2016 to 2020

Report on activities of the

IUGS Commission on Global Geochemical Baselines

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1. Introduction

On the 31st of August 2016 at the Fourth Ordinary Session of the IUGS Council Meeting in Cape Town the establishment of an IUGS Commission on Global Geochemical Baselines was approved.

This is a summary report of the activities of IUGS Commission on Global Geochemical Baselines (CGGB) from 2016 to 2020. A detailed description of CGGB's activities will be found in the annual reports, which can be downloaded from its website:

- 2016 annual report: http://globalgeochemicalbaselines.eu.176-31-41-129.hs-servers.gr/datafiles/file/IUGS_CGGB_Annual_Report_2016_Final.pdf;
- 2017 annual report: https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS_CGGB_Annual_Report_2017_Final_Web.pdf;
- 2018 annual report: https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2018_Annual_Report_final.pdf, and
- 2019 annual report: https://www.globalgeochemicalbaselines.eu/datafiles/file/IUGS-CGGB_2019_Annual_Report_Final.pdf.

2. Manual of Standard Methods for Establishing the Global Geochemical Reference Network

Since February 2018 the CGGB's main work is the compilation of the '***International Union of Geological Sciences Manual of Standard Methods for Establishing the Global Geochemical Reference Network***'.

It is quite a difficult job because many people from all over the World are involved, and one of the problems is that the agreed deadlines are not always kept, because of either Geological Survey or contract work. The same applies with the reviewers, who are carefully selected because of their expertise in the sampling of the different sample types and procedures that must be followed for the establishment of an internally consistent harmonised and quality controlled Global Geochemical Reference Network database. It is planned to be completed and published in 2020, after its ratification by the IUGS Executive Committee.

3. Collaboration with the UNESCO International Centre on Global-Scale Geochemistry

- ***2016, 21st October to 30th November:*** Collaboration with the UNESCO International Centre on Global-scale Geochemistry (ICGG) in the finalisation and editing of (a) Governing Board Statutes, (b) Scientific Committee Statutes, (c) ICGG Statutes, (d) Six-year programme (2016-2021), and (e) compilation and editing of the First Newsletter of the ICGG; although the Newsletter was ready for publication at the end of November 2016, due to internal problems it was published in December 2017.
- ***2017, 27th to 30th September –*** *Workshop on Geochemical Mapping for "Belt and Road" Countries, Langfang, P.R. China.* The workshop was organised jointly with the UNESCO International Centre on Global-Scale Geochemistry, Langfang, China. Four days were devoted to lectures, and one day for demonstration in the field of the floodplain sediment sampling procedure. It was attended by 15 participants from

Cameroon, China, Mali, Mexico, Mongolia, Morocco, Russia, Uzbekistan, and Zambia.

- ***2018, 15th to 17th October –*** *Participation in the Second meeting of the Governing Board and Scientific Committee of the UNESCO International Centre on Global-Scale Geochemistry, Langfang, P.R. China.*

  The most important outcome of this meeting is the relationship of the CGGB with the Centre, which is now clearly specified in the approved and ratified Statutes of the Centre on the 16th of October 2018 as shown below:

  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*. Hence, the Centre is collaborating with the Commission in the compilation of the IUGS Methods Manual.

4. Workshops on Global Black Soil Critical Zone Geo-ecological Survey

Shenyang Geological Survey (SGS) of China Geological Survey invited the CGGB to participate in the Global Black Soil Critical Zone Geological Survey (BASGES - www.blacksoils.org/). The overall aim of the project is to map the current state of black soil, and make recommendations for its sustainable use and protection for future generations. The CGGB undertook the compilation of the IUGS Standard Geochemical Methods Manual, and to plan the geochemical sampling in all countries. The SGS will analyse *free gratis* all collected samples.

- ***2017, 8th to 12th December –*** *First Ice-Breaking BASGES Workshop Shenyang, Liaoning Province, P.R. China*. Two CGGB members attended the workshop and presented the European continental-scale geochemical projects, and the specifications that are required for carrying out the Global Geochemical Mapping of Black Soil.
- ***2018, 20th to 24th October –*** *Second BASGES Workshop, Harbin, Heilongjiang Province, P.R. China*. First version of the "***IUGS Manual of Standard Geochemical Methods for the BASGES project***" was presented, and all missing information, which is the responsibility of Shenyang Geological Survey, was discussed.
- ***2019, 20th & 21st November –*** Third BASGES Workshop, Chengdu, Sinchuan Province, P.R. China. The final version of the "***IUGS Manual of Standard Geochemical Methods for the BASGES project***" was presented, and outstanding issues that are the responsibility of SGS were discussed, and especially the development of large black soil secondary reference samples.

5. Global Reference Network

Robert G. Garrett (Geological Survey of Canada), *although retired*, had the original file of the Global Reference Network that was developed in 1994 by Nils Gustavsson (Geological Survey of Finland). Now, it is available from the CGGB's website along with other useful files (https://www.globalgeochemicalbaselines.eu/content/110/gtn-160x160-km-/):

- Global Reference Network (GRN) of 19,833 grid cells of 160x160 km (This Microsoft Excel file contains the 160x160 km grid cells covering the whole globe (terrestrial and marine parts)).
- Google Earth *.kml file of Global Reference Network of 19,833 grid cells of 160x160 km (zip file – It is the same as above, but in kml format).
- Geochemical Terrestrial Network (GTN) of 7356 grid cells of 160x160 km (This Microsoft Excel file contains the 160x160 km grid cells covering the terrestrial part of the globe).
- Google Earth *.kml file of Geochemical Terrestrial Network of 7356 grid cells of 160x160 km (zip file – It is the same as above, but in kml format).

6. Random sampling sites within Global Terrestrial Network grid cells

In collaboration with Geng Xiaoyuan and Juanxia He (*Canadian Soil Information Service, Science and Technology Branch, Agriculture and Agri-Food Canada*), the files of random points within the 160x160 km grid cells were generated and are available from the CGGB's website at:

https://www.globalgeochemicalbaselines.eu/content/111/sampling-design-/

- Microsoft Excel Workbook of 5 randomly selected points in each GTN grid cell of 160x160 km (version 1).
- Google Earth *.kml file of 5 randomly selected points in each GTN grid cell of 160x160 km (version 1 – zip file).
- Microsoft Excel Workbook of 8 randomly selected points in each GTN grid cell of 160x160 km (version 1)
- Google Earth *.kml file of 8 randomly selected points in each GTN grid cell of 160x160 km (version 1 – zip file).
- Microsoft Excel Workbook of 16 randomly selected points in each GTN grid cell of 160x160 km (*Not recommended for the Global Geochemical Reference Network project* – version 1).
- Google Earth *.kml file of 16 randomly selected points in each GTN grid cell of 160x160 km (*Not recommended for the Global Geochemical Reference Network project* – version 1 – zip file).

7. Contribution to IUGS Initiative *"Resourcing Future Generations"*

The CGGB contributed in the writing of the following publication:

Ali, S.H., Giurco, D., Arndt, N., Nickless, E., Brown, G., Demetriades, A., Durrheim, R., Enriquez, M.A., Kinnaird, J., Littleboy, A., Meinert, L.D., Oberhänsli, R., Salem, J., Schodde, R., Schneider, G., Vidal, O. & Yakovleva, N., 2017. ***Mineral supply for sustainable development requires resource governance***. Nature (Perspectives), 543(7645), 367-372; http://dx.doi.org/10.1038/nature21359;

Supplementary information: http://www.nature.com/nature/journal/v543/n7645/abs/nature21359.html#supplementary-information.

8. Production of promotional material

The 2nd version of the Arthur Darnley memorial DVD was compiled for distribution beginning with the 35th International Geological Congress in Cape Town. In total 1000 copies were made. *The DVD includes all publications and reports by the IGCP 259 & 360, and the Task Group (now Commission) from 1989 to 2008, the list of all publications from 1989 to 2016, and freely available publications from 2008 to 2016. It also includes the Geochemical Atlases of Europe, United States of America and Australia.* In total, 874 copies of the 2nd version of the Arthur Darnley DVD were distributed in conferences and workshops, and 1450 copies of the 1st version. Considering the material that was given for the past four years on USB memory sticks, the number reaches about 3500 copies, which were distributed all over the World.

9. Publications

Smith, D.B., Demetriades, A., Caritat, P. de, Wang, X., 2018. ***The history, progress, and future of global-scale geochemical mapping***. In: Licht, O.A.B. (Guest Editor), Geochemical 36 Mapping. Special Issue, Geochimica Brasiliensis, 32(2), 115-135; http://doi.org/10.21715/GB2358-2812.2018322115.

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

10. Conferences

The CGGB promoted the Global Geochemical Baselines project by participation in conferences, either as participants or organisation of dedicated sessions:

- ***2016, 27th June to 1 July –*** *Simposio Servicio Geológico Colombiano 100 años de producción científica al servicio de los colombianos, Centro Empresarial y Recreativo El Cubo, Bogotá, Colombia:* Oral presentations on the continental-scale Geochemical Mapping of Europe and the conterminous United States of America.
- ***2016, 30th August –*** *35th International Geological Congress, 3rd Arthur Darnley Symposium: Mapping the geochemistry of the Earth's surface at global to local scales, Cape Town, South Africa:* Oral presentations on geochemical mapping in Europe, China and Mongolia.
- ***2016, 11th to 13th November –*** *6th National Conference on Applied Geochemistry, Xi'an, China:* One oral presentation on the geochemical atlas of Europe.
- ***2017, 27th to 30th August –*** *4th YES Congress on "Mitigating Geohazards and Resources for Future Generations", Geological Survey of Iran, Tehran, Iran, 27-30 August 2017.* Keynote presentation on *"Global Geochemical Baselines for environmental and mineral resource management: Iran and neighbouring countries".*
- ***2018, 18th June***, RFG 2018 Vancouver, Canada. The CGGB organised a session with the title: *"Global-scale geochemical mapping: A critical component for resourcing future generations"*. Fifteen oral presentations were delivered; the session attendees varied from 17 to 52.
- ***2019, 22nd to 24th May*** *– 15th International Congress of the Geological Society of Greece, Athens, Hellas.* The CGGB, 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*" (23rd May 2019). It was attended by more than 60 conference participants.

- ***2019, 7th to 10th August***, International Symposium on Environmental Geochemistry, Peking University, Beijing, P.R. China. The CGGB organised a session on "*Regional and Global Geochemistry: Opportunities and Challenges*" and a keynote presentation on "*Continental-scale geochemistry for location of metallogenic provinces and environmental baselines*" was delivered (8th August 2019). It was attended by more than 60 conference participants.
- ***2019, 11th September*** – 5th YES Network Congress, Berlin, Germany. A plenary lecture on "*Global Geochemical Mapping for Resource and Environmental Management*" was delivered. It was attended by more than 60 people.
- ***2020, 2nd to 8th March*** – 36th IGC, Delhi, India. Organisation of a session entitled *"4th Arthur Darnley Symposium: Challenges and opportunities of Global-scale geochemical mapping"*. We have received abstracts for 12 oral and 7 poster presentations. Further, the CGGB prepared a two-page leaflet for distribution from the IUGS booth to interested congress participants, and a large poster to be displayed at the IUGS booth.

11. Seminars/Workshops

- ***2016, 31st March, 7th and 14th April 2016 –*** *12th Seminar of the Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, Hellas, (http://www.geol.uoa.gr/index.php/en): 3 part seminar on "The Geochemical atlases of Europe: Methodology and results"*. It was attended by more than 20 people from Hellas.
- ***2016, 12th to 17th May –*** *UNESCO International Centre on Global-scale Geochemistry, Opening Ceremony Workshop, Langfang, Hebei, P.R. China.* Lectures on the continental-scale Geochemical Atlases of Australia, China, Europe, Russia and the United States of America, and Geochemical Mapping in Africa, Colombia and Russia were delivered. It was attended by more than 50 people from China, and other countries in Asia, Africa, Middle East, Central and South America.
- ***2016, 27th & 28th August –*** *35th International Geological Congress, Workshop on Global-scale Geochemical Mapping, Cape Town, South Africa.* One-day workshop on "*Continental-scale Geochemical Mapping*", and a one-day field training course. It was attended by 19 people from 7 countries, Angola (1), Australia (2), China (4), Namibia (2), New Zealand (1), Nigeria (1) and South Africa (8).
- ***2017, 29th & 30th August –*** *On the occasion of the 4th YES Congress, Tehran, Iran, a two-day Workshop on "Global Geochemical Mapping"* was organised (one day of lectures and one day in the field. It was attended by 37 people from Iran.
- ***2018, 17th & 22nd June –*** On the occasion of RFG 2018, Vancouver, Canada, a two-day workshop was organised on "*Exploration Geochemistry – From fundamentals to the field*" in collaboration with the Association of Applied Geochemists. The first day (17 June) was devoted to lectures, and was attended by 26 people from Australia (1), Austria (1) Canada (8), Chile (1), China (1), Colombia (1), Finland (1), Germany (1), Ireland (2), Italy (1), South Africa (2), Tasmania (1), Uganda (2), United States of America (2). The second day (22 June) was devoted to a field-training course to Britannia Creek Cu mine and Squamish River catchment basins. The field-training course was unique, because there were 6 tutors: Peter A. Winterburn, John Gravel, Ray Lett, Colin Dunn, Patrice de

Caritat and Alecos Demetriades. The field-training was sponsored by the YES Network, and was attended by 16 participants from Australia (1), Austria (1) Canada (5), China (1), Chile (1), Colombia (1), South Africa (2), Uganda (2), and U.S.A. (2).

- ***2019, 24th May –*** On the occasion of the 15th International Congress of the Geological Society of Greece, Athens, Hellas, the CGGB organised a one-day Workshop on "*Global-scale Geochemical Mapping*". It was attended by 22 people from Hellas (17), Finland (1), Hungary (1) and Poland (3).
- ***2019, 2nd August –*** A one-day workshop on "*Applied Geochemistry*" was organised at Shangluo Institute, Shangluo, Shaanxi Province, P.R. China. It was attended by 15 people from China.
- ***2019, 5th & 6th August –*** A two-day workshop on "*Global-scale Geochemical Mapping*" was organised at Henan University, Kaifeng, Henan Province, P.R. China. It was attended by 14 people from China.
- ***2019, 8th & 9th September –*** A two-day pre-congress Workshop on "*Global Geochemical Baselines and Applied Geochemistry*" was organised on the occasion of the 5th YES Congress, Berlin, Germany. It was attended by 20 people from Argentina (1), Armenia (2), Azerbaijan (1), Egypt (1), India (4), Indonesia (1), Iraq (2), Namibia (5), Sri Lanka (2), and The Netherlands (1).
- ***2019, 22nd & 23rd November –*** A two-day workshop on "*Global-scale Geochemical Baselines and Applied Geochemistry*" was organised at Chan'an University, School of Earth Science and Resources, Xi'an, Shaanxi Province, P.R. China. It was attended by 23 people from China (18), Egypt (1), Namibia (1) Pakistan (2) and Rwanda (1).
- ***2020, 2nd to 8th March –*** 36th IGC, Delhi, India. Organisation of a one-day workshop with the title *"Geochemical mapping at all scales: Continental, regional and local"*. Up to now 26 people have registered for the workshop.

12. Presentation at African Directors' meeting

The Namibian CGGB member, delivered a presentation by the Commission at the 11th Annual General Meeting of the Organisation of African Geological Surveys (O.A.G.S., https://www.oagsafrica.org/), Dakar, Senegal, 23rd October 2018, about the need of Global Geochemical Baselines for Africa and the establishment of a Geochemistry Working Group similar to EuroGeoSurveys Geochemistry Expert Group. The O.A.G.S. approved the establishment of an African Geochemistry Working Group.

13. Collaboration in other international projects

The CGGB joined on the 12th 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/). GLOSOLAN's main objectives are: (i) Make soil information across labs, countries and regions comparable, interpretable; (ii) Build a set of agreed harmonisation principles; (iii) Improve quality assurance and control (QA/QC) of soil analyses, and (iv) Promote information and experience exchange.

14. Participation in IUGS Executive Committee's Open Session Meeting

A CGGB Steering Committee member participated in the open sessions of the following IUGS Executive Committee meetings and reported the activities of the previous year, and the planned work for the next fiscal year:

- ***2017, 15th to 18th February*** – 71st meeting, Paris, France.
- ***2018, 22nd to 23rd January*** – 72nd meeting, Potsdam, Germany.
- ***2019, 27th & 28th February*** – 73rd meeting, Beijing, P.R. China.
- ***2020, 15th & 16th January*** – 74th meeting, Busan, South Korea. The final version of the *"IUGS Manual of Standard Geochemical Methods for the BASGES project"* was submitted for ratification together with the letters from three reviewers.

15. Annual Business Meeting

The CGGB annual meetings were organised jointly with the EuroGeoSurveys Geochemistry Expert Group, and were hosted by the Geological Surveys of each country:

- ***2017, 20th & 21st April***, Vienna, Austria.
- ***2018, 16th to 19th May***, Madrid, Spain. First attempt to video the sampling procedures. Unfortunately, the result was not very good for presentation. However, it was a learning lesson that better preparation is needed.
- ***2019, 26th & 27th September***, Budapest, Hungary.

16. Redesigning CGGB'S Website

The CGGB redesigned its website in collaboration with a website design company. New software was used, which had to be adapted to CGGB needs. The process was quite slow, and it was completed in December 2018, and the new website was uploaded on the 17th of January 2019 (http://www.globalgeochemicalbaselines.eu/). The website is updated on a monthly basis.

17. Software development

There are many software programs that no longer work on 64-bit computers. The CGGB is converting many useful 32-bit software programs to 64-bit in order to work on modern platforms. These programs will be available for downloading from the Commission's website.

18. Assistance to CGGB members and workshop participants

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

One question concerned the display of geochemical data on maps, and the advice was to follow the map design of the FOREGS Geochemical Atlas of Europe (*Tarvainen et al., 2005; http://weppi.gtk.fi/publ/foregsatlas/article.php?id=2*).

Letters of support were provided for Ph.D. application to a D.R. Congo and Iran attendees of the YES Network Workshops in Tanzania and Iran, respectively.