, Th, Ti, Tl, U, V, W, Y, Zn, Zr
ICM14B	Aqua Regia Digestion	ICP-OES / ICP-MS	Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Pd, Pt, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, U, V, W, Y, Yb, Zn, Zr
ICM40B	Multi-acid Digestion	ICP-OES	Ag, Al, As, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, U, V, W, Y, Yb, Zn, Zr
ICM90A	Sodium Peroxide Fusion	ICP-OES / ICP-MS	Ag, Al, As, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, K, La, Li, Lu, Mg, Mn, Mo, Nb, Nd, Ni, P, Pb, Pr, Rb, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
ICM95A	Lithium Metaborate Fusion	ICP-OES / ICP-MS	Al_2O_3, Ba, CaO, Ce, Co, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe_2O_3, Ga, Gd, Hf, Ho, K_2O, La, Lu, MgO, MnO, Mo, Na_2O, Nb, Nd, Ni, P_2O_5, Pr, Rb, SiO_2, Sm, Sn, Sr, Ta, Tb, Th, TiO_2, Tl, Tm, U, V, W, Y, Yb, Zn, Zr
ICP40B	Multi-acid Digestion	ICP-OES	Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sc, Sn, Sr, Ti, V, W, Y, Zn, Zr
ICP90A	Sodium Peroxide Fusion	ICP-OES	Ag, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Ni, P, Pb, Sb, Sc, Sn, Sr, Ti, V, W, Y, Zn
ICP90B	Sodium Peroxide Fusion	ICP-OES	Al_2O_3, CaO, Co, Cr, Cu, Fe_2O_3, K_2O, MgO, MnO, Ni, P_2O_5, SiO_2, TiO_2
ICP90Q	Sodium Peroxide Fusion	ICP-OES / ICP-MS	Ba, Ca, Fe, Mg, Pb, Sn, Zn
ICP95A	Lithium Metaborate Fusion	ICP-OES	Al_2O_3, Ba, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, Nb, Nb_2O_5, P_2O_5, PF, SiO_2, Total, Sr, TiO_2, V, Y, Zn, Zr
IMS95A	Lithium Metaborate Fusion	ICP-MS	Ag, Ba, Be, Ce, Co, Cs, Cu, Dy, Er, Eu, Ga, Gd, Hf, Ho, La, Lu, Mo, Nb, Nd, Ni, Pr, Rb, Sm, Sn, Sr, Ta, Tb, Th, Tl, Tm, U, V, W, Y, Yb, Zr
IMS95AS	Lithium Metaborate Fusion	ICP-MS	Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sm, Tb, Th, Tm, U, Y, Yb
IMS95R	Lithium Metaborate Fusion	ICP-MS	Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sm, Tb, Th, Tm, U, Y, Yb
ISE03A	Fusion and Dissolution	Fluoride Ion-Selective Electrode	F
ISE03B	Fusion and Dissolution	Chloride Ion-Selective Electrode	Cl
PHY01E	Calcination at 1000 °C	Loss on Ignition (LOI)	—
XRF75V	Chlorine Determination – Pressed Powder	X-ray Fluorescence (XRF)	Cl
XRF79C	Lithium Metaborate Fusion	X-ray Fluorescence (XRF)	Al_2O_3, BaO, CaO, Co, Cr_2O_3, Cu, Fe_2O_3, FeO, K_2O, MgO, MnO, Na_2O, Nb_2O_5, Ni, NiO, P_2O_5, PF, PbO, SiO_2, SnO_2, Total, SrO, TiO_2, V_2O_5, WO_3, ZnO, ZrO_2
XRF79C	Lithium Tetraborate Fusion	X-ray Fluorescence (XRF)	Ag, Al, Al_2O_3, As, Au, B, Ba, BaO, Be, Bi, Ca, CaO, Cd, Ce, Co, Cr, Cr_2O_3, Cs, Cu, Dy, Er, Eu, Fe, Fe_2O_3, Ga, Gd, Ge, Hf, Hg, Ho, In, K, K_2O, La, Li, Lu, Mg, MgO, Mn, MnO, Mo, Na, Na_2O, Nb, Nb_2O_5, Nd, Ni, P, P_2O_5, PF, Pb, Pr, Pt, Rb, Re, S, Sb, Sc, Se, SiO_2, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, TiO_2, Tl, Tm, U, V, V_2O_5, W, Y, Yb, Zn, Zr
XRF82GR (graphite)	Lithium Tetraborate and Lithium Carbonate Fusion	X-ray Fluorescence (XRF)	Al_2O_3, BaO, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, PF, SiO_2, SrO, TiO_2, V_2O_5
XRF82MN (Mn ore)	Lithium Tetraborate and Lithium Carbonate Fusion	X-ray Fluorescence (XRF)	Al_2O_3, BaO, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, Mn, Na_2O, P_2O_5, SiO_2, TiO_2, V_2O_5

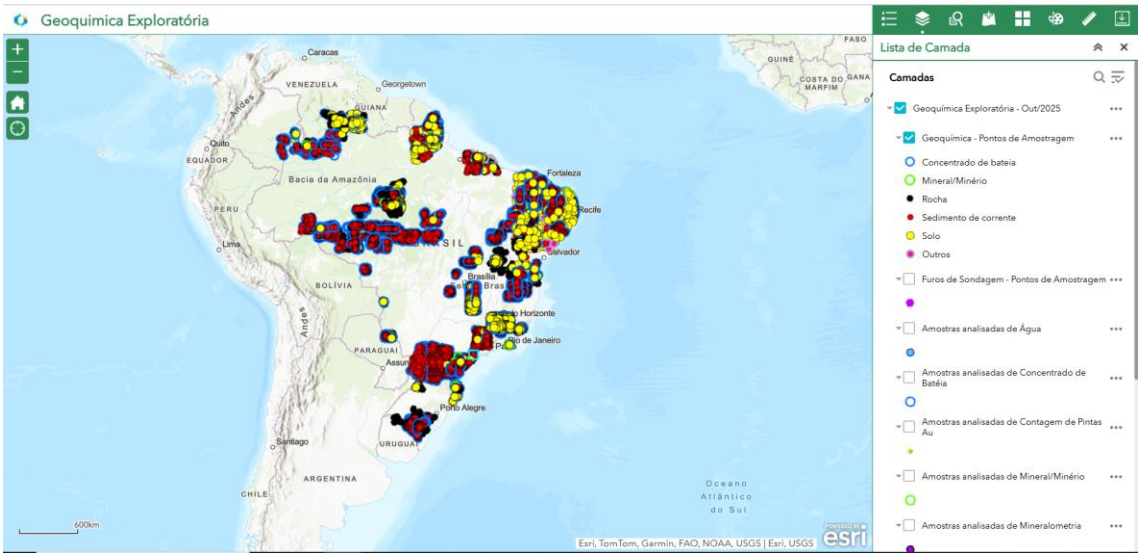

Fig. A2.3.3.1: The SGB-CPRM Geoportal (available at https://geoportal.sgb.gov.br/geoquimica) highlights the spatial distribution of the compiled projects and their respective sample types.

Geochemical Studies Published in the Last Years

Technical Reports:

- Geochemical Atlases – consolidation of soil/rock/sediment geochemical data, thematic maps (elemental spatial distribution), regional anomaly identification, exploratory statistics, granulometric normalisation, and map generation to support mineral prospecting and environmental studies. Highlighted reports in: https://rigeo.sgb.gov.br/search?spc.page=1&query=atlas%20geoquimico
- Thematic or Regional Geochemical Reports – prospecting reports based on map sheets showing metallogenetic anomalies in stream sediments, including upstream/downstream flow direction interpretation, integration with local geology to prioritise follow-up sampling areas, anomaly threshold establishment, and element ratio plots (*e.g.*, Cu/Zn, Pb/Zn) with anomaly maps.
- Highlighted reports in: https://rigeo.sgb.gov.br/search?spc.page=1&query=mapeamento%20geoqu%C3%ADmico
- Geology–Geophysics–Geochemistry Integration Studies – multi-dataset integration to improve the resolution of structural interpretations and correlate geophysical and geochemical anomalies, using GIS overlays, 2D/3D modeling, and favorability maps. Highlighted reports in: https://rigeo.sgb.gov.br/search?spc.page=2&query=integra%C3%A7%C3%A3o%20geol%C3%B3gica-geoqu%C3%ADmica-geof%C3%ADsica%20.
- Methodological Studies on Grain Size Effects in Stream Sediments – comparison of sampling methods and granulometric fraction effects on elemental results, evaluation of sampling biases, recommendations for analytical fractions in prospecting, and statistical corrections for more robust geochemical interpretations (avoiding false positives/negatives). Available at: https://rigeo.sgb.gov.br/items/851dc263-185f-4f43-a7ce-5fb296a672e9
- Mineral Resource Evaluation and Metallogenetic Province Studies – synthesis of regional data to understand crustal evolution and metallogenetic controls, creation of multi-element anomaly maps, and proposals for mineral interest areas, as for example the manganese in the Carajás Mineral Province (Araújo Neto & Sousa, 2018). Available at: https://rigeo.sgb.gov.br/handle/doc/20421.
- The Thematic Projects *Lithium* and *Pegmatite Potential Assessment (2021–2026)* – series of reports evaluating lithium potential through integrating pegmatite, stream sediment (sampling

and chemical analysis) and mineralogical data, with mapping of Li-Cs-Rb anomalies, correlation with known pegmatite fields, and identification of prospective areas using multi-element indices and regional comparison patterns.

Articles published in scientific journals:

Pereira Da Costa, Alan; Cavalcante, Rogerio; Regina Rodrigues Domingos, Nitzschia; Meloni, Raul; Duarte Marques, Eduardo; Ferreira Da Silva, Guilherme; Leite Do Nascimento, Marcos Antonio; De Freitas Toledo, Poliana Iara; Carjoa Freitas Camara, Hismana, 2026. Prospectivity maps for polymetallic skarn and orogenic gold mineralization in the Rio Piranhas-Seridó Domain, Borborema Province (NE Brazil): An aid to exploration targeting. Journal of the Geological Survey of Brazil, v.9, p.1.4. https://doi.org/10.29396/jgsb.2026.v9.n1.4

Amarante R.T., Marques E.D., Ruchkys Ú.A., Silva-Filho E.V., Almeida G.S., Mello I. and Salomão G.N. (2025). Geochemical baseline and multivariate analysis of potentially toxic elements in stream sediments of the Vazante zinc district, Minas Gerais, Brazil. Front. Environ. Sci. 13:1684687. https://doi.org/10.3389/fenvs.2025.1684687

Medeiros Filho, Lucio Cardoso De; Salomão, Gabriel Negreiros; Dall'agnol, Roberto; Almeida, Gabriel Soares De; Amarante, Rafael Tarantino; Sahoo, Prafulla Kumar; Guimarães, José Tasso Felix; Silva Filho, Emmanoel Vieira Da ; Marques, Eduardo Duarte; Leão, Lucas Pereira ; Mendonça, Raquel Fernandes; Soares Junior, Abraão Gomes, 2025. Spatial distribution, potential sources and geochemical baseline of Fe and potentially toxic elements in stream sediments in Quadrilátero Ferrífero, Brazil. Applied Geochemistry, v.190, 106483. https://doi.org/10.1016/j.apgeochem.2025.106483.

Almeida, M. E., Santos, C.C., Larizzatti, J.H., Eberhardt, D.B., Melo, S.C., Moreira, A.P.C. 2024. A Synthesis of the National-Scale Geochemical Survey in the Last 50 Years in Brazil. Journal of the Geological Survey of Brazil 7(3), 263−275. https://doi.org/10.29396/jgsb.2024.v7.n3.3.

Marques, Eduardo Duarte; Castro, Cassiano Costa; De Assis Barros, Renato; Lombello, Júlio César; De Souza Marinho, Marcelo; Araújo, Joanna Chaves S., Santos, Everton A.M., 2023. Geochemical mapping by stream sediments of the NW portion of Quadrilátero Ferrífero, Brazil: Application of the exploratory data analysis (EDA) and a proposal for generation of new gold targets in Pitangui gold district. Journal of Geochemical Exploration, v. 250, 107232. https://doi.org/10.1016/j.gexplo.2023.107232.

A2.3.4. Chile

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

- Juan Pablo Lacassie Reyes (Chief Geologist; juan.lacassie@sernageomin.cl)
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- Felipe Astudillo Wells (Project geologist; felipe.astudillo@sernageomin.cl)

General Information

The Geochemical Map of Chile is a government programme that, since 2011, has been conducted by the Unit of Geochemistry of SERNAGEOMIN (Geological and Mining Survey of Chile). The objective of this programme is to promote sustainable growth in Chile by establishing geochemical baselines and identifying areas with potential mineral resources.

The Unit of Geochemistry is composed of 4 geologists (Figure A2.3.4.1), 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 (Figure A2.3.3.2).

Figure A2.3.4.1. Professionals of the unit of geochemistry: From left to right: Juan Pablo Lacassie (inset), Rafael Mardones, Felipe Astudillo and Pablo Oliva, during field work in the Atacama Desert (March 2021). Photograph by J.P. Lacassie.

Achievements and activities in 2025

During the year 2025, two official products were published:

1. **Regional study on REE geochemistry in the Los Ríos Region, southern Chile:** Lacassie, J.P., Mardones, R., Astudillo, F., Oliva, P., Barra, A., 2025. Geoquímica de tierras raras, región de Los Ríos, Chile. Servicio Nacional de Geología y Minería, Informe Registrado IR-25-122 (Inédito), Santiago, 123 pp.

2. **Geochemical map of the Vallenar Sheet**: Mardones, R., Lacassie, J.P., Oliva, P.; Astudillo, F., Creixell, C., Ortiz, M., Ramírez, C., 2025. Geoquímica de sedimentos de la Hoja Vallenar, regiones de Atacama y Coquimbo. Servicio Nacional de Geología y Minería, Carta Geológica de Chile, Serie Geoquímica 5, Santiago, 150 pp., 1 anexo.

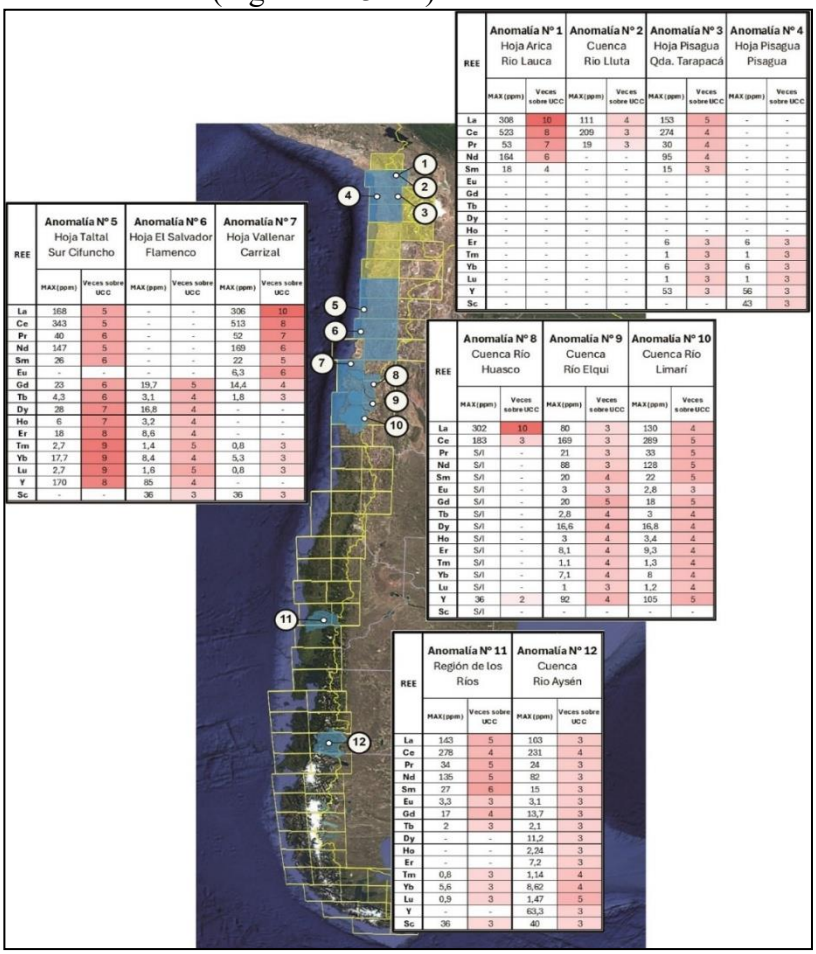
Additionally, the following achievements and activities stand out:

- Rare Earth Elements (REE) project.
- Geochemistry of residual soil of Chile (application of IUGS-CGGB Manual of Standard Methods procedures).
- Chile-Honduras and Chile-Republic of El Salvador cooperation projects.
- Cooperation agreement in geochemistry, between SERNAGEOMIN and Münster University.
- International and national meetings.
- Geochemical map of Latin America (GEGEOQ-ASGMI).
- First web-interactive geochemical Map: Vallenar Sheet, Chile.
- Geochemical sampling in northern (highlands) and southern (Bueno River Basin) Chile.
- Eight (8) theses in geochemistry associated with the geochemical programme.

All these activities are described in more detail below.

Rare Earth Elements (REE) project

The year 2025 marks the launch of the first national-scale geochemical studies focused primarily on rare earth elements (REE). In addition to the publication of the regional study by Lacassie *et al.* (2025), background information was generated to support the design of a multidisciplinary initiative to explore REE in Chile (Figure A2.3.4.2).



REE	Anomalía N° 1 Hoja Arica Río Lauca		Anomalía N° 2 Cuenca Río Lluta		Anomalía N° 3 Hoja Pisagua Qda. Tarapacá		Anomalía N° 4 Hoja Pisagua Pisagua	
	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC
La	308	10	111	4	153	5	-	-
Ce	523	8	209	3	274	4	-	-
Pr	53	7	19	3	30	4	-	-
Nd	164	6	-	-	95	4	-	-
Sm	18	4	-	-	15	3	-	-
Eu	-	-	-	-	-	-	-	-
Gd	-	-	-	-	-	-	-	-
Tb	-	-	-	-	-	-	-	-
Dy	-	-	-	-	-	-	-	-
Ho	-	-	-	-	-	-	-	-
Er	-	-	-	-	6	3	6	3
Tm	-	-	-	-	1	3	1	3
Yb	-	-	-	-	6	3	6	3
Lu	-	-	-	-	1	3	1	3
Y	-	-	-	-	53	3	56	3
Sc	-	-	-	-	-	-	43	3

REE	Anomalía N° 5 Hoja Taltal Sur Cifuncho		Anomalía N° 6 Hoja El Salvador Flamenco		Anomalía N° 7 Hoja Vallenar Carrizal	
	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC
La	168	5	-	-	306	10
Ce	343	5	-	-	513	8
Pr	40	6	-	-	52	7
Nd	147	5	-	-	169	6
Sm	26	6	-	-	22	5
Eu	-	-	-	-	6,3	6
Gd	23	6	19,7	5	14,4	4
Tb	4,3	6	3,1	4	1,8	3
Dy	28	7	16,8	4	-	-
Ho	6	7	3,2	4	-	-
Er	18	8	8,6	4	-	-
Tm	2,7	9	1,4	5	0,8	3
Yb	17,7	9	8,4	4	5,3	3
Lu	2,7	9	1,6	5	0,8	3
Y	170	8	85	4	-	-
Sc	-	-	36	3	36	3

REE	Anomalía N° 8 Cuenca Río Huasco		Anomalía N° 9 Cuenca Río Elqui		Anomalía N° 10 Cuenca Río Limarí	
	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC
La	302	10	80	3	130	4
Ce	183	3	169	3	289	5
Pr	S/I	-	21	3	33	5
Nd	S/I	-	88	3	128	5
Sm	S/I	-	20	4	22	5
Eu	S/I	-	3	3	2,8	3
Gd	S/I	-	20	5	18	5
Tb	S/I	-	2,8	4	3	4
Dy	S/I	-	16,6	4	16,8	4
Ho	S/I	-	3	4	3,4	4
Er	S/I	-	8,1	4	9,3	4
Tm	S/I	-	1,1	4	1,3	4
Yb	S/I	-	7,1	4	8	4
Lu	S/I	-	1	3	1,2	4
Y	36	2	92	4	105	5
Sc	S/I	-	-	-	-	-

REE	Anomalía N° 11 Región de los Ríos		Anomalía N° 12 Cuenca Río Aysén	
	MAX (ppm)	Veces sobre UCC	MAX (ppm)	Veces sobre UCC
La	143	5	103	3
Ce	278	4	231	4
Pr	34	5	24	3
Nd	135	5	82	3
Sm	27	6	15	3
Eu	3,3	3	3,1	3
Gd	17	4	13,7	3
Tb	2	3	2,1	3
Dy	-	-	11,2	3
Ho	-	-	2,24	3
Er	-	-	7,2	3
Tm	0,8	3	1,14	4
Yb	5,6	3	8,62	4
Lu	0,9	3	1,47	5
Y	-	-	63,3	3
Sc	36	3	40	3

Figure A2.3.4.2. Distribution and main characteristics of the 12 sectors with REE anomalies in Chile, detected using geochemical information generated by the Geochemical Programme of the SERNAGEOMIN. The tables show the maximum concentrations recorded in drainage sediment samples in the anomalous areas. The relative enrichment to the concentrations in the upper continental crust is also shown ("Veces sobre UCC"). Only enrichment values greater than 3 are displayed. Map sheets and river basins with geochemical data from published and ongoing projects are indicated by blue and yellow polygons, respectively (only in Chilean territory).

Geochemical study of the residual soil of Chile - Application of IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network

During 2025, the first study of residual soil in Chile was conducted using the methodology of the defined by CGGB in the ***IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network***. Preliminary results from this study, conducted in collaboration with the Austral University of Chile (UACH), were presented at the XV National Congress of Soil Sciences in Chile (Figure A2.3.4.3).

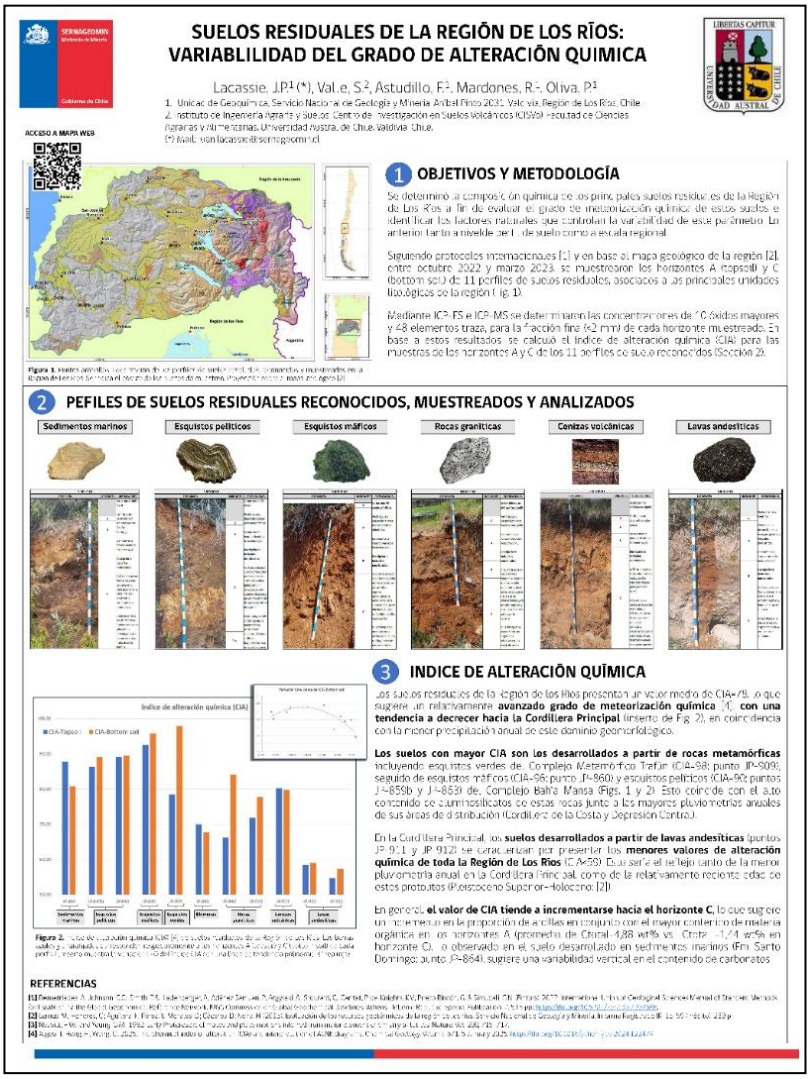


Figure A2.3.4.3. Screenshot of the poster presented at the XV National Congress of Soil Science in Chile (La Serena, October 2025). In addition to the poster, the paper titled "Residual Soils of the Los Ríos Region: Variability of the Degree of Geochemical Alteration" was also presented at the lecture session. This constitutes the first study of SERNAGEOMIN in the field of residual soil geochemistry in Chile.

Chile-Honduras cooperation project:

Given the positive results of the initial phase (2023-2024), the governments of Chile and Honduras have decided to extend the cooperation project between their geological and mining services, with a particular focus on geochemistry. The first mission took place in Honduras in December 2025 and included training in geochemical sediment sampling for professionals from INHGEOMIN (Honduras) and geology students from the National Autonomous University of Honduras (UNAH). The training focused on the environmental assessment of drainage systems impacted by mining tailings (Figure A2.3.4.4).

Figure A2.3.4.4. Training activities carried out in Honduras during Mission 1 of the Chile-Honduras cooperation project. (a) Isla del Tigre, Gulf of Fonseca: recognition of pyroclastic flows; (b) Sampling of mining tailings for geochemical and mineralogical evaluation; (c,e) recognition of lithologies associated with mineralised zones; (d) Petrography workshop of volcanic rocks, held at the National Autonomous University of Honduras (UNAH), and (f) geochemical sampling of drainage sediments, in La Tigra National Park, Valle de Los Ángeles. Photographs by Laura Bono and Juan Pablo Lacassie.

Chile-El Salvador cooperation project

The first mission of the Chile-Republic of El Salvador cooperation project was carried out in March 2025. During this mission, Rafael Mardones (Geochemistry Unit) and Paulina Vásquez (Regional Geology Unit) provided training to El Salvadorian professionals on all relevant aspects of geochemical sampling and data collection using smartphone applications (Figure A2.3.4.5).

Figure A2.3.4.5. Training activities carried out in El Salvador during mission 1 of the Chile - El Salvador cooperation project. (a) Sihuapilapa River, El Salvador: Geochemical sampling of river sediments; (b) Sihuapilapa Beach, El Salvador: Collecting geological information using smartphones; (c) Lempa River, El Salvador: Geochemical sampling of river sediments; (d) All participants in the training at the Puerta del Diablo viewpoint.

Cooperation agreement in geochemistry, between SERNAGEOMIN (Chile) and Münster University (Germany):

A cooperation agreement was signed between the two institutions in 2025. This agreement enabled the mineralogical analysis of drainage sediments collected in Chile as part of SERNAGEOMIN's Geochemical Map of Chile programme. These analyses will be carried out at the University of Münster from 2026 onwards. It is estimated that this will generate valuable insights into sedimentary processes in the Andean Range.

International and national meetings:

- Congress: XV Congreso Nacional de la Ciencia del Suelo: "Innovación en la Ciencia del Suelo para Enfrentar Desafíos Globales". Presentation by Juan Pablo Lacassie: "Alteración química de suelos residuales de la región de los ríos: factores naturales que controlan su variabilidad." October 2025 (Figure A2.3.4.6). Link: https://laplatina.inia.cl/schcs2025/
- ASGMI-Webinar: "Generando Información Geoquímica para la Sociedad". Presentation by Rafael Mardones: "Procedimientos de control de calidad de muestras en la exploración geoquímica - Metodología de SERNAGEOMIN Chile". November 2025 (Figure A2.3.4.6). Link: https://asgmi.org/wp-content/uploads/2025/11/00-Agenda-General.pdf
- III Jornada de Fortalecimiento de la Gestión de Información Geoespacial en Emergencias. Presentation by Pablo Oliva: "*Mapa Geoquímico de la Región de Arica y Parinacota: Resultados preliminaries*". Universidad de Tarapacá, Arica, November 2025 (Figure A2.3.4.6).

Figure A2.3.4.6. Photographs and presentations of some of the talks given by professionals from the Geochemistry Unit in 2025. (a) Presentation by Pablo Oliva: "Geochemical Map of the Arica and Parinacota Region: Preliminary Results". (b) Presentation by Juan Pablo Lacassie: "Chemical alteration of residual soils in the river region: natural factors that control their variability". (c) Presentation by Rafael Mardones: "Sample quality control procedures in geochemical exploration - SERNAGEOMIN Chile Methodology".

Geochemical map of Latin America (GEGOQ-ASGMI)

In the context of cooperation coordinated by the GEGEOQ-ASGMI Geochemistry Expert Group, the first geochemical maps of Chile were generated in 2025. These maps can be integrated into the Geochemical Map of Latin America. These maps were plotted using an established methodology

designed to generate geochemical maps on a continental scale. The initial development of this type of map in Chile was conducted as part of Mr. Jorge Mansilla's (Austral University of Chile) university practice, resulting in a report that included a guide for generating this type of cartography using ArcGIS software (Figure A2.3.4.7).

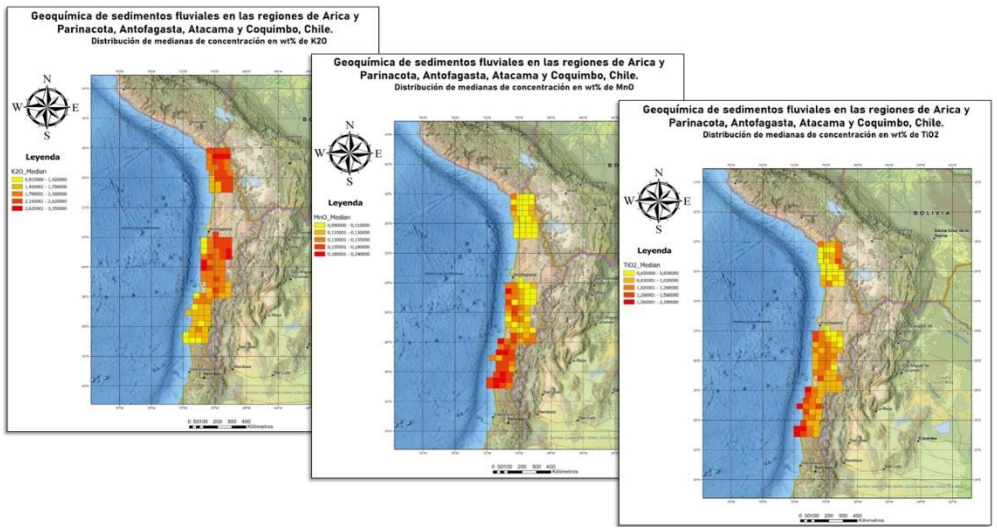


Figure A2.3.4.7. Examples of the first geochemical maps of Chile generated with the objective of integrating into the Geochemical Map of Latin America, coordinated by ASGMI-GEG.

First web-interactive geochemical map

The Vallenar Sheet geochemical map, developed in 2025, is the first of its kind to be produced in a fully digital format. This allows interaction with geochemical elements related to environmental and prospective aspects, including rare earth elements (Figure A2.3.4.8).

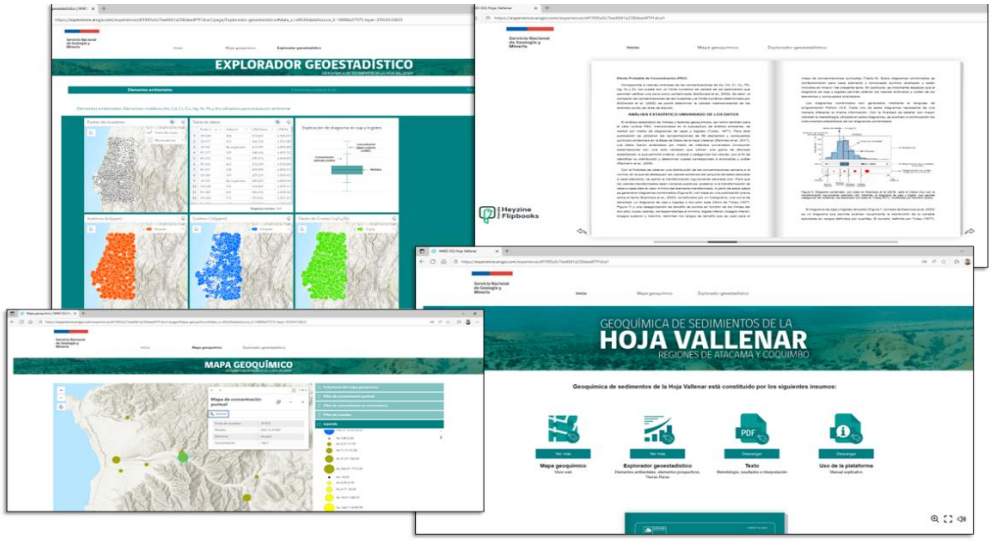


Figure A2.3.4.8. Geochemical map of the Vallenar Sheet in digital format. Different aspects of visualisation and interaction with geochemical data and with the main text.

Geochemical sampling of Chile

Five geochemical sampling campaigns were carried out during 2025. Four of these focused on the northern zone, including the Visviri, Collacagüa and Pisiga map sheets in the highlands, and the Tocopilla and Quillagüa map sheets in the Coastal Range, while the fifth focused on the southern

zone of the country (the Rio Bueno basin). The geological and geographical diversity of the sampled areas demonstrates the usefulness of a standardised geochemical sampling methodology (Figure A2.3.4.9).

Figure A2.3.4.9. Geographical conditions of the sampled areas during the year 2025. (a, c) Geochemical sampling in the Río Bueno basin, southern Chile. Access to many of the points requires the use of kayaking. (b, d, e) Geochemical sampling in the Altiplano area (Pisiga, Collacagüa and Visviri sheets). Average altitudes exceed 4,000 m above sea level. The presence of "bofedales" (b) is noteworthy. The "llareta" compact trees (d) are characteristic of altitudes between 3,200 and 4,800 metres above sea level. Photographs by Pablo Oliva and Juan Pablo Lacassie.

Eight (8) theses in geochemistry associated with the geochemical programme of SERNAGEOMIN

- **Carolina Olmedo (2025):** "Factores de control de concentraciones de tierras raras en sedimentos de drenaje de la Hoja Arica, Región de Arica y Parinacota, Chile". Geologist degree Thesis, Universidad Santo Tomás.
- **Camila Navarrete (2025):** "Caracterización ambiental-prospectiva en base a la geoquímica de los sedimentos fluviales de la Hoja Aguas Blancas, Región de Antofagasta, Chile". Geologist degree Thesis, Universidad Austral de Chile (Fig. 10).
- **Antonia Bravo (2025):** "Evaluación geoquímica ambiental de la cuenca del Río Lauca, Región de Arica y Parinacota, Chile". Geologist degree Thesis, Universidad Nacional Andrés Bello (Figure A2.3.4.10).
- **Francisco Correa (2025):** "Geoquímica de sedimentos de la Hoja Visviri, Región de Arica y Parinacota, Chile (17°30´- 18°00´S)". Geologist degree Thesis, Universidad Nacional Andrés Bello (Fig. 10).
- **Nicolás Cisternas (2025):** "Evaluación geoquímica ambiental de la cuenca del Río Rapel, Región del Libertador Bernardo O´Higgins, Chile". Geologist degree Thesis, Universidad Nacional Andrés Bello.
- **Ángela Barra (2025):** "Geoquímica de tierras raras en sedimentos fluviales en las Regiones de Los Ríos y la parte sur de la Araucanía, Chile". Geologist degree Thesis, Universidad Austral de Chile.
- **Aileen Venegas (2025):** "Evaluación ambiental basada en geoquímica de sedimentos fluviales: caso de estudio de la Hoja Taltal, norte de Chile". Geologist degree Thesis, Universidad Austral de Chile.

- **Andrea Valenzuela (2025):** “Evaluación medioambiental de la cuenca del Río Salado, Región de Atacama, en base a parámetros geoquímicos de sedimentos fluviales”. Geologist degree Thesis, Universidad Austral de Chile.

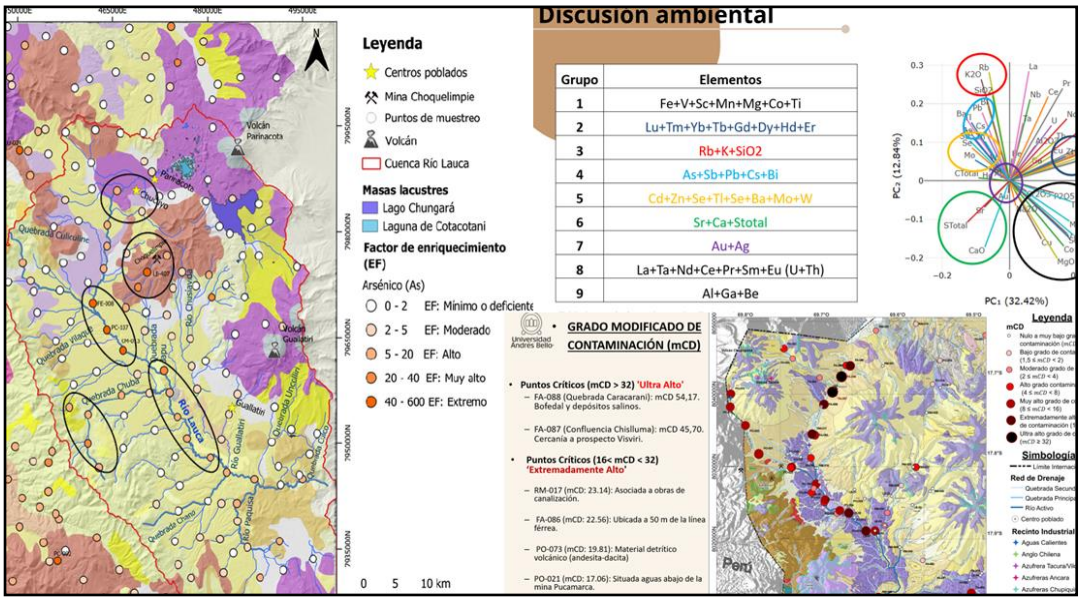


Figure A2.3.4.10. Images associated with the theses of Camila Navarrete (CoDa analysis, Aguas Blancas Sheet), Antonia Bravo (Enrichment Factor, Lauca River Basin) and Francisco Correa (Igeo index, Visviri Sheet).

A2.3.5. Colombia

Report by the specialists from the Geological Service of Colombia (Servicio Geológico Colombiano, SGC). Written by Johanna Duarte Ordónez (joduarte@sgc.gov.co) with the collaboration of Juan Fernando Jiménez, Leonardo Ceballos, Nicolás Duque, Gabriela Alzate, Sebastián Jiménez, Alexander Mateus, Giovanny Peña, Sebastián Bustos, Andrés Galindo, Derly Benítez and Adrián Pérez.

Introduction

In 2025, the Servicio Geológico Colombiano (SGC) made significant progress in regional geochemical and isotopic baseline studies by carrying out systematic field sampling campaigns in three key regions of the country. These activities involved collecting surface water, sediment, soil and rock samples in accordance with the SGC’s internal protocols. The corresponding chemical and isotopic analyses were carried out in specialised laboratories and are currently undergoing quality control and validation.

The objective of the studies conducted in 2025 was to establish and consolidate regional geochemical and isotopic baselines to improve understanding of the spatial and temporal distributions of chemical species across different environmental matrices. The projects sought to identify areas with natural or anomalous concentrations of potentially toxic elements, evaluate the influence of geological, hydrogeological, climatic and seasonal factors on their mobilisation and characterise the hydrogeochemical and isotopic processes associated with the hydrological cycle. Additionally, these studies aim to provide technical information to strengthen regional conceptual models, support comprehensive and responsible water and environmental management, and generate scientific reference data for future geoenvironmental assessments at a local scale.

Objectives of the studies

The studies conducted in 2025 had the shared objective of establishing and consolidating regional geochemical and isotopic baselines, with the aim of improving the understanding of spatial and temporal distribution of chemical species in different environmental matrices. The projects sought to identify areas with natural or anomalous concentrations of potentially toxic elements, evaluate the influence of geological, hydrogeological, climatic and seasonal factors on their mobilisation and characterise the hydrogeochemical and isotopic processes associated with the hydrological cycle. These studies also aimed to provide technical information to strengthen regional conceptual models, support comprehensive and responsible water and environmental management, and generate scientific reference data for future geoenvironmental assessments at a local level.

Projects carried out during 2025

Definition of the geochemical and isotopic baseline in the Quindío Alluvial Fan

The project covered an area of approximately 2,768 km², including parts of the departments of Quindío, Risaralda, and Valle del Cauca (Figure A2.3.5.1). In 2025, a sampling campaign of surface waters and active stream sediments was conducted during the rainy season. The collected samples constitute the basis for defining the geochemical and isotopic baseline of the alluvial fan and its relationship with geology, hydrogeology, seasonality, and element mobilisation processes.

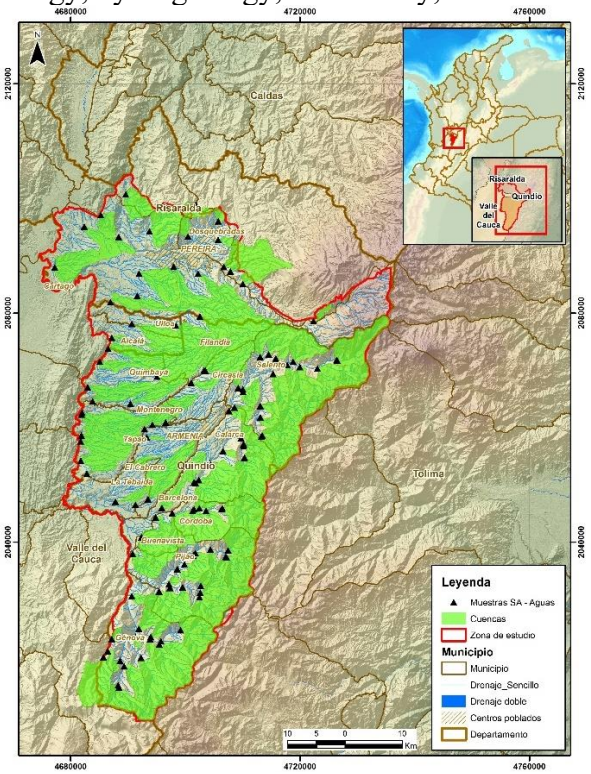


Figure A2.3.5.1. Distribution of water and active stream sediment samples collected in the Quindío study area.

Geochemical and isotopic baseline in the Bogota Hydrological Region

This project covered the Bogotá River basin, including approximately 52 municipalities in the upper and middle basins of the Cundinamarca department (Figure A2.3.5.2). In 2025, progress was made in the systematic sampling of surface waters and active stream sediments, with emphasis on areas influenced by urban, agricultural, mining, and industrial activities. The information obtained will allow the characterisation of the regional geochemical baseline and evaluation of the influence of natural and anthropogenic factors on environmental quality.

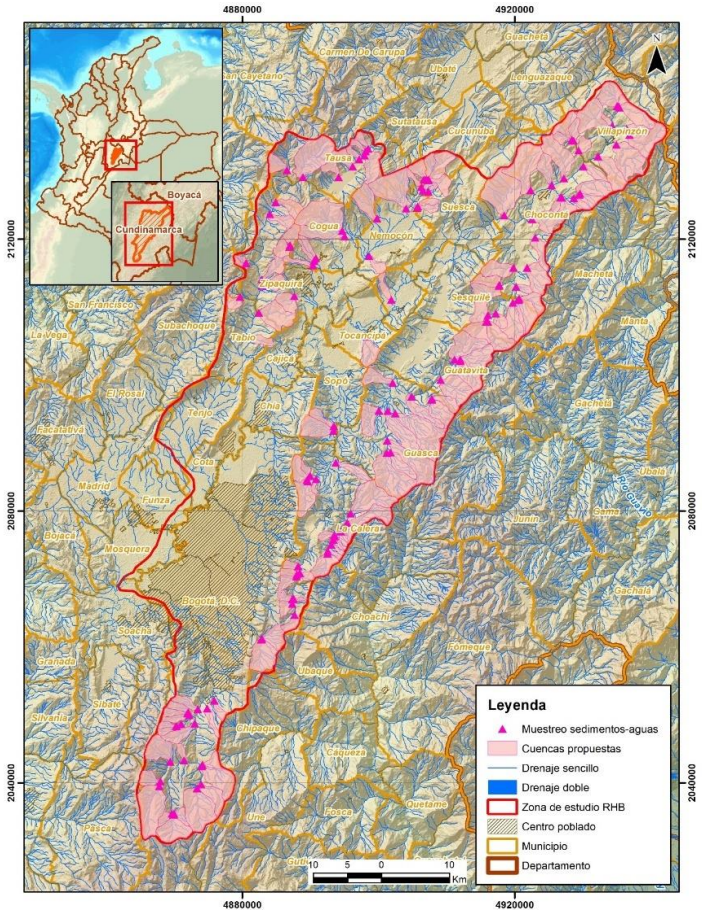


Figure A2.3.5.2. Distribution of water and active stream sediment samples collected in the Bogotá Hydrological Region study area.

Geochemical and isotopic baseline in the Cartago – Ibague sector

The study area covers approximately 1,360 km² on both sides of the Central Cordillera, including parts of the Valle del Cauca, Quindío and Tolima departments (Figure A2.3.5.3). In 2025, a sampling campaign of surface waters and active stream sediments was conducted during the rainy season. Interpreting these data will enable us to establish a geochemical baseline and evaluate the influence of seasonality, evaporation and moisture sources on the regional isotopic signal.

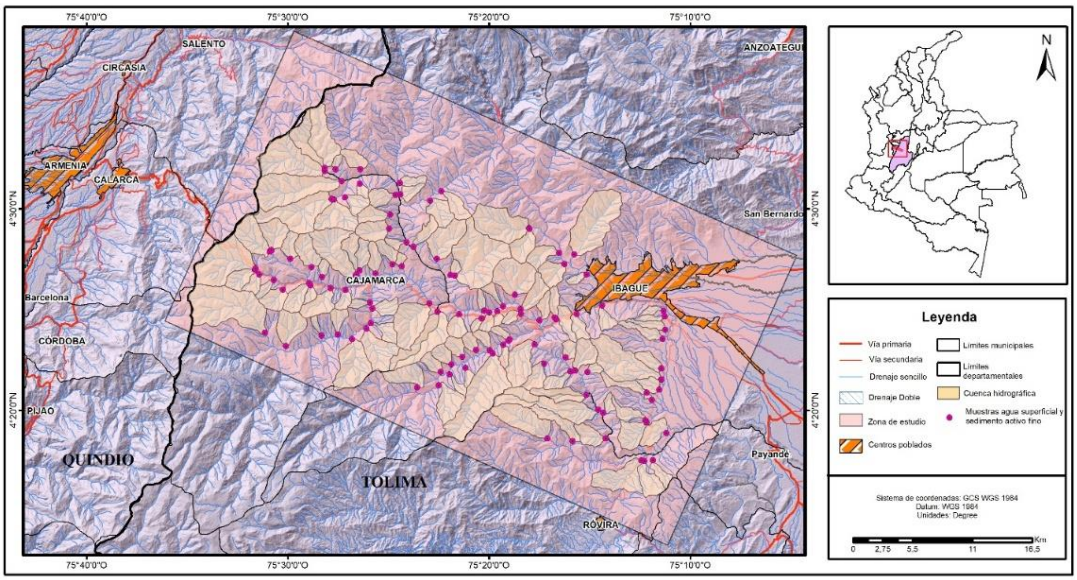


Figure A2.3.5.3. Distribution of water and active stream sediment samples collected in the Cartago-Ibague study area.

Current status

By the end of 2025, all three projects had successfully completed the fieldwork phase, achieving the collection of a robust and comparable data set of environmental matrix samples obtained under homogeneous methodological criteria. The chemical and isotopic analyses are currently undergoing quality control and validation, prior to the integrated interpretation of the results, the definition of regional baseline values, the identification of spatial and temporal patterns, and the preparation of the final technical reports and cartographic products.

A2.3.6. Cuba

Report by the specialists from the Institute of Geology and Palaeontology/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)

Under a Collaboration Agreement with the China Geological Survey (CGS), the Institute of Geology and Palaeontology/Cuba Geological Survey (IGP/SGC) has been conducting multi-element, multi-purpose geochemical mapping. This work is governed by a unique methodology, from projection to the edition of geochemical maps of global geochemical relevance. Sampling has been carried out at three scales:

- **Global Geochemical Mapping (ultra low density):** 177 sampling points, collecting 354 soil samples (top and deep) on a 40 × 40 km grid. Samples analysed for 76 chemical elements.
- **National Level:** 1101 sampling points on a 10 × 10 km grid, collecting 1101 stream sediment samples. Samples analysed for 69 chemical elements.
- **Regional Level:** 3001 sampling points on a 1.5 × 1.5 km grid, collecting 3001 stream sediment samples. Samples analysed for 39 chemical elements.

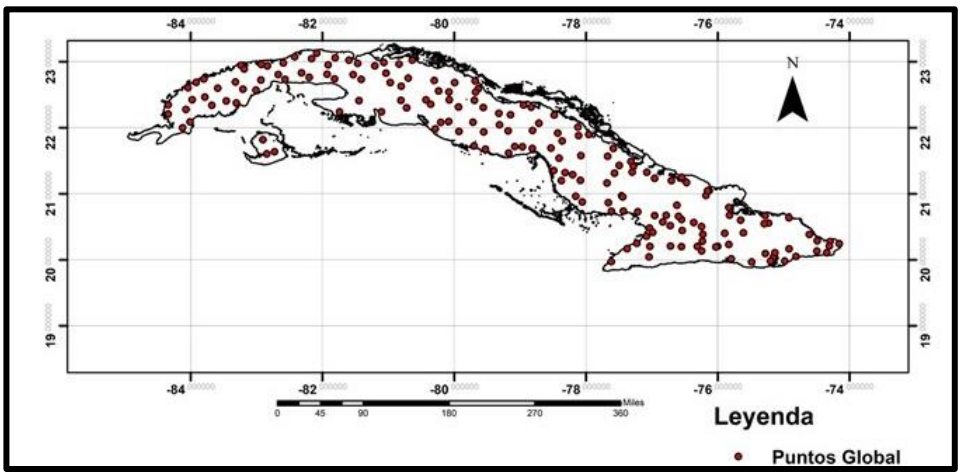


Figure A2.3.6.1. Global Level 177 sampling points for collecting top and deep soil samples.

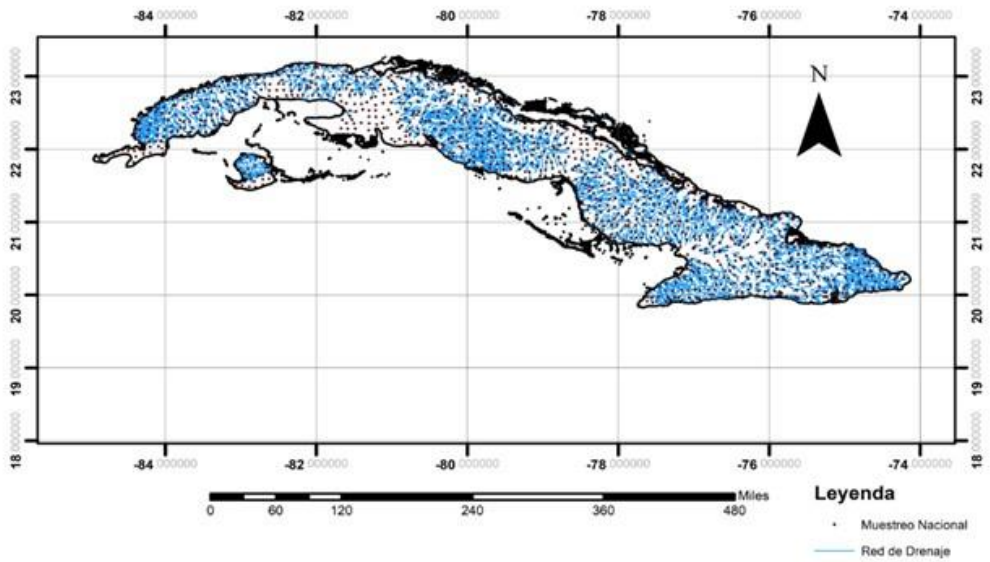


Figure A2.3.6.2. National Level. In total, 1101 sampling points were used for collecting stream sediment samples.

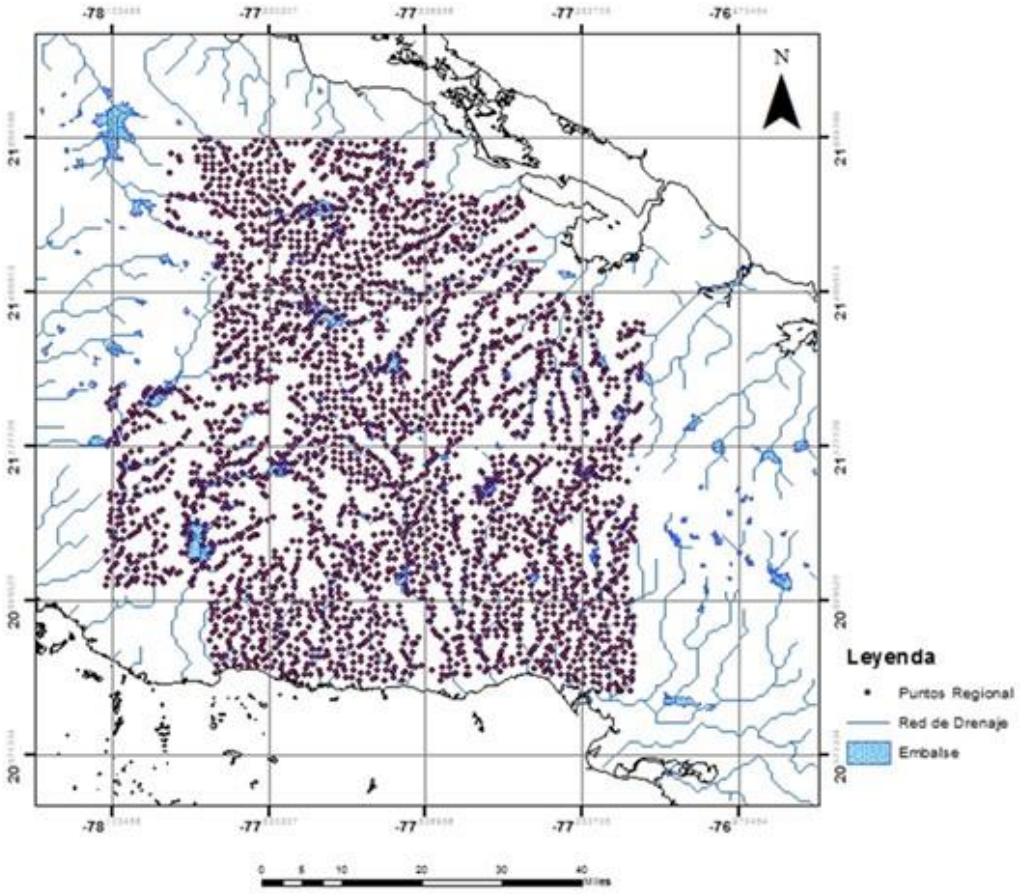


Figure A2.3.6.3. Regional Level. In total, 3001 sampling points were used for collecting stream sediment samples.

Sampling is currently being carried out simultaneously at global and national scales with 324 soil samples (top and deep) and 453 stream sediment samples collected.

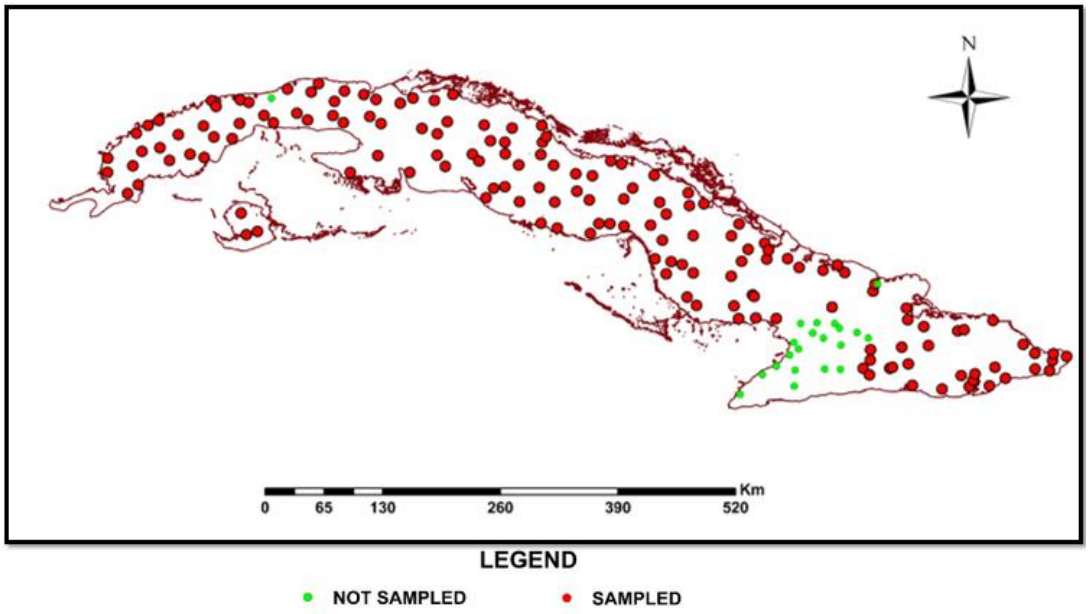


Figure A2.3.6.4. Global level sampling.

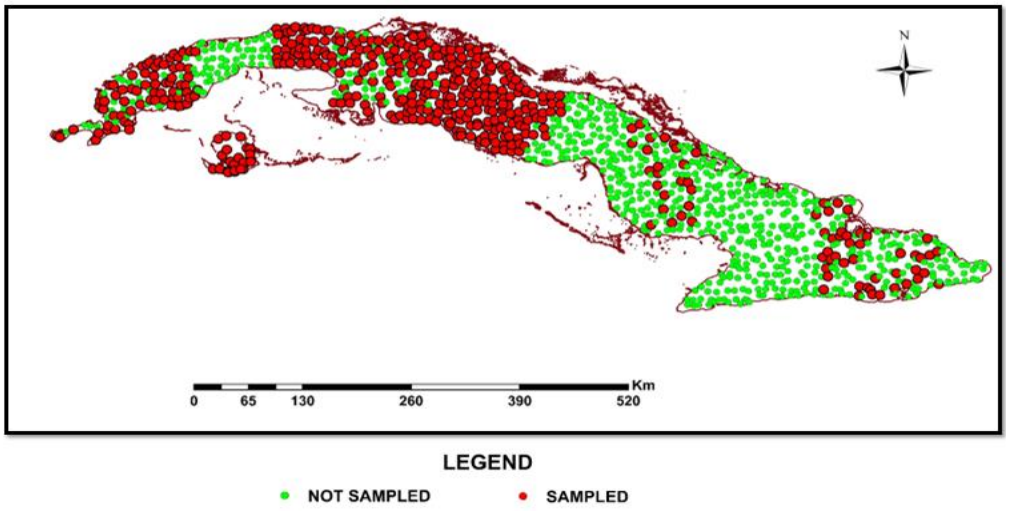


Figure A2.3.6.5. National level sampling.

Samples are prepared in Cuban laboratories and analysed in China using high-precision equipment with low detection limits, such as XRF and ICP-MS. The results are then processed and interpreted jointly by Cuban and Chinese specialists.

Results

To date, Cuba has sent 506 samples to China for analysis. China has returned results for 157 stream sediment samples analysed with the 69-element package. A preliminary review of these results revealed significant geochemical anomalies of scientific and economic interest.

Geochemical Mapping Workshop held in Cuba

In August, a delegation of Chinese specialists from the Institute of Geophysical and Geochemical Exploration (IGGE) visited Cuba as part of the Cuba–China International Cooperation Project. The visit included tours of the IGP/SGC and LACECMI laboratories, as well as a workshop for Cuban specialists from multiple institutions. Topics addressed were:

- The significance of geochemical mapping in China and worldwide.

- Applications in health, environmental pollution, mitigation, agriculture, and mineral exploration.
- Practical field training on correct procedures for sample collection and data capture.

Participants were:

- Chinese delegation: Dr. Zhou Jian, Dr. Bai Jinfeng, Eng. Guo Xinwei, Eng. Sun Wenlong.
- Cuban delegation: MSc. Jorge Lázaro Mulet Álvarez (Director, IGP/SGC), Dr. Xiomara Casañas Díaz (General Director, Department of Mineral Deposits, IGP/SGC), Dr. Enrique Armando Castellanos Abella (Director of Geology, MINEM), Eng. Raynel Alberto Herrera Molina (Project Leader).

Sampling Sheet for Global Geochemical Baselines

Soils and Sediments (drainage basin/overbank/floodplain sediments)

№ _____

Global grid: 1:200000/250000 map sheet: Top sample ID: Deep sample ID:

Sample Site Location: Province City/County Town/tumur/village/

Coordinates: Longitude ° ′ . ″, Latitude ° ′ . ″ altitude m

Site landscape/topography: 1、 plain; 2、 mountains/hills; 3、 lake; 4、 5、wetland

Land use: 1、agriculture; 2、grassland/pasture; 3、forest; 4、wetland; 5、Gobi; 6、sand desert; 7、other, specify

Possible contaimination sources: 1、agriculture; 2、industry; 3、mining; 4、habitant, 5. other, specify

Catchment area (km^2): <1000; 1000-2000; 2000-4000; 4000-6000; 6000-8000; 8000-10000; Sample location to river: m

Bedrock geology: 1. outcrops, specify 2. No outcrops

Sample type: 1. stream sediments; 2. overbank sediments; 3. floodplain sediments; 4. delta sediments; 5. lake sediments, 6. farmerland soils 7. grassland soils; 7、Gobi/desert soils; 8、loess soils; 10、other, specify

Colors: 1、white; 2、light grey; 3、grey; 4、dark grey; 5、black; 6、brown; 7、red-brown; 8、red; 10、orange; 11、yellow; 12、light yellow; 13、other, specify

Grain size: 1、Clay (-0.002mm); 2、silt (0.002-0.02); 3、sand (0.2-2.0 mm)

Sampling profile: depth (m): soil layers: water table depth:

Organic mater: 1、no; 2、low; 3、middle; 3、high salt: 1、no; 2、low; 3、middle; 4、high

Top sample				Deep sample			
Sampling depth(cm)	color	Grain size	Soil horizon	Sampling depth (cm)	color	Grain size	Soil horizon

Samplers: registrar: supervisor:

date: yy mm dd weather:

Figure A2.3.6.6. Geochemical data field sampling sheet.

Figure A2.3.6.7. Field training photograph. The Chinese specialists were demonstrating the procedures for collecting soil samples.

Conclusions

Cooperation between Cuba and China in geochemical mapping has enabled standardised methodologies to be applied across different sampling and analytical scales. This collaborative effort will produce valuable data for the geological sciences, while also strengthening technical and institutional capabilities. This will provide a robust basis for future research in environmental monitoring, mineral exploration and agricultural applications.

A2.3.7. Ecuador

Report by Mgs. Fernanda Dayana Andrade Mantilla (fernanda.andrade@geoenergia.gob.ec), Instituto de Investigación Geológico y Energético.

No activities have been reported this year.

A2.3.8. Peru

Report by: Cesar De La Cruz (cdelacruz@ingemmet.gob.pe), José Armando José Amado (jamado@ingemmet.gob.pe), Igor Espinoza (iespinoza@ingemmet.gob.pe), (INGEMMET - Geological Mining and Metallurgical Institute of Peru).

The National Geochemistry Programme of the Geological, Mining and Metallurgical Institute of Peru has completed global-scale soil studies across Peruvian territory and is continuing its regional-scale rock studies.

Soil geochemistry

The national soil geochemistry report, which will serve as the first geochemical baseline for soil in Peru, was completed in 2024. The study covered everything from sample collection to the analysis and interpretation of the geochemical distribution of the main elements (Ag, As, Cd, Cu, Cr, Pb, Zn and rare earth elements) in the Andean Orogen and the Amazonian Plain (Figure A2.3.8.1).

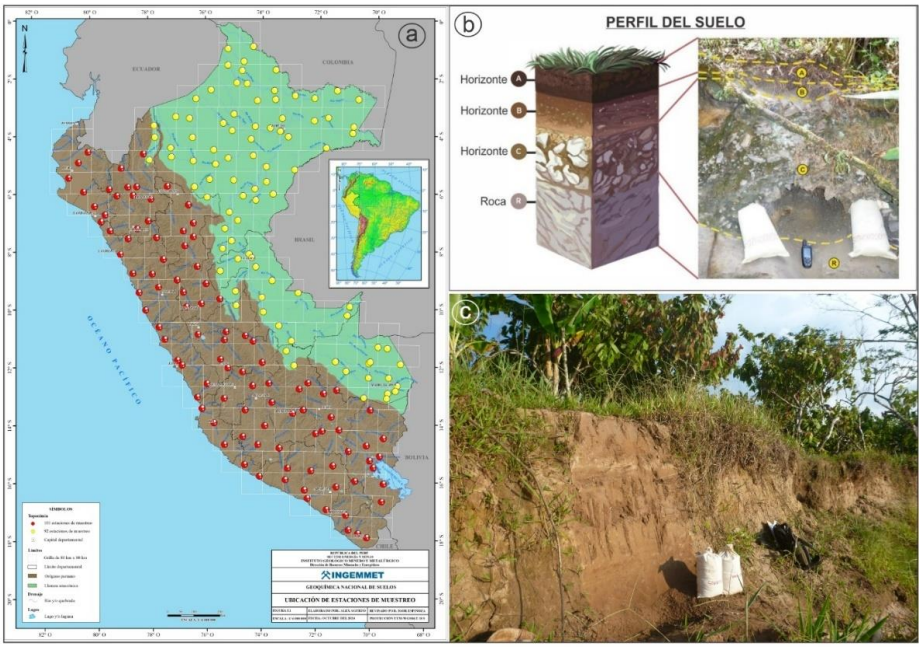


Figure A2.3.8.1. (a) Location of the samples collected in the Peruvian territory; (b) schematic soil profile (surface and deep horizon); (c) Soil profile and surface and deep soil sample collected in the district of Nuevo Progreso, San Martín region.

The study highlights the highest concentrations of geochemistry recorded in the surface soil of the Andean Orogen (2,180 ppm of zinc (Zn), 533 ppm of arsenic (As), 7.1 ppm of mercury (Hg), 4.5 ppm of cadmium (Cd), 131 ppm of lithium (Li), 2.8% of magnesium (Mg) and 689.59 ppm of total rare earth oxides (TREO)) and the Amazonian Plain (27 ppm of scandium (Sc)). These values are comparable to those found in deep soil in the Andean Orogen (2,431.7 ppb of Au, 94.3 ppm of Ag, 671 ppm of Cu, 5,981 ppm of Pb, 7.2 ppm of Mo, 260.2 ppm of Sb, 1,666 ppm of Ba, 108 ppm of Ni, 109 ppm of Co, 6.5 ppm of U, 66 ppm of W, 329 ppm of V, 8.3% of Fe and 0.3% of Mn) and in the Amazonian Plain (163 ppm of Cr). Mineralogically, quartz is the most abundant primary mineral in surface soil. Regarding secondary minerals, calcite (7.3%) is predominant in the soil of the Peruvian Orogen, and kaolinite (3.8%) in the Amazonian Plain.

Rocks

The study, titled 'Magmatism and Geochemistry of the Eastern Cordillera Batholith in Central Peru: Its Relationship with Strategic Elements and Areas of Prospective Interest', was conducted between 2023 and 2025. A total of 332 samples were collected at an approximate density of one sample per 4 km², and analysed at the laboratory of the Geological, Mining and Metallurgical Institute (INGEMMET). The Eastern Cordillera essentially consists of granitoids (Figure A2.3.8.2) and scattered outcrops of gabbro and diorite. The chemical analysis revealed high concentrations of rare earth elements in the studied region, including lanthanum (1,255.2 ppm), cesium (860.6 ppm), neodymium (791.2 ppm), yttrium (398 ppm) and gadolinium (221 ppm). Additionally, a total rare earth oxide (TREO) content of up to 0.48% was recorded, alongside significant concentrations of chromium (1,579 and 2,571 ppm) and nickel (912 and 2,260 ppm).

Figure A2.3.8.2. Syenogranite of the San Ramón Pluton located on Gavilán Hill, Junín region. (a) Halos of white clays surrounding quartz veinlets with oxides; (b) veins and veinlets of quartz with oxides arranged in a parallel to subparallel manner.

In 2025, the study "*Geochemical Prospecting of the W-Mo-Cu-Sn-Li Mineral System of Peraluminous Magmatism in the Áncash and La Libertad Regions*" was underway. Sampling was carried out in the intrusive units of the Cordillera Blanca Batholith as well as in the Jurassic and Cretaceous siliciclastic and carbonate sedimentary sequences. This study is well advanced and is currently in the results interpretation and geochemical map generation stage.

The geochemical databases are freely accessible and can be found on the GEOCATMIN platform, available at the following link: https://geocatmin.ingemmet.gob.pe/geocatmin/

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)

The main activities of the Environmental Geochemistry and Radioecology Departments at the Center for Ecological-Noosphere Studies (CENS), National Academy of Sciences of the Republic of Armenia, during the 2024–2025 period include continuing soil geochemical surveys across Armenia's regions and conducting baseline studies on various soil parameters from different areas.

1. With state budget funding, the **regional-scale soil survey of the Vayots Dzor region** was completed in 2024–2025, while the **soil survey of the Tavush region** of Armenia started. Overall, 80% of the country's territory is now covered. The Syunik region, one of Armenia's largest mining districts, remains under consideration and is scheduled for soil sampling within the next 1-2 years. In addition, measurements of other soil parameters, including pH, SOM, soil magnetic susceptibility, and soil texture, are underway using the soil bank from regional surveys. These efforts aim to establish a unified data set for the comprehensive geochemical characterisation of the studied territories.

   In studies related to urban areas, the local-scale (16 samples per 1 km2) soil geochemical survey data set for Vanadzor city was subjected to multivariate statistical analysis. The results revealed three geochemical associations of the studied chemical elements (i) V, Ti, Mn, Fe and Ba; (ii) Ca, K, Zr, Sr and Rb; and (iii) Cr, Zn, Cu and Pb. The elements included in the (i) and (ii) groups were identified as having a natural origin. Elements in the (iii) group showed high and very high contamination levels, suggesting a predominant anthropogenic origin for these elements in the city soil. Relatively high contents (>75%) of Cr, Zn, Cu and Pb were linked to the Ca, while in areas where elements with natural origin, Fe was found to be predominant (Tepanosyan *et al.*, 2025).

2. Between 2024 and 2025, soil samples from agricultural land in the Ararat Valley and Lori region of Armenia were analysed for a broad range of chemical elements (Na–U), including rare earth elements (REEs), using X-ray spectroscopy (Rigaku NEX DE), as part of two national projects (24FP-4C006 and 24LCG-1E008). These studies revealed areas with comparatively higher concentrations of lanthanum (La) and cerium (Ce). Additional sampling will be conducted at these sites in 2026, including vertical soil profiles, and the samples will undergo chemical analysis by ICP-OES/MS to obtain a complete list of REEs. Using data on arsenic (As) content in soil from the Lori region, three baseline levels were established and their application areas identified (Poghosyan *et al.*, 2025). Regarding the Ararat Valley (Armenia), the first geochemical characterisation of P content in agricultural soil was conducted, and baseline values were established (Pipoyan *et al.* 2025).

3. Background activity of naturally occurring radionuclides: ^{226}Ra, ^{232}Th, ^{40}K and reference activity of ^{137}Cs in the soil of Armenia were estimated in 2024-2025 using a judgemental sampling design. The topography of Armenia is characterised by mountainous terrain and heterogeneous geology, posing significant challenges for conducting large-scale geochemical surveys, including the assessment of radionuclide background levels. It was, therefore, assumed that altitude-oriented sampling transects established across mountain ridges and massifs, each representing key geological formations, would provide sufficiently informative

data for an initial evaluation of background and reference radionuclide activity in soil. A total of 131 undisturbed soil samples were collected from eight mountain ranges and massifs across Armenia. Radionuclide activity concentrations were quantified using HPGe detector–based gamma spectrometry. The parent rock and soil types were considered as the primary factors shaping soil radionuclide composition. Comparable estimates of background activity for naturally occurring radionuclides were obtained using both the "Median±2MAD" and Tukey's boxplot approaches. Depending on the objectives of the study, results from either method may be used as background values. As the distribution of ^{137}Cs showed a strong altitudinal gradient, its reference activity concentrations were determined for distinct elevation bands using the "Median±2MAD" method Pyuskyulyan *et al.* 2025.

4. Radioecological investigations were further extended on the Aragats Massif. The assessment of the vertical distribution of radionuclides (^{40}K, ^{226}Ra, and ^{232}Th) in soil and river sediments showed statistically consistent activity concentrations across different soil depths. This supports the idea that these radionuclides are of geogenic origin rather than products of significant vertical migration. The observed mean eTh/eRa ratio, which closely matches the global average, indicates limited leaching processes and supports the preservation of soil profile integrity under weakly oxidising conditions. In river sediments, natural radionuclide activity varied with respect to hydrodynamic conditions, with higher levels recorded in fast-flowing mountain rivers such as Kasagh, Gegharot, and Mantash. These elevated concentrations are likely driven by intensified mechanical erosion and weathering of radionuclide-bearing parent rocks in the upper catchments, combined with sediment transport processes. Notably, despite the proximity of the Metsamor River to residential areas and potential agricultural inputs, including potassium fertilisers containing 40K, this river showed the lowest activity levels of all measured radionuclides (Movsisyan *et al.*, 2025).

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Acknowledgment
The research was supported by the RA MESCS Higher Education and Science Committee in the frame of the state budget funding (Geochemical studies of the environment in different regions of Armenia), as well as research project №24FP-4C006 (Comprehensive geochemical characterisation of Ararat valley soils: unveiling the potential of rare earth elements for grape traceability), №24LCG-1E008 (Comprehensive geochemical characterisation of Rare Earth Elements in the soil of the Lori Province: application of compositional data analysis and machine learning (CompREES), №20AA-1E017 (Innovative approaches to assessing the radioecological situation of Aragats massif: Radionuclide background and baseline, migration and risk) #18T-1E311 (Radioecological Monitoring in Armenia: Phase II).

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.

No activities reported this year.

A2.4.3. India

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

New geochemical maps for India are being prepared for the bottom soil. An atlas for the entire country was prepared a couple of years ago, and now work is going on to prepare the atlas for India for the bottom soil samples

A2.4.4. Japan

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

No activities reported this year.

A2.5. AUSTRALASIA

A2.5.1. Australia

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

Accelerating Development of Australia's Rare Earth Resources

As part of the Australian Critical Minerals Research and Development Hub, Geoscience Australia is undertaking the *Accelerating Development of Australia's Rare Earth Resources (ADARER)* project. The objective of this project is to accelerate the discovery, extraction, and processing of rare earth element (REE) deposits, including clay-hosted REE deposits and heavy mineral sands. To support this goal, Geoscience Australia is developing mineralogical understanding at a national-scale through quantitative mineral identification (using X-ray Diffraction; XRD), including clay speciation, on two legacy sediment sample sets: the *National Geochemical Survey of Australia* (NGSA) and the *Northern Australia Geochemical Survey* (NAGS).

To date, no empirical national-scale maps of regolith mineralogy are available in Australia. While satellite-derived mineralogical proxy products (*e.g.*, ASTER, Landsat, Sentinel) exist, they

require on-the-ground validation. In this context, catchment outlet sediments collected over 80% of the continent as part of NGSA (and a regional case study of a smaller area covered by NAGS) afford a unique opportunity to rapidly and cost-effectively determine regolith mineralogy using archived sample material. These data are due to be released in March 2026.

Pilot Project – Industry Geochemistry

A pilot project between Geoscience Australia, RSC, and the Geological Survey of Western Australia has been undertaken to maximise the value of industry-collected geochemical data. Across Australia, the state and territory geological surveys store vast quantities of geochemical data that have been collected from mineral exploration companies. Due to the scale of this data and the fact that they have been analysed by multiple methods, laboratories, and over a large time period, means the quality of this data is uncertain. The goal of this project was to develop a standardised data structure, clean and validate the data, and build automated workflows that are robust and repeatable.

The pilot study was focused on whole-rock (four-acid or full digestion/fusion) samples analysed using ICP-MS and/or XRF/ICP-AES/ICP-OES since the year 2000. Using a python script the data were checked using statistical metrics and expected reasonable geochemical values. Any data that was flagged by this process could then be followed up by the relevant data custodian. The pilot project started with 30,813,963 drillhole samples with multielement geochemistry, which was reduced to 9,063,997 following the workflow.

The pilot project report, code, and data are expected to be released early next year, with continuing work to move the project to a national scale.

A2.5.2. New Zealand

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

No activities have been reported this year.

A2.6. EUROPE

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

The report was prepared by the 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). Refer to Appendix 1.

A2.6.2. Romania

This report was prepared by Valentina Cetean (valentina.cetean@yahoo.com) and George Dinca (georgedinca@rocketmail.com), Geological Institute of Romania.

Geochemistry International Conferences Participation

Tabara D., Chelariu C., Nicoara I., Francovschi I., Tambur A., 2025. Palynostratigraphy and correlation of Carboniferous microflora from some subsurface sections in Eastern Europe (Romania and southern Ukraine). Conference: 57th Annual Meeting AASP - The Palynological Society. At: Maroc, Rabat

Dumitras D.-G., Duliu O., Luffi P., Marincea S., Smaranda D., Radășanu S., Iancu A., Perșa D., 2025. Comparative analysis of gypsum from four different deposits of Badenian age in Romania. Conference: EGU General Assembly 2025, At: Vienna, Austria DOI: 10.5194/egusphere-egu25-10131.

Smeu A., Francovschi I., Grytsenko V., Nicoara I., CIBOTARI A., Charushnikava H., 2025. Urban palaentology and geoheritage in Ukraine: The Ediacaran record from the city of Mohyliv-Podilskyi. Conference: International Scientific Symposium GEO-IAȘI 2025, At: Iași, Romania

Geochemistry-related projects

- **Occurrences and accumulations of critical and common raw materials associated with metamorphic events in Romania**, 2023-2026: Project funded by the Ministry of Education and Research through the Core Programme, with the Geological Institute of Romania as the contractor (contract no. 34N/2023, project code PN 23 39 02 03).
- **Alluvial sediments: tool for lanthanide exploration and improved forecasting of critical high technology resources,** 2023-2026: Project funded by the Ministry of Education and Research through the Core Programme, with the Geological Institute of Romania as the contractor (contract no. 34N/2023, project code PN 23 39 02 04).
- **Emerging energy recovery technologies developed to cancel out salinity gradients – blue energy (CENERG-BLUE)**, 2023-2026: Project funded by the Ministry of Education and Research through the Core Programme, with the Geological Institute of Romania as the contractor (contract no. 34N/2023, project code PN 23 39 02 02).
- **Assessment of the impact of anthropogenic activities on soils in the Șureanu Mountains** 2023-2026: Project funded by the Ministry of Education and Research through the Core Program, with the Geological Institute of Romania as the contractor (contract no. 34N/2023, project code PN 23 39 04 02).

There are also several contracts with commercial companies in which the GeoEcoLab Laboratory has done geochemical analyses.

Geochemistry-related publications

Dincă G., Popescu G.C.; Topa D., 2025. Decoding the mineralogy and geochemistry of sulfosalts in the Săcărâmb Au-Ag-Te ore deposit (Romania): Unveiling a fresh insight into the evolution of a complex hydrothermal system. Ore Geology Reviews, 176, 106424. https://doi.org/10.1016/j.oregeorev.2024.106424

Gawęda A., **Munteanu M.**, Šiliauskas L., Kupczak K., Chew D., Waśkowska A., Szopa K., Belskyy V., **Pantia A.-I.**, Marciniak-Maliszewska B., Jokubauskas P., 2025. *Connecting East with West: constraining polygenetic Variscan – to post-Variscan metamorphism in the Marmarosh/Maramuresh Massif, Ukraine/Romania*. Geological Magazine, 162. https://doi.org/10.1017/S0016756824000542.

Lőrincz S., Munteanu M., Marincea Ș., Roban R. D**., Cetean V. M., Dincă G**., Melinte-Dobrinescu M., 2025., The Exotic Igneous Clasts Attributed to the Cuman Cordillera: Insights into the Makeup of a Cadomian/Pan-African Basement Covered by the Moldavides of the Eastern Carpathians, Romania. Geosciences, 15(7), 256. https://doi.org/10.3390/geosciences15070256.

Neagoe A., Manu M., Onete M., Mihai L.S., **Dincă G.**, Jianu D., Stelian I., Iordache V., 2025. Increasing the fungal inoculation of mine tailings from 1 to 2% decreases plant oxidative stress and increases the soil respiration rate. Sci Rep **15**, 30030 https://doi.org/10.1038/s41598-025-14973.

Sirbu-Radasanu D., Huzum R., **Dumitraș D.G.**, Stan C., **Marincea S.**, 2025. *Soil geochemistry and manganese contamination risk in the abandoned mining area – Eastern Carpathians*. Environmental Geochemistry and Health, 47. https://doi.org/10.1007/s10653-025-02836-8.

Stoicescu D., **Dumitraș D.G., Duliu O.**, Zinicovscaia I., **Dinca G.**, Necula C., Dinca I. Culicov O., **Pantia A., Marincea S.**, (2025) *Chemical and mineralogical analysis of a basaltic lava from Reykjanes peninsula: a comparative multi-analytical approach*. Romanian Reports in Physics. https://doi.org/10.59277/romrepphys.2025.77.707.

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).

No activities have been reported this year.