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**2019  
ANNUAL REPORT**

*of the*

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

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December 2019

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# 2019 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).

## 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 Reference Network (GRN) 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.

This database is urgently needed by environmental and natural resource managers throughout the world. To reach this goal, the Commission works with applied geochemists throughout the world to establish 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 terranes;
- ✓ 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 meeting 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 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 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 newly established 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

*Co-Chairs:* 1<sup>st</sup> Co-chair: David B. Smith, United States Geological Survey

2<sup>nd</sup> Co-chair: Xueqiu Wang, UNESCO International Centre on Global-Scale Geochemistry

*Scientific Secretary:* Patrice de Caritat, Geoscience Australia

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

*Treasurer:* Alecos Demetriades, Institute of Geology and Mineral Exploration, Hellas

As the two Co-chairs, Scientific Secretary and Treasurer will be standing down at the end of the current four-year term, the new Steering Committee is proposed to consist of ten members as from March 2020 following its approval by the IUGS EC and ratification by the IUGS Council at its March 2020 meeting in Delhi on the occasion of the 36<sup>th</sup> IGC. The reason for this structure, and especially the three former members of the Steering Committee to serve as an Advisory Panel, is to assist the new members in their work, and to transfer their experience. The proposal for the Steering Committee members for the 2020-2024 period is:

*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, University of Nigeria, Nsukka, Nigeria

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

Enrique Espinosa, SGM, Pachuca, Mexico

Robert G. Garrett, Ottawa, Ontario, Canada

### **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, Geological and Mining Survey of Chile, Santiago, Chile

Gloria Prieto, Servicio Geológico Colombiano, Bogotá, Colombia

### **4.6.4. Australasia**

Patrice de Caritat, Geoscience Australia, Canberra

### **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, France  
Anna Ladenberger, Geological Survey of Sweden

#### 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

## 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.*

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 2<sup>nd</sup> 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).

## 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 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; (ii) 4<sup>th</sup> YES Congress in Tehran, Iran (29-30 August 2017), with 48 attendees, (iii) RFG2018 in Vancouver, Canada (18 & 22 June 2018), and on the occasion of the 5<sup>th</sup> YES Congress in Berlin (8-9 September 2019) as detailed in [Section 6.3](#). 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.

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; a short report is given in [Appendix 2](#). 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) covers 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 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 the 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 will be discussing with the AfriGEOSS capacity building programme in Phase II of PanAfGeo.

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](#)).

### 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.

### **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 2019**

### **6.1. 73<sup>rd</sup> IUGS EXECUTIVE COMMITTEE MEETING & DDE KICK-OFF**

The 73<sup>rd</sup> IUGS open Executive Committee (EC) meeting was organised in Beijing (P.R. China) from the 27<sup>th</sup> of February to the 2<sup>nd</sup> of March 2019; the open session was on the 27<sup>th</sup> and 28<sup>th</sup> of February 2019.

On the 26<sup>th</sup> of February 2019 all 73<sup>rd</sup> IUGS EC meeting participants attended the opening ceremony of the new IUGS Initiative, [Deep-time Digital Earth \(DDE\)](#), which will be of a ten-year duration (2019-2028) (Figures 1a, b).

At the open session of the EC meeting the IUGS-CGGB Treasurer reported the [Commission's 2018 activities](#), and the 2019 programme, as well budget requirements. The IUGS Executive Committee was pleased with the progress made on the two standard geochemical methods manuals: (i) Manual of Standard Methods for the Global Geochemical Baselines project, and (ii) Manual of Geochemical Methods for the Black Soil project, as the work of the Commission is to put in place standards for establishing baselines that can be employed by the broad Earth Science community, as per the IUGS definition of Commissions.

### **6.2. ANNUAL BUSINESS MEETING**

The joint annual business meeting of the EuroGeoSurveys Geochemistry Expert Group and IUGS Commission on Global Geochemical Baselines was hosted by the [Mining and Geological Survey of Hungary](#) at its premises in Budapest on the 26<sup>th</sup> and 27<sup>th</sup> September 2019 (see [Appendix 1](#)). In total, 26 people attended the meeting from China, Russia and European countries (see Table 1; Figure 2). In the second day, the EuroGeoSurveys Secretary General, Dr. Slavko Solar joined the meeting.



(a)



(b)

*Figure 1. (a) Group photograph of DDE participants, and (b) DDE conference participants. Photograph: Professional photographer.*



Table 1. List of participants of joint annual meeting.

1. Philippe Négrel (Chair, France)	14. Gyozo Jordan (Hungary)
2. Anna Ladenberger (Deputy Chair, Sweden)	15. Belinda Flem (Norway)
3. Slavko Solar (EGS)	16. Manfred Birke (Germany)
4. Gerhard Hobiger (Austria)	17. Ajka Sorsa (Croatia)
5. Alejandro Bel-lan (Spain)	18. Irena Wysocka (Poland)
6. Maria João Batista (Portugal)	19. Alvar Soesoo (Estonia)
7. Timo Tarvainen (Finland)	20. Mairead Glennon (Ireland)
8. George Morris (Sweden)	21. Alecos Demetriades (IUGS-CGGB)
9. Jasper Griffioen (The Netherlands)	22. Ariadne Argyraki (IUGS-CGGB)
10. Mateja Gosar (Slovenia)	23. Chaosheng Zhang (Ireland)
11. Daniella Tolmács (Hungary)	24. Victor A. Kilipko (Russia)
12. György Falus (Hungary)	25. Olga Kalyeva (Russia)
13. Edit Király (Hungary)	26. Yao Wensheng (China)

*Note:* In addition, three students from the Eötvös Loránd University (ELTE) in Budapest attended the meeting: Margareth Yissel López Marin (Columbia), Nelson Salazar (Ecuador) and Tserendorj Davaakhuu (Mongolia).



Figure 2. Group photograph of meeting participants. Photograph: Chaosheng Zhang.

### 6.3. INTERNATIONAL CONFERENCES: SESSIONS AND WORKSHOPS

In 2019, the Commission organised sessions in three International Conferences, and workshops in two:

- 15<sup>th</sup> International Congress of the Geological Society of Greece, Athens, Hellas, 22-24 May 2019 (Session and Workshop);
- International Symposium on Environmental Geochemistry, Peking University, Beijing, P.R. China, 7-10 August 2019 (Session only and delivery of keynote presentation), and
- 5<sup>th</sup> YES Network Congress ‘Rocking the Earth’s Future’, Berlin, Germany, 9-13 September 2019 (Workshop only and delivery of keynote presentation).

### 6.3.1. 15<sup>th</sup> International Congress of the Geological Society of Greece

#### 6.3.1.1. Session: Geochemical mapping for environmental and resource management

The Commission, together with the Society for Environmental Geochemistry and Health (SEGH) and the EuroGeoSurveys Geochemistry Expert Group, organised a Special Session on “Geochemical Mapping for Environmental and Resource Management” on the 23<sup>rd</sup> May 2019. It was attended by more than 60 conference participants (Figure 3). In total, there were two keynote, ten oral and eleven poster presentations (Table 2).

Table 2. List of oral and poster presentations.

1. Oral presentations:	
<b>1<sup>st</sup> Keynote: GEMAS: Geochemistry of European Soil for Producing Good Quality Food</b>	<b>Anna Ladenberger, <i>Ph. Négrel</i></b>
FOREGS, EGG and GEMAS: European Continental-scale Geochemical Projects for Environmental and Resource Management	<i>A. Demetriades</i> , T. Tarvainen, C. Reimann, <i>Ph. Négrel</i> , A. Ladenberger, M. Birke, M. Sadeghi
GEMAS: Geochemical Mapping of Mg in Agricultural Soil of Europe and its Criticality Assessment	<i>Ph. Négrel</i> , A. Ladenberger, C. Reimann, M. Birke, A. Demetriades, M. Sadeghi
European-wide Data on Arsenic Concentrations in Agricultural Soils, Waters and Crops (AgriAs Project)	<i>T. Tarvainen</i> , T. Hatakka, K. Loukola-Ruskeeniemi
Soil Geochemical Baselines of Ni on a Continental, National and Local Scale	<i>T. Hatakka</i> , T. Tarvainen
Decoupled Geochemical Behaviour of Tl, Au, As in Sea-floor Massive Sulphides, Kolumbo Arc-volcano: Evidence from LA-ICP-MS Elemental Mapping of Arsenian Pyrite	<i>N. Zegkinoglou</i> , S.P. Kiliyas, M. Keith, D.J. Smith, P. Nomikou, P. Polymenakou
<b>2<sup>nd</sup> Keynote: Soil Contaminant Baselines in the management of urban ecosystems</b>	<b>Andrew S. Hursthouse</b>
Combining Geochemical Mapping with Mineralogical and Chemical Data for Improved Interpretation of Elemental Mobility in the Urban Environment	<i>A. Argyraki</i> , E. Kelepertzis
Fate of Trace Elements in Urban Surface Drainage Deposits of the Athens Basin, Greece	<i>P. Kourgia</i> , A. Argyraki, E. Dasenakis, M. Skoullou, V. Paraskevopoulou
Application of Dual Isotopes ( $\delta^{15}\text{N}$ , $\delta^{18}\text{O}$ ) to Determine Nitrate Contamination Sources in Cr(VI)-impacted Groundwater of Central Greece Aquifers	<i>E. Kelepertzis</i> , K. Pyrgaki, A. Argyraki, F. Botsou, P. Boeckx, I. Megremi, S. Karavoltzos, M. Dassenakis
Field-portable X-ray Spectrometry as Rapid Measurement Tool for Environmental Geochemical Investigations in Former Mining Areas: The Case of Kirki Mines (Greece)	<i>A. Liakopoulos</i> , B. Lemiére, V. Laperche
Detection of Engineered, Incidental, and Natural Nanoparticles in Marine Waters in the Proximity of Islands	<i>A. Gondikas</i> , T. Kalampaliki, A. Dura, P. M. Chronakis, Nomikou, A. Godelitsas, S. Pergantis, T. Mertzimekis, M. Hasselov
2. Poster presentations:	
URGE: The EuroGeoSurveys Geochemistry Expert Group's Urban Geochemistry Projects	A. Demetriades, Ch. C. Johnson, M. Birke, A. Ladenberger
Urban Geochemical Surveys in Hellas	S. Tassiou, A. Liakopoulos, A. Demetriades
Environmental Contamination of Soils by Cadmium, Associated with Former Zn-Pb Ore Mining Activity in the Upper Silesia Region (southern Poland)	A. Pasieczna, A. Konon, I. Wysocka
Application of Phosphates in Mine Affected Soils Increases Arsenic Availability for Plant Uptake: Preliminary Results	I. Zafeiriou, G. Kalyvas, D. Ioannou, I. Massas
Environmental Impact of Mn Mining Wastes on the Accumulation of Potential Hazardous Elements in Soil and Crop Grains in Western Drama Plain, Macedonia, Northern Greece	E. Sofianska, K. Michailidis

<b>2. Poster presentations:</b>	
Distribution of Trace Elements in Old Lignite Disposal Sites and Potential Impact on the Local Environment, Oropos Basin, Northern Attika	E. Karampetsou, L. Arvaniti, K. Kollias, C. Stouraiti, E. Kampouroglou
Development of a GIS Story Map for Improved Communication of the ERANETMED CrITERIA Project Results on Cr(VI)-Impacted Water Bodies of the Mediterranean	S. Potamousis, A. Argyraki, K. Pyrgaki, E. Kelepertzis, F. Botsou, I. Megremi
Single Particle Electrochemistry for Detecting Nanoparticles in Water Environments	Th. Kalampaliki, A. Godelitsas, P. Nomikou, A. Gondikas
Seasonal and Temporal Variation of the Piezometric Level in the Alluvial Aquifer of Loutraki (Korinthia), with the Use of GIS Mapping Techniques	K. Pyrgaki, P. Krassakis, V. Gemeni, N. Koukouzas., A. Argyraki, K. Voudouris
Variability and Enrichment of Metals in Soils and Sediments along Karvounoskala Stream (NE Chalkidiki, Northern Greece)	A. Karetou, M. Vavelidis, K. Giouri, N. Kantiranis, L. Papadopoulou, C.L. Stergiou
Geochemical Survey Database of Hungary - Concept, Development and Application	D. Tolmacs



(a)



(b)



(c)

Figure 3. (a) and (b) Philippe Négrel and Andrew Hursthouse, respectively, delivering their keynote presentations, and (c) session attendees. Photographs: Alecos Demetriades.

### 6.3.1.2. Workshop on Global-Scale Geochemical Mapping

The tutors of the Workshop were: Alecos Demetriades (Treasurer and Chairperson of IUGS Commission on Global Geochemical Baselines), Timo Tarvainen (Chairperson of Data Management Committee), and Ariadne Argyraki (Chairperson of Public Relations and Finance Committee).

The Workshop lectures were:

1. *Introduction to Applied Geochemistry (including Exploration Geochemistry)* by Alecos Demetriades



2. *Sampling and sampling designs (stream sediment, soil, overbank sediment and rock for mineral exploration, including environmental geochemistry surveys)* by Alecos Demetriades
3. *Sample preparation, sample randomisation, insertion of control samples and submission to laboratory* by Alecos Demetriades
4. *Quality control scheme (independent quality control, and elaboration of different statistical techniques for data validation)* by Ariadne Argyraki (Figure 4a)
5. *Statistical-geostatistical data treatment – Data processing by graphical methods – Geochemical background, threshold and anomalies* by Alecos Demetriades
6. *Data management and map plotting of continental-scale geochemical projects* by Timo Tarvainen (Figure 4b)
7. *Global- to local-scale geochemical surveys (The FOREGS, EGG and GEMAS projects)* by Alecos Demetriades

To each Workshop participant was given (i) a certificate of attendance signed by the three tutors, and (ii) a USB-memory stick with the Workshop lectures together with directories that contain useful bibliography in directories: (1) Applied Geochemistry, (2) Sampling, (3) Sample preparation & analyses, (4) Quality control, (5) Statistics-Geostatistics, (6) Data management, (7) Global- to Local scale geochemistry, (8) Mineral exploration, (9) Environmental contamination, (10) Writing Geochemical Reports, (11) Geochemical Atlases (FOREGS, USA, Australia) and (12) GEMAS Periodic Tables.

The workshop was attended by 22 people (Figure 4).



(a)



(b)

Figure 4. (a) Ariadne Argyraki and (b) Timo Tarvainen delivering their lectures. Photographs: Alecos Demetriades.

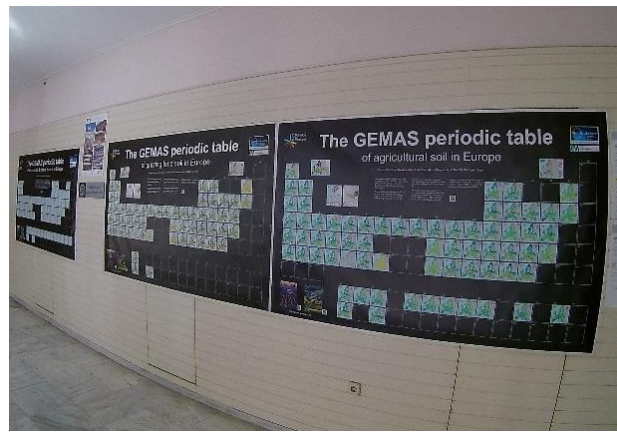
### 6.3.1.3. Promotional success of Global Geochemical Baselines

The organisers of the 15<sup>th</sup> International Congress of the Geological Society of Greece agreed for the:

- (i) display of two roll-up posters (Figure 5a), and GEMAS project's periodic tables (Figure 5b), and
- (ii) inclusion of the Workshop material on the USB-memory stick prepared for the conference participants. In total, the USB-memory stick was given to 708 participants from 19 countries.



(a)



(b)

Figure 5. Display in front of the central conference auditorium (a) SEGH and IUGS-CGGB roll-up posters and (b) the three GEMAS periodic tables displaying at the place of each element (i) [geochemical maps of agricultural soil](#) (ii) [geochemical maps of grazing land soil](#) and (iii) [mineral deposit maps](#). Photographs: Alecos Demetriades.

### 6.3.2. International Symposium on Environmental Geochemistry, Beijing, P.R. China

At the invitation of Chaosheng Zhang (IUGS-CGGB member, Ireland), the Commission organised a session on “*Regional and Global Geochemistry: Opportunities and Challenges*” on the occasion of the 11<sup>th</sup> International Symposium on Environmental Geochemistry (ISEG 2019), held in Peking University (Beijing, P.R. China) from the 7<sup>th</sup> to the 10<sup>th</sup> August 2019. The session was on the 8<sup>th</sup> of August 2019, and was attended by more than fifty people, although the attendance varied from twenty-five to over fifty attendees (Figure 6).



(a)



(b)

Figure 6. (a) Alecos Demetriades delivering the keynote presentation, and (b) session participants. Photographs: Chaosheng Zhang.

In total, there were 1 keynote and 7 oral presentations. However, only two presentations were relevant to the session title, namely:

- *Continental-scale geochemistry for location of metallogenic provinces and environmental baselines* by Alecos Demetriades (keynote presentation), and
- *Use of spatial machine learning to reveal hidden patterns and relationships in national and international geochemical databases* by Chaosheng Zhang.

The reason was that the conference organisers never informed the session conveners about the abstracts submitted for this particular session. Further, there was a disappointment for there were no presentations from the staff of the UNESCO International Centre on Global-Scale Geochemistry, and also no attendance.

### 6.3.3. 5<sup>th</sup> YES Network Congress ‘*Rocking the Earth’s Future*’, Berlin, Germany

The 5<sup>th</sup> YES Network Congress venue was organised in the conference centre of Freie University (Berlin).

#### 6.3.3.1. *Plenary session*

In the plenary session of the 11<sup>th</sup> of September 2019, Alecos Demetriades (Treasurer and Chairperson of Sampling Committee) delivered a keynote presentation with the title ‘*Global Geochemical Mapping for Resource and Environmental Management*’. More than sixty people attended the plenary session.

#### 6.3.3.2. *Pre-congress Workshop*

A two-day pre-congress workshop was organised on the 8<sup>th</sup> and 9<sup>th</sup> of September 2019 in the Geology Department of Freie University. The tutors were Ariadne Argyraki (Chair of Public Relations and Finance Committee) and Alecos Demetriades (Treasurer and Chair of Sampling Committee) (Figure 7a).

The Workshop lectures were:

1. *Introduction to Applied Geochemistry (including Exploration Geochemistry)* by Alecos Demetriades
2. *Sampling and sampling designs (stream sediment, soil, overbank sediment and rock for mineral exploration, including environmental geochemistry surveys)* by Alecos Demetriades
3. *Sample preparation, sample randomisation, insertion of control samples and submission to laboratory* by Alecos Demetriades
4. *FOREGS laboratory scheme (Forum of European Geological Surveys: Geochemical Atlas of Europe)* by Alecos Demetriades
5. *Quality control scheme (independent quality control, and elaboration of different statistical techniques for data validation)* by Ariadne Argyraki
6. *Quality control scheme: Case study – Soil and house dust survey in a mining village* by Ariadne Argyraki
7. *Quality control scheme: Case study – Urban soil mapping in Athens, Hellas* by Ariadne Argyraki
8. *Quality control scheme: Case study – In-situ heterogeneity and uncertainty of measurement* by Ariadne Argyraki
9. *Quality control scheme: Case study – Soil and house dust survey in a mining village* by Ariadne Argyraki
10. *Quality control scheme: Case study – Practical exercise: Evaluation of statistical data of environmental geochemistry – The importance of sampling* by Ariadne Argyraki
11. *Statistical-geostatistical data treatment – Data processing by graphical methods – Geochemical background, threshold and anomalies* by Alecos Demetriades
12. *Global- to local-scale geochemical surveys (The FOREGS, EGG and GEMAS projects)* by Alecos Demetriades
13. *Phased mineral exploration programme for the location and delineation of mineralised structures (orientation surveys, reconnaissance stream sediment survey, follow-up stream sediment survey, detailed soil and rock surveys, trenching and drilling)* by Alecos Demetriades
14. *Quantitative interpretation of stream and soil orientation surveys* by Alecos Demetriades delivering a lecture by Chris Benn with his permission



The Workshop was attended by 20 people from Argentina, Armenia, Azerbaijan, Egypt, India, Indonesia, Iraq, Namibia and The Netherlands (Figure 7b). To each Workshop participant was given (i) a certificate of attendance signed by the two tutors, and (ii) a USB-memory card with the Workshop lectures together with useful bibliography in directories: (1) Applied Geochemistry, (2) Sampling, (3) Sample preparation & analyses, (4) Quality control, (5) Statistics-Geostatistics, (6) Data management, (7) Global- to Local scale geochemistry, (8) Mineral exploration, (9) Environmental contamination, (10) Writing Geochemical Reports, (11) Geochemical Atlases (FOREGS, USA, Australia) and (12) GEMAS Periodic Tables.

The USB-memory card was provided *free-gratis* by Bureau de Recherches Géologiques et Minières (BRGM), France, arranged by Philippe Négrel.



Figure 7. (a) Alec Demetriades (left) and Ariadne Argyraki (right) in front of *The FOREGS periodic table of residual topsoil in Europe*, and (b) group photograph of Workshop participants and tutors. Photographs: (a) Camila Neder and (b) automatic.

### 6.3.4. Other workshops organised in Chinese Universities

#### 6.3.4.1. Shangluo University, Shangluo

A one-day workshop on Applied Geochemistry was organised in Shangluo University on the 2<sup>nd</sup> of August 2019. The arrangements were made by Chaosheng Zhang (IUGS-CGGB member, Ireland), and Professor Pei Zhao (Shangluo University). A list of proposed lectures was sent to Shangluo University and the following three lectures were selected and delivered:

- *Sampling and sampling designs (stream sediment, soil, overbank and rock for mineral exploration, including environmental geochemistry surveys)* by Alec Demetriades
- *Use of spatial machine learning to reveal hidden patterns and relationships in national and international geochemical databases* by Chaosheng Zhang
- *Preparing manuscripts in English for publication in International Journals* by Alec Demetriades

The Workshop was attended by 15 people (Figure 8).

A USB-memory card with the Workshop lectures together with useful bibliography in directories was given to Professor Pei Zhao for distribution to attendees: (1) Applied Geochemistry, (2) Sampling, (3) Sample preparation & analyses, (4) Quality control, (5) Statistics-Geostatistics, (6) Data management, (7) Global- to Local scale geochemistry, (8) Mineral exploration, (9) Environmental contamination, (10) Writing Geochemical Reports, (11) Geochemical Atlases (FOREGS, USA, Australia) and (12) GEMAS Periodic Tables.



Figure 8. Group photograph of Shangluo University Workshop participants. Photograph: Unknown student.

#### 6.3.4.2. Henan University, Kaifeng

A two-day workshop on Global-scale Geochemical Mapping was organised in Henan University on the 2<sup>nd</sup> of August 2019. The arrangements were made by Chaosheng Zhang (IUGS-CGGB member, Ireland), and Professor Zhifan Chen (College of Environment and Planning). A list of proposed lectures was sent to Henan University and the following five lectures were selected and delivered by Alecos Demetriades (IUGS-CGGB Treasurer and Chair of Sampling Committee):

- *Sampling and sampling designs (stream sediment, soil, overbank sediment and rock for mineral exploration, including environmental geochemistry surveys)*
- *Sample preparation, sample randomisation, insertion of control samples and submission to laboratory*
- *FOREGS laboratory scheme (Forum of European Geological Surveys: Geochemical Atlas of Europe)*
- *Quality control scheme (Independent Quality Control, and elaboration of different statistical techniques for data validation)*
- *Statistical-geostatistical data treatment – Data processing by graphical methods – Geochemical background, threshold and anomalies.*

The Workshop was attended by 14 people (Figure 9).

A USB-memory card with the Workshop lectures together with useful bibliography in directories was given to Professor Zhifan Chen for distribution to attendees: (1) Applied Geochemistry, (2) Sampling, (3) Sample preparation & analyses, (4) Quality control, (5) Statistics-Geostatistics, (6) Data management, (7) Global- to Local scale geochemistry, (8) Mineral exploration, (9) Environmental contamination, (10) Writing Geochemical Reports, (11) Geochemical Atlases (FOREGS, USA, Australia) and (12) GEMAS Periodic Tables.





Figure 9. Group photograph of Henan University Workshop participants. Photograph: Unknown student.

#### 6.3.4.3. Chang'an University, Xi'an

A two-day workshop on Applied Geochemistry and Global-scale Geochemical Mapping was organised on the 22<sup>nd</sup> and 23<sup>rd</sup> November 2019 at Chang'an University, following an invitation from Dr. Xin Lin of the School of Earth Science and Resources. Nine lectures were delivered during the two-day workshop by Alecos Demetriades (IUGS-CGGB Treasurer and Chair of Sampling Committee:

- *Introduction to Applied Geochemistry (including Exploration and Environmental Geochemistry).*
- *Geochemical sampling and sampling designs (stream sediment, soil, overbank sediment and rock for mineral exploration, including environmental geochemistry surveys).*
- *Sample preparation, sample randomisation, insertion of control samples and submission to laboratory.*
- *FOREGS laboratory scheme (Forum of European Geological Surveys: Geochemical Atlas of Europe).*
- *Quality control scheme (Independent Quality Control, and elaboration of different statistical techniques for data validation).*
- *Statistical-geostatistical data treatment – Data processing by graphical methods – Geochemical background, threshold and anomalies.*
- *Global to local-scale geochemical surveys (The FOREGS, EGG and GEMAS projects).*
- *Phased mineral exploration programme for the location and delineation of mineralised structures (orientation surveys, reconnaissance stream sediment survey, follow-up stream sediment survey, detailed soil and rock surveys, trenching and drilling).*
- *Preparing manuscripts in English for publication in International Journals.*

The Workshop was attended by 23 people from China (18), Egypt (1), Namibia (1) Pakistan (2) and Rwanda (1) (Figure 10).

A USB-memory card with the Workshop lectures together with useful bibliography in directories was given to Dr. Xin Lin for distribution to attendees: (1) Applied Geochemistry, (2) Sampling, (3) Sample preparation & analyses, (4) Quality control, (5) Statistics-Geostatistics, (6) Data management, (7) Global- to Local scale geochemistry, (8) Mineral exploration, (9) Environmental contamination, (10) Writing Geochemical Reports, (11) Geochemical Atlases (FOREGS, USA, Australia) and (12) GEMAS Periodic Tables.



Figure 10. Group photograph of Chang'an University Workshop participants. Dr. Xin Lin (lecturer, School of Earth Science and Resources, Chang'an University, Xi'an, P.R. China) explaining in Chinese the last part of the data processing lecture concerned with compositional data analysis. Photograph: Alecos Demetriades.

#### 6.4. MANUAL OF STANDARD METHODS FOR ESTABLISHING THE GLOBAL GRN

The Commission is continuing the work on the compilation of a comprehensive '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*', which started in the first quarter of 2018. The [FOREGS Field Geochemical Mapping Field Manual](#) (Salminen, Tarvainen *et al.*, 1998) is used as basis, because it was the first multinational project to be carried out in 26 European countries according to the specifications of IGCP 259 ([Darnley \*et al.\*, 1995](#)). As it was mentioned in the 2018 annual report, the present manual will be far more extensive and well-illustrated, and the outline was given, as well as the principal authors. It is anticipated that this will be a unique manual of methods used in applied geochemistry, because the authors of each chapter have considerable experience in geochemical methods from sampling, sample preparation, laboratory techniques, quality control, data management and data processing.

Although the original plan was to complete the manual by the first half of 2019, as stated in the 2018 annual report, many unexpected problems arisen, some personal in nature. However, most are due to Geological Survey or University work, which takes precedence, and in one case with respect to the Arctic terrain, our colleague from Chile was unable to go in the field at the planned period, which has been postponed to January 2020.

The chapter that apparently is giving most problems is the Residual Soil Sampling chapter. It has been agreed that the bottom or deep soil sample must be collected from the C horizon because this is the reference horizon, there are problems, however, with the sampling of the

topsoil horizon. Problems that are mainly due to the different morpho-climatic environments. Therefore, a consensus must be reached especially by the four soil scientists that are participating in its writing.

Finally, the external reviewers are not always available to review Chapters in the time that is usually allocated, *i.e.*, four-weeks.

An effort will be made for the Manual to be completed within the first five months of 2020, and submitted to the IUGS Executive Committee for ratification together with written opinions of the two external reviewers for each chapter.

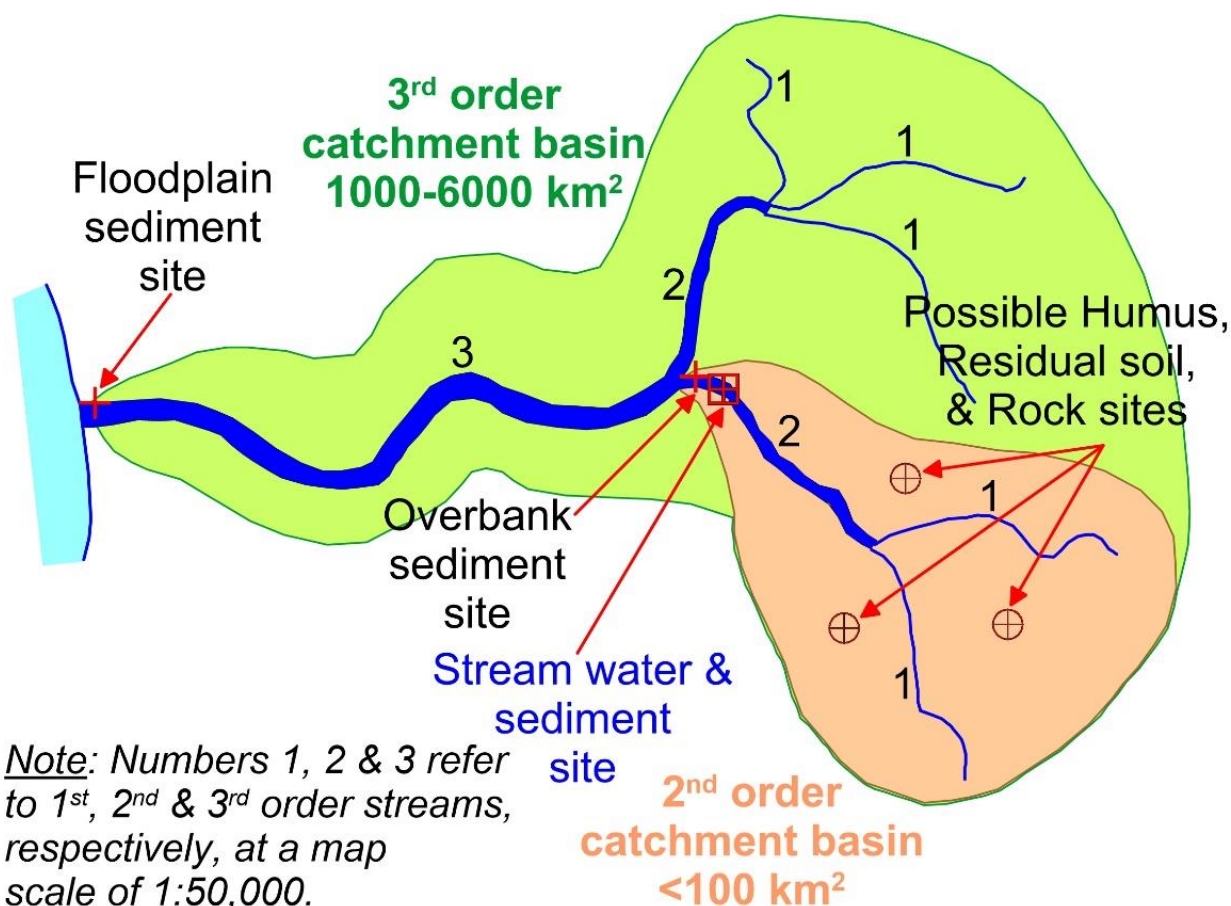
Table 3 shows the progress in the writing of the different sections and chapters.

Table 3. Progress in the compilation of the 'International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network'.

<i>Chapter title</i>		<i>Stage in the writing process</i>		
Abstract				
Preface				
Acknowledgements		In progress		
Chapter 1. General introduction		1st draft		
Chapter 2. GTN grid cells and Selection of sample sites		1st draft		
Chapter 3. Sampling				
<b>3.1. Samples to be collected from &lt;100 km<sup>2</sup> catchment basin</b>				
	3.1.1. Stream water	Completed	Under review	
	3.1.2. Stream sediment	Completed	Under review	
	3.1.3. Overbank sediment	Completed	Under review	
	3.1.4. Residual soil	Discussed		
	3.1.5. Rock	1st draft		
<b>3.2. Samples to be collected from 1000 to 6000 km<sup>2</sup> catchment basin</b>				
	3.2.1. Floodplain sediment	Completed	Under review	
<b>Chapter 4. Special terrains</b>				
	4.1. Karst	Completed	Under review	
	4.2. Desert & semi-grassland - Savannah	1st draft		
	4.3. Tropical - Rain forest	Under writing		
	4.4. Arctic-Antarctic	Under writing		
Chapter 5. Sample preparation		1st draft		
Chapter 6. Preparation of Reference materials for external QC		Completed	Under review	
Chapter 7. Analytical methods		Completed	Under review	
Chapter 8. QC and estimation of measurement uncertainty		Final corrections		
Chapter 9. Data conditioning		Completed	Reviewed	Revised
Chapter 10. Criteria of Global Geochemical Baselines Database		1st draft		
Chapter 11. Data processing and presentation		1st draft		
Appendix 1. World soil profiles		Completed	Under review	
Appendix 2. Quality control script			Completed	
Appendix 3. Five-random sample site generation script			Completed	
Appendix 4. Eight-random sample site generation script			Completed	
Appendix 5. Sixteen-random sample site generation script			Completed	
Appendix 6. Generation of random sample numbers for randomisation of samples			Completed	
Appendix 7. Taking good photographs for sample documentation		Under writing		
Field observation sheets		Completed		



Ideally, all recommended sample media, including parent rocks, should be collected for the establishment of a Geochemical Reference Network for the whole terrestrial surface of our home planet Earth (Figures 11 & 12). It is stressed that the UNESCO International Centre on Global-Scale Geochemistry is only collecting top and bottom floodplain sediment samples from the large 3<sup>rd</sup> order rivers, according to the agreed methodology, discussed during the October 2018 meeting in Langfang (P.R. China), and which is included in the under compilation IUGS Standard Methods Manual.



*Note:* Numbers 1, 2 & 3 refer to 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> order streams, respectively, at a map scale of 1:50,000.

Figure 11. Diagram showing the recommended sample types to be collected from the random drainage basins within the 160x160 km grid (refer to [2018 IUGS-CGGB Annual Report](#), Section 6.8.1, p.31-33). In total 10 samples should be collected, i.e., 8 samples from the small 2<sup>nd</sup> order catchment basin of <100 km<sup>2</sup> in area: (i) Humus where possible; (ii) topsoil horizon (still to be defined in the manual); (iii) parent rock (dominant rock type within the small catchment basin); (iv) bottom soil from the C horizon, which is considered the reference point (dominant soil type within the small catchment basin); (v) top surface horizon of overbank sediment; (vi) bottom overbank sediment horizon at a depth that is considered pristine; (vii) stream water, and (viii) active stream sediment, and 2 samples from the large 3<sup>rd</sup> order river of 1000-6000 km<sup>2</sup> in area, i.e., (ix) top surface horizon of floodplain sediment (not alluvial agricultural soil), and (x) bottom horizon of floodplain sediment, again from a depth that is considered pristine. Diagram plotted by Alecos Demetriades with Golden Software's MapViewer™ v8.

#### 6.4.1. Contribution to the Manual by the UNESCO ICGG

The UNESCO International Centre on Global-Scale Geochemistry (ICGG) is contributing to the:

- Geoanalytical Chapter by updating the methods used by the laboratory of the Institute of Geophysics and Geochemistry in Langfang, which were described in the '[Blue Book](#)' by Darnley *et al.* (1995) on page 107 (Section §12.6.1.1 Multi-element analytical system used in China. Yao Wensheng (Director of the ICGG Secretariat Office) has undertaken this updating. Further, he is compiling the Quality assurance and control procedure used

by Chinese laboratories; the first version was received on the 9<sup>th</sup> of December 2019, and requires English language correction and editing.

- Chapter on Desert terrains. Dr. Xueqiu Wang (Executive Director of ICGG) is leading this chapter. The Chapter requires considerable English language correction and editing before sending it to other contributors from Algeria, Egypt, Saudi Arabia and United Kingdom.

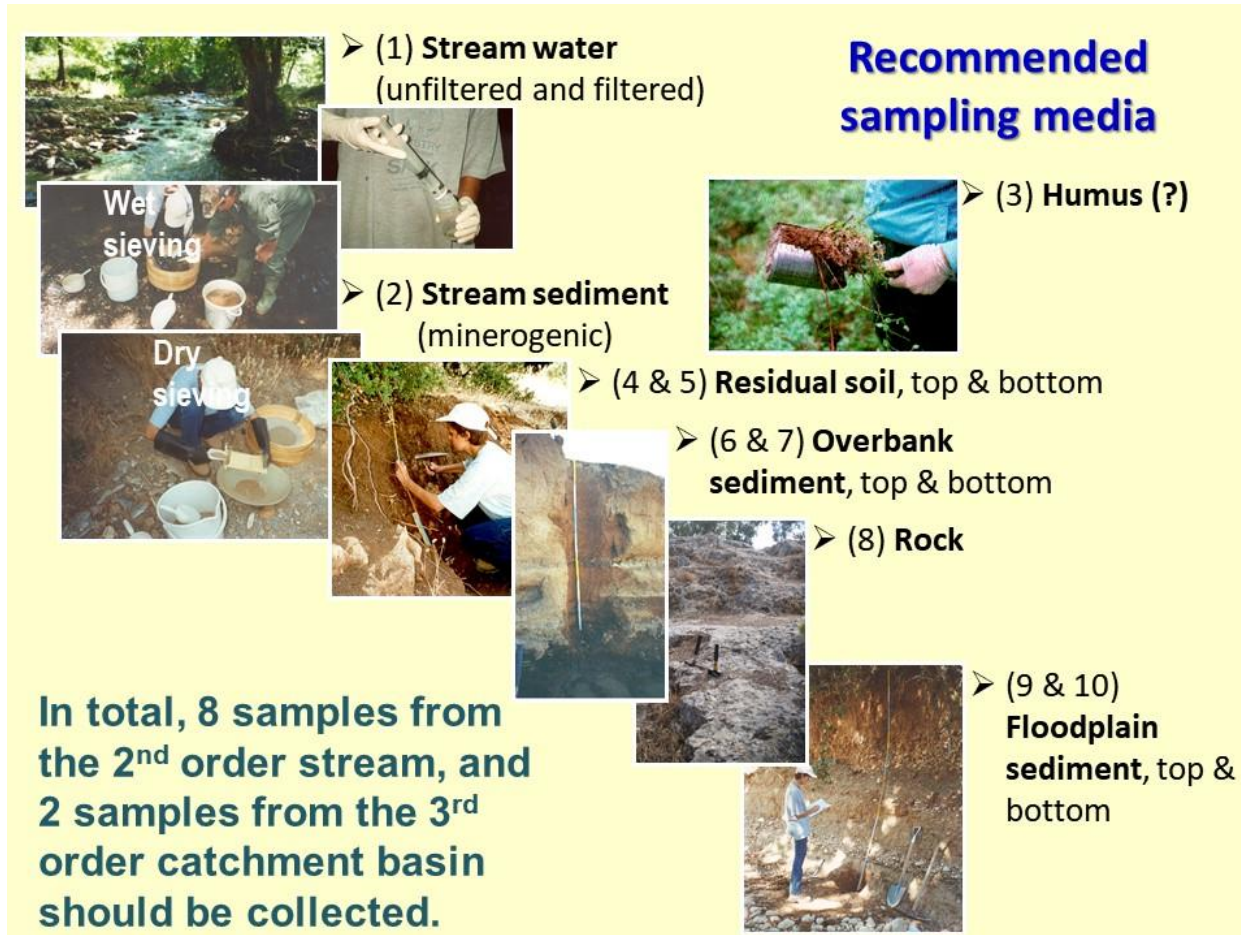


Figure 12. Diagram showing the recommended sample types to be collected from the random drainage basins within the 160x160 km grid. Photographs: Alecos Demetriades, except Humus by Timo Tarvainen.

## 6.5. PARTICIPATION IN THE THIRD BLACK SOIL PROJECT WORKSHOP

The Sampling Committee chair is representing the Commission in the [Global Black Soil Critical Zone Geo-ecological Survey](#) (BASGES) project. The third Workshop was organised by the Shenyang Geological Survey in Chengdu, the capital of south-western China's Sichuan province. The two-day workshop was on the 20<sup>th</sup> and 21<sup>st</sup> of November 2019, and was attended by 67+ people (Figure 13), mainly from China (62+), and five geoscientists from the Czech Republic (1), Hellas (1) and Ukraine (3).

The final version of the Manual of Standard Geochemical Methods for the BASGES project was presented (Figure 14), and the requirements that should be fulfilled before the start of the project were presented, and subsequently discussed. These are:

- Preparation of two large Black Soil project reference samples – Secondary Reference Materials (SRMs);
- Preparation of one large Black Soil project blank reference sample;



- Compilation of a detailed protocol of the analytical methods that will be used for the analysis of the Black Soil project samples;
- Decision where the Global Black Soil project samples are going to be prepared, and permanently stored;
- Decision where the Global Black Soil project samples are going to be analysed, and by which analytical methods and for which determinands;
- Purchase of field and laboratory equipment by Black Soil Project Management, and distribution to participants, and
- Field training of representatives from each participating country, and start of field sampling campaign with a deadline to be agreed.

After the meeting, Dai Huimin, the leading applied geochemist, informed the Commission that it was decided to prepare the two large Black Soil project reference samples for external quality control.



Figure 13. Group photograph of the 3<sup>rd</sup> BASGES Workshop participants, Chengdu, Sichuan, P.R. China. Photograph: Professional photographer.

### 6.5.1. Manual of standard geochemical methods for the Global Black Soil project

In the BASGES manual are included photographs of Black soil profiles from China, Russia and the United States of America (*e.g.*, Figures 15 & 16). Igor Savin, co-author, observed that the thickness of the ‘mollic’ horizon is <40 cm in many profiles, and according to the definition given by the [Global Soil Partnership](#) (GSP) these cannot be considered as black soil *sensu stricto* (Figures 15 & 16). The GSP defines ‘Black Soil’ as the different soil types that have:

- A well-structured, dark-coloured surface horizon due to their enrichment in high-quality humus down to a depth of more than 40 cm (mostly 60 to 80 cm);
- A high base saturation (*i.e.*, a high percentage of the cation exchange capacity is occupied by the basic cations  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  and  $\text{K}^{+}$ ), and
- A moderate to high content in organic matter (more than 1% of organic carbon).



Figure 14. Alecos Demetriades presenting the final version of the IUGS Global Black Soil Project Manual of Standard Geochemical Methods. Photograph: Liu Xuemin, Lecturer, College of Earth Sciences of Chengdu University of Technology.

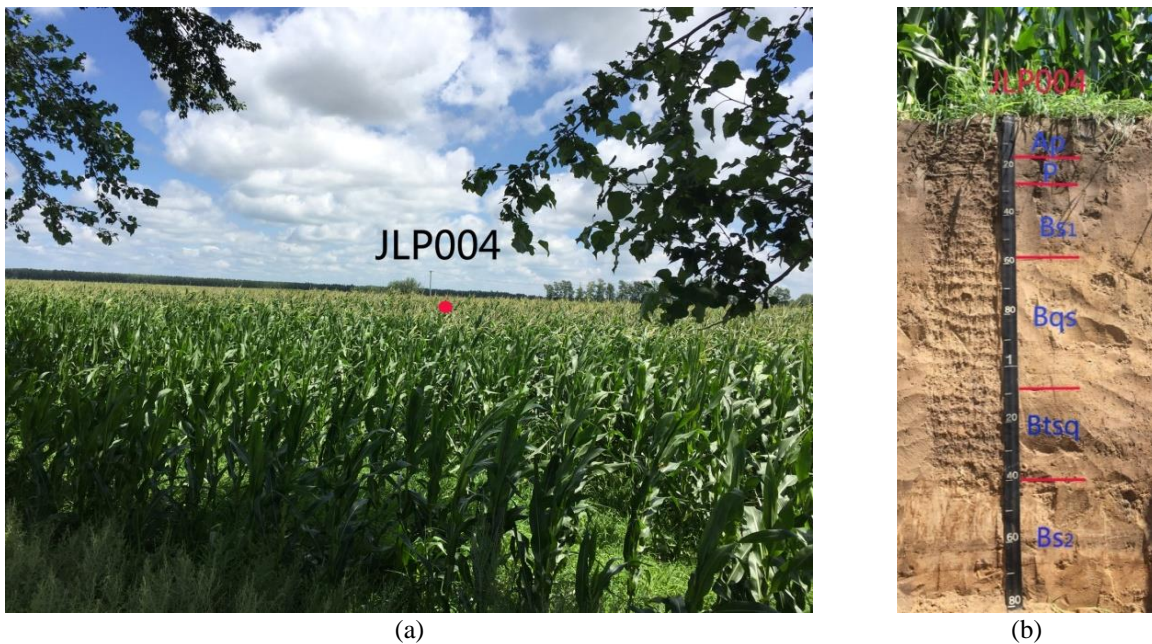


Figure 15. Black Soil landscape (a) and profile (b), Deshegn Town, Fuyu Country, Songyuan City, Jilin Province. Longitude 125°38'9.27"E, Latitude 45°28'50.5"E. Photographs: Lui Kai, Shenyang Geological Survey.

The Black Soil horizon is not well-developed and is <40 cm. Photograph: Lui Kai, Shenyang Geological Survey. After the above observation, the overall and specific objectives of the BASGES project were reviewed:

- The **overall objective** of the geochemical survey of ploughed Black Soil regions of the World is the establishment of a global Geochemical Reference Network for Black Soil, which will be used for monitoring future changes, and to provide the basic data for global climate changes.





Figure 16. Geloll, interior Alaska — This landscape and soil are in the Interior Alaska Highlands approximately 80 km east of Fort Yukon. The mollic horizon is <40 cm. Source: <https://www.uidaho.edu/cals/soil-orders/mollisols#gallery-a2872e8f-1029-4734-b8ff-1eff284545d0--slideshow>.

- The **specific objectives** of the geochemical survey of the Black Soil regions of the World are:
  - To assess the current global geochemistry and chemical quality of Black Soil, and to define the global geochemical baseline at the beginning of the 21<sup>st</sup> century;
  - To provide basic data for global climate changes, and
  - To establish a global Geochemical Reference Network for Black Soil, which will be used for monitoring future changes.

It was finally decided to define ‘Black Soil’ according to the overall and specific objectives of the BASGES project. Therefore, in the BASGES project manual, **Black Soil** is defined as *a dark-coloured surface soil down to a depth of more than 20 cm, consisting of a well-structured humic horizon with a high base saturation (i.e., a high percentage of the cation exchange capacity is occupied by the basic cations  $Ca^{2+}$ ,  $Mg^{2+}$  and  $K^+$ ), and with a moderate to high content in organic matter.*

The *limiting factor* is the ploughing depth of 20 cm down to which the agricultural soil is normally churned, and the Black Soil horizon to be sampled must have a thickness of more than 20 cm.

The final version of the BASGES project’s manual is presently being reviewed by external reviewers, and will be submitted to the IUGS Executive Committee for ratification at the beginning of 2020. Directly afterwards it will be published as an e-Book with an ISBN and DOI number, and will be made available through the Commission’s website. The reason for its publication as an e-Book is that twenty-four countries will be involved in the BASGES project, *i.e.*:

- Asia: China, Mongolia, Kyrgyzstan, Kazakhstan, Azerbaijan, Armenia, Georgia and Russia;
- Europe: Ukraine, Moldova, Romania, Bulgaria, Hungary, Slovakia, Czechia, Germany;
- North America: Canada, and United States of America;
- South America: Argentina, Peru, Bolivia, and Paraguay, and
- Africa: Tanzania and Kenya.



### 6.5.1.1. New map of Global Black Soil regions

In the ‘*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*’, the first appendix by Edith Haslinger, Harald Loishandl-Weisz, Robin Friedrich and Thomas Rosmann describes ‘*The Soils of the World*’, a very important contribution to the manual, which will be useful to applied geochemists worldwide as it describes the characteristics of each major soil type, its geographical distribution, parent material, usage and the most important geochemical processes.

The authors extracted from the [Harmonised World Soil Data Base](#) (HWSD) the 28 major soil mapping units, and have generated Google Earth \*.kml files, which will be made available to interested parties from the Commission’s website.

According to the HWSD classification, Black Soil is referred to as Chernozem (also known as Mollisol). Figure 17 shows the distribution of Chernozems worldwide, and if it is compared with the hitherto known map of the University of Idaho, which shows the [Global Distribution of Mollisols](#), there are distinct differences in the distribution of Black Soil. Therefore, the decision is to use the HWSD map for the planning of the Black Soil global sampling campaign.

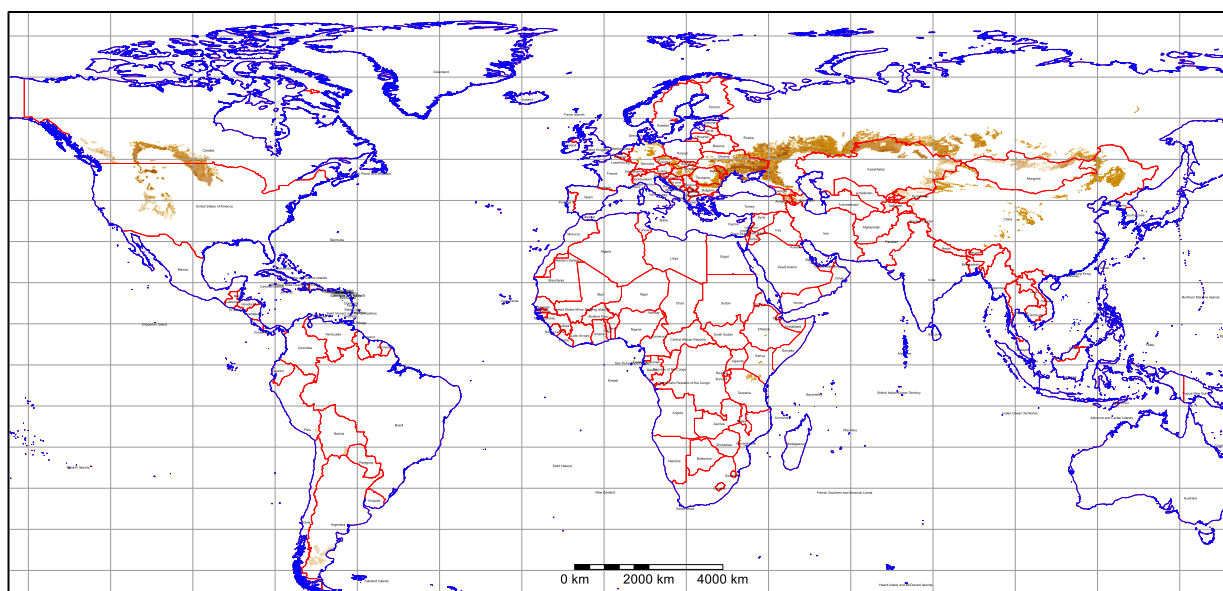


Figure 17. Map showing the occurrence of Black Soil in Asia (China, Mongolia, Kyrgyzstan, Kazakhstan, Azerbaijan, Armenia, Georgia, Russia), Europe (Ukraine, Moldova, Romania, Bulgaria, Hungary, Slovakia, Czechia, Germany), North America (Canada, United States of America), South America (Argentina, Peru, Bolivia, Paraguay), and Africa (Tanzania, Kenya). Brown colour intensity on the map refers to the percentage of Black Soil (the darker – the greater is the Black Soil acreage). Refer to Appendix 2 for larger regional maps. Source: Google Earth kml file by Edith Haslinger & Robin Friedrich (Austrian Institute of Technology GmbH, Centre for Energy, Vienna, Austria), and Harald Loishandl-Weisz & Thomas Rosmann (Federal Environment Agency Austria, Department of Groundwater, Vienna, Austria). Map plotted with Golden Software’s MapViewer™ v8 by Alecos Demetriades, Institute of Geology and Mineral Exploration (I.G.M.E.), Athens, Hellas & IUGS Commission on Global Geochemical Baselines (IUGS-CGGB).

## 6.6. COMMISSION’S 2019 WEBSITE

During 2018, considerable time was devoted on the collaboration with the Web-hosting and Web construction company on the redesign of the Commission's new Website. The reason was that a new bi-lingual (Hellenic-English) user-friendly platform was used, and all the Hellenic text had to be removed, and the original design formats modified.

After reviewing the needs of Social Media, it was decided to use experimentally ‘facebook’ (<https://www.facebook.com/CGGBIUGS>; @CGGBIUGS) and ‘Twitter’

([https://twitter.com/CGGB\\_IUGS](https://twitter.com/CGGB_IUGS); @CGGB\_IUGS), and to upload the sampling video films to YouTube.

The work was completed in December 2018, and the new website was uploaded on the 17<sup>th</sup> of January 2019 (Figure 18; <http://www.globalgeochemicalbaselines.eu/>).

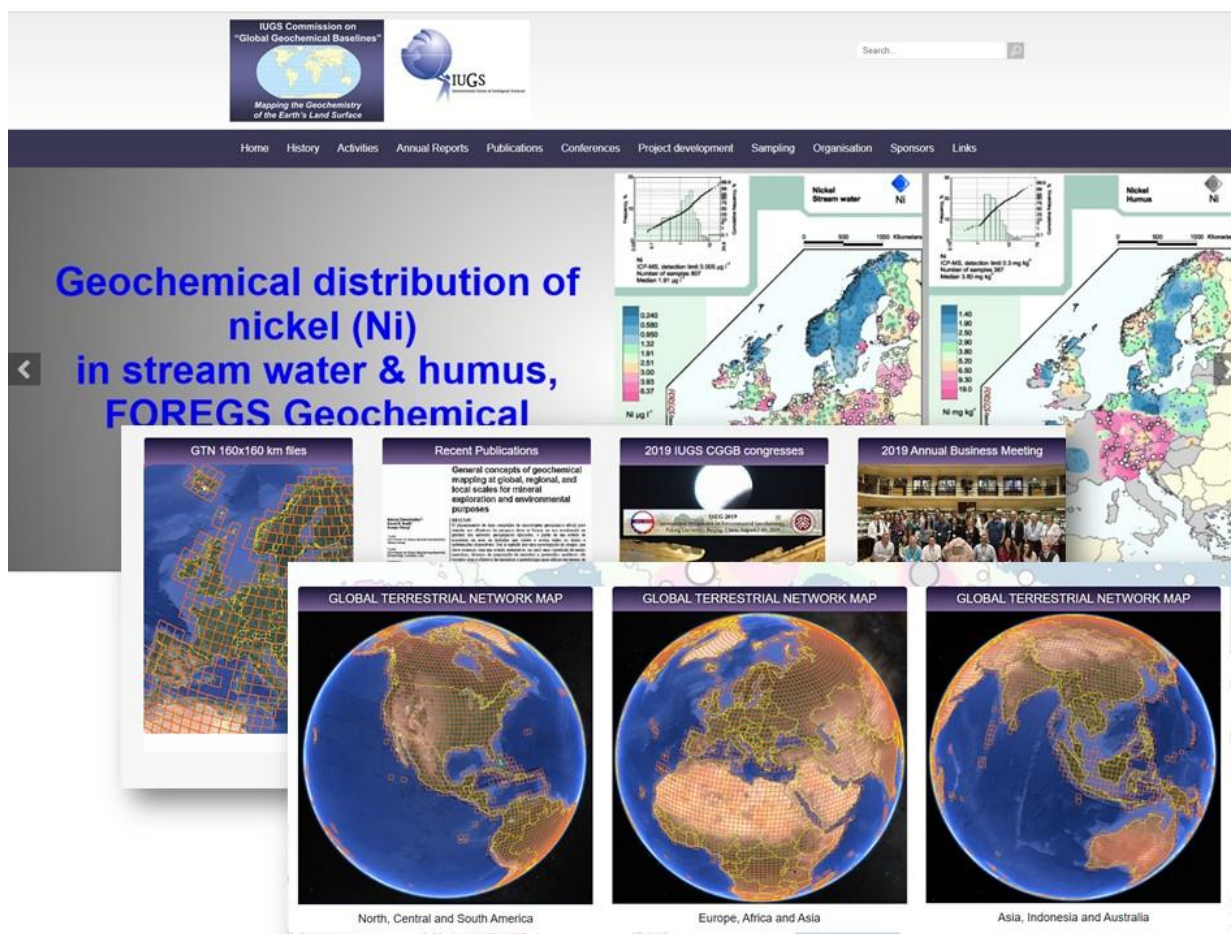


Figure 18. Screen shots of the Commission's new website.

## 6.7. WORK OF CGGB COMMITTEES

During 2019 members of the Sampling, Analytical and Data Management Committees were and still are busy in the writing of the relevant chapters of the '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*' (see [Section §6.4](#)).

The Public Relations and Finance Committee's main work was the redesigning of the Commission's website in collaboration with the hosting company's designers (see [Section §6.6](#)), and the continuous updating of the contents. Further, is exploiting a few options for obtaining sponsorships.

## 6.8. ASSISTANCE TO MEMBERS AND WORKSHOP PARTICIPANTS

Assistance was provided to Commission members from Brazil, Brunei, Morocco and Namibia, which concerned mainly the supply of the Global Terrestrial Network grid cells of 160x160 km, and random sampling sites. Also, advice was given in the planning of soil sampling campaigns at different mapping scales in Brunei.

## 6.9. PUBLICATIONS

Publications directly related to the Global Geochemical Baselines project were not published this year. However, there are publications for the continental-scale projects carried out in different continents. These will be found in [Appendix 2: Regional Reports](#).

The Commission sent a two-page report about its September 2019 activities, which were published in the [IUGS-E-bulletin No. 159](#) in October 2019. A similar report was sent for the November 2019 activities.

## 7. REGIONAL REPORTS

Regional reports were provided from [Africa](#), North America ([United States of America](#)), South America ([Brazil](#), [Colombia](#)), Asia ([Armenia](#), [India](#), [Japan](#)), Australasia ([Australia](#) and [New Zealand](#)), and [Europe](#). These reports are in [Appendix 2: Regional Reports](#).

## 8. NEW MEMBERS

In 2019, the Commission added 17 new members, who come from 11 countries, *i.e.*, Algeria (1), Argentina (2), Brunei (1), Colombia (2), Cuba (2), Ecuador (2), Egypt (1), Honduras (1), Peru (1), Saudi Arabia (2), and Uruguay (2). As these new members were added the last couple of months, the Commission is still waiting for their affiliations in order to add them to the Members web page. In total, the Commission has 151 members in 70 countries (see [Members list](#) in Commission's web page; Figure 19).

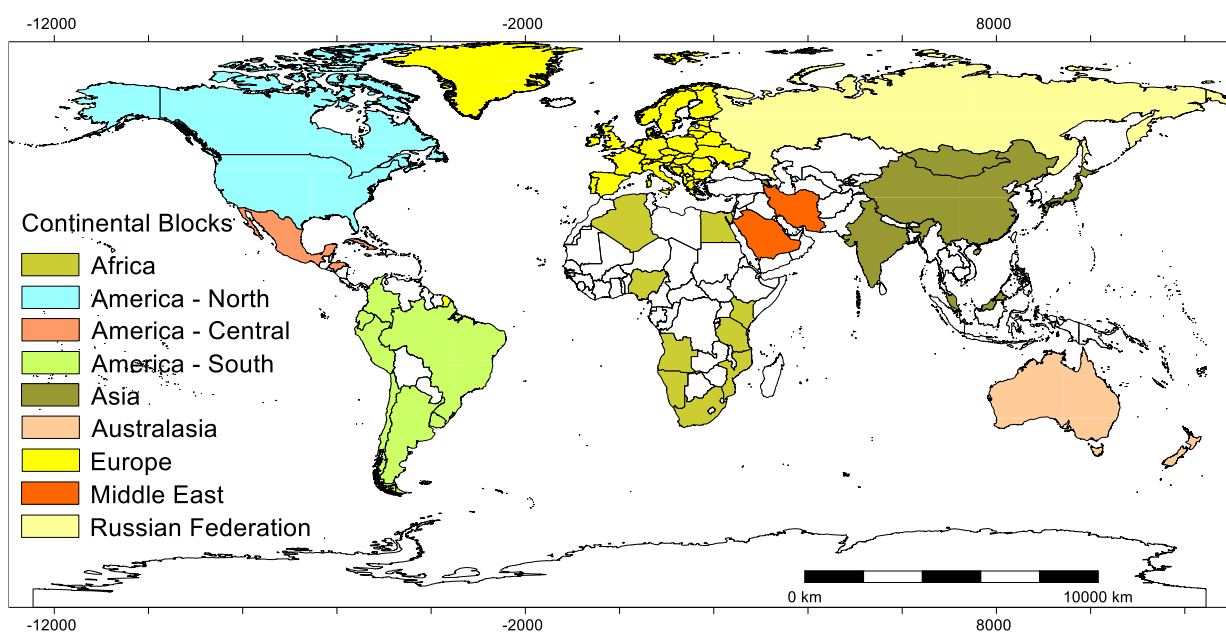


Figure 19. Map showing countries with Commission members. The different colours represent continental blocks. The Russian Federation has its own colour because it is in two continental blocks, Europe and Asia. Map plotted with Golden Software's MapViewer™ v8 by Alecos Demetriades, I.G.M.E. & IUGS-CGGB.

## 9. AD HOC REVIEW COMMITTEE MEETING IN ATHENS HELLAS

At the 73<sup>rd</sup> IUGS Executive Committee meeting in February 2019 it was decided that the Commission must undergo an Ad-hoc Review (ARC), since the last review was in 2012. According to the IUGS Statutes and Byelaws, all Commissions and other bodies funded by IUGS must undergo a formal review on an approximate 4-year cycle. The Chair of the ARC

Committee, Professor Roland Oberhänsli (IUGS President 2012-2016) contacted the Commission, and a mutual agreement was reached for the review to be performed in Athens (Hellas) because two Steering Committee members are based in Athens, as well as the proposed Treasurer for the 2020 to 2024. The dates for the ARC review were agreed, and these were 15<sup>th</sup> and 16<sup>th</sup> of November 2019.

All the Steering Committee members were invited for the ARC review, but could not participate due to either their work schedule did not allow it or this trip was not budgeted for.

The Athens Steering Committee members arranged the hotel, meeting place, lunch and evening meals for the ARC review Committee experts.

Professor Michael Scoullou was contacted for the organisation of the meeting at the premises of the Mediterranean Information Office for Environment, Culture and Sustainable Development ([MIO-ECSDE](#)). He agreed and asked us to get in touch with the MIO-ECSDE Head Officer, Dr. Anastasia Roniotes and Secretary Mrs. Olga Papathanasopoulou. As the meeting programme was from 09:00 to 17:00, Dr. Roniotes asked Mrs. Papathanasopoulou if she was willing to work the extra hours and the additional day (Saturday). Mrs. Papathanasopoulou consented, and all arrangements for the meeting were made in collaboration with her.

Ad hoc Review Committee Members were (Figure 20):

- Roland Oberhänsli – IUGS Past-President (ARC Chair)
- Kristine Asch – IUGS Vice President (ARC Secretary)
- Mateja Gosar – Geological Survey of Slovenia (Environmental Geochemistry)
- Stephanos P. Kiliadis – National and Kapodistrian University of Athens (Ore and Bio-geochemistry)

The IUGS-CGGB Members were (Figure 20):

- Alecos Demetriades – CGGB Treasurer
- Ariadne Argyraki – CGGB Public Relations and Finance Officer
- Christina Stouraiti – CGGB Treasurer (proposed for the 2020-2024 term).

The Steering Committee members prepared a PowerPoint presentation report, according to the written instructions of Professor Roland Oberhänsli, *i.e.*,

- aims
- achievements
- outreach activities
- web site/communication
- cooperation (links with other IUGS bodies and others)
- budget and expenditures
- future plans

The PowerPoint presentation report was divided into two sections: (a) 2012-2016 term of IUGS Task Group on GGB, and (b) 2016-2019 term of IUGS Commission on GGB.

The schedule of the meeting was as follows:

14.11.2019	Arrival in Athens afternoon/evening
15.11.2019	ARC Meeting 09:00 – 17:00
16.11.2019	ARC Meeting 09:00 – 12:00 IUGS closed session 14:00 – 17:00
17.11.2019	Return travel



Alecos Demetriades and Ariadne Argyraki presented the PowerPoint presentation report on Friday morning (15<sup>th</sup> of November 2019), and afterwards there was a very fruitful discussion with the ARC members, which continued in the morning session of Saturday (16<sup>th</sup> November 2019).

The Commission thanks the Ad hoc Review Committee members, and also Professor Michael Skoulios and the staff of MIO-ECSDE for the hospitality, and especially Mrs. Olga Papathanasopoulou for all the arrangements.



*Figure 20. IUGS ARC meeting participants. Evening after a hard day's work: from left to right Ariadne Argyraki and Alecos Demetriades (IUGS-CGGB Steering Committee members), and Roland Oberhänsli, Mateja Gosar, Kristine Asch and Stephanos P. Kiliadis (IUGS Ad-hoc Review Committee members). Photograph: Dionisios Gkoutis, Deputy General Director of Hellenic Survey of Geology and Mineral Exploration.*

## **10. IUGS FUNDING FROM 2013 TO 2019**

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, and US\$4000 for 2019.

For 2019, there were additional amounts of:

- (i) US\$3200 for the 36<sup>th</sup> IGC in Delhi in March 2020, and
- (ii) US\$3500 for the Workshop organised on the occasion of the 5<sup>th</sup> YES Congress in Berlin in September 2019 (see [Section §6.3.3.2](#)).

## **11. USAGE OF IUGS 2019 ALLOCATION**

Usage of allocated 2019 fund of US\$4000 and outstanding 2018 balance of US\$1,035.35 (**total: US\$5,035.35**) is tabulated in Table 4 below, together with the additional funding received for the 36<sup>th</sup> IGC of US\$3200 and the 5<sup>th</sup> YES Congress Workshop of US\$3500, plus Interest US\$0.87

(Interest US\$1.04 – Income tax of US\$0.17 = US\$0.87) making an overall total of **US\$11,736.22** for 2019.

Table 4. Expenses incurred during 2019 and first quarter of 2020 (prepaid).

<b>Expenses incurred</b>	<b>US\$</b>
Bank charges on the transfer of the IUGS allocations (3 transfers)	11.90
Reporting at 73 <sup>rd</sup> IUGS EC meeting, Beijing, P.R. China (26-28/2/2018). Various expenses (travel insurance, local travel, snack at airport)	150.16
35 <sup>th</sup> International Congress of Geological Society of Greece, Athens, Hellas (Registration fee, roll-up banner, Workshop attendance certificates)	278.72
Participation of one Steering Committee member at ISEG2019, Beijing & Workshops at Universities in Shangluo and Henan (Travel insurance & local travel expenses)	189.09
Participation of 2 Steering Committee members in the joint business meeting of EGS-GEG & IUGS-CGGB, Budapest (26-27/9/2019). Travel (airline & local), Travel insurance, Hotel and sustenance expenses	1,874.33
Annual website hosting fee (2018-2019)	255.90
Sledgehammer & gloves for rock sampling photos & FOREGS Topsoil poster	90.58
ARC review meeting expenses in mid-November 2019 (e.g., coffee/tea/juices, cookies, meals, copying of report)	635.45
3 <sup>rd</sup> BASGES Workshop and Chang'an University Workshop expenses (Travel insurance, Visa issue & local travel expenses)	215.05
<b>Sub-total 1 (budgeted 2019 expenses, except ARC meeting expenses):</b>	<b>3,701.18</b>
<b>5<sup>th</sup> YES Congress Workshop expenses</b>	
Participation of 2 Steering Committee members in the 5 <sup>th</sup> YES Congress & Organisation of Workshop, Berlin, Germany (7-12/9/2019). Travel (airline & local), Travel insurance, Hotel and sustenance expenses)	2,876.68
<b>Sub-total 2:</b>	<b>2,876.68</b>
<b>2020 Expenses (prepaid)</b>	
Airline ticket for Busan, S. Korea – Treasurer reporting at 74 <sup>th</sup> IUGC EC meeting in January 2020	1,179.29
36 <sup>th</sup> IGC, Delhi (March 2020), Registration fees (US\$521.32), Airline ticket (US\$925.43) and hotel (US\$1120.30). Organisation of session and workshop, and participation in the IUGS Council meeting	2,567.05
<b>Sub-total 3:</b>	<b>3,746.34</b>
<b>TOTAL:</b>	<b>10,324.20</b>

As is shown in Table 4, the total 2019 expenses are **US\$10,324.20**, which are apportioned in

- (a) budgeted expenses US\$3,701.18 (except the ARC meeting expenses of US\$635.45, which were not budgeted);
- (b) 5<sup>th</sup> YES Congress Workshop expenses US\$2876.68;
- (c) 36<sup>th</sup> IGC expenses US\$2567.05, and
- (d) an expense that was not budgeted for is the reporting at the 74<sup>th</sup> IUGS Executive Committee meeting in Busan (South Korea) at US\$1,179.29 up to now.

The outstanding balance in the Commission's bank account is US\$1,412.02, which should be adequate to cover additional 2020 expenses for the 74<sup>th</sup> IUGS Executive Committee in Busan, and the 36<sup>th</sup> IGC in Delhi.

**IMPORTANT NOTE:** The expenses incurred for Workshops and participation in international conferences are considerably more than the ones reported, which concern only the IUGS annual allocation. For example, in the following cases the airline tickets, hotel and meals were paid by the hosts, and only minor expenses were charged to the IUGS allocation:

- Participation of one Steering Committee member at ISEG2019, Beijing & Workshops at Universities in Shangluo and Henan (Travel insurance & local travel expenses charged to IUGS allocation), and
- 3<sup>rd</sup> BASGES Workshop and Workshop in Chang'an University (Travel insurance, Visa issue & local travel expenses charged to IUGS allocation).

## 12. FUNDING REQUEST FROM IUGS FOR 2020-21

### 12.1. PLANNED 2020 ACTIVITIES REQUIRING NO FUNDS

The main Commission tasks in 2020 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 by the end of May 2020, subject to the voluntary input by all the people that are involved in this very important reference work (see [Section §6.4](#));
- (ii) Publication of the '*International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network*' in a hard copy edition and distribution to all national Geological Surveys and University Geology Departments (external funding will be sought, e.g., UNESCO);
- (iii) Publication of the '*BASGES Project Manual of Standard Geochemical Methods*' as an e-Book (see [Section §6.5.1](#));
- (iv) 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;
- (v) Preparation of conference presentations, and workshop material;
- (vi) Preparation of Periodic Table Element maps of the Geochemical Atlas of Europe for stream water, stream sediment, subsoil and floodplain sediment for the compilation of large-size posters for promotion of the Global Geochemical Baselines project;
- (vii) Updating the Commission's website;
- (viii) Providing assistance and information to requests from different geological surveys and individuals, especially participants in workshops;
- (ix) Revision of the IGCP 259 Report, the '[Blue Book](#)' (Darnley *et al.*, 1995) by removing all contradictory parts, and
- (x) Compilation of a popular book for lobbying at the United Nations level in order for all 196 Member States to agree to carry out the project as will be detailed in the IUGS Standard Methods Manual. 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 2020.

### 12.2. PLANNED 2020-21 ACTIVITIES REQUIRING IUGS FUNDING

The following planned activities in 2020 require IUGS funding:

- Participation in the 74<sup>th</sup> IUGS Executive Committee meeting in Busan, South Korea (15-18 January 2020);

- Participation in the [36<sup>th</sup> International Geological Congress](#) in Delhi, India, in March 2020, as convener of (a) session 17.8 ‘*Challenges and Opportunities of Global-Scale Geochemical Mapping (4<sup>th</sup> Arthur Darnley Symposium)*’ under Theme 17: Advances in Geochemistry, and (b) short one-day Workshop with the title ‘*Geochemical mapping at all scales: Continental, regional and local*’, as well participation in the open meeting of the IUGS-IGC Council on the 6<sup>th</sup> and 7<sup>th</sup> of March 2020. For the IUGS Booth, material has already been prepared and sent to the IUGS Secretariat office (see [Appendix 3](#));
- Making short video films to show the sampling procedures, as it is impossible to train all the national sampling teams, which will be involved in the establishment of the Global Geochemical Reference Network;
- Participation in the International Conference ‘*Environment, Health, GIS and Agriculture in the Big Data Era*’ with a session entitled ‘*Geochemical mapping at all scales: evidence from soil, sediment and plants*’, 2-9 August 2020, Galway, Ireland. Three conferences are combined: (a) 5<sup>th</sup> International Symposium on Environment and Health; (b) 6<sup>th</sup> International Conference on Environmental Pollution and Health, and (c) 7<sup>th</sup> International Conference on Research Frontiers on Chalcogen Cycle Science and Technology; <http://www.nuigalway.ie/iseh2020>;
- Participation in the 4<sup>th</sup> BASGES Workshop organised by the Shenyang Geological Survey in the autumn of 2020;
- Organisation and participation in the two-day autumn annual joint business meeting of the Commission and the EuroGeoSurveys Geochemistry Expert Group, which will be on the 5<sup>th</sup> and 6<sup>th</sup> November 2020 in Athens (Hellas), and the Commission will jointly host it with the Hellenic Institute of Geology and Mineral Exploration;
- Organisation of Workshops in different continents for teaching the IUGS Standard Geochemical Methods;
- Printing of remaining posters on canvas of the Periodic Table of mapped elements of the European Geochemical Atlas of Europe for stream water, stream sediment, subsoil and floodplain sediment for promotion of the Global Geochemical Baselines project;
- Web-hosting fee and addition of Google analytics to each web page to extract statistics of visits to each page, and
- Participation in the 75<sup>th</sup> IUGS Executive Committee meeting at a place to be decided by the IUGS Executive Committee in early 2021.

The Commission is, therefore, requesting financial support from IUGS in the order of:

- US\$13,000 for the 2020 planned work and commitments (Table 5), and
- US\$2,000 for the first quarter of 2021 to cover the expenses for its participation in the 75<sup>th</sup> IUGS Executive Committee meeting (Table 5).

**Thus, making a total request of US\$15,000 for 2020 and first quarter of 2021.**

It should be mentioned that in the 2020 budget (Table 5), the cost of US\$30,000 for the organisation of training workshops recommended by the 2019 ARC report is not included, as this depends on the availability of funds from IUGS. However, 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 5. Estimated expenses for 2020 and first quarter of 2021.

Event category	Cost in US\$
74 <sup>th</sup> EC meeting, Busan, South Korea (15-18 January 2020); Participation of Treasurer for reporting Commission's 2019 activities, and 2020 work plan. Costs: Issue of visa, Hotel, travel insurance, local travel to and from airport	500.00
Participation in the 36 <sup>th</sup> International Geological Congress in Delhi, India, in March 2020, as convener of the 4 <sup>th</sup> Arthur Darnley Symposium & Workshop, and participation in the open meeting of the IUGS-IGC Council on the 6 <sup>th</sup> and 7 <sup>th</sup> of March 2020. Costs: Issue of visa, travel insurance, local travel to and from airport, and sustenance expenses	800.00
Video filming of sampling techniques: Hire of 4-wheel vehicle for 5 days with a comprehensive insurance (≈450 US\$); petrol (≈300 US\$); sandblasting of equipment (≈50 US\$); unforeseen expenses (≈100 US\$)	900.00
Participation in the International Conference 'Environment, Health, GIS and Agriculture in the Big Data Era' with a session entitled ' <i>Geochemical mapping at all scales: evidence from soil, sediment and plants</i> ', 2-9 August 2020, Galway, Ireland	1500.00
Participation in the 4 <sup>th</sup> BASGES Workshop organised by the Shenyang Geological Survey in the autumn of 2020. Costs: Travel insurance, local travel to and from airport	250.00
Organisation and participation in the two-day autumn annual joint business meeting of the Commission and the EuroGeoSurveys Geochemistry Expert Group, which will be on the 5 <sup>th</sup> and 6 <sup>th</sup> November 2020 in Athens, and the Commission will jointly host it with the Hellenic Institute of Geology and Mineral Exploration. Costs of organisation of meeting and financial assistance for at least one member of Steering Committee to come to the meeting	4,000.00
Organisation of Workshops in different continents for teaching the IUGS Standard Geochemical Methods	5,000.00
Printing of remaining posters on canvas of the Periodic Table of mapped elements of the European Geochemical Atlas of Europe for stream water, stream sediment, subsoil and floodplain sediment for promotion of the Global Geochemical Baselines project	300.00
Website hosting fee 2020-2021, addition of Google analytics and additional space on server	600.00
Participation in the 75 <sup>th</sup> IUGS Executive Committee meeting at a place to be decided by the IUGS Executive Committee in early 2021	2,000.00
<b>Total estimated expenses in US \$ for 2020-21:</b>	<b>15,850.00</b>
<b>Outstanding balance (US\$) in Commission's bank account at the end of 2019:</b>	<b>1412.02</b>
<b>Estimated minimum amount (US \$) required to cover 2020-21 expenses:</b>	<b>14,437.98</b>

### 12.2.1. 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 to be at US\$858.

Without any reserve funds, it is difficult to plan the 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.

## 13. 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/>.

## 14. DETAILS OF ANNUAL REPORT AUTHORS

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## APPENDIX 1: MINUTES OF THE ANNUAL BUSINESS MEETING

The minutes were prepared by Anna Ladenberger, Deputy chair of EGS GEG, and subsequently edited for inclusion in this report.

### Thursday, 26<sup>th</sup> September 2019

9:45-9:00. Registration of all meeting participants

9:00. Welcome by Daniella Tolmács and György Falus.

- Short presentation about the Hungarian Survey
- Welcome from the Chairman of the EGS Geochemistry Expert Group (GEG)  
Philippe Négrel

9:30. Minutes of 2018 meeting presented by Philippe Négrel and accepted by the members.

9:20. Report from EGU 2019 (Philippe Négrel )

- Mateja Gosar and Jasper Griffioen had presentations, and these are reported in the 2019 half-yearly report.
- Discussion of how we should be represented at the various conferences next year, *e.g.*, Goldschmidt, EGU, IGC, *etc.*

9:30. EGS-GEG 2018 activities (Anna Ladenberger, Philippe Négrel)

- Philippe attended the EGS Directors meeting in Warsaw
- Anna Ladenberger attended the EGS National Delegates meeting in February 2019
- GEG members are active in GeoEra projects
- GEMAS publications 2018 and 2019
- The 4<sup>th</sup> QC report with Br, I, CNS, colour and magnetic measurements under writing. Colour and magnetic data needed from Karl Fabian (Norway)
- GEMAS Calendar 2019 by Peter Hayoz: you can download it from the GEMAS website. Next Calendar 2020 will be based on Hellas sampling
- GEMAS website: Sebastian Pfliederer and Paolo Valera responsible for the update (<http://gemas.geolba.ac.at/>)

11:00. IUGS-CGGB report (Alec Demetriades and Ariadne Argyraki)

- Replacements in the Steering Committee related to retirements (4 years term – 2020-2024 - with possibility of an extension).
- Establishment of an Advisory Panel of past Steering Committee members for smooth transition.
- New IUGS-CGGB website (<https://www.globalgeochemicalbaselines.eu/>).
- Workshop in exploration geochemistry in Vancouver and field course (YES network).
- RFG 2018 Vancouver Session on Global Geochemical Baselines (12 oral presentations and 4 posters – June 2018).
- Information about 2018 activities can be found in the Commission's annual report ([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))
- Manual of standard methods for establishing the global Geochemical Reference Network (GRN), should be ready by December 2019, and after its ratification by the IUGS Executive Committee will be published (early 2020)
- GTN grid cell system for sampling as well as 5 and 8 random points within each grid cell available from IUGS-CGGB website.



- Second Black Soil project workshop (BASGES) in Harbin, China (October 2018); manual of standard geochemical methods will be published at the beginning of 2020, again after its ratification by the IUGS Executive Committee.
- African Geochemistry Working Group approved by the Organisation of African Geological Surveys (Gloria Simubali, Namibia).
- Deep-time Digital Earth (DDE) is a new IUGS Initiative – Harmonised data for science, industry and general public (similar to OneGeology).
- International Congress of the Geological Society of Greece (May 2019), Athens (Keynote presentation by Philippe Négrel). Also, a one-day Workshop (Timo Tarvainen, Ariadne Argyraki and Alecos Demetriades).
- International Symposium on Environmental Geochemistry (August 2019), Peking University, Beijing, China (Keynote presentation by Alecos Demetriades).
- Workshops in Applied Geochemistry at Universities in China, August 2019 (Shangluo Institute: Chaosheng Zhang and Alecos Demetriades; Henan University, Kaifeng: Alecos Demetriades).
- Workshop on Global Geochemical Baseline and Applied Geochemistry organised by YES Network Congress, Berlin, Germany (September 2019; Alecos Demetriades and Ariadne Argyraki).
- Social Media (Ariadne Argyraki): Facebook, Twitter with moderate impact.
- Need for workshop and training courses in various countries, but no money at the moment.

#### 11:30. Planned publications

1. Ag, Au, PGEs, Tl (Alecos Demetriades): under preparation
2. Zr (Dee Flight & Clemens Reimann), Philippe Négrel interested to take over, need to contact Dee & Clemens
3. FOREGS (Perchlorate) not active at the moment (Manfred Birke)
4. I, Br (Manfred Birke): under preparation
5. Mo (D. Cicchella): status unknown
6. XRF/AR (Enrico Dinelli): status unknown
7. 4<sup>th</sup> QC, Data from Karl Fabian, on the way
8. Zn (Italian colleagues): status unknown
9. Grain Size, no progress
10. Colour (Karl Fabian): status unknown
11. Element deficiency (Koen Oorts): status unknown
12. Medical Geochemistry (Anna Landenberger, Pat O'Connor, AG): no progress
13. Spatial analysis of Cr (Gyozo Jordan): written paper 80%
14. Spatial analysis of Hg (Gyozo Jordan): under preparation
15. Sn and W (Maria Joao Batista): no progress
16. Mg (Philippe Négrel): under preparation
17. GEMAS in house standard – we should have an article, no leader right now
18. XRD Mapping (Jasper Griffioen): whole Ap (possibly) Make a budget, contact USGS and check labs and prices.

#### 12:00. Future meetings and conferences:

- EGU 2020 Vienna (The critical zone).
- IHES 2020 Galway (Session proposed: Geochemical mapping at all scales).

- IGC 2020 Delhi: IUGS-CGGB has a session (Challenges and Opportunities of Global-Scale Geochemical Mapping (4<sup>th</sup> Arthur Darnley Symposium); free abstract submission extended to 31<sup>st</sup> October 2019).

12:20. GEMAS e-book (Manfred Birke), and FOREGS & GEMAS project samples

- BGR will prepare maps in GeoViewer, and all chapters for download;
- Entry via periodic table of elements;
- About 500 maps are in the process of preparation (Maps: shape files, pdf, png);
- 1: 18,000,000 limitation of the zoom;
- 1.5-2 terabyte volume;
- New GIS server for the GEMAS project, the most expensive is the license for the GIS service, 5-6 months of work is needed.
- Moving FOREGS & GEMAS samples from BGS to SGU before Brexit, and the cost of such movement. Anna Ladenberger and George Morris will discuss this.

Presentations of recent or ongoing activities in the Surveys (1):

13:30. Victor A. Kilipko: Regional geochemical studies in Russia: State of the art

13:45. Olga Kalyeva: Multi-purpose assessment of territories using geochemical data (as exemplified by the Volga Federal District)

14:15. Yao Wensheng: Geochemical Mapping in China and International Cooperation

14:45. QC procedures in Applied Geochemistry (Ariadne Argyraki)

15:00. QC programs (Alec Demetriades)

15:15. Timo Tarvainen: Application of geochemical data in the assessment of soil remediation needs, re-use of excavated soil and re-use of construction and demolition waste

### **Friday, 27<sup>th</sup> September 2019**

9:15-10:30. EGS-GEG Activities including project proposals

- Reports on ongoing projects including international collaboration and GeoEra
- SGU data on ore geochemistry (Anna)
- Discussion on how to increase the visibility of our data: raw data availability, website, e-book, publications, EGDI platform, follow the FOREGS model, stakeholder analysis, understandable communication with potential stakeholders, more outreach outside geochemical community

11:00-12:30. Slavko Solar (EGS Secretary General) presents the activities of the EGS office:

- Introduction on EGS and its Strategy (GeoERA, EGDI, OUTREACH),
- Horizon Europe & EGS proposal with stress on EG input/science topics
- Impact at the policy level
- Data infrastructure
- Outreach: sharing capacity, knowledge
- Expert groups 8 and 2 TF: 10 groups
- Several ongoing projects
- Expert meetings, EGS chairs meeting together with National Delegates (ND), Director's workshop, GeoEra workshop
- Statutory meetings
- ND Forum (Brussels, Lisbon): annual report, new chairs, GeoEra, EGDI/EPOS

- Message from the Chairs:

#### Communication with EGS members within the surveys and ND

- Blind test of the GEMAS flyer in different survey with their Communication Division (BRGM yet planned this internally)
- Joint outreach of Expert Groups in future research programmes
- Bring Urban Geology Expert Group and EGS-GEG together, explore collaboration options
- Bottom-up ideas and top-down mandates (directors)
- Portfolios of products/pilots attracting interest of EC
- Coordinated engagement of DG's with EGS secretariat
- Evaluation of the work of expert groups
- Horizon Europe: EGS Horizon Europe team (GeoEra foresight and EGS members), with involvement of ND and ExCom group
- Geological Service for Europe, sustainable subsurface management
- EGS strategy
- EPOS-EGS contract
- EGDI sustainability activities
- EG Science Topics-document
- EP-GSE, long-term collaboration
- Networking
- What is the need? What information, maps, and databases are required?
- Policy makers want to know how much information the Geological Surveys have...
- How to fund the projects? Is co-funding necessary?
- To find out: (a) External partners; (b) Conflict of interest; (c) Partnership; (d) Only surveys; (e) Research institutes, and (f) Industry.
- Outreach for general public, how to do it?
- Communication TF: must provide communication strategy for EGS

13:30-16:00. Presentations of recent or ongoing activities in the Surveys (2)

13:30. Mairead Glennon - Applied geochemistry update at Geological Survey Ireland

13:45. Belinda Flem - Geochemistry at NGU: current and future opportunities

14:00. George Morris - Regional geochemical mapping in Bergslagen, Sweden

14:15. Jasper Griffioen - Behaviour of natural and agricultural phosphate during exfiltration of anoxic groundwater via tile drains in a clay polder

14:30. Anna Ladenberger - Mapping of critical raw materials in Sweden

15:00. Chaosheng Zhang - Exploration of spatially varying relationships in environmental geochemistry in the big data era

15:15. Gyoza Jordan - Ni, Cr and Hg digital image processing

16:00-17:30. Presentations of recent or ongoing activities in the Surveys (3)

16:00-16:30. Jasper Griffioen - Developing and testing quality control procedures for groundwater analyses (note: a follow-up of our sediment analyses investigation from last year)

16.30-17:00. Maria João Batista - Ongoing geochemical activities at LNEG, Geological Survey of Portugal

17:00-17:20. Alejandro Bel-Ian - Ongoing geochemical activities at IGME Spain

17:20-17:30. Mateja Gosar - Slovenian soil geochemical background and threshold for chemical elements  
17:00-17:45. Gyozo Jordan - Simona project  
17:45-17:55. Presentation for the next Annual meeting in Athens (2020) (Alecos Demetriades & Ariadne Argyraki) 5-6<sup>th</sup> November 2020



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## APPENDIX 2: REGIONAL REPORTS

### A2.1. AFRICA

Report by Theophilus C. Davies (Dept. of Geology, University of Nigeria, Nsukka, Nigeria; [theo.clavellpr3@gmail.com](mailto:theo.clavellpr3@gmail.com))

#### A2.1.1. Introduction

In 2019, large-scale geochemical activities involving sampling, analyses and data handling techniques related to the “*Africa Geochemical Database (AGD) Project*”, were at a low ebb. Few geological surveys (e.g., Geological Survey of Namibia, Council of Geoscience of South Africa) recorded further work on regional geochemical database programmes that were already started.

Reasons for the lowly position of the AGD in geoscience agendas of African countries are well articulated in the 2018 Annual Report of the International Union of Geological Sciences Commission on Global Geochemical Baselines (IUGS-CGGB, 2019).

A number of international workshops with significant African participation were held during 2019, at which various technical aspects of the *Global Geochemical Database Program*, useful to the AGD campaign, were discussed.

#### A2.1.2. The Geological Survey of Namibia

In 2019, the *Regional Geochemistry Subdivision* of the Geological Survey of Namibia (GSN) continued to focus on the country-wide baseline *Regional Geochemical Survey Programme (RGSP)* that commenced in the year 2000. This programme was envisaged to generate valuable information with respect to potential economic deposits, land use planning, environmental monitoring, pollution control and many other applications.

Using map sheets at a scale of 1:250 000, survey design, sample collection (sample density of about 1 sample/10 km<sup>2</sup>) sample preparation, data archiving, interpretation, and map and report production are done on soil or stream sediment media, depending on the topography of the area under consideration.

The sampling procedure used is based on the recommendations from the final report of the IGCP Project 259: *A Global Geochemical Database* (Darnley *et al.*, 1995). Samples collected are properly catalogued and stored at the Geological Survey Core-storage Facility (Core Shed). The samples selected for analysis were processed by milling with the Planetary Agate Ball Mill, followed by digestion with acids for analysis with ICP-OES, or pressed into powder pellets and fused beads for analysis with the WD-XRF. Largely paraphrased from:

<http://www.mme.gov.na/directorates/gsn/geochem/> (accessed 26.11.2019).

#### A2.1.3. The Council for Geoscience, South Africa

Current status of work done by the Council for Geoscience (CGS) in applying regional soil sampling and analyses data collected in the Pofadder region of Namaqualand, South Africa, was presented by Hlatshwayo *et al.*, entitled: *The Regional Geochemical Mapping of the 2918 Pofadder 1:250,000 scale sheet: A Geochemical Atlas* at the Council for Geoscience Conference held at the CSIR in Pretoria on the 11<sup>th</sup> of February, 2019. A brief description of this project was given in a previous annual report of the IUGS Task Group on Global Geochemical Baselines (IUGS-TGGB, 2015).

#### A2.1.4. Workshops

A number of workshops on the Global Geochemical Database program were held during 2019, but only two of these saw the attendance of a significant number of African participants. These were:

- A two-day Workshop (8<sup>th</sup> and 9<sup>th</sup> September, 2019) on *Global Geochemical Baseline and Applied Geochemistry* took place during the Young Earth Scientists (YES) Congress (9<sup>th</sup> to 13<sup>th</sup> September) at the Freie University in Berlin, Germany. Participants from Egypt and Namibia took part. All workshop material was given to participants on a USB-memory card containing the lectures and lots of bibliography (see [Section §6.3.3.2](#)).
- A ten-day Workshop of the *UNESCO International Centre on Global-Scale Geochemistry* was held in Tianjin, Langfang and Zhengzhou, respectively, at different days during the Workshop held from 8<sup>th</sup> to 17<sup>th</sup> of October 2019, with illustration of specific aspects of geochemical mapping techniques at each venue.

#### A2.1.5. Publication

Davies, T.C., 2019. A Medical Geology curriculum for African geoscience. *South African*, 6, e00131, 21 pp.; <https://doi.org/10.1016/j.sciaf.2019.e00131>.

#### A2.1.6. PanAfGeo

Report by Maria João Batista (Laboratório Nacional de Energia e Geologia, Amadora, Portugal; [mjoao.batista@lneg.pt](mailto:mjoao.batista@lneg.pt))

PanAfGeo is a European Commission financed training project in which there is collaboration of African and European Experts in English, French and Portuguese languages. One of the EuroGeoSurveys Geochemistry Expert Group members has given geochemistry training in Portuguese in WP4 – Environmental Management of Mines in Tete, Mozambique. The content of the lessons was from basic chemistry to case studies of waste management, including also metal mobility, sampling of the solid mine waste material, analytical methods, lixiviation tests, and quality control.

Because the region commodity is coal, all the practical case studies, site visits and support were given by the Vale company in Moatize mine.

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

#### A2.1.7. References

- Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steinfeld, A., Tauchid, M., Xie, X., Garrett, R.G. & Hall, G.E.M., 1995. *A Global Geochemical Database for Environmental and Resource Management: Final Report of IGCP Project 259*. Earth Sciences 19, UNESCO Publishing, Paris, 122 pp.; [http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/Blue\\_Book\\_GGD\\_IGCP259.pdf](http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/Blue_Book_GGD_IGCP259.pdf).
- IUGS-CGGB, 2019, 2018. *Annual Regional Report on Geochemical Database, Africa*. In: D.B. Smith, X. Wang, P. de Caritat & A. Demetriades (Editors), 2018 Annual Report of the International Union of Geological Sciences Commission on Global Geochemical Baselines, p. 64-69; [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).
- IUGS-TGGB, 2016. *2015 Annual Regional Report on Geochemical Database, Africa*. In: D.B. Smith, X. Wang, P. de Caritat & A. Demetriades (Editors), 2015 Annual Report of the

International Union of Geological Sciences Commission on Global Geochemical Baselines, p.17-23; [http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/TGGGB\\_Annual\\_Report\\_2015\\_Final\\_HR.pdf](http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/TGGGB_Annual_Report_2015_Final_HR.pdf).

## **A2.2. AMERICA, NORTH**

### **A2.2.1. United States of America**

Report by David B. Smith (United States Geological Survey; [dbsmith13@gmail.com](mailto:dbsmith13@gmail.com))

In 2019, the U.S. Geological Survey published an interactive website where users can view geochemical and mineralogical maps for soils of the conterminous US (approximately 8 million km<sup>2</sup>) and also view interpretations of the major patterns observed for each element and mineral. The report provides links to the original data sets and also provides the capability of downloading each map into Google Earth for further exploration. The website can be found at <https://pubs.usgs.gov/sir/2017/5118/index.html>. The complete reference is:

Smith, D.B., Solano, Federico, Woodruff, L.G., Cannon, W.F., Ellefsen, K.J., 2019. *Geochemical and mineralogical maps, with interpretation, for soils of the conterminous United States*. U.S. Geological Survey Scientific Investigations Report 2017-5118; <https://doi.org/10.3133/sir20175118> [Available as HTML].

## **A2.3. AMERICA, SOUTH**

### **A2.3.1. Brazil**

Report by Otavio Augusto Boni Licht (Universidade Federal do Paraná, Centro Politécnico; [otavio.licht@gmail.com](mailto:otavio.licht@gmail.com))

Crisigiovanni, F.L., Licht, O.A.B., Ferrary, V.C. & Porto, C.G., 2019. *Geochemical mapping based on regularly spaced composite stream sediment samples produced from stored aliquots – State of Paraná pre-Cambrian Shield, Brazil*. *Geochimica Brasiliensis*, 33(3), 234-259; <https://doi.org/10.21715/GB2358-2812.2019333234>.

### **A2.3.2. Colombia**

Report by Gloria Prieto (Colombian Geological Survey; [gprieto@sgc.gov.co](mailto:gprieto@sgc.gov.co); [g.prietor@outlook.com](mailto:g.prietor@outlook.com))

In 2019, the Colombian Geological Survey carried out diverse and systematic geochemical mapping programmes: (a) low-density sampling for geochemical mapping as part of the Global Geochemical Baseline Project; (b) medium density sampling for the Colombian Geochemical Atlas, and (c) high density sampling for mineral resources exploration, Metallogenetic Map, and for applications to minerals fingerprinting, health and environment studies.

#### ***A2.3.2.1. Low Density Geochemical Mapping in Colombia for the Global Geochemical Baseline***

In execution of the agreement between the Colombian Geological Survey (SGC) and the Geological Survey of China, signed in 2016, to carry out diverse geochemical sampling programmes in Colombia, the Mineral Resources Division of the Colombian Geological Survey achieved a covering of 75% of the Colombian territory using low-sampling density geochemical programme (Figure A2.1).



In 2019, the sampling programme advanced by covering 127 sampling stations, located in the eastern part of Colombia, a rain forest region and the most difficult geographical area to access. At each sampling station, were collected surface water and floodplain or overbank samples according to the basin size (Figures A2.2 & A2.3), following standardised methodologies according to the Global Geochemical Baselines Programme of UNESCO-ICGG<sup>1</sup>.

At the Colombian Geological Survey laboratories, the water samples were analysed following standard methods, and the analytical data together with the quality control parameters (QA / QC) were archived in the EXPLORA database of the Mineral Resources Division.

In the field campaign, using field protocols and formats, geological data as well as environmental and social information of the working area were recorded (Figure A2.4).

According to the Agreement signed between the SGC of Colombia and the CGS of China, the samples of floodplain and overbank sediments were packed following standardised protocols, and were sent for chemical analysis to the laboratories of the Geological Survey of China (UNESCO International Centre on Global-Scale Geochemistry).

Up to now, the Colombian Geological Survey has received analytical results for 104 stations (208 samples and 22 duplicates), 316 are in analysis and 286 are in preparation (air drying), and will be sent to China for analysis (Figure A2.5)<sup>2</sup>.

The generated analytical data were validated and stored in the geodatabase EXPLORA of the Mineral Resources Division, and directly afterwards their computer data processing was initiated. The procedures included Exploration Data Analysis (EDA), univariate and bi- variate correlation analysis, cross correlation analysis, principal component analysis and element concentration maps plotted according to catchment basin (Figures A2.6 & A2.7) for 56 chemical elements. In 2020, it is expected to receive the complete set of analysis in order to continue the data processing, map production and interpretation.

#### ***A2.3.2.2. Geochemical Atlas of Colombia***

With regard to medium-density sampling (grid of 5 x 5 km) for the Colombian geochemical mapping, a systematic geochemical programme was initiated in mid-2019. In this programme, the following samples are collected at each sampling station using a nominal grid of 5 x 5 km: stream sediment, soil and surface water. This survey covers systematically map sheets for which there are no samples.

Up to November 2019, 251 samples have been collected (Figures A2.8 & A2.9). Stream water samples are analysed at the Colombian Geological Survey laboratories, and stream sediment and soil samples are prepared (drying & sieving) and subsequently are sent to the laboratory for analysis.

The objective of the Mineral Resources Division is to produce new geochemical maps of Colombia in order to compile a new version of the Geochemical Atlas of Colombia (GAC version 2020) at the end of 2020.

As a complement, the Colombian Geological Survey is working hard in order to produce litho-geochemical data to elaborate a new version of the Metallogenic Map of Colombia in 2020.

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<sup>1</sup> Comments by Alecos Demetriades (Chairperson of IUGS-CGGB Sampling Committee): (1) It is expected that the floodplain sediment sampling is carried out according to the agreed specifications of the IUGS Commission on Global Geochemical Baselines at the October 2018 meeting of the UNESCO-ICGG Scientific Committee. From the photographs it appears to be so.

<sup>2</sup> (2) The analysis of batches of samples of different sampling campaign in different years is a procedure that must be avoided, because such a procedure will most likely cause quality control problems. Therefore, it is strongly recommended to analyse all samples, collected during the different sampling campaigns, in the same laboratory, with the same analytical method or methods and during the same time period, and definitely not in different time periods.

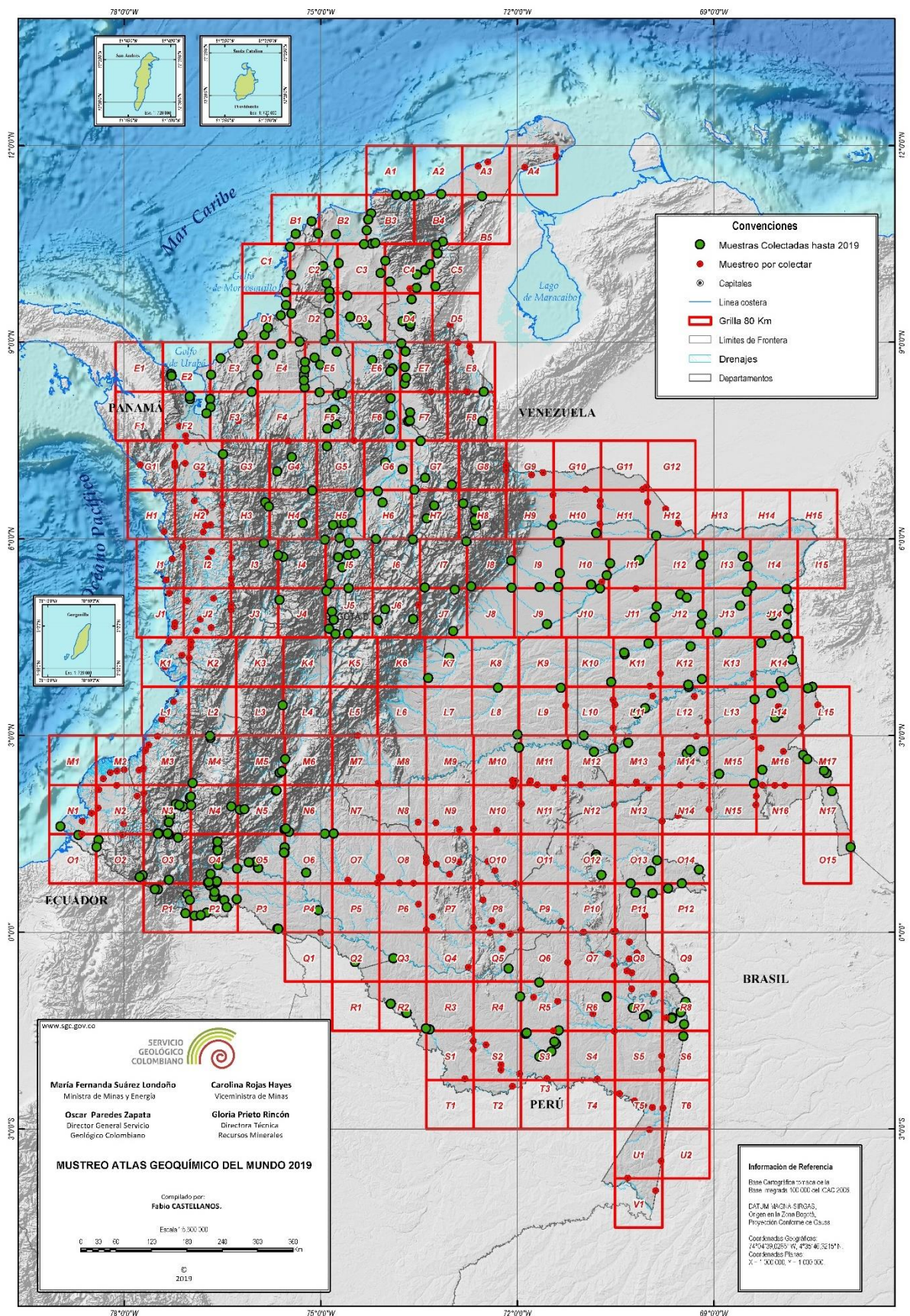


Figure A2.1. Map of Colombia, scale 1:5,500,000 with grid cells of 80 x 80 km (212 cells). Sampling points covered during the 2019 sampling campaign are shown with green dots, and stations for sampling in 2020 in red dots.





Figure A2.2. Sampling site on Zulia River, Norte de Santander Department.



(a)



(b)

Figure A2.3. Sampling of floodplain sediment, using (a) a trench of 170 cm depth, and (b) a trench of 100 cm depth down to the groundwater table.



Figure A2.4. Geological and environmental data collection during the field sampling campaigns.



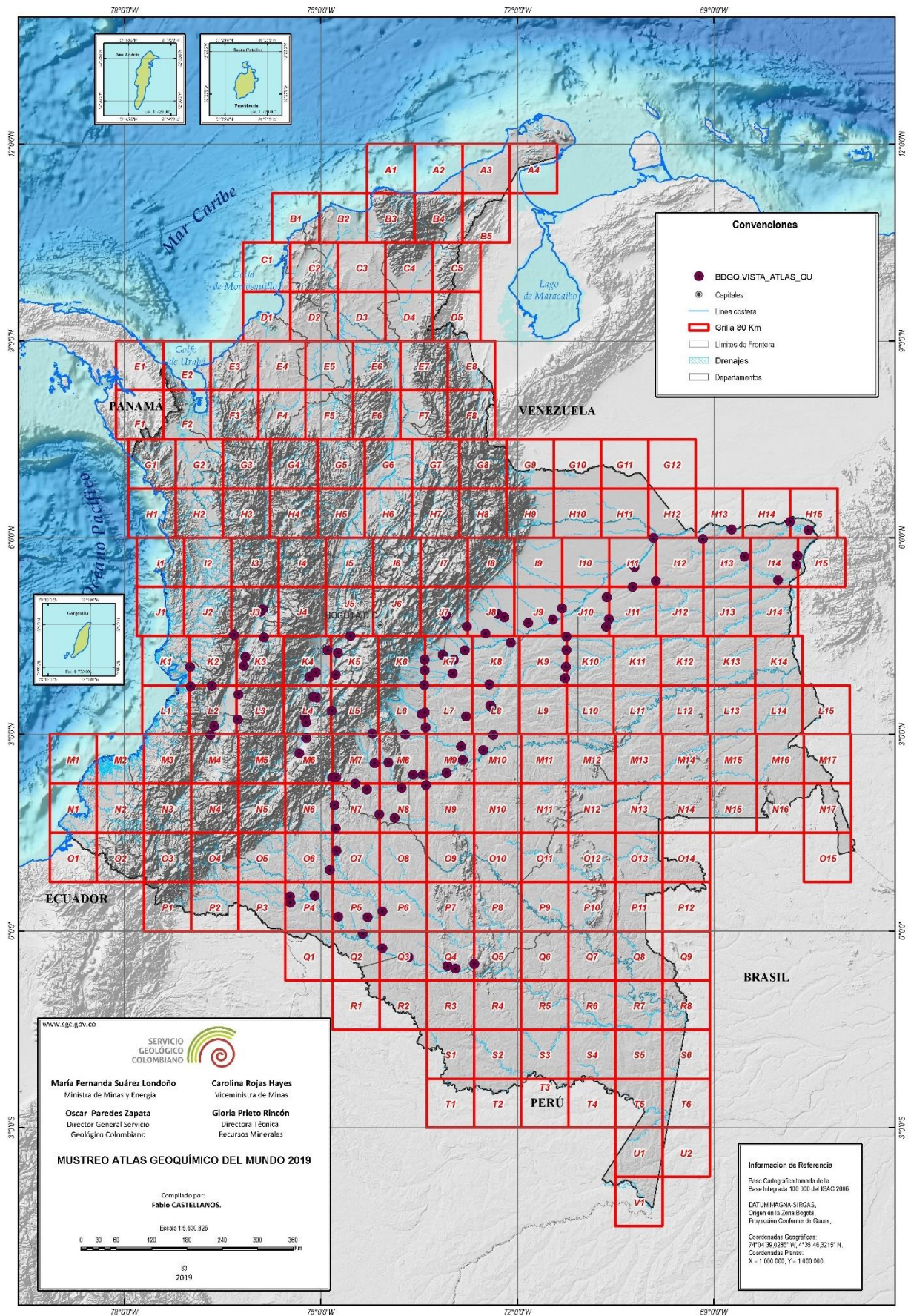


Figure A2.5. Map of Colombia with grid cells of 80 x 80 km (212 cells). In black dots are the samples with geochemical results.



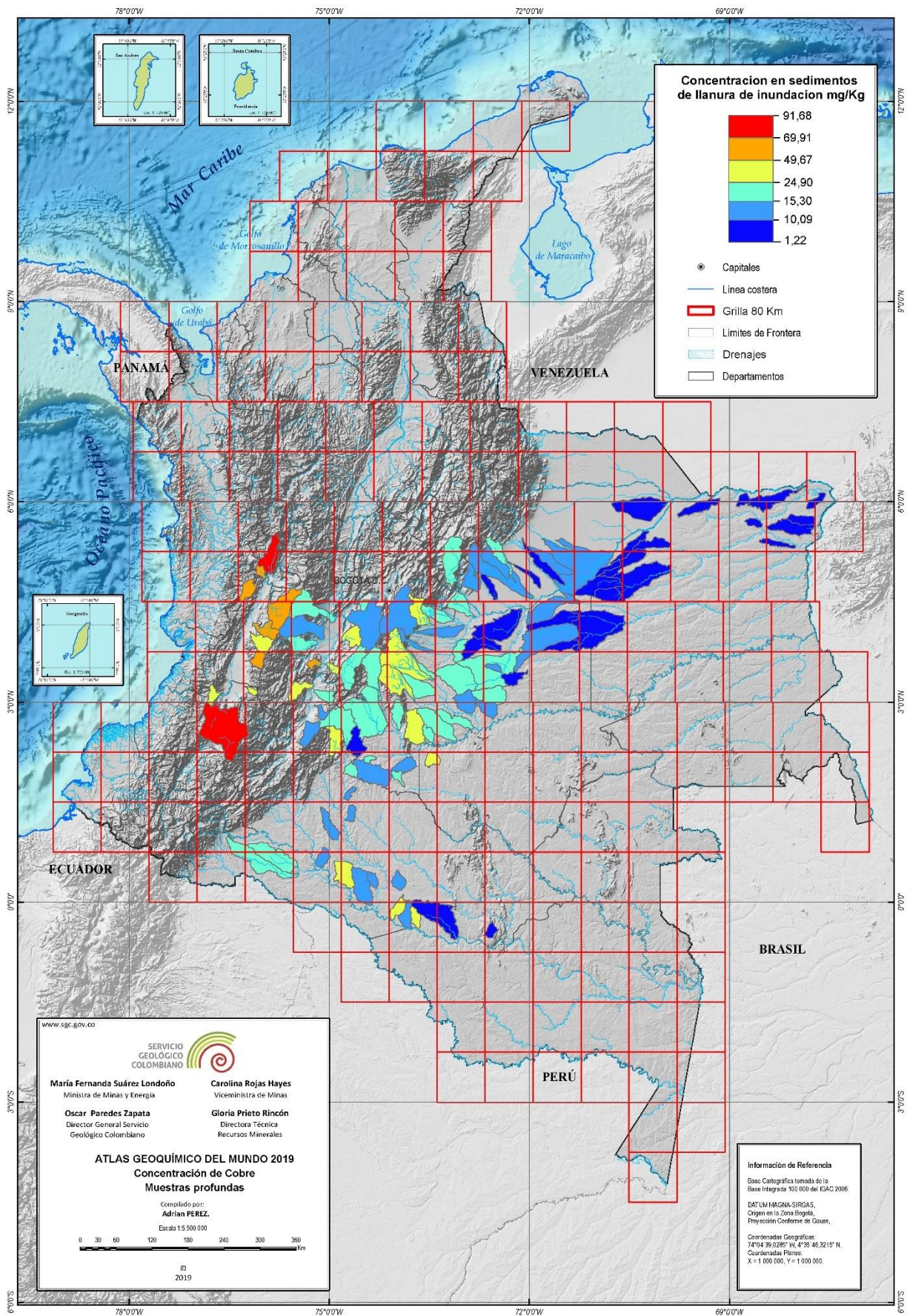


Figure A2.6. Catchment basin map showing the distribution of Cu (mg/kg) in bottom floodplain sediment samples.



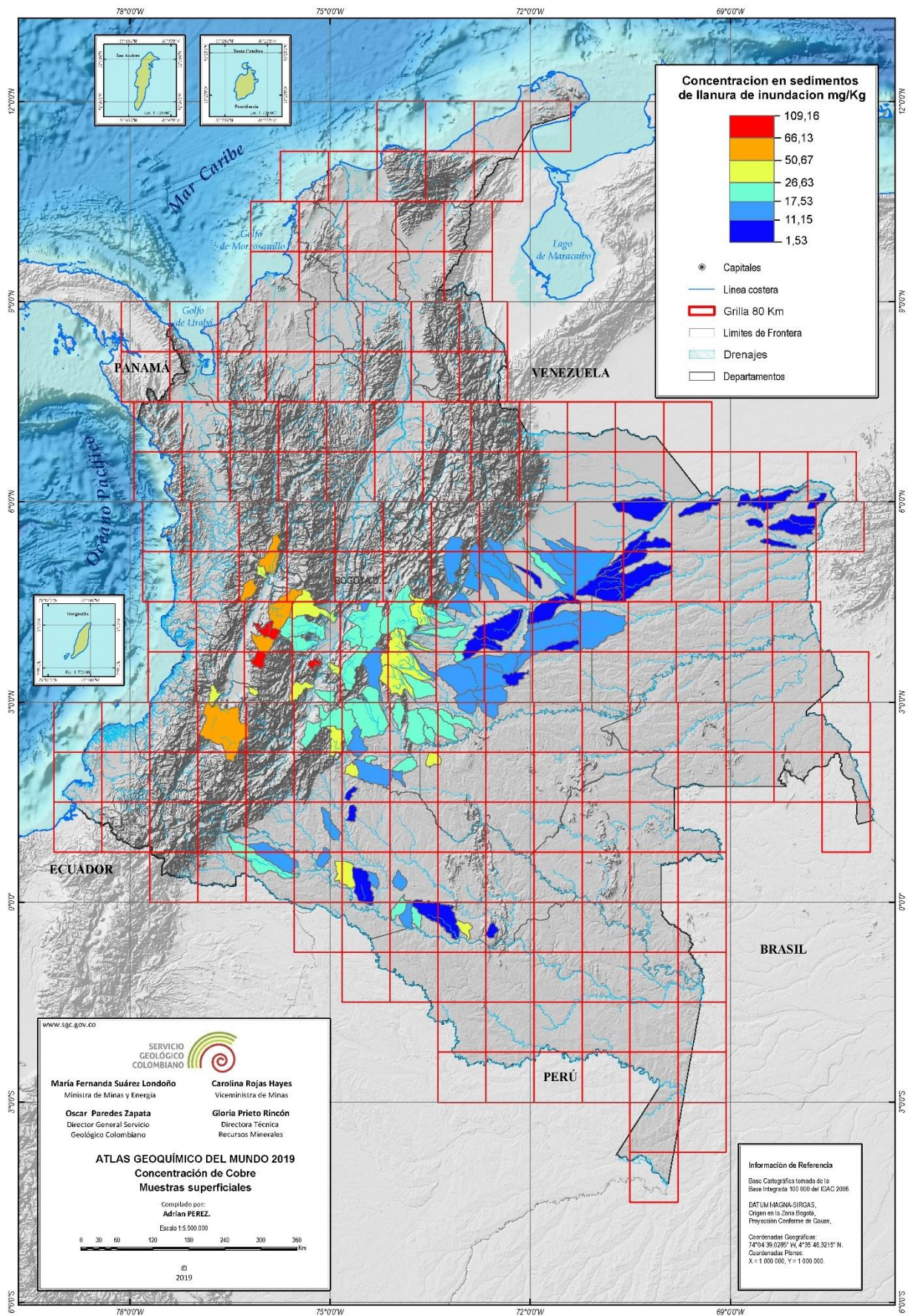


Figure A2.7. Catchment basin map showing the distribution of Cu (mg/kg) in top floodplain sediment samples.





Figure A2.8. Stream sediment sampling in the Playon River, Santander Department.

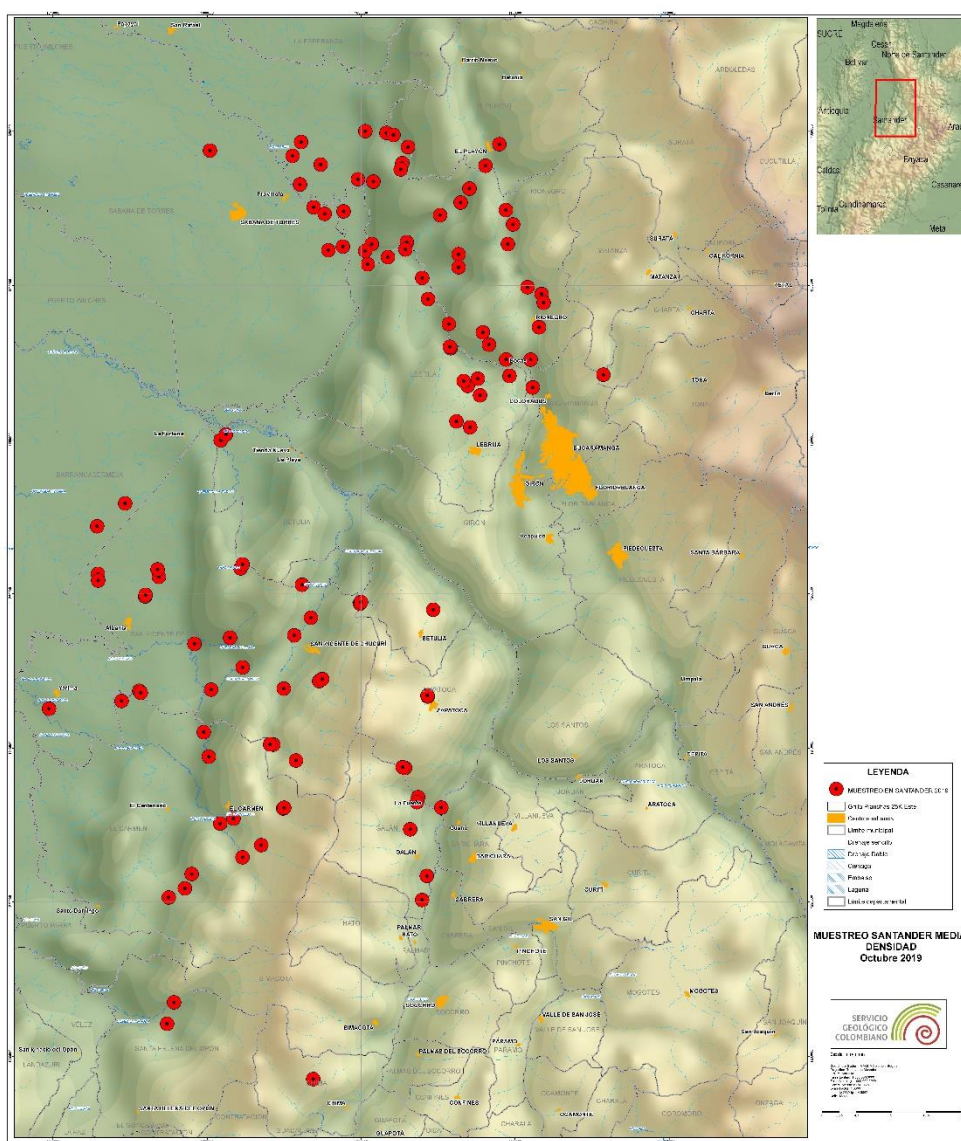


Figure A2.9. Sampling stations in Santander Department.

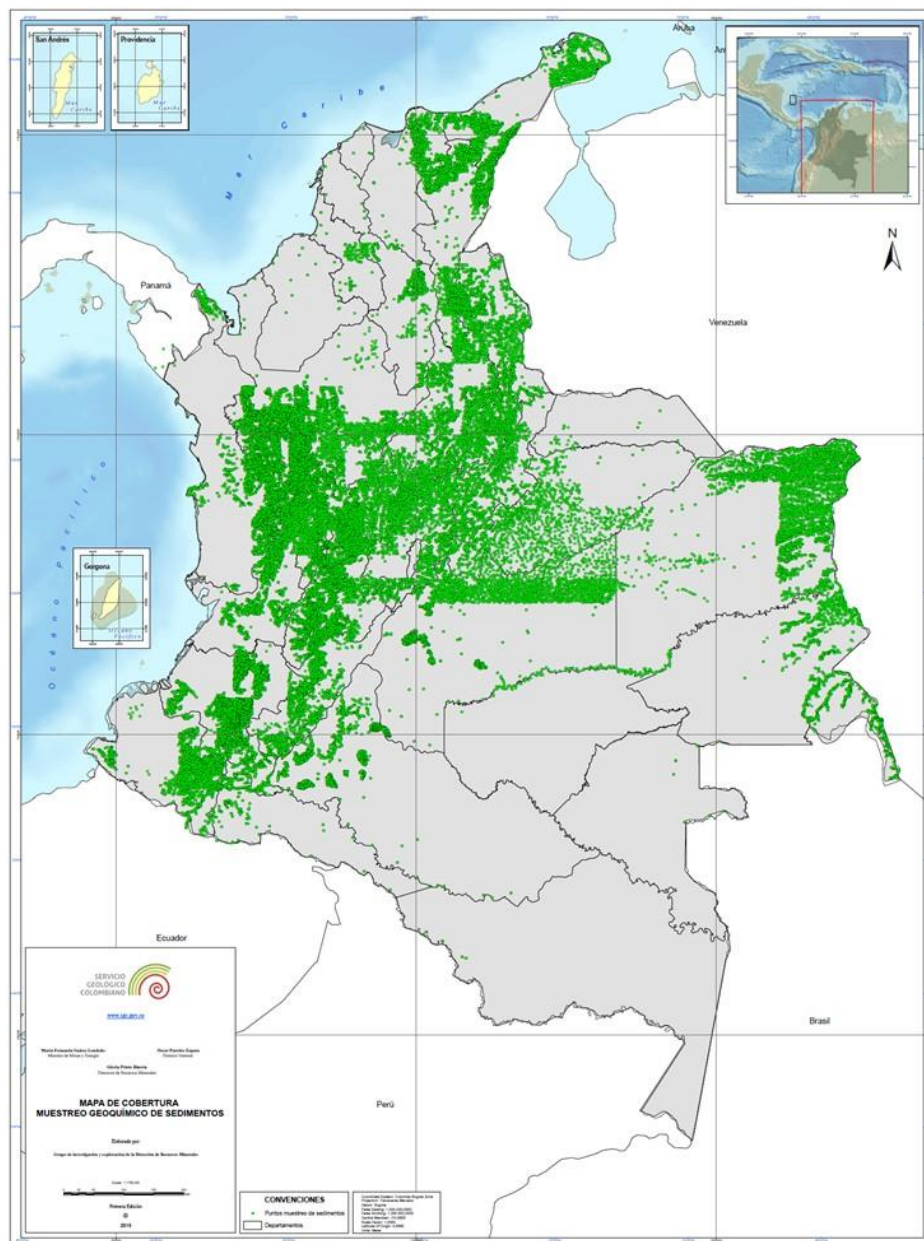


Figure A2.10. Map showing the coverage with samples of stream sediment at low and high sampling density, depending on the needs and application of the geochemical data (1 sample/25 km<sup>2</sup>, 1 sample/16 km<sup>2</sup>, 1 sample/9 km<sup>2</sup> and 1 sample/km<sup>2</sup>).

### A2.3.2.3. Geochemical Sampling to Evaluate Potential of Mineral Resources

To evaluate mineral resources potential in metallogenic districts, the Colombian Geological Survey established a high-density geochemical sampling programme in six areas of interest for copper – gold and polymetallic minerals. Following standard methodologies, samples of stream sediment (Figure A2.10), soil, rock and water were collected in San Diego, La Paz, Codazzi, Nutibara, Carauta, Valle de San Juan, and Rovira. Additionally, samples were collected from contact zones, alterations, and mineralised rocks, as well as panned concentrates (Figure A2.11). The samples were packed and sent to the laboratories of the SGC and to other commercial laboratories for chemical analysis. Field and analytical information was archived in the EXPLORA geodatabase. The information was processed using specialised software (Geosoft, Iogas, ArcGis, SPSS, among others), geochemical anomalies were identified, concentration and distribution maps were produced by region and by basin. Following integration of geological, geophysical and metallogenic information, targets were identified for mineral exploration.





Figure A2.11. Sampling of rocks and panned concentrates.

#### A2.3.2.4. Geochemical Sampling for Environmental Geochemistry and Geomedicine

A geochemical sampling programme for environment and health studies it was established as a ‘geomedicine’ project. In this project, a systematic sampling programme in areas with high concentration of cadmium and arsenic was carried out. Samples of water (surface and groundwater), stream and suspended sediments (Figure A2.12), soil, rock and organic material were collected. The project will continue in 2020 for the study of mercury and other potentially harmful elements.



Figure A2.12. Sampling of stream sediment for the Colombian Geochemical Atlas.

Finally, the geochemistry programme of the Colombian Geological Survey, Mineral Resources Division, began a project for the fingerprinting of Colombian minerals (Figure A2.13), which will contribute to the identification of the origin of ore, especially gold. Presently, five gold mining districts are being explored.

The Geochemistry Group of the Colombian Geological Survey, Mineral resources Division, is shown in Figure A2.14.



Figure A2.13. Sampling for gold in the fingerprinting project.



Figure A2.14. Geochemistry Group of the Colombian Geological Survey, Mineral resources Division.

## A2.4. ASIA

### A2.4.1. Armenia

Report by Gevorg Tepanosyan (Center for Ecological-Noosphere Studies NAS RA;  
[gevorg.tepanosyan@cens.am](mailto:gevorg.tepanosyan@cens.am))

#### ***A2.4.1.1. Report of Environmental Geochemical and Radiological Surveys in Armenia***

The main activities of the Environmental Geochemistry Department at the Center for Ecological-Noosphere Studies of the National Academy of Sciences of the Republic of Armenia during 2019 has been the ongoing activities of the soil survey of city of Alaverdi and the start of soil geochemical survey of Armenia regions.

The city of Alaverdi hosting the Alaverdi copper smelter was investigated within the project entitled ‘*Eco-Geochemical Investigations as a Base of Decision Making (case study of the city of Alaverdi)*’ funded by the Science Committee of the MES of RA (18T-1E145, 2018-2020). Approximately 207 soil samples (16 samples/km<sup>2</sup>) collected down to a depth of 5 cm were analysed by X-ray fluorescence spectrometry for Ti, Fe, Ba, Mn, Co, V, Pb, Zn, Cu, Cr, Mo and As. The results are included in a manuscript, which is now under revision and will be resubmitted to the journal of Environmental Pollution for possible publication.

In 2019, saw the start of a 5 year long project, which is funded by the Science Committee of the MES of RA entitled “*Development of Geochemical Maps to Ensure Sustainable Agricultural Development and Food Safety – GeoMAS*” (1-12/TB, 2019-2023). The aim of this soil study is the determination of potentially hazardous element concentrations and gross alpha/beta activity. During 2019, a soil survey (down to a depth of 20 cm) was conducted in Armavir region of Armenia and approximately 60 samples (1 sample/25 km<sup>2</sup>) were collected and analysed by X-ray fluorescence spectrometry and gross alpha/beta counting system. The results will be used to calculate the regional baseline, to study the main spatial pattern of elements and gross alpha/beta activity distribution, as well as to identify sources and assess the health risk of potentially hazardous elements.

The Radioecology department is implementing a national research project “*Radioecological monitoring in Armenia: Phase II – REMA II*” (18T-1E311, 2018-2020) in six mountain ridges and two massifs in order to assess the background activity of naturally occurring radionuclides



( $^{238}\text{U}$ ,  $^{232}\text{Th}$  and their daughters and  $^{40}\text{K}$  as well) and baseline activity of artificial  $^{137}\text{Cs}$  in soil and stream sediment by altitudinal belts. The network of five monitoring stations was designed in Aragats massif (the highest point of Armenia) by altitudinal belts (from 990 to 3200 m above sea level) in order to monitor transboundary migration of artificial  $^{137}\text{Cs}$  with dry atmospheric deposition. In total, 140 soil and stream sediment samples, 55 moss and 40 samples of dry deposition were collected. Gamma-ray spectrometry of collected samples is in progress. Intermediate results were reported at the 2<sup>nd</sup> International Conference on Radioanalytical and Nuclear Chemistry / RANC 2019 (May 5–10, 2019 / Budapest, Hungary).

#### A2.4.2. India

Report by Pradip K. Govil (National Geophysical Research Institute, Hyderabad, India)

The National Geophysical Research Institute, under [CSIR-skill initiative programme](#), organised a training workshop on the “*Assessment of contaminated soil and groundwater*” in Hyderabad from the 13<sup>th</sup> to the 26<sup>th</sup> of February 2019. Master and Ph.D. students from different Indian universities and research institutes participated in the workshop.

Dr. Pradip K. Govil delivered a lecture on “*Global Geochemical Baselines Mapping for Environmental Management in India*” (Figure A2.15).

The long awaited Geochemical Atlas of India was released on the 11<sup>th</sup> of November 2019 (Figure A2.16).



Figure A2.15. Dr. Pradip Govil delivering the lecture on “*Global Geochemical Baselines Mapping for Environmental Management in India*”.



Figure A2.16. Release of the Geochemical Atlas of India.

### A2.4.3. Japan

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

In 2019, there were no geochemical activities.

## A2.5. AUSTRALASIA

### A2.5.1. Australia

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

2019 saw the final release of the results of the Northern Australia Geochemical Survey (NAGS), a part of the Australian Government's 'Exploring for the Future' (2016-2020; EFTF) programme (<http://www.ga.gov.au/eftf>). NAGS field work was completed in 2017 in collaboration with the geological surveys of the Northern Territory and Queensland. NAGS targeted overbank/floodplain sediments at the downstream end of large hydrographic catchments at a density of approximately one sample per 500 km<sup>2</sup>. Within 2018 to 2020, NAGS geochemical data, metadata and digital maps are released on an ongoing basis through Geoscience Australia's website (<http://www.ga.gov.au/eftf/minerals/fis/nags>).

The second and final data release occurred in 2019 and included results of XRF analyses and ICP-MS analyses for the coarse (<2 mm) fraction of the samples; results of ICP-MS analyses of the *Aqua Regia* extractions for both the fine (<75 µm) and coarse (<2 mm) fractions; and results of Fire Assay analyses of both the fine (<75 µm) and coarse (<2 mm) fractions. Besides conventional data interpretation and maps, ongoing work includes machine learning processing and presentation of data, integrating geochemical, geological, geomorphological and climatic factors, and levelling and integrating legacy geochemical data sets with national and continental geochemical baselines.

#### A2.5.1.1. Published articles, papers, atlases and books

- Talebi, H., Mueller, U., Tolosana-Delgado, R., Grunsky, E.C., McKinley, J.M. & Caritat, P. de, 2019. *Surficial and deep earth material prediction from geochemical compositions*. Natural Resources Research, 28, 869-891; <https://doi.org/10.1007/s11053-018-9423-2>.
- Caritat, P. de & Mann, A., 2019. *An improved method for assessing the degree of geochemical similarity (DOGS2) between samples from multi-element geochemical datasets*. Geochemistry: Exploration, Environment, Analysis, 19, 58-73; <https://doi.org/10.1144/geochem2018-021>.
- Grunsky, E.C. & Caritat, P. de, 2019. *State-of-the-art analysis of geochemical data for mineral exploration*. Geochemistry: Exploration, Environment, Analysis, Online June 2019; <https://doi.org/10.1144/geochem2019-031>.
- Main, P.T., Bastrakov, E.N., Wygralak, A., Czarnota, K. & Khan, M. 2019. *Northern Australia Geochemical Survey Data release 2: Total (coarse fraction), Aqua Regia (coarse and fine fraction), and Fire Assay (coarse and fine fraction) element contents*. Record 2019/02. Geoscience Australia, Canberra, 33 pp.; <https://doi.org/10.11636/Record.2019.002>.

#### A2.5.1.2. Oral and poster presentations

- Grunsky, E., Caritat, P., McKinley, J. & Mueller, U., 2019. *Using surface regolith and soil geochemistry to map the major crustal blocks of the map the major crustal blocks of the Australian continent and Northern Ireland*. IUGG 2019 (International Union of Geodesy and Geophysics) Conference (Montreal, Canada, 8-18 July 2019), Oral Presentation, Proceedings: Abstract IUGG19-1494. Available at: <http://www.iugg2019montreal.com/abstract-book.html>



Main, P.T., Bastrakov, E.N., Champion, D.C., Czarnota, K. & Wilford, J.R., 2019. *Geochemistry of northern Australia: putting it together*. Geological Survey of Queensland Technical Workshop: Data and Research Innovations for Exploration. Townsville, Queensland, 5-6 June 2019. Available at: [https://smi.uq.edu.au/files/44064/D204\\_Main\\_Geochemistry%20of%20Northern%20Australia.pdf](https://smi.uq.edu.au/files/44064/D204_Main_Geochemistry%20of%20Northern%20Australia.pdf)

### A2.5.2. New Zealand

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

A publication was released using magnetic mineralogy in soil as a pollution and provenance tool (Martin *et al.*, 2018) that was also presented at the Society for Geology Applied to Mineral Deposits conference (Martin *et al.*, 2019a). A second journal article reported findings of an urban geochemical baseline study in southern New Zealand (Turnbull *et al.*, 2019), in which they attributed geochemical variation to geogenic sources and anthropogenic inputs, in particular from leaded fuel and leaded paint (Figure A2.17). A third article proposed a new approach to water quality modelling, which in part utilises chemistry in soil data from the southern New Zealand geochemical baseline survey (Rissman *et al.*, 2019).

A short paper was published discussing regional-scale multi-element in soil baseline surveys over prospective mineral camps in New Zealand (Martin *et al.*, 2019b), which was also presented at the Mineral Systems of the Pacific Rim Congress (PACRIM) conference (Martin *et al.*, 2019c). The final short paper looked at novel normalisation techniques of elements in soil as a pathfinder to orogenic mineralisation, which was also presented at the Society for Geology Applied to Mineral Deposits (SGA) conference. A paper was presented at the International Conference on Earth Observations and Societal Impacts (ICEO & SI2019) conference discussing geological and human impacts in soil from New Zealand and the Loyalty Islands.

GNS Science has newly funded a five-year programme (2019-2024) that will, in part, fund 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. New Pb isotope in soil measurements have been made on the samples that make-up the southern New Zealand urban survey.

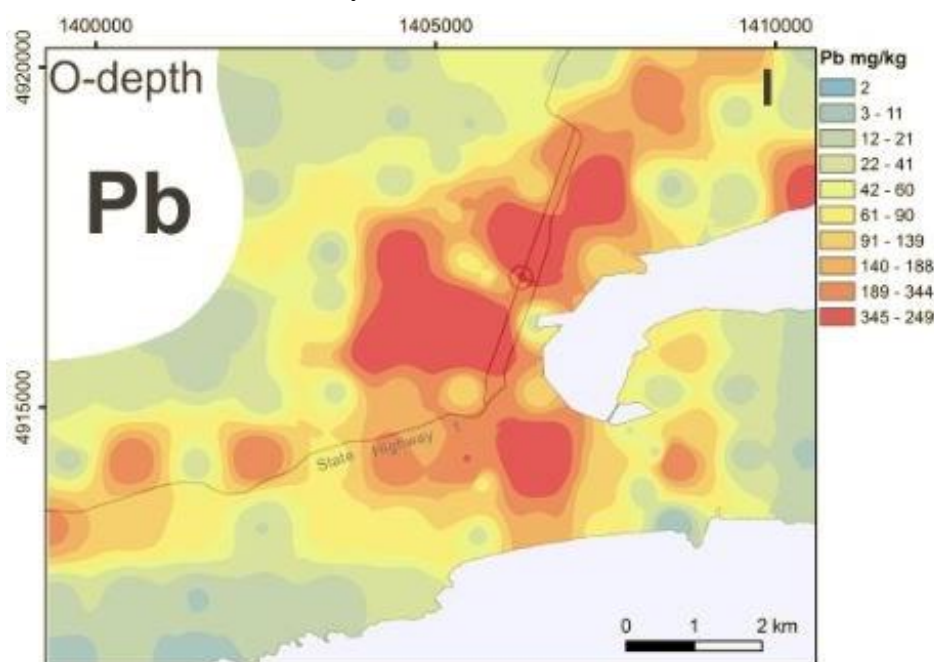


Figure A2.17. Interpolated lead (Pb) data at 0-2 cm-depth across Dunedin City in southern New Zealand. Data are from aqua regia ICP-MS on the <2 mm soil fraction.

#### **A2.5.2.1. Published articles, papers, atlases and books**

- Martin, A.P., Ohneiser, C., Turnbull, R.E., Strong, D.T. & Demler, S., 2018. *Soil magnetic susceptibility mapping as a pollution and provenance tool: an example from southern New Zealand*. *Geophysical Journal International*, 212(2), 1225-1236; <https://doi.org/10.1093/gji/ggx484>.
- Martin, A.P., Ohneiser, C., Turnbull, R.E., Strong, D.T. & Rieger, P., 2019a. *Soil magnetic susceptibility mapping as a vectoring tool for mineral exploration: an example from southern New Zealand*. p.1385-1388 In: *Proceedings of the 15<sup>th</sup> SGA Biennial Meeting, 27-30 August 2019, Glasgow, Scotland*. Society for Geology Applied to Mineral Deposits.
- Martin, A.P., Gazley, M.F., Turnbull, R.E., Frontin-Rollet, G. & Strong, D.T., 2019b. *Normalisation of pathfinder element in soil data to aid orogenic gold exploration with an example from southern New Zealand*. p.811-813 In: *Proceedings of the 15<sup>th</sup> SGA Biennial Meeting, 27-30 August 2019, Glasgow, Scotland*. Society for Geology Applied to Mineral Deposits.
- Martin, A.P., Turnbull, R.E., Rattenbury, M.S., Strong, D.T., Christie, A.B., Rogers, K.M., Gazley, M.F. & Smillie, R.W., 2019c. *Regional-scale multi-element in soil baseline surveys over prospective mineral camps in New Zealand*. p.287-289 In: D. Sims (chair) *PACRIM 2019, 3-5 April 2019, Auckland, New Zealand*. Carlton, Vic.: Australasian Institute of Mining and Metallurgy. Publication series / Australasian Institute of Mining and Metallurgy 1/2019.
- Turnbull, R., Rogers, K., Martin, A., Rattenbury, M. & Morgan, R., 2019. *Human impacts recorded in chemical and isotopic fingerprints of soils from Dunedin City, New Zealand*. *Science of The Total Environment*, 673, 455-469; <https://doi.org/10.1016/j.scitotenv.2019.04.063>.
- Rissmann, C.W.F., Pearson, L.K., Beyer, M., Couldrey, M.A., Lindsay, J.L., Martin, A.P., Baisden, W.T., Clough, T.J., Horton, T.W. & Webster-Brown, J.G., 2019. *A hydrochemically guided landscape classification system for modelling spatial variation in multiple water quality indices: Process-attribute mapping*. *Science of The Total Environment*, 672, 815-833; <https://doi.org/10.1016/j.scitotenv.2019.03.492>.

#### **A2.5.2.2. Oral and poster presentations**

##### ***Mineral Systems of the Pacific Rim Congress (PACRIM) 2019, 3-5 April 2019, Auckland, New Zealand***

- Martin, A.P., Turnbull, R.E., Rattenbury, M.S., Strong, D.T., Christie, A.B., Rogers, K.M., Gazley, M.F. & Smillie, R.W., 2019. *Regional-scale multi-element in soil baseline surveys over prospective mineral camps in New Zealand*.

##### ***Society for Geology Applied to Mineral Deposits (SGA), 27-30 August 2019, Glasgow, Scotland***

- Martin, A.P., Gazley, M.F., Turnbull, R.E., Frontin-Rollet, G. & Strong, D.T., 2019. *Normalisation of pathfinder element in soil data to aid orogenic gold exploration with an example from southern New Zealand*.
- Martin, A.P., Ohneiser, C., Turnbull, R.E., Strong, D.T. & Rieger, P., 2019. *Soil magnetic susceptibility mapping as a vectoring tool for mineral exploration: an example from southern New Zealand*.

##### ***The International Conference on Earth Observations and Societal Impacts (ICEO&SI2019). 23<sup>rd</sup> – 26<sup>th</sup> June 2019, Taiwan***

- Rogers, K.M., Turnbull, R.E., Martin, A. P., Rattenbury, M.S., Jeanpert, J., Rakowski, D., Zhang, Z. & Liu, Z., 2019. *Digging into the human and geological impacts recorded by geochemical and isotopic fingerprints in soils from New Zealand and Loyalty Islands*.

## A2.6. EUROPE

### A2.6.1. EuroGeoSurveys Geochemistry Expert Group

Report by Philippe Négrel and Anna Ladenberger (EuroGeoSurveys Geochemistry Expert Group; [p.negrel@brgm.fr](mailto:p.negrel@brgm.fr); [anna.ladenberger@sgu.se](mailto:anna.ladenberger@sgu.se))

The main activities of the EuroGeoSurveys Geochemistry Expert Group during 2019 were:

- The organisation of the joint annual business meeting of the EuroGeoSurveys Geochemistry Expert Group and IUGS Commission on Global Geochemical Baselines in Budapest in September 2019 (see [Appendix 1](#));
- The organisation of a session at the EGU meeting in Vienna, Austria (April 2019);
- Participation in the 15<sup>th</sup> International Geological Congress of the Geological Society of Greece (May 2019), Athens, Hellas (see [Section §6.3.1.1](#));
- Search for funding the second pan-European Urban Geochemical Mapping project, based on the manual:

Demetriades, A. & Birke, M., 2015. *Urban Topsoil Geochemical Mapping Manual (URGE II)*. EuroGeoSurveys, Brussels, 52 pp.; [http://www.eurogeosurveys.org/wp-content/uploads/2015/06/EGS\\_Urban\\_Topsoil\\_Geochemical\\_Mapping\\_Manual\\_URGE\\_II\\_HR\\_version.pdf](http://www.eurogeosurveys.org/wp-content/uploads/2015/06/EGS_Urban_Topsoil_Geochemical_Mapping_Manual_URGE_II_HR_version.pdf).

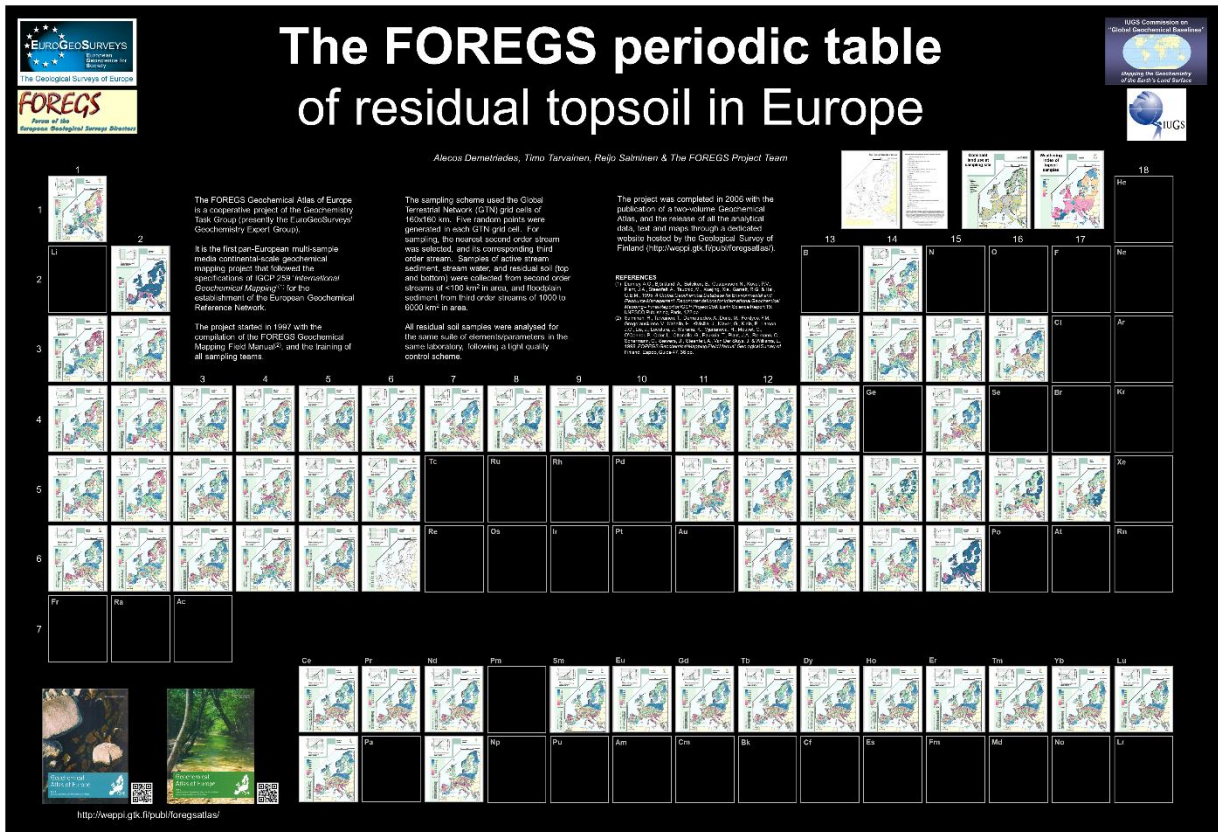
Continued work on the [GEMAS](#) project samples and data, with the publication of four papers:

- Hoogewerff, J.A., Reimann, C., Ueckermann, H., Frei, R., Frei, K.M., van Aswegen, Th., Stirling, C., Reid, M., Clayton, A., Ladenberger, A. & The GEMAS Project Team, 2019. *Bioavailable <sup>87</sup>Sr/<sup>86</sup>Sr in European soils: A baseline for provenancing studies*. *Science of The Total Environment*, 672, 1033-1044; <https://doi.org/10.1016/j.scitotenv.2019.03.387>.
- Xu, H., Demetriades, A., Reimann, C., Jiménez, J.J., Filser, J., Zhang, C. & GEMAS Project, Team, 2019. *Identification of the co-existence of low total organic carbon contents and low pH values in agricultural soil in north-central Europe using hot spot analysis based on GEMAS project data*. *Science of The Total Environment* 678, 94-104; <https://doi.org/10.1016/j.scitotenv.2019.04.382>.
- Négrel, P., Ladenberger, A., Reimann, C., Birke, M., Demetriades, A., Sadeghi, M. & The GEMAS Project Team, 2019. *GEMAS: Geochemical background and mineral potential of emerging tech-critical elements in Europe revealed from low-sampling density geochemical mapping*. *Applied Geochemistry* (published on-line in December 2019, 104425); <https://doi.org/10.1016/j.apgeochem.2019.104425>.
- Sæther, O.M., Flem, B., Fabian, K. & Reimann, C., 2019. *150 år med det periodiske system (150 years with the periodic table)*. *GEO: Energi & ressurser*, 22(7), 28-29; <https://geo365.no/geoforskning/150-ar-med-grunnstoffene/>.

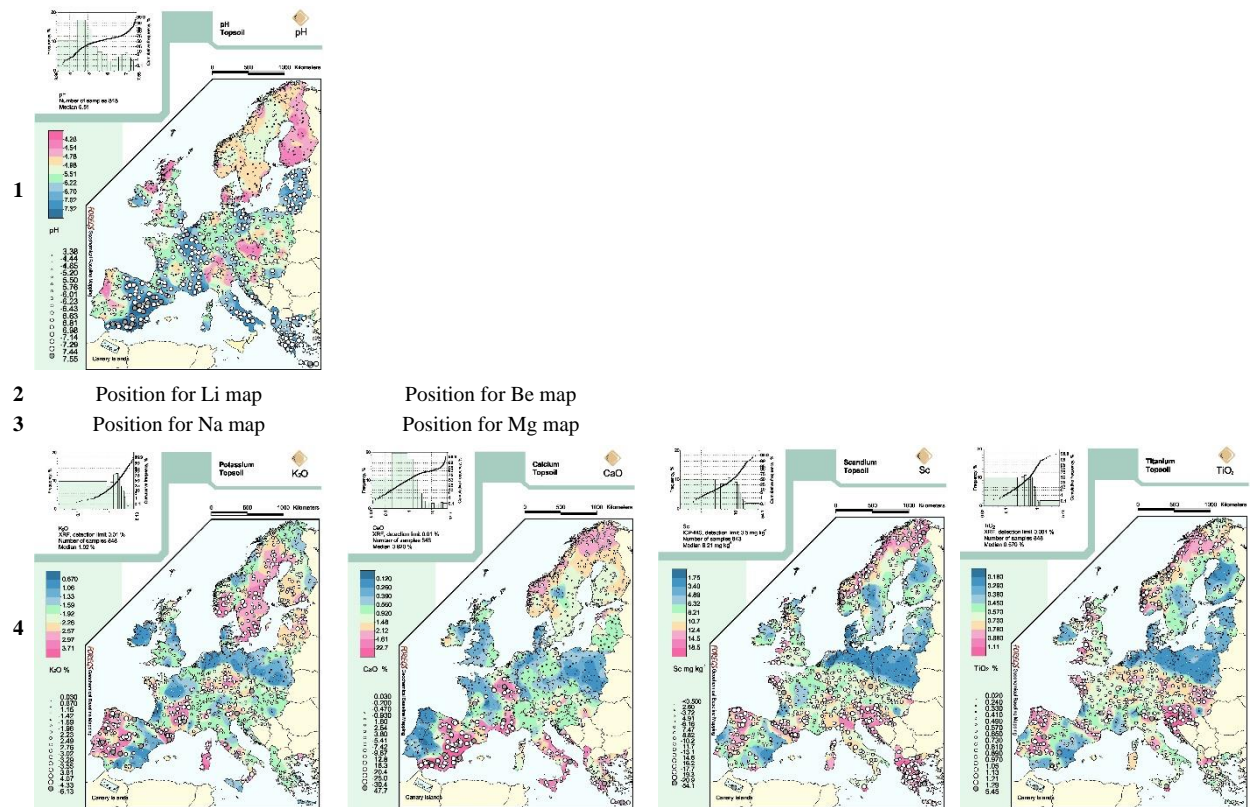


# APPENDIX 3: MATERIAL FOR 36<sup>TH</sup> IGC, DELHI, 2020

Periodic Table of elements in topsoil from the Geochemical Atlas of Europe to be displayed at the IUGS booth on the occasion of the 36<sup>th</sup> IGC in Delhi.




Below the geochemical maps of periods 1 and 4 are shown at a larger scale:






In the next two pages, the two-page leaflet of the IUGS Commission on Global Geochemical Baselines, are displayed. It will be distributed from the IUGS booth on the occasion of the 36<sup>th</sup> International Geological Congress in Delhi in March 2020.



**IUGS**

## GLOBAL GEOCHEMICAL BASELINES

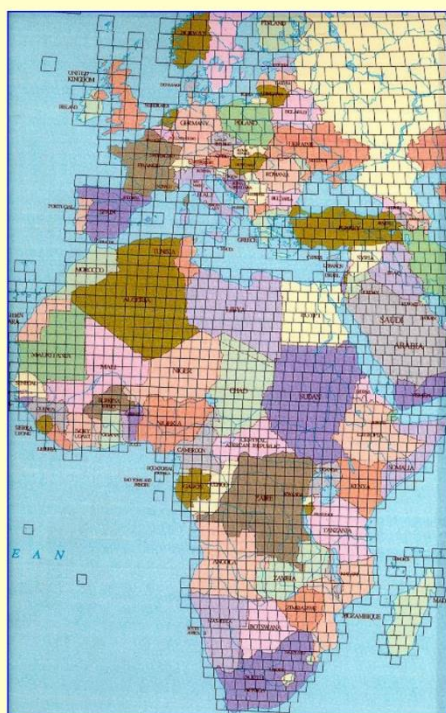
*An international project to establish a global-scale  
geochemical database for sustaining natural environments  
and resources*



IUGS Commission on  
"Global Geochemical Baselines"  
Mapping the Geochemistry  
of the Earth's Land Surface

There is a growing international concern regarding the possible hazardous consequences on the health of humans, animals and plants, because of environmental contamination by toxic elements. Rapid rates of economic development and population increase on our planet have caused the degradation of our environment through uncontrolled urban and industrial development, intensive agriculture and overexploitation of water and mineral resources. All these problems are affecting, on a global scale, the chemistry of the Earth's surface and sustainability of life support systems. It is, therefore, critical to determine the current abundance and spatial distribution of chemical elements in the Earth's near-surface environment, and to establish a baseline against which future changes can be quantified.

**The Commission on Global Geochemical Baselines operates under the auspices of the International Union of Geological Sciences(IUGS-CGGB)**



The Global Terrestrial Network covers the land surface of the Earth by 7356 grid cells with dimensions of 160 x 160 km. In each grid cell five random drainage basins are selected from which samples of humus, residual soil, rock, sediment (stream, overbank & floodplain), and stream water will be collected.

#### AIMS:

- To supply systematic multi-element geochemical data, which will be used to compile the Baseline Geochemical Atlas of the land surface of the Earth.
- To provide reliable information on the chemical composition of different surface materials (*e.g.*, humus, residual soil, rock, stream/overbank/floodplain sediment, and stream water) at sampling sites that uniformly cover the land surface of the globe.
- To have specific sampling sites in each country for continuous monitoring of their geochemistry, which will facilitate the recognition and measurement of 'changes' caused by any future human activities or natural events.
- To have reference sites for standardisation of the more detailed national geochemical data sets of each country, and the development of a harmonised international database.
- To have an archive of reference materials from each country that will be used for other, more specialised studies, *e.g.*, isotopic determinations, chemical speciation studies, determination of persistent organic pollutants, *etc.*

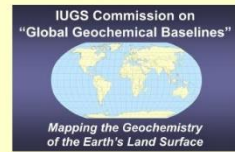
**The systematic multi-element geochemical mapping of the Earth's land surface will provide compatible results, which will be useful to agriculture, environmental regulation, epidemiology, urban planning, natural resources, and to policy- and decision-makers concerned with the sustainable development of our home planet.**





# IUGS Commission on Global Geochemical Baselines

<http://www.globalgeochemicalbaselines.eu/>  
Facebook: @CGGBIUGS – Twitter: @CGGB\_IUGS



## SAMPLE TYPES TO BE COLLECTED

A catchment/drainage basin approach is used for the collection of samples. Active stream sediment, stream water, overbank sediment (top and bottom layers), humus, residual soil (top and bottom horizons) and rock samples are collected from the small drainage basin of <math><100 \text{ km}^2</math> in area. Samples of floodplain sediment (top and bottom layers) are collected from large catchment basins of 1000 to 6000  $\text{km}^2$  in area.



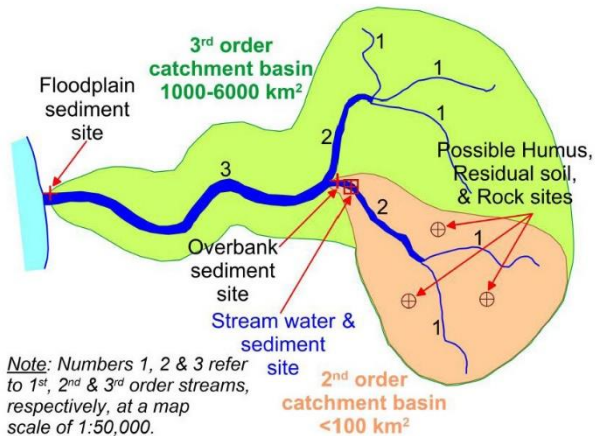
Stream water



Stream sediment



Residual soil



Catchment basin showing sampling sites on 2<sup>nd</sup> and 3<sup>rd</sup> order streams



Overbank sediment



Floodplain sediment



Rock

Photographs: Alecos Demetriades

## INFORMATION

Countries wishing to participate in the Global Geochemical Baselines project should consult the website of the IUGS Commission on Global Geochemical Baselines, and the social media sites. Additional information can be obtained from the members of the Steering Committee: 1<sup>st</sup> Co-chair: Dr. David B. Smith (E-mail: [dsmith@usgs.gov](mailto:dsmith@usgs.gov)); 2<sup>nd</sup> Co-chair: Dr. Xueqiu Wang (E-mail: [geochemistry@sina.com](mailto:geochemistry@sina.com)); Scientific Secretary: Dr. Patrice de Caritat (E-mail: [patrice.decaritat@ga.gov.au](mailto:patrice.decaritat@ga.gov.au)); Public Relations & Finance: Dr. Ariadne Argyraki (E-mail: [argyraki@geol.uoa.gr](mailto:argyraki@geol.uoa.gr)); Treasurer: EurGeol Alecos Demetriades (E-mail: [alecos.demetriades@gmail.com](mailto:alecos.demetriades@gmail.com)).