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**2021  
ANNUAL REPORT**

*of the*

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

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January 2022

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**2021 ANNUAL REPORT of the  
IUGS COMMISSION ON GLOBAL GEOCHEMICAL BASELINES**

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

## **1. TITLE OF CONSTITUENT BODY**

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

## **2. OVERALL OBJECTIVES**

The mission of the Commission is to:

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

The global geochemical database is urgently needed by environmental and natural resource managers throughout the world. To reach this goal, the Commission established an international network of applied geochemists throughout the world in order to provide standards for global-scale geochemical mapping. The Commission also promotes and facilitates the implementation of harmonised sample collection, preparation, quality control, and analysis protocols for geochemical mapping programmes.

Commission activities include:

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

### 3. RELATED GOALS TO OVERALL IUGS SCIENTIFIC OBJECTIVES

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

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

### 4. STRUCTURE AND ORGANISATION

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

#### 4.1. STEERING COMMITTEE

The Commission's [Steering Committee members](#) for the 2020-2024 period are:

*Co-Chairs: 1<sup>st</sup> Co-chair:* Anna Ladenberger, Geological Survey of Sweden

*2<sup>nd</sup> Co-chair:* Kate V. Knights, Consultant Geochemist, Dublin, Ireland

*Deputy-Chairs: 1<sup>st</sup> Deputy-chair:* Gloria Prieto, Servicio Geológico Colombiano

*2<sup>nd</sup> Deputy-chair:* Gloria Simubali, Geological Survey of Namibia

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

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

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

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

Patrice de Caritat, Geoscience Australia

Alecos Demetriades, Institute of Geology and Mineral Exploration, Hellas

#### 4.2. SAMPLING COMMITTEE

*Chair:* Alecos Demetriades, Hellas

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

#### 4.3. ANALYTICAL COMMITTEE

*Chair:* Gwendy Hall, Canada

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

#### **4.4. DATA MANAGEMENT COMMITTEE**

*Chair:* Timo Tarvainen, *Finland*

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

#### **4.5. PUBLIC RELATIONS AND FINANCE COMMITTEE**

*Chair:* Ariadne Argyraki, *Hellas*

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

#### **4.6. REGIONAL REPRESENTATIVES**

##### **4.6.1. Africa**

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

Marthinus Cloete, Council for Geoscience, Pretoria, South Africa

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

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

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

##### **4.6.2. America - North**

David Smith, United States Geological Survey, Denver, USA

Robert G. Garrett, Ottawa, Ontario, Canada

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

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

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

##### **4.6.3. America - South**

Carlos Alberto Lins, CPRM - Geological Survey of Brazil, Recife - PE, Brazil

João H. Larizzatti, CPRM – Geological Survey of Brazil, Rio de Janeiro, Brazil

Juan Pablo Lacassie Reyes, Servicio Nacional de Geología y Minería, Valdivia, Chile

Gloria Prieto, Servicio Geológico Colombiano, Bogotá, Colombia

##### **4.6.4. Australasia**

Patrice de Caritat, Geoscience Australia, Canberra, Australia

Adam Martin, GNS Science, Avalon, Lower Hutt, New Zealand

##### **4.6.5. China**

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

##### **4.6.6. Europe**

Philippe Négrel, Bureau de Recherches Géologiques et Minières, Orléans, France

Anna Ladenberger, Geological Survey of Sweden, Uppsala, Sweden

Jasper Griffioen, Geological Survey of The Netherlands (TNO), Utrecht, The Netherlands

#### 4.6.7. Indian Subcontinent

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

#### 4.6.8. Japan

Atsuyuki Ohta, Geological Survey of Japan, AIST, Tsukuba, Japan

## 5. INTERACTION WITH OTHER INTERNATIONAL ORGANISATIONS

### 5.1. UNESCO INTERNATIONAL CENTRE ON GLOBAL-SCALE GEOCHEMISTRY

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

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

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

*7.1. Apply the standardised global-scale geochemical methods developed by the IUGS Commission on Global Geochemical Baselines, so as to document the concentration and spatial distribution of chemical elements in the various environmental compartments of the Earth's surface, and to establish global geochemical baselines for monitoring future geochemical changes;*

*7.2. Foster the implementation of global geochemical baseline programmes by securing funds, managing and coordinating these activities according to the scientific guidelines, determined by an External Advisory Committee cooperating with the IUGS Commission on Global Geochemical Baselines.*

After the October 2018 meeting of the UNESCO Centre's Governing Board and Scientific Committee (refer to the [2019 Annual Report](#)), it was expected that the collaboration between the Centre and the Commission was going to be smooth as five of the Commission's 2016-2020 Steering Committee members are also members of the Centre's Governing Board and Scientific Committee, and the Centre's Executive Director was the 2<sup>nd</sup> Co-chair of the Commission until 2020. However, this expectation was finally proved to be deceptive. There is minimal communication and collaboration between the Centre and the Commission. The Centre does not even inform its international Governing Board and Scientific Committee members of its activities except for once every two years just before the scheduled biennial meeting of the Governing Board and Scientific. After almost six years of the Centre's operation, the hope that the situation will change is, unfortunately, extremely doubtful. The dismay of the international Councillors was expressed during the 3<sup>rd</sup> Session of the Governing Board and Scientific Committee, which was held virtually on the 10<sup>th</sup> of December 2021 (see [Appendix 2](#)).



The majority of the international Councillors voted against the acceptance of the biannual ICGG report, and the approval of the application to UNESCO for the renewal of the agreement for another six years. Two international Councillors abstained in both counts.

As the work that was carried out by ICGG was dictated by the interests of China Geological Survey, and the international Councillors were never consulted during the operation of the ICGG from 2016 to 2021, the recommendation is for IUGS not to support the application of China Geological Survey for the renewal of the agreement with UNESCO. The ICGG can continue its work under the auspices of China Geological Survey as it has done for the past six years. For additional information [Appendix 2](#) should be consulted.

## 5.2. INTERFACE WITH OTHER INTERNATIONAL ORGANISATIONS

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

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

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

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

In 2021, members of the EGS GEG and GGB Commission have joined technical working groups at [EUSO](#) (European Soil Observatory) ([Appendix 3](#))

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

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

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

The Commission submitted in August 2015 a joint proposal entitled '*Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity building phase*' to the Group on Earth Observations ([AfriGEOSS](#)) in collaboration with the [EGS Geochemistry Expert Group](#), the [Geological Society of Africa](#) and the [Organisation of African Geological Surveys](#). In August 2017, it became obvious that the GEO Group on Earth Observations is not a funding platform, and funding should be sought from other sources. Hence, the AfriGEOSS proposal was discussed with the EGS Secretary General, and Philippe Négrel, Chairperson of the EGS Geochemistry Expert Group discussed with the AfriGEOSS capacity building programme in Phase II of PanAfGeo.

[PanAfGeo2](#) has started in 2021 and is a continuation of the well-established [PanAfGeo](#). Project objectives are to develop a set of knowledge and best practices in exchange programmes for African geoscientists to acquire the state-of-the-art tools and learn new methods and skills in several geoscientific competences. Maria João Batista, a Commission member, is this time in charge of coordination of WP-B – Mineral Resources Assessment (see [Appendix 3](#)).

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

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

In South America, the Commission has established in 2019 a link with the Geochemistry Working Group of the Asociación de Servicios de Geología y Minería Iberoamericanos (ASGMI: <http://asgmi.org/en/>).

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

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

#### **5.2.1. New collaboration link with FAO's GLOSOLAN project**

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

GLOSOLAN's main objectives are:

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

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

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

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

In 2019, the Commission initiated contact with the Global Observatory on Pollution and Health. The Global Observatory was established in 2018 as a collaborative effort among Boston College, the United Nations Environment Program, and the Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health. The primary goal of the Global Observatory is to track efforts to control pollution and prevent pollution-related diseases. Mapping will be an important function of the Global Observatory. Data collected from various sources will be geocoded and entered into a Geographic Information System model for each country. Global-scale geochemical data sets from the

IUGS Commission on Global Geochemical Baselines are a potentially important source of information for the Global Observatory. These data sets will provide a better understanding of the natural variation of potentially toxic elements in the Earth's near-surface environment and will provide a baseline against which future changes in the geochemistry caused either by human activities or natural processes may be recognised. Brief articles about the Global Observatory can be found at <https://www.bc.edu/bc-web/centers/schiller-institute/programs/global-observatory-on-pollution-and-health.html>, and <https://www.unenvironment.org/news-and-stories/press-release/un-environment-and-boston-college-establish-global-pollution>.

## **6. ACTIVITIES IN 2021**

### **6.1. STEERING COMMITTEE VIRTUAL MEETING**

One virtual Steering Committee meeting was organised on the 27<sup>th</sup> of May 2021, which was chaired by the 1<sup>st</sup> Co-chair Anna Ladenberger. At this meeting all the members of the Steering Committee participated together with all the advisory panel members. The minutes of this meeting are in [Appendix 1](#).

### **6.2. OTHER MEETINGS AND WORK PERFORMED**

#### **6.2.1. Monthly IUGS e-Bulletin publication**

Since May 2021 the IUGS E-Bulletin editorial team encouraged Commissions, Task Groups and Initiatives to send a concise report of their activities. The Commission has responded almost every month that had any news to transmit. The contributions are in the following [E-Bulletins](#):

- [IUGS E-Bulletin No. 175](#) – June 2021 (p.3)
- [IUGS E-Bulletin No. 176](#) – July 2021 (p.5-6)
- [IUGS E-Bulletin No. 177](#) – August 2021 (p.4)
- [IUGS E-Bulletin No. 178](#) – September 2021 (p.4-5)
- [IUGS E-Bulletin No. 181](#) – December 2021 (p. 6)

The Commission would like to acknowledge Gurmeet Kaur, Giuseppe di Kapua and Dolores Pereira for doing a great communication job.

#### **6.2.2. CoDA Workshop (virtual) – 18<sup>th</sup> November 2021**

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

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

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

The recorded video of the workshop is available to watch on the CGGB YouTube channel: [https://youtu.be/8ILd\\_hDnAok](https://youtu.be/8ILd_hDnAok). The 6 workshop presentations (Figure 1), as well as a selection of related bibliographic references, are available for download from the CGGB website by using the following hyperlink: <https://www.globalgeochemicalbaselines.eu/content/129/workshops/>

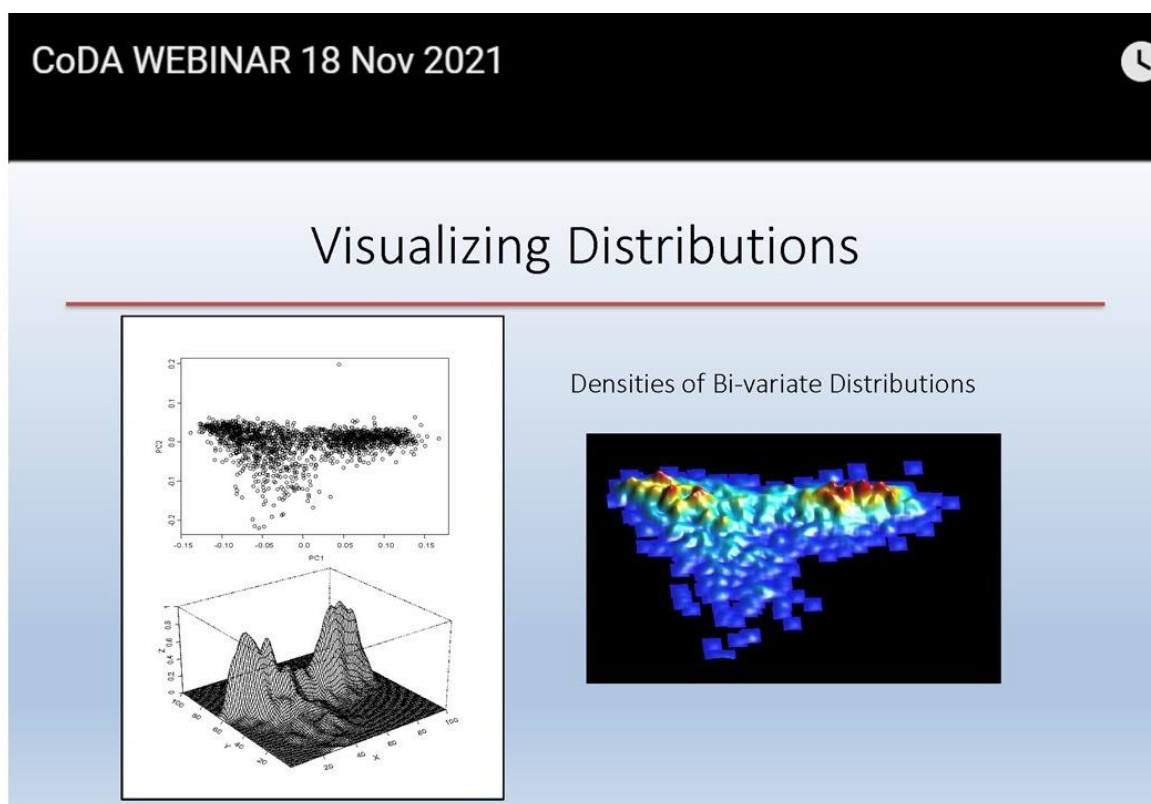


Figure 1. Screenshot of CoDa webinar presented by Eric Grunsky and Michael Greenacre.

## 6.3. INTERNATIONAL CONFERENCES: SESSIONS AND WORKSHOPS

### 6.3.1 Spread of information regarding relevant events

The Commission is acting as a networking channel among Societies, Universities, Institutes, *etc.* by spreading information about their activities to all CGGB members. During 2021, the Commission has circulated information for the following events:

- ✓ 26 January: Virtual roundtable on the inclusion of Environmental, Social and Governance (ESG) factors in reporting of mineral deposit estimates and exploration results, within the Horizon 2020 funded INFACCT project.
- ✓ 12-26 February: Critical Minerals Forum sessions organized by the Geological Survey of Canada, Geoscience Australia, and the United States Geological Survey, [www.americangeosciences.org/webinars/critical-minerals-forum-2021](http://www.americangeosciences.org/webinars/critical-minerals-forum-2021)
- ✓ 17 June: CoDAWork 2021 virtual conference, <https://www.coda-association.org/en/online-coda-day-2021/>
- ✓ 11 February: EFG webinar “Prospect Generator Business Model” <https://www.eventbrite.be/e/prospect-generator-business-model-tickets-139619161671>



- ✓ 24 February: EFG Webinar “Mineral resources of Sweden”, organised by the European Federation of Geologists
- ✓ 8 April: “EU Strategy to Secure Access to Mineral Raw Materials” organised by the European Federation of Geologists.
- ✓ 27-28 April: Webinar CRMs in NE Europe
- ✓ 4 May: Compositional Data Analysis Seminar. Analysing pairwise logratios revisited approach
- ✓ 11 May: Webinar “Career Pathways for Geoscientists Using GIS”, organised by the American Geosciences Institute.
- ✓ 4 June: Webinar "Towards Zero pollution: Launch of the Global Assessment of Soil Pollution", organised by FAO's Global Soil Partnership.
- ✓ 28 June: Webinar on Critical Minerals Mapping Initiative, organised by the American Geosciences Institute.
- ✓ 30 July: 9th International Conference on Medical Geology MEDGEO 2021
- ✓ 12 October: IMGA invitation: WEBINAR "Toxins and Treasures – A Medical Geology Story.
- ✓ 15 December: SEGH workshop for the Asian region “E-waste pollution and public health”

### 6.3.2. 36<sup>th</sup> International Geological Congress, Delhi, India, 2-8 March 2020

Due to the Covid19 pandemic situation in 2020 the 36<sup>th</sup> International Geological Congress in Delhi was postponed to begin with for 2021, and subsequently was cancelled. The Congress registration fees were reimbursed partially in August 2020, but other costs such as hotel, visa, *etc.* were not refunded (see for the CGGB has not been refunded so far (see [Section §10](#) for additional details).

### 6.3.3 Goldschmidt 2021 (Virtual)

The IUGS Commission on Global Geochemical Baselines (CGGB) together with the Geochemistry Expert Group (GEG) of EuroGeoSurveys organised a session entitled “[Geochemical mapping at all scales for all reasons](#)” under Theme 12 “*Environmental Geochemistry and Human Health*” at the Goldschmidt 2021 conference, which was held as a virtual conference this year due to the COVID-19 pandemic. The session was chaired by Philippe Négrel (GEG Chair) and Anna Ladenberger (1st Co-Chair of CGGB and GEG Deputy Chairperson). The main topic of the session was systematic geochemical mapping and its methodology to document the spatial variation of chemical elements in geomaterials occurring at or below the Earth's surface, *i.e.*, rock, soil, sediment, stream water, groundwater, and vegetation. The resulting geochemical databases have a wide range of applications, including mineral exploration, agriculture, forestry, land use planning, environmental monitoring, medical and forensic science, *etc.*

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

It is worth mentioning that the keynote lecture given by Patrice de Caritat (Geoscience Australia and member of CGGB Advisory Panel) gained enormous media attention and several articles about geochemical mapping applications to forensics were published during

and shortly after the conference. The presentation was selected as one of only eight talks among over 1000 presentations by the [conference press centre](#) for a [media release](#). The Goldschmidt press release was widely disseminated, including by [Science Magazine](#), [Eos Magazine](#), [Forensic Magazine](#), [Technology Networks](#), [National Geographic \(Spain\)](#), [Forbes](#), [Radio Canada](#) and other media outlets in Australia, Europe, the USA, and Asia.

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

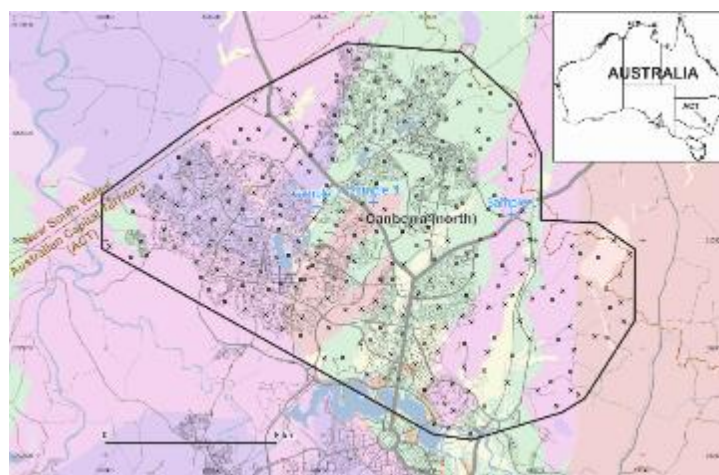


Figure 2. Simplified geological map of north Canberra, showing the location of the soil geochemical survey samples (black crosses) and of three simulated provenancing (blind) samples (blue plusses).

#### 6.4. MANUAL OF STANDARD METHODS FOR ESTABLISHING THE GTN

The work on the ‘*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*’ is at the final stage of revision. All chapters have been reviewed by two external reviewers, and presently are under technical revision, according to their comments and subsequently final editing.

The plan is to complete the manual, if possible, in the first couple of months of 2022 in order to be submitted for publication approval at the pending March 2022 meeting of the IUGS Executive Committee.

#### 6.5. GLOBAL BLACK SOIL PROJECT

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

1. [International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project](#) by Alecos Demetriades, Dai Huimin, Liu Kai, Igor Savin, Manfred Birke, Christopher C. Johnson and Ariadne Argyraki, which was published in 2020 after the approval by the IUGS-EC on its 74<sup>th</sup> meeting in Busan of South Korea on the 17<sup>th</sup> of January 2020, and
2. [First glimpse of the geochemistry of European Black Soil by using the GEMAS agricultural and grazing land soil data sets](#) by Alecos Demetriades, Manfred Birke,

The first presentation was to inform all Workshop participants that the Manual of Standard Methods for the Global Black Soil Project has been published, and the outstanding issues that should be tackled before the project can start (see [Section §6.5.1](#)).

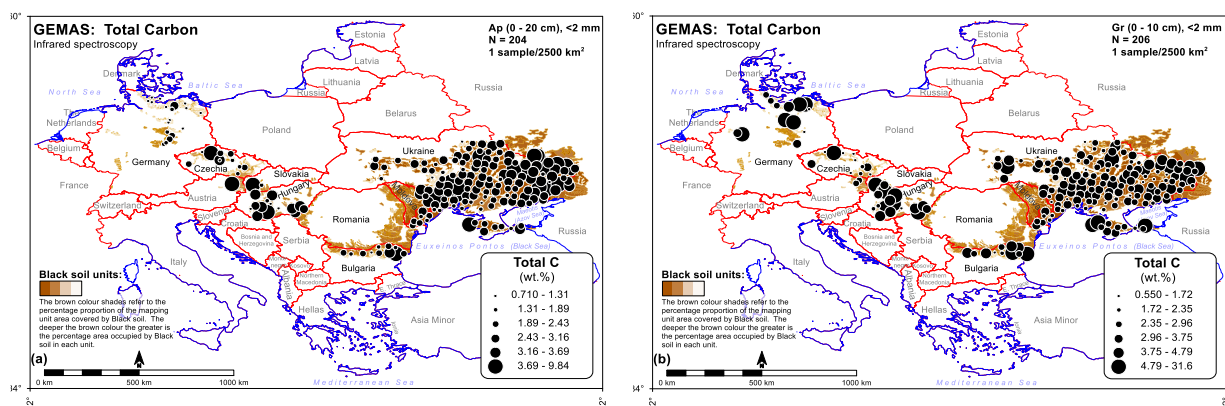


Figure 3. The two maps show the distribution of Total Carbon in (a) agricultural and (b) grazing land soil samples. The results are from the [EuroGeoSurveys Geochemistry Expert Group](#)'s project on the [geochemistry of agricultural and grazing land soil](#) with the acronym [GEMAS](#). Map plotted with Golden Software's [MapViewer™ v8](#) by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.

### 6.5.1. Requirements that must be fulfilled by the Shenyang Centre of CGS

The requirements that should be fulfilled before the start of the Global Black Soil project are now in the hands of the Shenyang Centre of China Geological Survey. They were presented and discussed at the 3<sup>rd</sup> Black Soil Workshop in November 2019, and have been repeated at the 4<sup>th</sup> virtual Black Soil Workshop in 2021, and these are:

- 1) Preparation of two large Black Soil project reference samples – Secondary Reference Materials (SRMs). The recommendation was the preparation of two 1000 kg SRMs, finally two 100 kg SRMs were prepared, and they now need to undergo an international ring test, and for this purpose the Commission has contacted laboratories in other countries. It is hope that the international ring test will be carried out in 2022.
- 2) Preparation of one large Black Soil project blank reference sample. This has not been prepared, and remains a requisite.
- 3) Compilation of a detailed protocol of the analytical methods that will be used for the analysis of the Black Soil project samples. This has not been prepared, and remains a requisite.
- 4) Decision where the Global Black Soil project samples are going to be prepared, and permanently stored. This is another important requisite, and the recommendation, following discussions, with other Commission members is that the sample preparation must be carried out in an agreed single facility, otherwise it will be very difficult to control the quality of sample preparation.
- 5) Decision where the Global Black Soil project samples are going to be analysed, and by which analytical methods and for which determinands. The samples are supposed to be analysed at the laboratories of the Shenyang Centre of China Geological Survey. However, the laboratory procedures that will be used need to be discussed and finalised.
- 6) Purchase of field and laboratory equipment by the Black Soil Project Management, and distribution to all participating countries. This condition is still outstanding, and will be



tackled when the number of participating countries and number of field sampling teams is known.

- 7) Field training of representatives from each participating country, and start of field sampling campaign with a deadline to be agreed. This condition is still outstanding and cannot proceed until conditions 1 to 5 are fulfilled.

## 6.6. COMMISSION'S WEBSITE

The [Commission's website](#) is updated on a regular basis. On checking the statistics of visits to the website, it was discovered that Google Analytics were not installed on each webpage during the redesigning of the website in 2018. So, the Web design company was asked to install Google Analytics on each web page, and also to add a pale yellow colour to the dropdown menus in order to be visible. This work was done in October 2020 at no cost. Figure 4 shows the Google Analytics statistics for 2021.

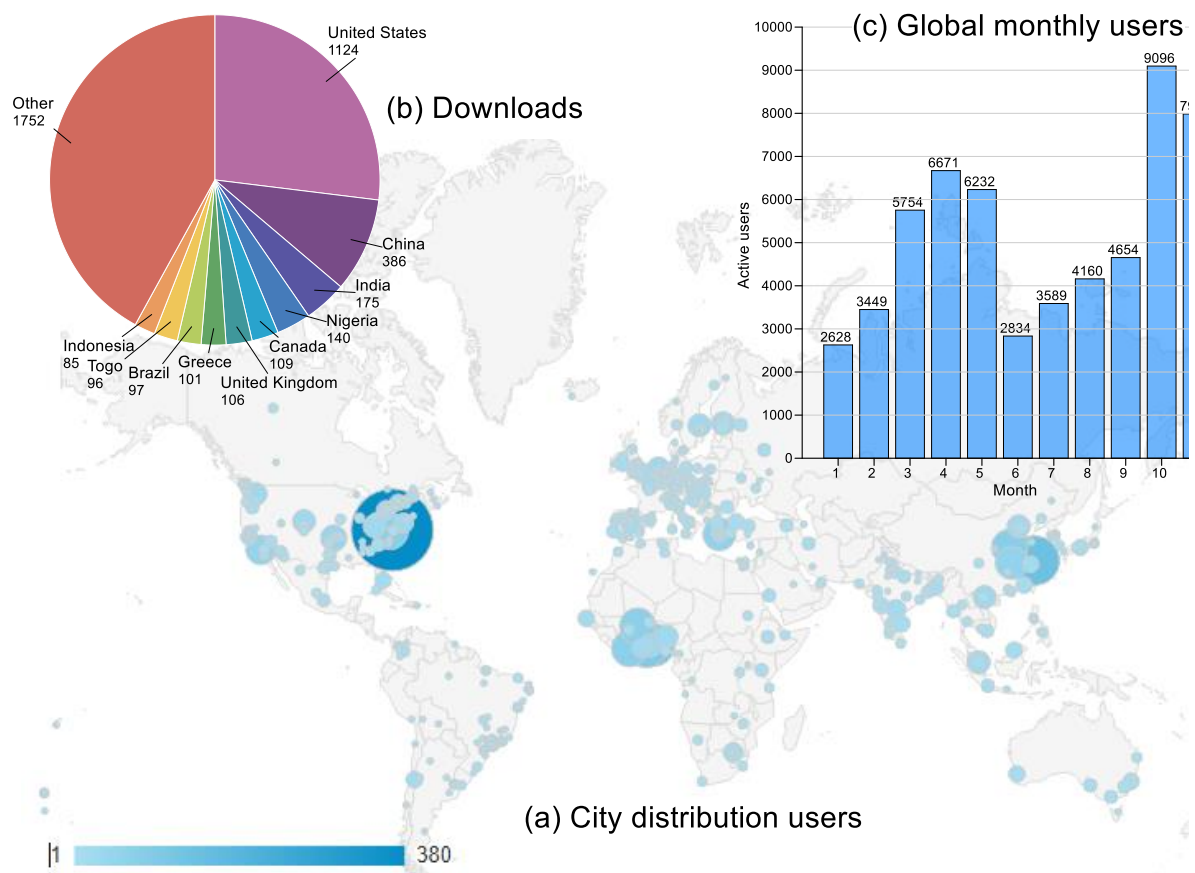


Figure 4. Shows (a) a screen shot of Google Analytics city location map of sessions from the 1<sup>st</sup> of January to the 31<sup>st</sup> of December 2021; (b) a pie chart of the total country downloads and (c) Global monthly users. The global distribution of the 4,153 users from 73 countries and 1047 cities is quite impressive.

## 6.7. WORK OF COMMISSION'S COMMITTEES

### 6.7.1. Sampling, Analytical & Data Management Committees

During 2021 members of the Sampling, Analytical and Data Management Committees were and still are busy in the revising of the relevant chapters of the *'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network'* according to the recommendations of the external reviewers (see [section 6.4](#))

### **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 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. During 2021 with the reviewing of Chapter 7 on 'Quality Control Procedures' by the two external reviewers the '[ROBCOOP4](#)' by Ramsey (1998) has been revised according to their recommendations.

Program 'Merge' combines two files by using the same identification code, *e.g.*, (a) file with sample number and site coordinates with (b) file with analytical data. Program 'ROBCOOP4' by Ramsey (1998) uses robust balanced analysis of variance (RANOVA) to estimate the total measurement uncertainty and also to quantify the contributions to that uncertainty arising from the processes of primary sampling and chemical analysis, the sampling and analytical variance, respectively. This is a useful program for testing the quality of analytical data.

All programs with instructions and their source codes will be made freely available from the Commission's website directly after the publication of the '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*'.

### **6.7.2. Public Relations and Finance Committee**

The Public Relations and Finance Committee's main work was the updating of the Commission's website in collaboration with the web hosting company where necessary. For example, (a) the visual improvement of drop-down windows, (b) the uploading of some files to the web server.

In the work schedule is included still the exploitation of a few options for obtaining sponsorships. However, due to the Covid-19 pandemic, and the problems caused to many potential sponsors this work was postponed to better future times.

The Public Relations and Finance Committee also informed all Commission members about webinars and conferences of interest as is indicated in [Section §6.3.1](#).

Constant updates of all Commission's activities as well as links to related topics of other organisations are also uploaded on the social media pages of CGGB (Twitter: [@CGGB\\_IUGS](#) and Facebook: [@CGGBIUGS](#)). A steady increase of follower numbers is noted for 2021, reaching 119 (+17) followers in Twitter, and 577 (+113) followers in Facebook. We also made CGGB's debut in YouTube with the [CoDA webinar](#) upload on the Commission's Channel on the 26<sup>th</sup> of November 2021 (189 views and 9 subscribers up to the end of 2021).

## **6.8. ASSISTANCE TO MEMBERS AND WORKSHOP PARTICIPANTS**

### **6.8.1. Assistance to members and workshop participants**

This year due to the Covid-19 pandemic there were no requests for assistance by Commission members and workshop participants.

## 6.9. PUBLICATIONS

Publications directly related to the Global Geochemical Baselines project were not published this year. However, there are publications for the continental-, regional and local scale projects carried out in different continents. These will be found in [Appendix 3](#).

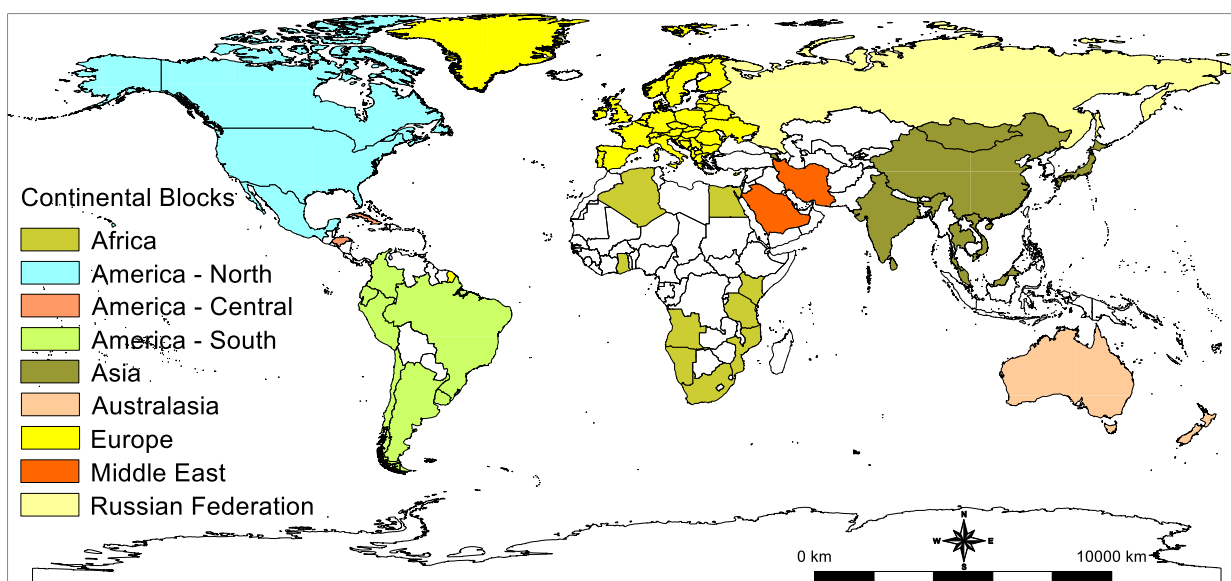
The Commission sent one-page reports, which were published in the [IUGS E-Bulletin](#) (see [section 6.2.1](#)).

## 7. REGIONAL REPORTS

Regional reports were provided from South America ([Colombia](#)), Australasia ([Australia](#) and [New Zealand](#)), and Europe ([EuroGeoSurveys Geochemistry Expert Group](#)). These reports are in [Appendix 3: Regional Reports](#).

## 8. NEW MEMBERS

In 2021, the Commission made 6 new members from Belgium (1), Hellas (2), Sri Lanka (1), Thailand (1) and Vietnam (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 202 members in 73 countries (see [Members list](#) in Commission's web page, and their countries are shown in Figure 5).



*Figure 5. Map showing countries with Commission members. The new countries are Sri Lanka and Vietnam. The different colours represent continental blocks. The Russian Federation has its own colour because it is in two continental blocks, Europe and Asia. Map plotted with Golden Software's MapViewer™ v8 by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.*

## 9. IUGS FUNDING FROM 2003 TO 2021

Funding from IUGS has consisted of US\$1500 per year for 2003 to 2008; US\$4000 for 2009 and 2010; US\$5000 for 2011 and 2012; no funding for 2013; US\$5000 for 2014, 2015 and 2016; US\$4500 for 2017; US\$4000 for 2018; US\$2800 for 2019; US\$2800 for 2020, and US\$4000 was the annual allocation for 2021. Additional amounts of (i) US\$3500 was allocated 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.

## 9.1. ALLOCATED FUNDS LOST FROM THE 36<sup>TH</sup> IGC, DELHI, INDIA

The postponement of the 36<sup>th</sup> IGC in Delhi resulted in the loss of IUGS allocated funds, *i.e.*,

- Registration fees paid were US\$521.32, and the refund was US\$398.49, *a loss of US\$122.83*.
- Return airline fee Athens-New Delhi-Athens was US\$1,179.29, and the refund was US\$882.29, *a loss of US\$297.00*.
- Hotel booking and transfer from and to airport, and from hotel to venue through the 36<sup>th</sup> IGC desk was *US\$1,120.30*. This amount has not been refunded yet, and should be considered lost. According to information from the hotel, the payment was never received from the IGC 36 organisers, and there was no reservation.
- India visa cost was *US\$80.00*, which is lost too.

The total amount lost from the cancellation of the 36<sup>th</sup> IGC due to Covid-19 is: *US\$1,620.30*.

## 10. USAGE OF IUGS 2021 ALLOCATION

Usage of allocated 2021 fund of US\$4,000 and outstanding 2020 balance of US\$4,583.13, making an overall total of **US\$8,583.13** is shown in Table 1.

Table 1. Expenses incurred during 2021.

<i>Expenses incurred</i>	<i>US\$</i>
Bank charges on the transfer of the IUGS 2021 allocation	4.28
Sandblasting of sampling equipment	37.16
Zoom annual licence fee for webinars up to 100 persons	201.34
Zoom add-on for webinars up to 500 persons* (paid by Ariadne Argyraki and refunded)	67.79
Bank chargers for the transfer of the above amount	2.76
Annual Commission's website hosting fee and domain renewal (2021-2022)	286.94
Bank charges on the transfer of the Annual website hosting fee & domain renewal	2.80
<b>Total 2021 expenses:</b>	<b>683.07</b>

\*The Zoom add-on was necessary because 397 participants registered for the Commission's online training workshop on "[Extracting, visualising and interpreting structure in geochemical data through compositional data analysis \(CoDa\)](#)" and the actual attendance was 191 during the live session. Ariadne Argyraki as the Public Relations officer was coordinating the session (refer to Section §6.2.2 in the Commission's 2021 Annual Report).

## 11. FUNDING REQUEST FROM IUGS FOR 2022-2023

### 11.1. PLANNED 2022 ACTIVITIES REQUIRING NO FUNDS

The main Commission activities in 2022 that require no funds are:

- (i) Completion of the '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*', which is planned to be completed in the first few months of 2022, always subject to the voluntary input by all the people that are involved in this especially important reference work for global and regional geochemical surveys (see [Section §6.4](#)). The

- in-kind engagement includes both authors, reviewers and editors. This work will be accompanied by the publication of (a) the R-scripts for the generation of [5, 8 and 16 random sites within the 160x160 km GTN grid cells](#), and (b) the program for estimating the parameters of balanced ANOVA.
- (ii) Conversion of statistical programs from MS-DOS Fortran 77/Power Station 4 to 32- and 64-bit Windows platform, and made freely available through the Commission's website (see [Section §6.7.1.1](#)).
  - (iii) Virtual participation in the following EGU22, Session ESSI 3.2 3.2: [Making Geoanalytical Data FAIR: Managing Data from Field to Laboratory to Archive to Publication](#). The conveners of this session state: "*Globally, geoscience and research analytical laboratories collect ever increasing volumes of data: an acute challenge now is how to collate, store and make these data accessible in a standardised, interoperable and machine-accessible form that is FAIR*". According to our experiences the analytical data that should be made available to researchers are data of high quality and integrity. Therefore, it is important to take part in this session even virtually if none of Commission country representatives will be attending this conference.
  - (iv) Preparation of workshop material.
  - (v) Preparation of short videos for the 60<sup>th</sup> Anniversary celebration of IUGS.
  - (vi) Preparation and printing of Periodic Table Element maps of the Geochemical Atlas of Europe for stream water, stream sediment, subsoil and floodplain sediment for the printing of large-size posters for promotion of the Global Geochemical Baselines project.
  - (vii) Organisation of webinars for the promotion of the '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*', and other aspects of applied geochemistry.
  - (viii) Updating the Commission's website.
  - (ix) Providing assistance and information to requests from different geological surveys and individuals, especially participants in past workshops.
  - (x) 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 will be detailed in the IUGS Manual of Standard Methods. This activity is in-line with the objective '*to increase the awareness of policy and decision makers of the need for harmonised geochemical data at the global scale.*' The promotion of the Global Geochemical project is an activity that will be carried out beyond 2022. Although no funds are requested for the above work, it should be stressed that they are funded by Commission member Geological Surveys and Universities. Hence, it is considered important that a conservative estimate of person-months should be made. It is estimated that all colleagues from all over the world contributing to the above work is about 30 person-months parts [it will start after the completion of item (i)]
  - (xi) Revision of the IGCP 259 Report, the '[Blue Book](#)' (Darnley *et al.*, 1995) by removing all contradictory parts [it will start directly after the completion of items (i) and (x)].

## 11.2. PLANNED 2022-2023 ACTIVITIES REQUIRING IUGS FUNDING

As the World is still in uncharted waters with respect to the Covid-19 pandemic, and the waiting for the vaccination of 70% of the population to achieve immunity, we are a little conservative with respect to any activities that need personal contact until the end of August 2022.

The following planned activities in 2022, and first quarter of 2023, require IUGS funding:



- Virtual participation in EGU22, Session ESSI 3.2 3.2: [Making Geoanalytical Data FAIR: Managing Data from Field to Laboratory to Archive to Publication](#), Vienna, Austria, 23-27 May 2022.
- Organisation of workshops/webinars for up to 300 participants using Zoom. We have the material to organise two- to three-day webinars. The first will use the Berlin YES Workshop material. Organising webinars will be an important activity after the publication of the ‘*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network and Regional Geochemical Surveys*’ (see [Section §6.4](#)). This activity requires the purchase of Zoom 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 2022).
- Organisation of the three-day autumn annual joint business meeting of the Commission and the EuroGeoSurveys Geochemistry Expert Group, which is planned for November 2022 in Athens (Hellas), if it is Covid safe. The Commission will jointly host the meeting with the Hellenic Survey of Geology and Mineral Exploration.
- Production of five (5) hard copies and accompanying CDs for the ‘*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*’. One copy will be submitted to the IUGS Executive Committee for publication approval, and four copies are required to be submitted to the National Library of Greece for the issue of the ISBN number). This work will be accompanied by the publication of (a) the R-scripts for the generation of [5, 8 and 16 random sites within the 160x160 km GTN grid cells](#), and (b) the program for estimating the parameters of balanced ANOVA.
- Participation in the 5<sup>th</sup> BASGES Workshop organised by the Shenyang Centre of China Geological Survey in the autumn of 2022 on the condition that it is safe to travel.
- Printing of remaining posters on canvas of the Periodic Table of mapped elements of the [Geochemical Atlas of Europe](#) for stream water, stream sediment, subsoil and floodplain sediment for promotion of the Global Geochemical Reference Network project.
- Web-hosting annual fee and domain renewal (2022-2023) of the Commission’s website, and
- Participation in the 78<sup>th</sup> IUGS Executive Committee meeting in February 2023 at a place to be determined by the IUGS EC, subject to be safe for travel.

It should be mentioned that in the 2022 budget (Table 2), the cost of US\$30,000 for the organisation of training workshops for CCOP countries recommended in the 2019 ARC report is not included, as this depends on the availability of funds from IUGS, and because of the Covid-19 pandemic is unlikely to plan any physical workshops during 2022. 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 2. Estimated expenses for 2022 and first quarter of 2023.

<i>Event category</i>	<i>Cost in US\$</i>
Participation in the 77 <sup>th</sup> IUGS Executive Committee meeting in March 2022 in Paris	3,000.00
Virtual participation in EGU22, Session ESSI 3.2 3.2: <a href="#">Making Geoanalytical Data FAIR: Managing Data from Field to Laboratory to Archive to Publication</a> , Vienna, Austria, 23-27 May 2022	300.00

<i>Event category</i>	<i>Cost in US\$</i>
Organisation of webinars for up to 300 participants using Zoom. We have the material to organise two to three days webinars. The first is to use the YES Workshop material as an introduction, and to be followed by workshops with material from the IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network. Purchase of Zoom add-on licences, depending on the number of registered participants	500.00
Printing and book-binding of five (5) hard copies and accompanying CD's of the 'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Networks'. One copy will be submitted to the IUGS Executive Committee for publication approval, and four copies are required to be submitted to the National Library of Greece for the issue of the ISBN number).	2000.00
Printing and book-binding of accompanying volumes of above (five copies): R-scripts for the generation of random sites, and (b) program for estimation of balanced ANOVA parameters	1000.00
Participation in the 5 <sup>th</sup> BASGES Workshop organised by the Shenyang Centre of China Geological Survey in the autumn of 2022. Costs: Travel insurance, local travel to and from airport	250.00
Organisation of the three-day autumn annual joint business meeting of the Commission and the EuroGeoSurveys Geochemistry Expert Group, which is planned for the 3 <sup>rd</sup> , 4 <sup>th</sup> and 5 <sup>th</sup> of November 2022 in Athens (Hellas). The amount includes organisation expenses and providing financial support to members of the Steering Committee	5,000.00
Printing of remaining posters on canvas of the Periodic Table of mapped elements of the <a href="#">Geochemical Atlas of Europe</a> for stream water, stream sediment, subsoil and floodplain sediment for promotion of the Global Geochemical Baselines project	300.00
Annual Commission's website hosting fee and domain renewal (2022-2023) and additional space on server	600.00
Participation in the 78 <sup>th</sup> IUGS Executive Committee meeting in January/February 2023 at a place to be decided by the IUGS Executive Committee	3,000.00
<b>Total estimated expenses in US\$ for 2022-23:</b>	<b>15,950.00</b>
<b>Outstanding balance (US\$) in Commission's bank account at the end of 2021:</b>	<b>7,981.20</b>

Taking into account the outstanding balance in the Commission's bank account of **US\$7,981.20**, the estimated smallest amount required to cover 2022-23 expenses, as well as unforeseen expenses, is in the region of about **US\$7,968.20**.

The Commission is, therefore, requesting financial support from IUGS in the order of **US\$8,000** to cover planned expenses in 2022 and first quarter of 2023.

### 11.2.1. Development of analytical reference materials

An important activity is the development of analytical reference materials. All IUGS Commissions are charged to set standards for their geoscientific discipline. Therefore, the Commission is mandated to set standards in geochemical mapping. The first such standard is the '[International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project](#)', which was approved by the IUGS EC and published in 2020, and is freely available from the Commission's website. The second and most significant standard work is the publication in 2022 of the '[International Union of Geological Sciences Manual of Standard Methods for the Global Geochemical Reference Network and Regional Geochemical Surveys](#)'.

However, the global project, as envisaged by Darnley *et al.* (1995) in the '[Blue Book](#)', cannot start without the development of large reference materials of at least one tonne each for all the sampling types that will be collected, *i.e.*, stream sediment, overbank/floodplain sediment, residual soil, and rock. As IUGS is the global geoscientific body that sets standards in geosciences, it is appropriate to start the development of analytical reference materials. The Commission has the expertise and the laboratory that can make these reference materials, and we ask the IUGS EC to consider it.

### **11.2.2. IUGS Annual allocation to cover first six months of following fiscal year**

The Commission enjoyed a sort of freedom in the planning of its work and commitments until 2017, because it was able to accumulate slowly a reserve fund, which at the end of 2017 totalled about US\$10,289. The insistence of an EC Councillor to use this reserve fund for RFG2018 resulted at the end of 2018 the outstanding balance to be at US\$858.

Without any reserve funds, it is difficult to plan activities and make commitments for the following fiscal year, and especially the first six months, because the annual allocation is usually made available round about April or May of the calendar year. Therefore, it is proposed that the IUGS funding should cover the first six months of the following fiscal year.

## **12. LINK TO IUGS WEBSITE**

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

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## APPENDIX 1: MINUTES OF CCGB VIRTUAL MEETING, 27 MAY 2021

Time: 15:00 London

### Present:

Anna Ladenberger (AL)  
Katherine Knights (KK)  
Gloria Prieto Rincón (GPR)  
Gloria Namwi Simubali (GNS)  
Paula Adánez Sanjuan (PAS)  
Christina Stouraiti (CS)  
Ariadne Argyraki (AA)  
David Smith (DS)  
Patrice de Caritat (PC)  
Alec Demetriades (AD)

### Agenda:

- Update on the IUGS Manual of Standard Methods for Establishing the Global Geochemical Reference Network
- Workshop/webinar on Compositional Data Analysis
- Popular e-book for global geochemical mapping

### I. Update on the IUGS Manual of Standard Methods for Global Geochemical Baselines

**AD:** Soil sampling chapter. Discussion with soil scientists to find a final consensus. Next week the chapter will be sent again to all co-authors for a final review. The manual should be finished within this year (maybe, IUGS approval before the annual meeting at the beginning of next year).

Rock geochemistry chapter is another issue, the two people who could best review the chapter, sadly, have recently passed away (Gerry Govett) and been killed (Peter Winterburn).

Anna recommends Hugh Rollinson, author of the book "*Using Geochemical Data: Evaluation, Presentation, Interpretation*", and will send his email to Alecos.

About 65-70% of the manual is completed. Each completed chapter is reviewed by two and sometimes three external reviewers. The editorial committee will make the final review.

The idea is to publish it as an e-book. However, it will be discussed with UNESCO if they can publish it. The disadvantage here is that the publication could be delayed by up to 18 months as the Manual will be typeset and edited.

### II. IUGS Bulletin article

Paula will write two reports for the e-bulletin in the following two months.

- The first one will be about the newspaper article about the Tierra de Fuego studies related to the CCGB Manual.
  - The second one will be about the Black Soil Workshop and CCGB participation.
- Everybody agrees.

### **III. Workshop/webinar on Compositional Data Analysis**

Alecos knows Michael Greenacre and Eric Grunsky who have prepared material for a virtual workshop, and this can be organised any time we want. Only logistics would be required.

There is an interest in this topic. Anna suggests scheduling the workshop for mid-November (after vacation, sampling campaigns, *etc.*). Kate suggests using geochemistry data sets. Anna could provide the Swedish Atlas data as showcase examples. GEMAS, FOREGS data are also suggested.

We should agree about the webinar content and dates as soon as possible so we can send invitations to IUGS members and other potential participants.

David: Grunsky has already worked with Patrice de Caritat's national-scale data for Australia and national-scale data for the US. So, he has workshop material "in-hand" for global-scale data without having to do any new work on other data sets.

### **IV. Development of Reference Materials\* (seeking sponsors, e.g., AAG, EAG, IAGC, and even private companies)**

AD: Two black soil reference samples have been prepared and at present their round robin analysis is being organised in European and American laboratories (Sweden, Norway, France, U.K., Mexico, Colombia).

All IUGS Commissions must set standards. We provide a 'Manual of Standard Geochemical Methods for Establishing the Global Geochemical Reference Network'. However, reference materials are needed worldwide. To prepare the reference samples is not so expensive. According to our Slovakian colleagues, the cost of sampling, homogenization, *etc.* is very low compared to the cost of vials.

AD, AL, KK, DS: Something that has to be decided is the authorship of the reference materials. Would it be the IUGS? This would definitely be a good promotion of the Commission's work. We have firstly to decide what we need, and then ask for the real costs.

Alecos informed everybody that in the Manual there is a Chapter on the preparation of reference materials by our Slovakian colleagues. The Chapter is completed and will be reviewed by Philippe Negrel (France) and Belinda Flem (Norway).

Kate volunteers to coordinate this project, and suggests that the Chapter could be reviewed by Dr Charles Gowing from BGS. Alecos suggested as this is a big job, we could establish a Sub-commission for preparation of reference materials.

We should organise a meeting only about the preparation of reference materials.

### **V. Popular e-book for global geochemical mapping**

AD, AL, KK: Brochure format to be attractive to a broad audience (potential members, politicians, *etc.*). We should define who will be our audience. Fit the infographic message in a visual way. It must catch people's attention and it could be translated to other languages.

Alecos will send the leaflets of GEMAS and urban geochemistry in order to get ideas.

Anna volunteers to start with Alecos.

### **VI. Autumn joint Annual meeting in Athens (depending on vaccination progress)**

GS: Vaccination in Namibia is going slow and she doesn't think in autumn will be able to travel.

GP: In Colombia the vaccination is not the only goal to achieve, since the political situation is also difficult in the last months. Not sure to be able to travel in autumn.

A virtual meeting is proposed and to be spread over several days, but shorter in time (3h per day).

Anna will start the organisation of the meeting/programme/ideas.

The CGGB IUGS virtual meeting should be organised as separate meeting from the European Geochemistry Expert Group.

#### **VII. Out of agenda discussion**

AA: Goldschmidt 2021 session.

AL: Patrice de Caritat will be the keynote speaker, there are 21 contributions in the session. The oral presentations will be 10 minutes, and the talks have to be uploaded before the meeting. She will send the links.

Discussion about our presence in other meetings/conferences (IAG Symposium, EGU).

AL: We should be present in the International Applied Geochemists Symposium, while in the EGU it would be difficult to make a big session.

#### **VIII. Mining waste sampling manual**

Anna proposes to compile a “good practice” manual on how to sample, analyse and manage the data when studying mining and smelter wastes.

We all agree that this is a very difficult and variable sampling medium, but there should be some basic routines, as there is a growing interest by the Geological Surveys (and Ministries) to study the mining wastes as potential secondary resources.

18.00 end of the meeting, and next virtual meeting about reference materials to be convened at a time to be decided.

## APPENDIX 2: COMMENTS ON THIRD SESSION OF UNESCO ICGG

Virtual meeting organised on the 10<sup>th</sup> of December 2021

**Comments made by Alecos Demetriades, who represents the IUGS Commission on Global Geochemical Baselines as Councillor in the Governing Board and Scientific Committee of the UNESCO International Centre on Global-Scale Geochemistry**

Note: The comments were made after reading the documents that were sent by the UNESCO-ICGG Secretariat Director, Dr. Bimin Zhang.

### **Comments on Document: 3GB-1-Item1-Report on Status of Governing Board Councillors and Changes of Administrative Personnel**

I agree with all comments made by Gloria Simubali about the work of the Centre in relation with the work carried out by China Geological Survey, and I would like to make additional comments.

#### **GOVERNING BOARD**

**Item 1:** Report on Status of Governing Board Councillors and Transfer of Administrative Personnel.

**Comment:** It may not be obligatory from the Statutes to inform the Governing Board members about the transfer and appointment of the Centre's Administrative Personnel, but professional etiquette and courtesy demands at least for the Councillors to be informed in advance of such changes.

The Director-General of ICGG changed in December 2019 from Dr. Peng Xuanming to Dr. Zhang Zuoheng, and we are informed after two years.

Dr. Hao Guojie, Deputy Director-General of ICGG and IGGE left, and we are now informed about his leaving.

The Director of the Secretariat Office has changed a few months ago, and we were informed three months ago about this change.

**I stress that such procedures are professionally and ethically unacceptable.**

I was pleased to see in Bimin's presentation the admittance of the "*Lack of communications with the Councillors of Governing Board and Scientific Committee of the Centre*". Considering our experience up to now, I expect you will make the same comment in the future too.

### **Comments on Document: 3GB-2-Item 2-ICGG Biennial Work Report 2018-2020**

The date of the Biennial Work Report is December 31<sup>st</sup> 2020, and was never circulated to the Councillors of the Governing Board and Scientific Committee until the 31<sup>st</sup> of October 2021. I really cannot understand the reason for such a delay.

You have carried out all this work without consulting or informing any Councillors of the Governing Board and Scientific Committee. This is an unacceptable procedure.

I stress that we have already commented on this lack of prior consultation in the second session of the Governing Board and Scientific Committee. In fact, Mr. Philippe Pypaert, the then UNESCO representative asked again the then ICGG Director Dr. Peng Xuanming, why the Councillors are not informed in advance about the ICGG activities. Dr. Peng's answer was that now we have the approved Statutes we will be informing them.

**It is indeed interesting to read on page 71:**

**Item 6 – with the title: Representatives of ICGG Communicate with Scientific Committee Members**

Scientific Committee Members make suggestions to the scientific research work of ICGG:

- Since the projects of ICGG usually last for 2 years. *It is suggested that ICGG submits Annual Report on Scientific Research and Project Progress each year.* This proposal was made by Cheng Qiu Ming, and it was accepted.

Although we have agreed on this procedure, you still continue to ignore the existence of the Scientific Committee Councillors and even the Governing Board Councillors. **I, therefore, ask the question: What is our role?**

**On page 4** concerning the Scientific Committee's discussion on the 17<sup>th</sup> of October 2018. I stress that the Scientific Committee has reached a consensus on only the "*Protocol for Sampling Catchment Basin Sediments*", and not the "Protocols of Global Geochemical Baselines used by ICGG". This is, of course, clarified on pages 68 and 69 about the Agreement reached on "Catchment Basin Sediment Sampling". So, it is professionally and scientifically proper to use the same wording. Therefore, the following correction on page 4 the "Protocols of Global Geochemical Baselines used by ICGG" should be changed to the "Protocol of Catchment Basin Sediment Sampling".

**Figure 1 on page 7** with the sampling sites of the Global Geochemical Baselines Project. As presented is unacceptable as there are countries that have not followed procedures according to Blue Book specifications, as for example the United States of America and Australia. These two countries should not be on this map, and also it will be a good idea to mention that the samples collected are floodplain or catchment basin samples.

**Figure 2 again on page 7** showing the Global geochemical baselines map of lead is unacceptable for it combines incompatible data – different types of samples, different sample preparation and different analytical method. Because of data incompatibility Europe is shown as having high lead values, which is not true.

I have criticised these maps, and it appears that your scientists are not listening that they should stop using such maps, because the patterns are not true, and they make a mockery of applied geochemistry.

My strong recommendation is that this map must be removed from the report, and never to be used again.

**The ICGG Website** most of the time is not working, and I received many complaints from colleagues from all over the World that tried to access it.

**Analytical procedures:** The analytical methods used have not been released.

**Quality Control:** It is stated that there is a Global Laboratory and Quality Control Division, but no quality control results are reported. You show geochemical maps, but

nothing about the quality control that is carried out. Without the quality control report all these maps are unacceptable. Also, the Global Laboratory should have its own quality control procedure installed. This is completely different from the quality control that is needed for an international geochemical mapping project.

What is needed is an independent quality control procedure, which is managed by the Project Manager and his team. I, therefore, suggest that you consult the three Quality Control Reports of the GEMAS project, which are freely available from its website in order for you to understand what I mean.

Reimann, C., Demetriades, A., Birke, M., Eggen, O. A., Filzmoser, P., Kriete, C. & EuroGeoSurveys Geochemistry Expert Group, 2012. *The EuroGeoSurveys Geochemical Mapping of Agricultural and grazing land Soils project (GEMAS) - [Evaluation of quality control results of particle size estimation by MIR® prediction, Pb-isotope and MMI® extraction analyses and results of the GEMAS ring test for the standards Ap and Gr.](#)* NGU Report 2012.051, 136 pp.;  
[https://www.ngu.no/upload/Publikasjoner/Rapporter/2012/2012\\_051.pdf](https://www.ngu.no/upload/Publikasjoner/Rapporter/2012/2012_051.pdf).

Reimann, C., Demetriades, A., Eggen, O.A., Filzmoser, P., 2011. The EuroGeoSurveys geochemical mapping of agricultural and grazing land soils project (GEMAS) - Evaluation of quality control results of total C and S, total organic carbon (TOC), cation exchange capacity (CEC), XRF, pH, and particle size distribution (PSD) analysis. Norges Geologiske Undersøkelse Report, 2011.043, 90 pp.;  
[https://www.ngu.no/upload/Publikasjoner/Rapporter/2011/2011\\_043.pdf](https://www.ngu.no/upload/Publikasjoner/Rapporter/2011/2011_043.pdf).

Reimann C., Demetriades A., Eggen O. A., Filzmoser P. and the EuroGeoSurveys Geochemistry Expert Group, 2009. *[The EuroGeoSurveys Geochemical Mapping of Agricultural and Grazing Land Soil Project \(GEMAS\) - Evaluation of Quality Control Results of Aqua Regia Extraction Analysis.](#)* NGU Report 2009.049. ISSN 0800-3416. Geological Survey of Norway, 94 pp.;  
[https://www.ngu.no/upload/Publikasjoner/Rapporter/2009/2009\\_049.pdf](https://www.ngu.no/upload/Publikasjoner/Rapporter/2009/2009_049.pdf).

## **REPORTING ON THE WORK CARRIED OUT IN DIFFERENT COUNTRIES**

Reading the reports about the work carried out in the different countries, it was interesting to see the inclusion of a country that the collaboration has stopped before the sampling was completed. This particular country asked for my help, because the geochemists were not happy with the sampling carried out by China Geological Survey and ICGG. I urged you to read Section 6.11.1. “*Evaluation of questionable sampling and recommendation*” on pages 26 to 28 in the 2020 Annual Report of IUGS Commission on Global Geochemical Baselines, which is freely available on its website

([https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB\\_2020\\_Annual\\_Report\\_Final.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2020_Annual_Report_Final.pdf)). There you will find photographs of the sampling.

Therefore, I am very sceptical about the training and sampling that CGS and ICGG are carrying out in all these countries.

## **NEWSLETTER**

Only one Newsletter was compiled during the past six years, and this Newsletter was compiled and edited by me during my 40-day stay in October to December 2016, and instead of publishing it directly afterwards, you have waited a whole year. It was published in December 2017. I never found the reason for the delay.



**VOTE:** I do NOT adopt the ICGG Biennial Work Report on the ground that I was never consulted and informed about this work.

### **Comments on: 3GB-3-Item 3-Proposal to Renew the Agreement between the UNESCO and China**

I have supported China to lead the Global Geochemical Baselines project and started discussions in 2002 to 2003 with Professor Xie Xuejing. As I wanted the Global Geochemical Mapping project to go ahead, I stayed in Langfang for 40 days in 2016 to help in the organisation of the International Centre.

Unfortunately, I am not at all pleased with the work done by the UNESCO International Centre on Global-Scale Geochemistry in the past six years, as the work was really governed by the interests of China Geological Survey. *The reason is quite simple, the work that should be done MUST be independent of the interest of an individual nation or organisation.*

China Geological Survey and the International Centre do not fulfil this condition, as they have shown from the work performed during the past six years.

**Therefore, my proposal is for UNESCO NOT to renew the Agreement.**

If UNESCO wants the Global Geochemical Mapping project to continue, then it should seek another organisation or country. Here I stress an organisation or country that understands what international professional collaboration is about, and to fulfil the condition that the work will be *carried out systematically and independent of the interest of the individual nation or organisation.*

**VOTE:** I do NOT adopt the renewal of the agreement between UNESCO and China Geological Survey.

### **Comments on Scientific presentation by Prof. Wang Xueqiu<sup>1</sup> by Alecos Demetriades**

If Professor Wang wanted to do this work together, he should have consulted us a long time ago.

Unfortunately, Professor Wang gives a completely wrong account of the European FOREGS sampling methodology, which is being used all over the World. The sampling carried out was on the grid of 160x160 km, and the quadrants of 80x80 km. So, I recommend that he studies very carefully the procedure used in the [FOREGS Geochemical Mapping of Europe](#), before making such unsubstantiated statements.

Another important historical scientific fact that Professor Wang is forgetting is that the standard for overbank or floodplain sediment sampling was developed by Ottesen *et al.* in the mid 1980's. They covered the whole of Norway, and we have seen the results in 1986 during our first meeting as Western European Geochemistry Group. Ottesen and co-authors published the overbank sediment procedure in 1989. Afterwards pilot projects were carried out in different European countries in 1989 to 1991 and it was developed further. The procedure and results are reported in the 1990 to 1993 reports.

Afterwards, Professor Xie, with the assistance of Rolf Ottesen and Jim Bogen from Norway, tested the feasibility of overbank or floodplain sediment for wide-spaced global

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<sup>1</sup> Professor Wang Xueqiu is the Scientific Director of ICGG.



geochemical mapping by using the whole of China as the pilot survey area, and published the data in 1997.

The historical outline of the global geochemical mapping effort is in the 1<sup>st</sup> Newsletter of ICGG with the title “*Historical outline of global geochemical baselines leading to the establishment of the UNESCO International Centre on Global-Scale Geochemistry*” to which Professor Wang is co-author. So, I suggest that he reads this, as well as the references therein, before making such unsubstantiated statements.

Professor Wang mentioned the quality of the data, but we have not been informed on the quality control procedures. The International reference materials used are for the laboratory. What about the independent quality control procedure, which should be installed? So, again, I suggest that Professor Wang studies the three quality control reports of the GEMAS project in order to understand what quality control is all about.

I am very pleased that it was mentioned that the Chinese reference materials used have not undergone an international ring test. Hence, these results are not acceptable internationally.

I definitely agree with Dong Shuwen’s, Qiuming Cheng’s and Belinda Flem’s comments. All international Councillors are open for transparent collaboration, because this is the only way forward for international projects. In Europe, what we have achieved up to now was done with collaboration and Team-work. Something that we have been asking for since the beginning. The Centre must open-up for transparent collaboration and Team-work, as this is the only way for international projects.

### **1989**

Ottesen, R.T., Bogen, J., Bølviken, B. & Volden, T., 1989. Overbank sediment: a representative sample medium for regional geochemical mapping. In: S.E. Jenness (Editor), *Geochemical Exploration 1987*. *Journal Geochemical Exploration*, 32(1-3): 257-277. [https://doi.org/10.1016/0375-6742\(89\)90061-7](https://doi.org/10.1016/0375-6742(89)90061-7).

### **1990**

Bølviken, B., Demetriades, A., Hindel, A., Locutura, J., O'Connor, P., Ottesen, R.T., Plant, J., Ridgway, J., Salminen, R., Salpeteur, I., Schermann, O. & Volden, T. (Editors), 1990. *Geochemical Mapping of Western Europe towards the Year 2000*. Project Proposal. Western European Geological Surveys (WEGS). Geological Survey of Norway, Trondheim, NGU Report 90-106, 12 pages and 9 appendices; [http://www.ngu.no/upload/Publikasjoner/Rapporter/1990/90\\_106.pdf](http://www.ngu.no/upload/Publikasjoner/Rapporter/1990/90_106.pdf).

Demetriades, A., Ottesen, R.T. & Locutura, J. (Editors), 1990. *Geochemical mapping of Western Europe towards the Year 2000*. Pilot Project Report. Western European Geological Surveys, Geological Survey of Norway, Trondheim, Open File Report 90-105, 9 pages and 10 appendices; [http://www.ngu.no/upload/Publikasjoner/Rapporter/1990/90\\_105.pdf](http://www.ngu.no/upload/Publikasjoner/Rapporter/1990/90_105.pdf).

### **1991**

Bogen, J., Hasholt, B., Jacobsen, O.S., Ottesen, R.T., 1991. *Geochemical Mapping of Western Europe towards the Year 2000*. On the occurrence of overbank sediment in Denmark. Report from a field excursion in Denmark, 23 May 1991. Report No. 6, Western European Geological Surveys (WEGS). Geological Survey of Norway, Trondheim, NGU Report 91-205, 5 pp.; [http://www.ngu.no/upload/Publikasjoner/Rapporter/1991/91\\_205.pdf](http://www.ngu.no/upload/Publikasjoner/Rapporter/1991/91_205.pdf).

Bølviken, B., 1991. *Geochemical Mapping of Western Europe towards the Year 2000*. Annual Report 1990-91. Report No. 7, Western European Geological Surveys (WEGS).

Geological Survey of Norway, Trondheim, NGU Report 91-206, 6 pp.;  
[http://www.ngu.no/upload/Publikasjoner/Rapporter/1991/91\\_206.pdf](http://www.ngu.no/upload/Publikasjoner/Rapporter/1991/91_206.pdf).

### **1993**

Bølviken, B., Bogen, B., Demetriades, A., De Vos, W., Ebbing, J., Hindel, R., Ottesen, R.T., Salminen, R., Schermann, O. and Swennen, R., 1993. Geochemical Mapping of Western Europe towards the Year 2000. Final Report of the Working Group on Regional Geochemical Mapping 1986-93. Forum of European Geological Surveys (FOREGS). Geological Survey of Norway, Trondheim, NGU Report 93.092, 18 pp. and 6 appendices;  
[http://www.ngu.no/upload/Publikasjoner/Rapporter/1993/93\\_092.pdf](http://www.ngu.no/upload/Publikasjoner/Rapporter/1993/93_092.pdf).

### **1997**

Demetriades, A. & Volden, T., 1997. Reproducibility of overbank sediment sampling in Greece and Norway. *Journal Geochemical Exploration*, 59(3), 209-217.  
[https://doi.org/10.1016/S0375-6742\(97\)00016-2](https://doi.org/10.1016/S0375-6742(97)00016-2).

Xie, X. & Cheng, H., 1997. The suitability of floodplain sediment as a global sampling medium: evidence from China. In: G.F. Taylor, & R. Davy (Editors), *Geochemical Exploration 1995, II. Special Issue*, *Journal Geochemical Exploration*, 58(1), 51-62.  
[https://doi.org/10.1016/S0375-6742\(96\)00051-9](https://doi.org/10.1016/S0375-6742(96)00051-9).

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## **ADDITIONAL INFORMATION WHICH IS IN THE COMMISSION'S ANNUAL REPORTS FROM 2017 TO 2020**

### **2017 IUGS CGGB annual report (p. 35 to 42) –**

[https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS\\_CGGB\\_Annual\\_Report\\_2017\\_Final\\_Web.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS_CGGB_Annual_Report_2017_Final_Web.pdf) - pages 35 to 42.

In the 2017 annual report, there is a section about the "Workshop on Geochemical Mapping for "Belt and Road" Countries, 23-30 September 2017: Starting on page 40 there are "*Comments on the Chinese floodplain sediment sampling technique*". It is also worth consulting the following published paper from page 165 and section 10. PITFALLS TO AVOID, and read it up to page 170.

Demetriades, A., Smith, D.B., Wang, X., 2018. General concepts of geochemical mapping at global, regional, and local scales for mineral exploration and environmental purposes. In: Licht, O.B. (Guest Editor), *Geochemical Mapping. Special Issue, Geochimica Brasiliensis*, 32(2), 136-179; <http://doi.org/10.21715/GB2358-2812.2018322136>.

### **2018 IUGS CGGB annual report (p. 10, 19-26 & 79) -**

[https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB\\_2018\\_Annual\\_Report\\_final.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2018_Annual_Report_final.pdf):

In the 2018 annual report there is a similar paragraph on page 10, and a footnote about the maps on p.79 - "*IMPORTANT COMMENT: It should be noted that the sampling protocols and the methods used to analyse the samples in these continental-scale projects are not consistent and, therefore, the data must not be presented on the same map. A recent paper compares continental-scale projects from North America, Europe, China and Australia, and quite rightly presents individual maps. The paper is by: Caritat, P. de, Reimann, C., Smith, D.B., Wang, X., 2018. Chemical elements in the environment: Multi-element geochemical*

*datasets from continental- to national-scale surveys on four continents. Applied Geochemistry, 89, 150-159; <https://doi.org/10.1016/j.apgeochem.2017.11.010>."*

Of course, there are other comments in the 2018 annual report, which are on pages from 19 to 26 under the section title:

**6.5. PARTICIPATION IN THE SECOND MEETING OF UNESCO ICGG.**

6.5.1. Comments on the Chinese floodplain sediment sampling method

6.5.2. Comments on the Agreements signed with other countries

**2019 IUGS CGGB annual report (p.8-9) –**

[https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB\\_2019\\_Annual\\_Report\\_Final.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2019_Annual_Report_Final.pdf):

*"Although it was expected after the October 2018 meeting of the Governing Board and Scientific Committee (refer to the 2019 Annual Report) that the collaboration between the Centre and the Commission was going to be smooth as its Steering Committee members are also members of the Centre's Governing Board and Scientific Committee, and the Centre's Executive Director is the 2nd Co-chair of the Commission, this expectation is finally proved to be deceptive. There is no close collaboration between the Centre and the Commission. **This year, not even the concise report about the Centre's activities was sent by the Centre's Executive Director to be included in the Commission's annual report.** It is hoped still that this situation will change in the coming months, following the clear relationship between the Centre and the Commission that is expressed in the Centre's approved Statutes (see Article 7 above)."*

**2020 IUGS CGGB annual report (p.10-11, 26-28 & 97) –**

[https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB\\_2020\\_Annual\\_Report\\_Final.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2020_Annual_Report_Final.pdf):

*"After the October 2018 meeting of the UNESCO Centre's Governing Board and Scientific Committee (refer to the 2019 Annual Report), it was expected that the collaboration between the Centre and the Commission was going to be smooth as five of the Commission's 2016-2020 Steering Committee members are also members of the Centre's Governing Board and Scientific Committee, and the Centre's Executive Director was the 2nd Co-chair of the Commission until 2020. However, this expectation was finally proved to be deceptive. There is minimal communication and collaboration between the Centre and the Commission. The Centre does not even inform its international Governing Board and Scientific Committee members of its activities except for once every two years just before the scheduled biennial meeting of the 11 Governing Board and Scientific Committee. After four-and-a-half years of the Centre's operation, the hope that the situation will change is, unfortunately, extremely doubtful."*

**Section 6.11.1. Evaluation of questionable sampling and recommendation**

(pages 26 to 28) –

[https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB\\_2020\\_Annual\\_Report\\_Final.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2020_Annual_Report_Final.pdf).

## APPENDIX 3: REGIONAL REPORTS

### A3.1. AMERICA, SOUTH

#### A3.1.1. Colombia

Report of the Advances of the Geochemistry Program in Colombia – 2021 by *Gloria Prieto* - [gprieto@sgc.gov.co](mailto:gprieto@sgc.gov.co); [g.prietor@outlook.com](mailto:g.prietor@outlook.com)

In the context of restrictions on activities given the public health situation of Covid-19, the Colombian Geological Survey advanced during the year 2021 in its multipurpose geochemical mapping program in the Colombian territory. Sampling activities restarted in October and continued until the end of the year, acquiring floodplain and overbank samples for ultra-low density sampling for the mapping program of the Global Geochemical Baselines project initiated by the Colombian Geological Survey (SGC) in 2016; samples of active fine sediments and dry bed, soils and waters for medium density sampling for the Geochemical Atlas of Colombia; and rock, sediment, soil and water samples for high-density sampling for mineral prospecting and exploration programs and for applications in mineral fingerprinting, metallogenetic studies and geomedicine.

During the year 2021, sample analysis, data and information verification, data processing and interpretation, map production, preparation of research documents and dissemination of geochemical information in congresses, forums and virtual seminars, and in specialized scientific publications were carried out.

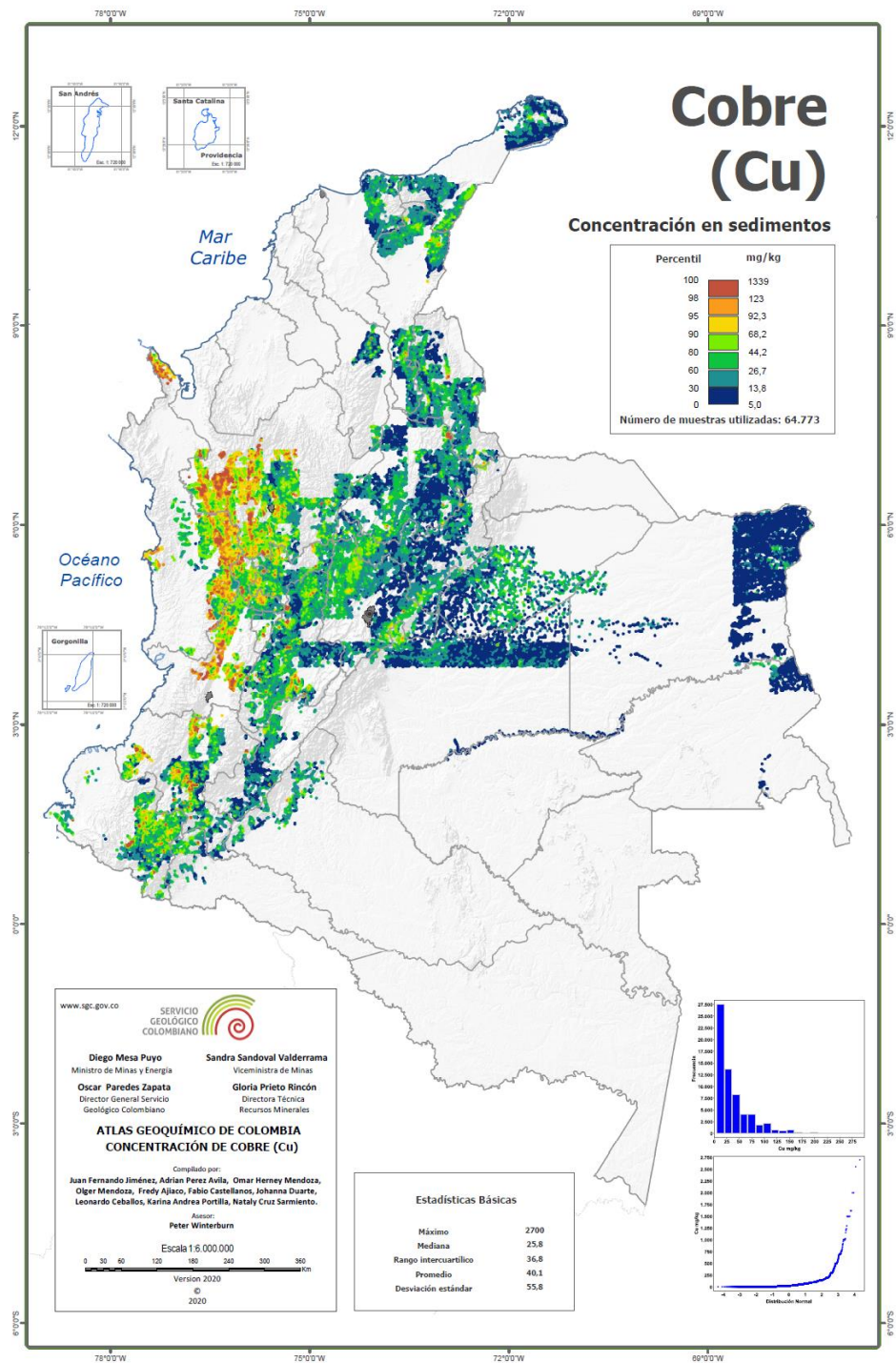
The publication and wide dissemination of the Geochemical Atlas of Colombia, version 2020 (AGC-2020), as part of the program of social appropriation of knowledge of the SGC is highlighted.

##### ***A3.1.1.1. Ultra-low density geochemical mapping in Colombia- geochemical baseline***

Continuing the ultra-low density sampling initiated in 2016 within the framework of the cooperation agreement between the Colombian Geological Survey and the Geological Survey of China, samples were sent to the laboratories of the Institute of Geophysical and Geochemical Exploration in China. Analytical data were received, results were validated, and QA/QC parameters were verified from both sampling and chemical analyses performed.

##### ***A3.1.1.2. Medium Density Multipurpose Geochemical Mapping -Geochemical Atlas of Colombia version 2020***

As part of the medium-density geochemical mapping program of the SGC, the dissemination of the Geochemical Atlas of Colombia (AGC) version 2020 was initiated. In execution of the activities of dissemination and social appropriation of knowledge, the launch of the Geochemical Atlas of Colombia, version 2020 (AGC-2020) was carried out in a virtual event. In this launch participated Dr. Alecos Demetriades who shared the conference "Geochemical Atlases for Multiple Uses" and was widely attended by stakeholders from Colombia and other countries. The Geochemical Atlas of Colombia (AGC) in its 2020 version is presented at a scale of 1:6,000,000 and includes 228 maps of 57 chemical elements. For each element, four types of maps were provided that represent the chemical concentration per element (Figure A3.1.1), the distribution of samples included in the atlas, the analytical techniques used and the decomposition methodologies of each sample. For each element, the basic statistical parameters are presented, a descriptive text of the geochemistry of the element and a description of the patterns of its geochemical distribution in the Colombian territory.



**Figure A3.1.1.** Copper concentration map (mg/kg), in sediments, taken from the geochemical atlas of Colombia (AGC) version 2020.

### A3.1.1.3. High density multipurpose geochemical mapping

#### Field information collection and sample collection

As a fundamental activity for the multipurpose geochemical mapping program of the SGC, in 2021 field campaigns were developed in which approximately 1100 km<sup>2</sup> were covered, acquiring field information and collecting samples of sediments (fine active and dry bed), rocks, paned concentrates, soils, and waters, with a density of one sample per 1.5 km<sup>2</sup> (Figure A3.1.2).

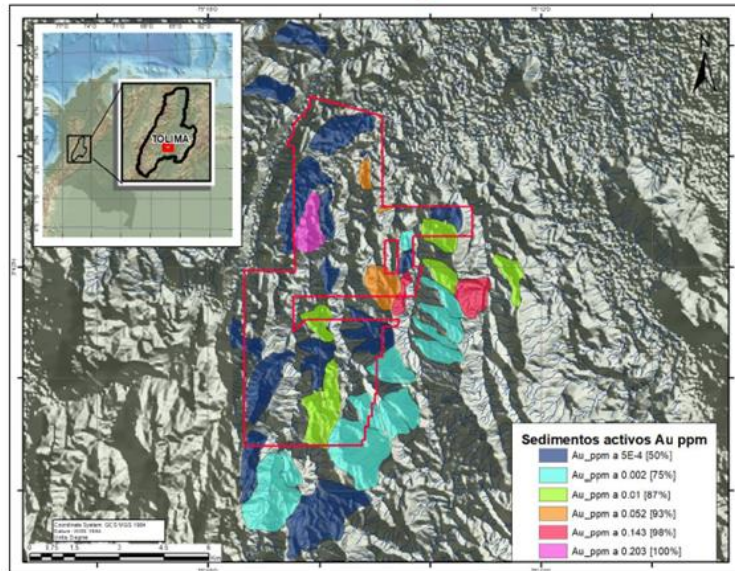




**Figure A3.1.2.** Collection of samples of (a) active stream sediment (top 3 photographs), and (b) floodplain and overbank sediments (bottom 2 photographs) in the low-density geochemical mapping project in Colombia with their respective identification codes. Photograph belonging to the SGC archive.

### **Application in prospecting and evaluation of mineral potential**

During 2021, sampling designs, sample collection, quality control of field and analytical information, processing and interpretation of geochemical data, analysis and interpretation of information aimed at identifying geochemical anomalies for prospecting and exploration of minerals in The Colombian territory were carried out (Figure A3.1.3).



**Figure A3.1.3.** Map of distribution of gold by basins in samples of active sediment, in Coyaima – Tolima, Colombia.

For application in the mineral exploration program in Colombia, data purification and verification (QA/QC), statistical processing, identification of geochemical anomalies (guide elements and associations) and production of maps for evaluation of geochemical potential for mineral exploration in Colombia were carried out.

#### **Research in medical (Geomedicine) and environmental geochemistry.**

In execution of the medical and environmental geochemistry program of the GSC, progress was made in sampling, verification and validation of data and information, processing and interpretation was carried out and maps were produced on specific topics, such as baseline of mercury (Hg) in Colombian coals, cadmium (Cd) in agricultural soils, selenium in livestock soils (Se) and arsenic (As) in waters (surface and underground) in areas with volcanic influence (Figure A3.1.4).



**Figure A3.1.4.** Collection of water samples for arsenic evaluation in waters of water basins of Risaralda, Colombia. Photograph belonging to the SGC archive.



## Mineral fingerprint research

The SGC multipurpose geochemistry program provides data and information for different purposes, one of which focuses on the identification of the "mineral fingerprint" with an emphasis on gold, as a contribution to monitoring and control in the mineral production chain in Colombia. In this program, progress was made in information processing and identification of mineral fingerprints in 2 gold zones of the Andean zone in the north and west of the country.

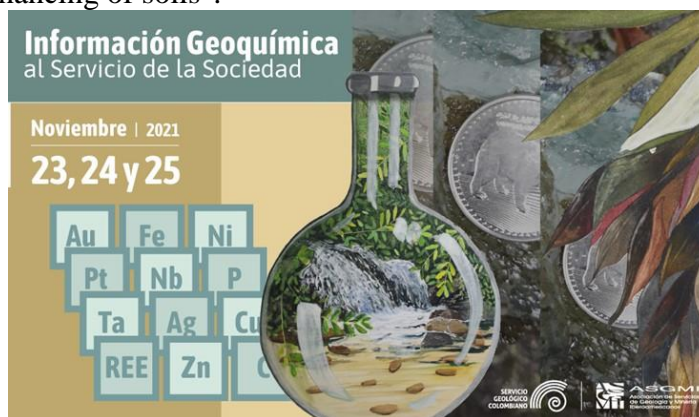
## Social appropriation of geochemical knowledge

One of the fundamental tasks of the SGC is the social appropriation of geochemical knowledge, for which thematic booklets were produced in geochemistry with simple language and accessible to the different social sectors and the products of research and geochemical cartography were disseminated in virtual events (Figure A3.1.5).



**Figure A3.1.5.** Invitation image to the launch webinar of the AGC version 2020, held on November 16, 2021. SGC file.

The SGC, as a member of the Group of Experts in Geochemistry (GEGEOQ) of the Association of Ibero-American Geology and Mining Services -ASGMI, participated in the Virtual Workshop on Geochemical Information at the Service of Society, held from November 23 to 25, 2021 (Figure A3.1.6), an international event in which it was attended by people interested in geochemical information from different continents and with the intervention of Ibero-American Geological Surveys (Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Spain, Mexico, Peru, Portugal, Dominican Republic), and experts from geochemistry groups from the United States (USGS), European Union (EGS), International Geosciences Union (IUGS) and UNESCO (earth Science Division). Dr Patrice de Caritat participated with the presentation "Geochemical mapping applied to forensic provenancing of soils".



**Figure A3.1.6.** Image of the event Geochemical Information at the Service of Society, held by ASGMI, from November 23 to 25, 2021. SGC image design for ASGMI.

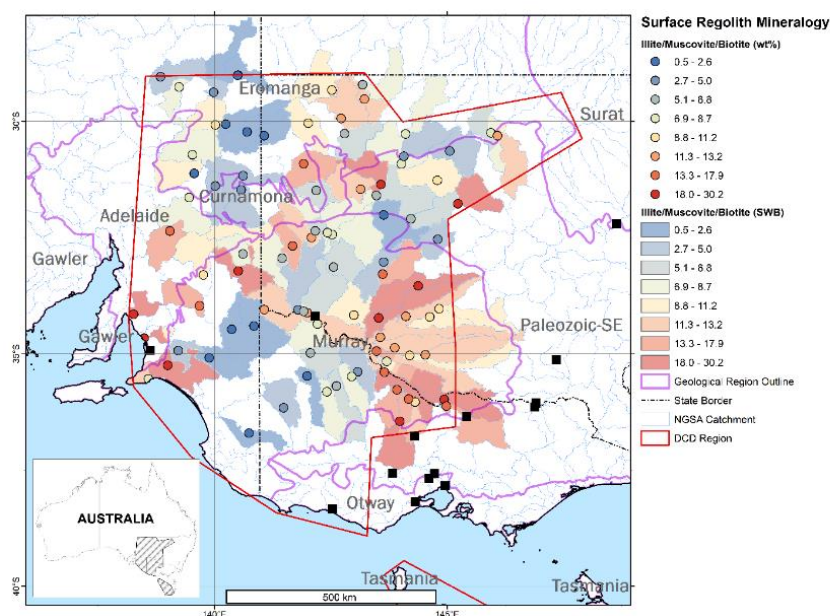


## A3.2. AUSTRALASIA

### A3.2.1. Australia

Report by Patrice de Caritat (Geoscience Australia; [Patrice.deCaritat@ga.gov.au](mailto:Patrice.deCaritat@ga.gov.au))

In 2021 national-scale work in Australia continued with testing and planning data acquisition around the existing National Geochemical Survey of Australia (NGSA) sample archive. Pilot projects were run for both Sr isotopes and regolith mineralogical characterisation. For the former (Sr isotopes), two study areas were selected, one in northern Australia, the other in southeastern Australia, with data interpretation and reporting in preparation at the time of writing. For the latter (regolith mineralogy), the same area in south-eastern Australia (Figure A3.2.1) was the subject of a mineralogy quantification feasibility study recently published as a Geoscience Australia Record. Candan Desem completed her PhD project at the University of Melbourne, compiling a national dataset of regolith Pb isotopes on the NGSA samples; it is hoped the national Pb isotope map and data set will be released publicly in 2022. Funding for a national rollout of the heavy mineral project, piloted last year as reported in the Commission's 2020 Annual Report, was identified in the Australian Government's Exploring for the Future program and work is underway. When released to the public, likely during financial year 2023-24, this will be the world's first heavy mineral map and database of a whole continent.



**Figure A3.2.1.** Distribution map of illite/muscovite/biotite abundance (wt%) in the Darling-Curnamona-Delamerian region of southeastern Australia, based on quantitative mineralogical assessment (X-ray diffraction and Siroquant<sup>®</sup> modelling) of 100 National Geochemical Survey of Australia (NGSA) samples, overlain on Australia's geological regions. Source: Caritat & Troitzsch (2021).

### Oral and poster presentations

Desem, C.U., Maas, R., Woodhead, J., Carr, G. & Caritat, P. de, 2021. A Pb isotope regolith map of the Australian continent. Australasian Earth Sciences Convention (Hobart, Tasmania, 9-12 February 2021), Abstracts.

Caritat, P. de, Dosseto, A. & Dux, F., 2021. Mapping the strontium isotope distribution in northern Australia. Goldschmidt 2021 Conference (Lyon, France, 4-9 July 2021), Abstract, 6636; <https://doi.org/10.7185/gold2021.6636>.

## Articles, papers, atlases and books

Caritat, P. de & Troitzsch, U., 2021. Towards a Regolith Mineralogy Map of the Australian Continent: A Feasibility Study in the Darling-Curnamona-Delamerian Region. *Geoscience Australia Record*, 2021/35, 347 pp.; <https://doi.org/10.11636/Record.2021.035>. Available at: <http://pid.geoscience.gov.au/dataset/ga/145916>

### A3.2.2. New Zealand

Report by Adam Martin (GNS Science; [a.martin@gns.cri.nz](mailto:a.martin@gns.cri.nz))

A Master's degree was awarded to Cody Lim from The University of Auckland in September 2021. It was based in part on the thesis *The spatial distribution of heavy metals in the soils of Auckland and relationships of human exposure to contaminated soils* from a geochemical baseline survey completed over the city of Auckland. Publication(s) from this survey are in preparation.

GNS Science (the New Zealand Earth, geoscience and isotope research institute) is in the third year of a five-year programme (2019-2024) that is, in part, funding geochemical baseline in soil studies. Collaborative efforts are underway amongst several New Zealand universities and institutions to collect further geochemical baseline in soil samples as part of this programme. Collaborations involve post-graduate studies to understand the implications of heavy metal and isotope distribution through soil and community science projects. New Zealand has been in a sample and data collection phase in 2021, with results expected in 2022 and beyond.

### Oral and poster presentations

Shrestha, G.; Calvelo-Pereira, P.; Roudier, P.; Martin, A.P.; Turnbull, R.E.; Anderson, C.W.N.; Kereszturi, G.; Jeyakumar, P. 2021 Accurately predicting low soil cadmium by combining x-ray fluorescence, visible-near-infrared and mid-infrared spectroscopy. p. 195 IN: [Soils, investing in our future: 2021 joint conference 27 Jun-2 Jul, Cairns, NZ, virtual]: oral abstracts. Braeside: Soil Science Australia

Shrestha, G.; Calvelo-Pereira, P.; Roudier, P.; Martin, A.P.; Turnbull, R.E.; Anderson, C.W.N.; Kereszturi, G.; Jeyakumar, P. 2021 Accurately predicting low soil cadmium by combining x-ray fluorescence, visible-near-infrared and mid-infrared spectroscopy. p. 195 IN: [Soils, investing in our future: 2021 joint conference 27 Jun-2 Jul, Cairns, NZ, virtual]: oral abstracts. Braeside: Soil Science Australia

## A3.3. EUROPE

### A3.3.1. EuroGeoSurveys Geochemistry Expert Group

Annual Report 2021 by Philippe Négrel (Chair, BRGM), Anna Ladenberger (Deputy Chair, SGU), Jasper Griffioen (Deputy Chair, TNO).

Number of Geochemistry Expert Group (GEG) Members in 2021: 56.

#### A3.3.1.1 Executive Summary

The 2021 activities of the EuroGeoSurveys Geochemistry Expert Group (GEG) were:

- Publication of papers and presentations using results from Geochemistry of Agricultural and Grazing land Soil (GEMAS) project. Activities were somewhat limited due to the pandemic crisis.

- Discussion of ideas for developing pan-European geochemical projects of interest to policy makers, the scientific community, and the public. Monitoring of EU Commission calls.
- Participation in on-line events related to soil protection initiatives by FAO, EEA and EU Commission.
- GEG members joined working groups at EUSO (EU Soil Observatory).
- The GEG chairs actively participated in planning of the CSA proposals in the topics of Groundwater, Coastal Security and Mineral Resources.
- Publication of the GEMAS on-line version on the BGR Geoviewer and the Product Center: all single element maps in WMS form, download files for the Product Center (in total 2009 files; shapefiles, PNG and PDF files including metadata descriptions). The whole material is freely available and downloadable from the BGR Geoviewer. English version will be prepared in 2022.
- The two-day autumn annual group meeting of the EuroGeoSurveys Geochemistry Expert Group (EGS-GEG) was held virtually on the 30<sup>th</sup> November and 1<sup>st</sup> December 2021.

#### ***A3.3.1.2. Mission and vision***

Sound scientific data must be in the forefront for monitoring, planning and political decision-making. The mission of GEG is, thus:

- To provide high quality geochemical data of near-surface geo-materials, which affect directly or indirectly our quality of life;
- To develop harmonised geochemical databases for multi-purpose use: “*one project – many users*”;
- To offer independent non-biased expert advice to the European Commission, and to supply sound geochemical background data to scientists for their research, and to the public in general, for education, research and other applications (*e.g.*, land use planning, agriculture, remediation).
- Results from all completed projects are relevant for various European Commission Directives and EU international commitments.

#### ***A3.3.1.3. Scope and focus***

The focus of GEG (<https://www.eurogeosurveys.org/expertgroups/geochemistry/>) is on the execution of pan-European applied geochemical projects using harmonised and quality-controlled procedures of sampling, sample preparation, and laboratory analysis to produce high-quality data for multipurpose use. The scope is to bring under the same umbrella applied geochemists with various specialties (*e.g.*, environmental, mineral exploration, ground water geochemistry) from all EGS member institutions, and to act as a forum for the exchange of expertise and to work together to deliver high quality professional products and services to European Union countries.

#### ***A3.3.1.4. Achievements 2021***

- The GEG has established a collaboration with other EGS expert groups in work on the CSA proposals. As a result, geochemistry should be present in the three topics: Groundwater, Coastal Vulnerability and Mineral Resources.
- 21<sup>st</sup> May 2021, the GEG representatives attended the 5<sup>th</sup> workshop on Global Black Soil Critical Zone Geo-ecological Survey (BASGES) organised by the Shenyang Centre of China Geological Survey which followed publication of the sampling manual “*International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project*” ([https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS\\_Manual\\_of\\_Standard-Geochemical-Methods\\_for\\_the\\_Global-Black-Soil-Project.pdf](https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS_Manual_of_Standard-Geochemical-Methods_for_the_Global-Black-Soil-Project.pdf)).

- GEG members have been involved in the publication of the “*IUGS Manual of Standard Methods for the Establishment of the Global Geochemical Reference Network*” which is under review.
- GEG members took an active part in the webinar “*Horizon Europe Candidate Partnership Agriculture of Data*” organised by the EU Commission on the 26<sup>th</sup> May 2021.
- GEG members joined technical working groups at EUSO (European Soil Observatory):
  1. Soil Pollution – Romain Meyer
  2. Data integration – Anna Ladenberger
  3. Soil Biodiversity – Belinda Flem
  4. Soil erosion – Philippe Négrel
- Presentation of the GEG activities during the ASGMI meeting of the Association of Iberoamerican Geological and Mining Surveys, 23-25 November 2021

### **GEG Projects**

(i) Writing of articles on different aspects of the GEMAS project; (ii) preparation of the 4<sup>th</sup> GEMAS quality control report (expected to be completed in 2022); (iii) launch of the new [GEMAS website by BGR](#), which is expected to be in full operation in 2022; and (iv) GEMAS data are included on the [EGDI/GeoEra](#) portal (under preparation by GEUS).

### **Involvement in EU Commission co-financed projects**

Members of the EGS-GEG continued to be involved in many EU Commission co-financed projects. For example:

SCREEN 2 (Solutions for CRITICAL Raw materials - a European Expert Network 2): Expert Networking and update of the EU raw materials factsheets for CRM assessment.

PANAFGEO2: a joint project between European Geological Surveys and African Geological Surveys. Maria Joao Batista (LNEG) in in charge of coordination of WP-B – Mineral Resources Assessment, preparing the presentation of the training programme where it will occur, at the moment Morocco, Mozambique, Angola, Zimbabwe and if possible, Madagascar. Training will include office planning, geochemistry taking in consideration the FOREGS guidelines (which are similar to the under preparation IUGS Manual of Standard Methods for the Establishment of the Global Geochemical Reference Network), mineral resources reconnaissance in the field and reporting and presentation of results.

EURAD: The aim of EURAD is ‘*to implement a joint Strategic Programme of research and knowledge management activities at the European level, bringing together and complementing EU Member State programmes in order to ensure cutting-edge knowledge creation and preservation in view of delivering safe, sustainable and publicly acceptable solutions for the management of radioactive waste across Europe now and in the future. EURAD coordinates activities on agreed priorities of common interest between European Waste, Management Organisations, Technical Support Organisations and Research Entities*’ (see <https://cordis.europa.eu/project/id/847593/reporting>).

### **Advisory work for European agencies and international organisations**

- Chairpersons of the GEG are involved in the new European Soil Condition Assessment 2020/2021 by EEA (Eionet NRC Soil).
- Members of the EGS-GEG were involved in the writing or review of the published “*International Union of Geological Sciences Manual of Standard Geochemical Methods for the Global Black Soil Project*” <https://www.globalgeochemicalbaselines.eu/content/162/black-soil-project-manual/>).

- Members of the EGS-GEG are involved in the writing or review of the manual that is being prepared by the IUGS Commission on Global Geochemical Baselines: “*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*” (under review).

### Advisory work at the national level (examples)

**Lithuania:** National representative in the EU expert group on Soil protection at EC DG Environment and NRC for Soil at the EEA EIONET.

**Slovenia:** Setting up an online information platform based on soil geochemical data in the town of Maribor, Slovenia. The platform was set up in cooperation of the Geological Survey of Slovenia, Joint environmental protection services of 6 municipalities, the National Institute of Public Health, and the National Laboratory of Health, Environment and Food (<https://okolje.maribor.si/okolje/>).

**Slovenia:** Project performed for the **Ministry of the environment and spatial planning** (Republic of Slovenia) MONITORING OF CLOSED FACILITIES FOR MANAGEMENT OF WASTE DERIVED FROM EXTRACTIVE INDUSTRIES (2020-2021) (Report on research work performed for the Ministry of the environment and spatial planning (Republic of Slovenia)).

**Sweden:** Agency representative in the Toxicological Council and committee work on Cadmium strategy for Sweden led by the Toxicological Council by the Swedish Chemicals Agency.

**United Kingdom:** Member of the United Nations Food and Agriculture Organisation (FAO) Global Soil Laboratory Network (GLOSOLAN) Technical Working Group. Member of the UK Health Security Agency (formerly Public Health England) Lead Exposure in Children Surveillance System (LEICSS) Steering Group.

**The Netherlands:** Member of the Groundwater Domain group for the Dutch BRO Key Register of the Subsurface.

**Portugal:** Member of EGS-GEG is also a member of the Scientific Board of IGCP-UNESCO (2016-2024) in Earth Resources and Geohazards Groups. <http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/international-geoscience-programme/igcp-council/>.

Member of EGS-GEG (Maria Joao Batista, LNEG) is Chair of the Geochemistry Group of ASGMI (*Association of Iberoamerican Geological and Mining Surveys*). Present mission is to prepare a Manual of Standard Geochemical Methods for the South American and Iberian Peninsula (it is noted that this will follow the under preparation IUGS Manual of Standard Methods for the Establishment of the Global Geochemical Reference Network). Maria Joao Batista is involved in compiling and coordinating the chapters of the Manual to be presented (if pandemic allows) in Colombia meeting in 2022 and participated in the preparation of the Virtual Seminar hosted by Geological Survey of Colombia (lead by Gloria Prieto) 23-25 November of 2021.

### Participation in regional/national projects and other research activities (examples)

- GeoZS is lead partner in **SIMONA** project (Sediment-quality Information, Monitoring and Assessment System to support transnational cooperation for joint Danube Basin water management) financed by The Danube Transnational Programme (Interreg).
- Participating in upscaling project funded by EIT Raw Materials **inSITE** (Insitu ore grading system using LIBS in harsh environments) <https://www.inesctec.pt/en/projects/insite#about>



- Launch of the UK stream sediment geochemistry atlas on the BGS webpages <https://www.bgs.ac.uk/geology-projects/applied-geochemistry/g-base-regional-geochemistry/stream-sediment-geochemical-atlas/> Everett, P.A., Lister, T.R., Fordyce, F.M., Ferreira, A.M.P.J., Donald, A.W., Gowing, C.J.B. and Lawley, R.S., 2019. Stream Sediment Geochemical Atlas of the United Kingdom. Open Report, OR/18/048. British Geological Survey, Keyworth, Nottingham. <http://nora.nerc.ac.uk/id/eprint/524956/>.
- Release of the South-West England Rare Earth Elements stream sediment data set <https://www.bgs.ac.uk/datasets/south-west-england-rare-earth-element-stream-sediment-maps-and-grids/> Lister, T.R., Fordyce, F.M., Ferreira, A.M.J.P., Everett, P., Lawley, R.S., 2020. SW England Rare Earth Element (REE) Stream Sediment Dataset User Guide. British Geological Survey Open Report, OR/19/050 Keyworth, Nottingham. <http://nora.nerc.ac.uk/id/eprint/524956/>.
- Release of the Brownfield ground risk calculator: <https://www.bgs.ac.uk/geology-projects/brownfield-ground-risk-calculator/>.
- Translation of regional geochemical expertise to agronomy geochemical studies in Ethiopia and Malawi <https://www.nature.com/articles/s41586-021-03559-3>
- Acid sulphate soils as a geo-biohazard in the Barents region. Partners: Geological Survey of Finland (GTK), Geological Survey of Sweden (SGU), Geological Survey of Norway (NGU), Geological Institute of the Kola Science Centre of the Russian Academy of Sciences (GI KSC RAS) and Aarhus University. Project is funded by Kolarctic.
- Urban geochemical mapping of Longyearbyen, Svalbard, Funded by Svalbard environmental fund.
- EU-WATERRES "EU-integrated management system of cross-border groundwater resources and anthropogenic hazards". Partners: Polish Geological Institute - National Research Institute, Geological Survey of Norway (NGU), Ukrainian Geological Company, Geological Survey of Estonia, University of Latvia, The Institute of Geology and Geochemistry of Combustible Minerals of National Academy of Sciences of Ukraine and the Latvian Environment, Geology and Meteorology Centre. Project funded through EEA and Norway Grants Fund for Regional Cooperation.
- Regional multi-disciplinary mapping project in the Bergslagen area of central Sweden (SGU).
- Mapping of secondary mineral resources in mining waste (Sweden).
- Environmental monitoring of organic pollutants and elements in Swedish marine sediments (SGU, Swedish EPA; 2020-2021).
- Characterization and remediation of contaminated fibrous sediments (from pulp and paper industry discharges). Partners: universities, governmental agencies and a consultant agency in Sweden and Germany.
- Entrance of thousands of geochemical sediment analyses in the Dutch geological database DINOLOKET
- Participation in Dutch research programme KIWK Knowledge Impulse Water Quality.
- Detailed Geochemical Map of Upper Silesia in scale 1:25 000 by Polish Geological Institute-National Research Institute (PIG-PIB). In 2021, next four sheets were completed: Tarnowskie Góry, Świerklaniec, Bytom and Piekary Śląskie. The results have been published in the form of separate atlases and are available on the website - <https://mapgeochem.pgi.gov.pl/en/>

## Book sales

- *Chemistry of Europe's Agricultural Soils* (GEMAS atlas, Reimann *et al.*; <https://www.schweizerbart.de/publications/detail/isbn/9783510968466>): In total, 11 copies of both volumes, and 3 copies of volume 1 were sold in 2018. The hitherto total sales by Schweizerbart are 544 copies of (Parts 1 & 2), and 13 copies of volume 1. In addition,

BGR has sent through its library exchange programme 140 copies of both volumes to national geological surveys, ministries or politicians. NGU has also given free volumes to different institutions. It is, therefore, difficult to estimate the exact number of hard copies that are worldwide since its publication in April 2014. A conservative estimate is around 700 to 750 copies.

- ***Geochemistry of European Bottled Water*** (C. Reimann & M. Birke, Eds; <https://www.schweizerbart.de/publications/detail/isbn/9783443010676/Geochemistry-of-European-Bottled-Water>): Book sales, since publication in August 2010, reached 925 copies.
- ***Mapping Chemical Environment of Urban Areas*** (Johnson C.C., Demetriades, A., Locutura, J & Ottesen R.T., Eds; <https://www.wiley.com/en-au/Mapping+the+Chemical+Environment+of+Urban+Areas-p-9780470670071>): Book sales, since publication in April 2011, reached 667 copies, and Royalties earned from the sale of 12 books up to the end of 2019 are £17.73, and the sale of 8 copies up to the end of 2020 £8.16. We do not yet have the Wiley statement on book sales in 2021 and royalties earned. This statement is expected in April 2022.

## Conferences

- One of the biggest events in 2021 was the GEG participation in the Goldschmidt Conference 2021. GEG together with the IUGS Commission on Global Geochemical Baselines organised a virtual session “***Geochemical mapping at all scales for all reasons***” under Theme 12 “*Environmental Geochemistry and Human Health*” at the Goldschmidt 2021 conference. The session was chaired by Philippe Négrel and Anna Ladenberger (GEG Chair and Co-chair). The main topic of the session was systematic geochemical mapping and its methodology to document the spatial variation of chemical elements in geomaterials occurring at or below the Earth's surface, *i.e.*, rock, soil, sediment, stream water, groundwater, and vegetation. The resulting geochemical databases have a wide range of applications, including mineral exploration, agriculture, forestry, land use planning, environmental monitoring, medical and forensic science, *etc.* The keynote lecture “*Geochemical mapping applications to forensics and intelligence*” was delivered by Patrice de Caritat (Geoscience Australia), and the invited talk “*Assessing the influence of the industrial past on an urban environment - what does the soil geochemistry?*” was given by Joanna Wragg (British Geological Survey). In total, there were 17 presentations. The session was attended by about 70 persons. It is worth mentioning that our keynote lecture gained enormous media attention and several articles about geochemical mapping applications to forensics were published during and shortly after the conference.
- Presentation during the virtual EGU (April 2021): Négrel, Ph., Ladenberger, A., Reimann, C., Birke, M., Demetriades, A., Sadeghi, M., 2021. *Major element geochemistry of European agricultural soil: weathering processes of silicate parent materials*. EGU General Assembly Vienna 2021.

## Publications of the group

Négrel, P., Ladenberger, A., Reimann, C., Birke, M., Demetriades, A., Sadeghi, M. & The GEMAS Project Team, 2021. GEMAS: Geochemical distribution of Mg in agricultural soil of Europe. *Journal of Geochemical Exploration* (2021), 106706; <https://doi.org/10.1016/j.gexplo.2020.106706>.

Demetriades, A., Reimann, C., Birke, M., Négrel, P., Ladenberger, A., Tarvainen, T., Sadeghi, M. & the GEMAS Team, 2021. GEMAS: Geochemistry of European agricultural and grazing land soil. *European Geologist* 52, 21–32; <https://doi.org/10.5281/zenodo.5770107>.

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#### ***A3.3.1.5. Future perspectives***

The Geochemistry Expert Group would like to see closer collaboration between the EGS expert groups regarding the future of Geological Services for Europe and GeoEra initiatives. Geological Surveys are the only geoscientific organisations that can develop truly harmonised databases. Pan-European projects that have high priority and could be carried out in EU countries by EGS associated surveys are:

- Water Geochemistry of Europe (WAGE) – Surface & spring water
- Urban geochemistry of Europe (URGE) Phase II
- Ore deposit geochemistry database (OREDAT)

Among the future perspectives, apart from on-going work on the GEMAS project samples, the following harmonised data sets have been identified as ‘urgently needed’ and GEG’s explores the possibilities to find both the external and internal financial sources to carry out the following projects:

- Modern isotope systematics on GEMAS samples
- Mineralogical analyses on GEMAS samples
- URGE - urban geochemistry phase II – towards the production of homogeneous and representative urban data sets (for this purpose a brochure was written – and the manual has been published - [https://www.eurogeosurveys.org/wp-content/uploads/2015/06/EGS\\_Urban\\_Topsoil\\_Geochemical\\_Mapping\\_Manual\\_URGE\\_II\\_HR\\_version.pdf](https://www.eurogeosurveys.org/wp-content/uploads/2015/06/EGS_Urban_Topsoil_Geochemical_Mapping_Manual_URGE_II_HR_version.pdf))
- Harmonised and coherent litho-geochemistry of Europe (complementary to the parent material map of Europe)
- Surface/Spring water geochemistry
- Low-sampling density geochemistry of the European shelf
- Forest soil geochemistry
- Geochemistry of the North Atlantic Basin (for this purpose a brochure was written in collaboration with EGS Marine Geology Expert Group)
- Internally consistent database of the geochemistry of European mineral deposits (complementary to the ProMine and Minerals4EU databases).
- Use of the GEMAS data as ground proofing data set for remote sensing (discussion with European Space Agency).