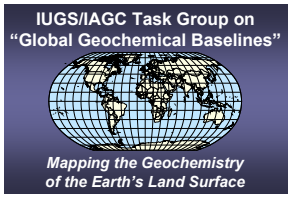

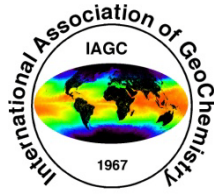

2015
ANNUAL REPORT

of the

TASK GROUP ON GLOBAL GEOCHEMICAL BASELINES

for the

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)
and
INTERNATIONAL ASSOCIATION OF GEOCHEMISTRY (IAGC)

November 2015

2015 ANNUAL REPORT of the TASK GROUP ON GLOBAL GEOCHEMICAL BASELINES for the INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS) & INTERNATIONAL ASSOCIATION OF GEOCHEMISTRY (IAGC)

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

1. TITLE OF CONSTITUENT BODY

IUGS/IAGC Task Group on Global Geochemical Baselines (TGGGB).

2. OVERALL OBJECTIVES

The mission of the IUGS/IAGC Task Group on Global Geochemical Baselines is (i) to prepare a global geochemical database, and its representation in map form, and (ii) to 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 resource managers throughout the world. To reach this goal, the Task Group promotes and facilitates the implementation of harmonised sampling, sample preparation, quality control, and analytical protocols in geochemical mapping programmes. Task Group activities include the following:

- Developing partnerships with countries conducting broad-scale geochemical mapping studies;
- Providing consultation and training in the form of workshops and short courses;
- Organising periodic international symposia and conferences to foster communication among the geochemical mapping community;
- Developing criteria for certifying those projects that are acceptable for inclusion in a global database;
- Acting as a repository for data collected by projects meeting the standards of harmonisation;
- Preparing complete metadata for the various certified projects; and ultimately
- Preparing a global geochemical database and atlas.

3. FIT WITHIN IUGS SCIENCE POLICY

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 Global Geochemical Baselines Task Group relates directly to all of these objectives through the establishment of a land-surface global geochemical reference network, providing multi-media, multi-element baseline data for a wide variety of environmental and resource applications. The project is also consistent with the strategic plan published by the IUGS Strategic Planning Committee (2000), and the International Year of Planet Earth (2005-2009) of 'Earth Sciences for Society'.

4. ORGANISATION

The project is led by a Steering Committee, which co-ordinates the activities of five Technical Committees and contributions made by regional representatives.

Steering Committee

Co-Leaders	David B. Smith	US Geological Survey
	Xueqiu Wang	IGGE, China
Scientific Secretary	Patrice de Caritat*	Australia
Treasurer	Alecos Demetriades	Hellas

Analytical Committee

Chair Gwendy Hall Canada

Co-ordinates the work plan for the analysis of GRN samples, the activities of the laboratories, and the supervision of analytical quality control data.

Sampling Committee

Chair Alecos Demetriades Hellas

Supervises development and co-ordination of sampling protocols in the various climatic and geomorphic provinces throughout the world.

Data Management Committee

Chair Timo Tarvainen Finland

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

Public Relations and Finance Committee

Chair Alecos Demetriades Hellas

Advertises and promotes the aims, objectives and achievements of the project world-wide, including by use of the World Wide Web, and takes responsibility for trying to secure funding for the project.

*Note: Patrice de Caritat is replacing Shaun Reeder, who was Scientific Secretary of the Task Group from October 2000 to March 2015. The members of the Steering Committee and other Committees thank Shaun Reeder for his work input all these years, and wish him the best of luck in his new job.

Regional Representatives

Africa:
Theo Davies (Mangosuthu University, Durban, South Africa)
Marthinus Cloete and J.H Elsenbroek (Council for Geoscience; Pretoria, South Africa)
Keith Sheppar (World Agroforestry Centre (ICRAF), Nairobi, Kenya)
Alhaji Lamin Turay (Geological Survey Department, Ministry of Mineral Resources, Sierra Leone)

Australia:
Patrice de Caritat (Geoscience Australia, Canberra)

China:
Xueqiu Wang (Institute of Geophysical and Geochemical Exploration, Langfang, China)

Europe:
Clemens Reimann (Geological Survey of Norway, Trondheim, Norway)

Indian subcontinent:
Pradip Govil (National Geophysical Research Institute; Hyderabad, India)
Mathew Joseph (Geological Survey of India; Kerala, India)
Ashvin Wickramasooriya (South Eastern University of Sri Lanka; Sammanthurai, Sri Lanka)

Japan:
Atsuyuki Ohta (Geological Survey of Japan, AIST, Tsukuba)

North America:
David Smith (United States Geological Survey, Denver, USA)
Juan Antonio Caballero Martínez (SGM, Pachuca, Mexico)
Andy Rencz (Geological Survey of Canada, Ottawa)

South America:
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)

5. EXTENT OF NATIONAL/REGIONAL/GLOBAL SUPPORT FROM SOURCES OTHER THAN IUGS and IAGC

The project does not have any other source of direct funding. However, many National Geological Surveys, and related institutes, have provided significant funds towards national- to continental-scale geochemical mapping projects in support of the Task Group's activities.

Within Europe, 26 National Geological Surveys, and associated institutes and universities, have provided staff time and support to the project to complete the preparation and updating of the European Geochemical Reference Network (GRN) as part of the FOREGS/EuroGeoSurveys programme as an input to the IUGS/IAGC Global Geochemical Baselines project [http://weppi.gtk.fi/publ/foregsatlas/]. A very conservative estimate of the cost for the production of the *Geochemical Atlas of Europe* is of the order of 5 million Euro (~7 million US$). A conservative estimate of the Geochemical Mapping of Agricultural and Grazing land soil in Europe (a follow-up of the Geochemical Atlas of Europe) reached the sum of 930,000 Euro (~1 million US$) for just the sampling equipment, preparation of two standard samples, analysis by aqua regia, and determination of grain size, about 2 million Euro (~2.15 million US$) for total determinations by XRF; sampling costs are estimated to be in the order of 1.5 million Euro (~1.6 million US$), and to date with the additional analyses the total cost exceeds 5 million Euro (>6.25 million US$). The Cyprus Geological Survey Department carried out (2006-2011) a fairly detailed soil geochemical project according to the specifications of the Global project. The cost of this project was in the order of 800,000 Euro (~1 million US$). The Geological Survey of Brazil and the Geology and Mineral Resources Directory invested about 4,262,800 US$ in sampling, and about 888,200 US$ in the analysis of samples. The Geological and Mining Survey of Chile was funded from 2011-2014 for geochemical mapping with about 2,000,000 US$. The Geological Survey of Sweden recently completed (2011-2014) the national geochemical atlas with external laboratory costs of approximately 240,000 Euro (~297,385 US$), not including the sampling and internal laboratory costs.

From 2007–2014, the USGS provided funding of approximately 6.5 million US$ for sampling, chemical/mineralogical analyses, and staff salaries for the soil geochemical survey of the conterminous United States. In 2013-2014, the USGS provided an additional 22,000 US$ for publication of data and maps from the national-scale soil geochemical and mineralogical survey.

From 2008–2013, the China Government has provided funding of approximately 5,000,000 US$ for sampling, chemical analyses, and staff salaries for the China Geochemical Baselines Project.

The cost of the National Geochemical Survey of Australia that was completed in 2011 reached A$ 1,900,000 (~2 million US$). This amount covered only the fieldwork, equipment, materials and external lab analyses, but does not include in-house XRF and ICP-MS analyses and salaries.

The geochemical mapping of two GTN cells in Nigeria from 2009 to 2011 cost about GBP 2,000,000 (~3 million US$).

In 2011, the Ministry of Commerce of the People's Republic of China sponsored a training course on Geochemical Mapping and Environmental Geochemical Survey for African Countries that took place in Beijing at a cost of approximately 600,000 Chinese Yuan (~95,000 US$). The course was organised by China Geological Survey.

In 2012, the Ministry of Commerce of the People's Republic of China sponsored the CGS-CCOP-IUGS/IAGC Seminar on CCOP Geochemical Mapping that took place from the 28 to 29 March 2012 in Nanjing, China at a cost of 400,000 Chinese Yuan (approx. 64,000 US$). The seminar was organised by the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) and China Geological Survey in collaboration with the IUGG/IAGC Task Group on Global Geochemical Baselines.

In 2013, the Ministry of Finance of the People's Republic of China sponsored through China Geological Survey the CGS-CCOP-ASEAN-IUGS/IAGC Workshop on "*CCOP-ASEAN Geochemical Mapping*" that took place from the 3 to 8 September 2013 in Nanning (Guangxi Province), P.R. China, at a cost of 300,000 Chinese Yuan (approx. 50,000 US$). The Workshop was organised by the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP), the Association of Southeast Asian Nations (ASEAN), the Institute of Geophysical and Geochemical Exploration (IGGE), Department of Land and Resources (Guangxi) and Guangxi Geological Survey in collaboration with China Geological Survey and the IUGG/IAGC Task Group on Global Geochemical Baselines. The latter also sponsored the travel of the Sampling Committee Chair from Europe to China at a cost of 1303.42 Euro (1762.87 US$).

In 2014, at the invitation of the Geological Survey of Iran, a one day training course on Global Geochemical Baselines was organised the day before (15/2/2014) the start of the 32nd National Symposium and 1st International Geosciences Congress, which was held in Tehran (Iran) from the 16th to 19th February 2014. The Task Group sponsored the travel of the Sampling Committee Chair from Europe to Iran at a cost of 697.40 Euro (968.04 US$).

In 2014, at the invitation of the Young Earth Scientists Network (http://www.networkyes.org/), a two day training workshop (12-13/8/2014) on "*International Geochemical Mapping and African Geochemical Baselines*", was organised as part of the 3rd Young Earth Scientists (YES) Congress 2014, which was held in Dar es Salaam (Tanzania) from the 11-14 August 2014, in conjunction with the 25th Colloquium of African Geology (CAG25). The Task Group sponsored the travel and part of the sustenance of the Sampling Committee Chair from Europe to Tanzania at a cost of 1,301.58 Euro (2,085.83 US$).

In 2014, the China Government provided funding of approximately:

- 500,000 US$ (3 million Chinese Yuan) for sampling and chemical analyses for the China-Mongolia Geochemical Mapping Project.
- 600,000 US$ for sampling and chemical analyses for the ASEAN/CCOP Geochemical Mapping Project.

In 2015, the China Government provided funding of approximately:

- 750,000 US$ for 4 training courses for Ethiopia, ASEAN countries, French-speaking countries from Africa, and Russian- speaking countries from Asia.
- 150,000 US$ for global geochemical sampling in Laos.
- 200,000 US$ for National low-density sampling in Papua New Guinea.
- 150,000 US$ for sample chemical analysis in China laboratories for China-Mongolia Cooperation Geochemical Mapping Project.

6. INTERFACE WITH OTHER INTERNATIONAL PROJECTS

This project is closely associated with the work of the EuroGeoSurveys (EGS) Geochemistry Expert Group (previously the Forum of European Geological Surveys, FOREGS Geochemistry Expert Group; http://www.eurogeosurveys.org/topics/geochemistry/). The project also has links with the International Atomic Energy Agency (IAEA) and potential links with GTOS, and the Global Terrestrial Observing System. The EGS Geochemistry Expert Group has also established closer links with the European Soil Bureau over the past few years, and was actively involved in the European Commission's *'Soil Thematic Strategy Group*' for the preparation of the EU's Soil Protection Document, and the final draft of the pending Soil Protection Directive. The EuroGeoSurveys Secretary General has established links to other European Commission projects, such as the GMES Forum (Global Monitoring of Environment and Security), and INSPIRE (Infrastructure for Spatial Information in Europe), since the Geochemical Atlas of Europe has been produced in a harmonised manner, according to IGCP 259 specifications (Darnley *et al.,* 1995) and, therefore, according to INSPIRE specifications. In 2013, EuroGeoSurveys became member of FAO's Global Soil Partnership, since the Geological Surveys of Europe are actively involved in soil geochemical mapping. A memorandum of understanding has been signed by EuroGeoSurveys 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 discussed and finalised the cooperation. EuroGeoSurveys also established cooperation with the Organisation of African Geological Surveys (OAGS) and developed a pan-African Geological project proposal (PanAfGeo), which will be financed by the European Commission. The project proposal was presented at a Workshop on the 14th August 2014 in Dar es Salaam (Tanzania) (http://www.oagsafrica.org/repositoryx/presentations/dar-es-salaam-2014), and the final results were presented at the OAGS Director's meeting in Gaborone (Botswana) from the 13-16 October 2014. The two-year joint project will cover 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 TGGGB 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; https://www.earthobservations.org/afrigeoss.php) with the EuroGeoSurveys Geochemistry Expert Group, the Geological Society of Africa (http://www.geologicalsocietyofafrica.org/) and the Organisation of African Geological Surveys (http://www.oagsafrica.org/). We have been informed that the proposal is included for funding in the 2016-17 programme of AfriGEOSS.

In North America, the project 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 Geologico Mexicano (SGM).

The Task Group also interfaces with the National Geochemical Survey of Australia and the China Geochemical Baselines Project.

The TGGGB contributed to the IUGS initiative "*Resourcing Future Generations*" by submitting comments in July 2017 on the White Paper "*Resourcing Future Generations: Mineral Resources and Future Supply*" in collaboration with the EuroGeoSurveys Geochemistry and Mineral Resources Expert Groups (https://www.geolsoc.org.uk/~/media/shared/documents/RFG/White%20Paper%20pdf.pdf?la=en). Also participated with a representative in the Workshop in Namibia (24-30 July 2015) (http://voices.nationalgeographic.com/2015/08/27/resourcing-future-generations/).

7. CHIEF ACCOMPLISHMENTS IN 2015

Scientific Accomplishments

There has been continued and significant progress in a number of areas during 2015, including:

AMERICA

North America (David B Smith, USGS; Juan Antonio Caballero Martínez , SGM)

The collaboration between the U.S. Geological Survey (USGS) and the Servicio Geológico Mexicano (SGM) for geochemical and mineralogical mapping of soil in the US and Mexico continues. In 2013, the USGS published soil geochemical and mineralogical data from 4,857 sites (1 site per 1,600 km^2, 14,424 samples) throughout the conterminous U.S. as USGS Data Series 801 (http://pubs.usgs.gov/ds/801/). In 2014, geochemical and mineralogical maps derived from this data set were published as USGS Open-File Report 2014-1082 (http://pubs.usgs.gov/of/2014/1082/). This publication contains 138 geochemical maps representing multiple depths/horizons for the following elements: aluminum (Al), calcium (Ca), iron (Fe), potassium (K), magnesium (Mg), sodium (Na), sulfur (S), titanium (Ti), silver (Ag), arsenic (As), barium (Ba), beryllium (Be), bismuth (Bi), total carbon (C), inorganic carbon, organic carbon, cadmium (Cd), cerium (Ce), cobalt (Co), chromium (Cr), cesium (Cs), copper (Cu), gallium (Ga), mercury (Hg), indium (In), lanthanum (La), lithium (Li), manganese (Mn), molybdenum (Mo), niobium (Nb), nickel (Ni), phosphorus (P), lead (Pb), rubidium (Rb), antimony (Sb), scandium (Sc), selenium (Se), tin (Sn), strontium (Sr), tellurium (Te), thorium (Th), thallium (Tl), uranium (U), vanadium (V), tungsten (W), yttrium (Y), and zinc (Zn). The publication also contains 50 maps showing the distribution of the following mineral components: quartz, potassium feldspar, plagioclase, total feldspar, 14-Å clays, 10-Å clays, kaolinite, total clays, gibbsite, calcite, dolomite, aragonite, total carbonates, analcime, heulandite, total zeolites, gypsum, talc, hornblende, serpentine, hematite, goethite, pyroxene, pyrite, and amorphous material. Also in 2014, the USGS released a website (http://mrdata.usgs.gov/soilgeochemistry/#/summary) from which the user can view all the geochemical and mineralogical maps along with statistical summaries and graphics (boxplots, histograms, and empirical cumulative distribution plots). All the maps can be downloaded from this website in a variety of formats. These formats include georeferenced TIFF files, which can be exported into any GIS software, and KML files that can opened directly into Google Earth.

The SGM completed sampling in Mexico (1,327 sites; 3,526 samples) in 2012, and in 2015 completed chemical analysis (total elemental content) for these samples.

South America

Chile (Juan Pablo Lacassie Reyes, SERNAGEOMIN, Santiago)

The Geochemical Map of Chile is a government programme that is carried out by the Geological and Mining Survey of Chile (SERNAGEOMIN). The objective is to promote sustainable growth of Chile by: (1) the definition of geochemical baselines, and (2) the identification of mineral resources.

From 2011-2015, the Government of Chile has provided funding of approximately US$ 2,500,000 for fieldwork, sampling, sample preparation, chemical analyses and staff salaries. During 2015, the Geochemical Programme of Chile has been focused on:

1) Generation of Geochemical Maps and Geochemical Databases (new product) with the geochemical data produced between 2011-2014.
2) Compilation of a Guide for Geochemical Mapping (an internal SERNAGEOMIN document), after a systematic revision of methods, concepts, strategies, tools and techniques for geochemical mapping and data treatment.
3) Definition and generation of the first Stream-sediment Mineralogical Map of Chile (new project).

Additionally, during 2015 the Geochemical Programme has been requested to:

a) Give technical support to regions of northern Chile, affected by massive landslides during March 2015 (Figure 1).
b) Generate a geochemical baseline for the Aysen Basin in southern Chile (Figure 2). Giving continuity to a series of regional projects, related to the generation of geochemical baseline information for relevant fluvial systems of Chile (Figure 3).
c) Provide training of young geologists interested in regional geochemical mapping and other related studies, such as spectrometric analysis of sediment samples (Figure 3).

The Chilean main achievements in 2015 include:

- Publication of 2 new series of Geochemical Maps (Arica and Pisagua sheets).
- Publication of 2 new Geochemical Databases (Iquique and Arica sheets).
- Edition of 2 new Geochemical Databases (La Serena and Pisagua sheets).
- Generation of a first version of a Guide for Geochemical Mapping (an internal SERNAGEOMIN document).
- Generation of 2 Technical Reports, associated with the geochemical study of two regions of northern Chile affected by landslides: Copiapo and Salado River Basins (Figure 1).
- Generation of 1 Technical Report (preliminary version), associated with the Geochemical Baseline of the Aysen Basin in southern Chile (Figure 2).

Figure 1. Geochemical sampling in the Copiapo River Basin, in northern Chile, which was affected by massive landslides during March 2015. Special clothing was used in order to avoid contact with potential contaminated materials.

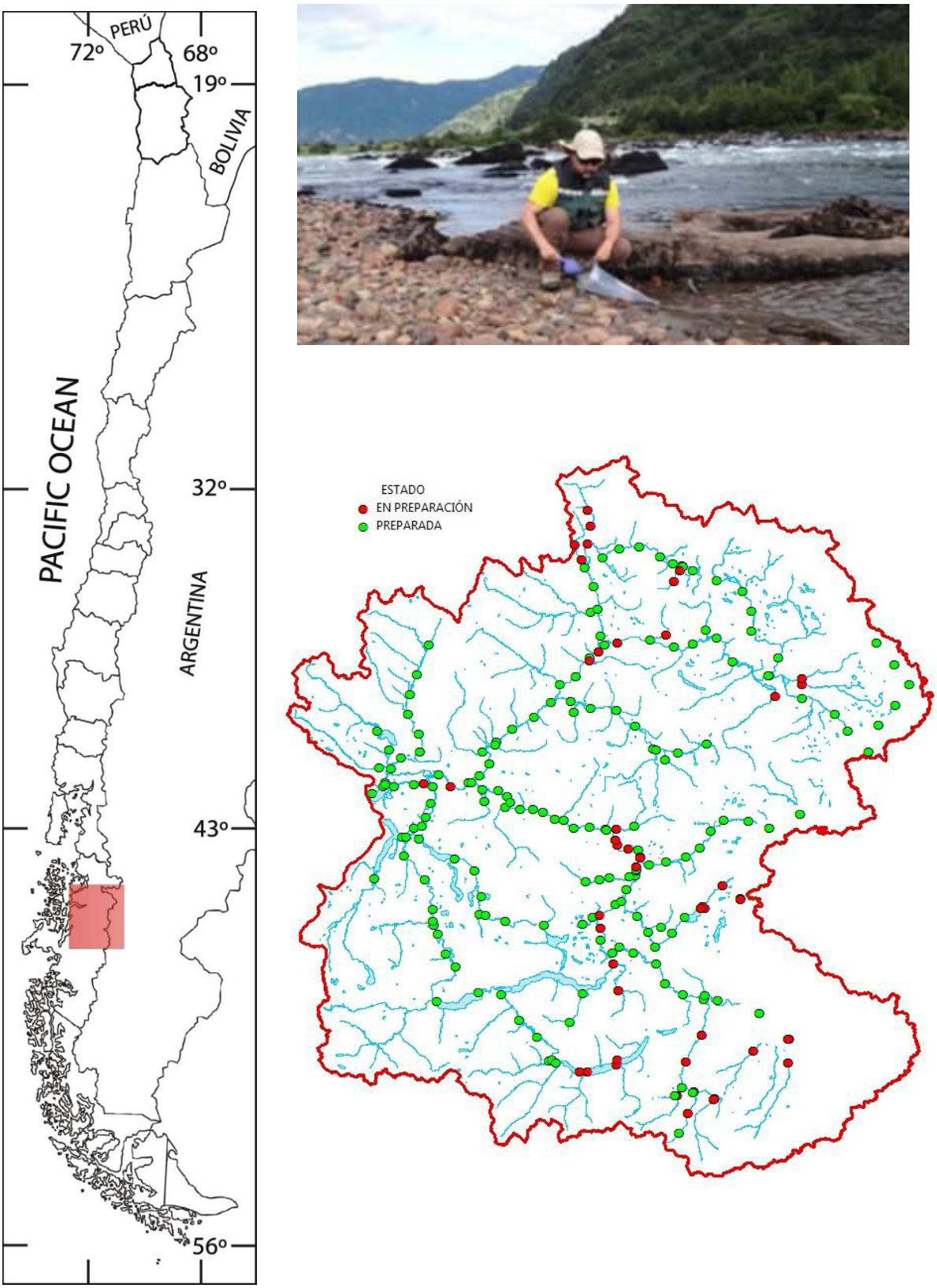

Figure 2. Geochemical sampling of the Aysen River Basin, in southern Chile. Red and green dots: Geographical distribution of the collected samples.

Number	Fluvial Basins	Year of study	Geologist
1	Lluta	2011	Leonardo Baeza (*)
	Azapa Vitor	2013	Francisca Espinoza (*)
2	Salado	2015	SERNAGEOMIN
	Copiapó	2015	SERNAGEOMIN
	Huasco	2009	Juan Pablo Lacassie / Alejandro Díaz
3	Elqui	2013 / 2014	Carolina Miralles (*) / Pablo Gómez (*)
	Limarí	2011 / 2013	Felipe Astudillo (*) / Felipe Carrasco (*)
4	Rapel	2008	Juan Pablo Lacassie
5	Aysen	2015	Jaime Barrera / Tania Roth (*)

(*) Associated with Thesis in Geology.

Figure 3. Geographical distribution of the Chilean fluvial systems studied by the Geochemical Programme of SERNAGEOMIN. The frames are only schematic and do not include Argentinean, Peruvian or Bolivian territory. The table indicates the studied fluvial basins, the geologist in charge and those who have developed their Thesis in Geology.

Colombia *(Gloria Prieto, Servicio Geológico Colombiano, Bogotá, Colombia)*

During 2015, the Geological Survey of Colombia continued to carry out geochemical mapping projects at different sample densities throughout the country in order to obtain information for the geochemical map of Colombia, and to identify geochemical anomalies for the mineral exploration programme (Figure 4).

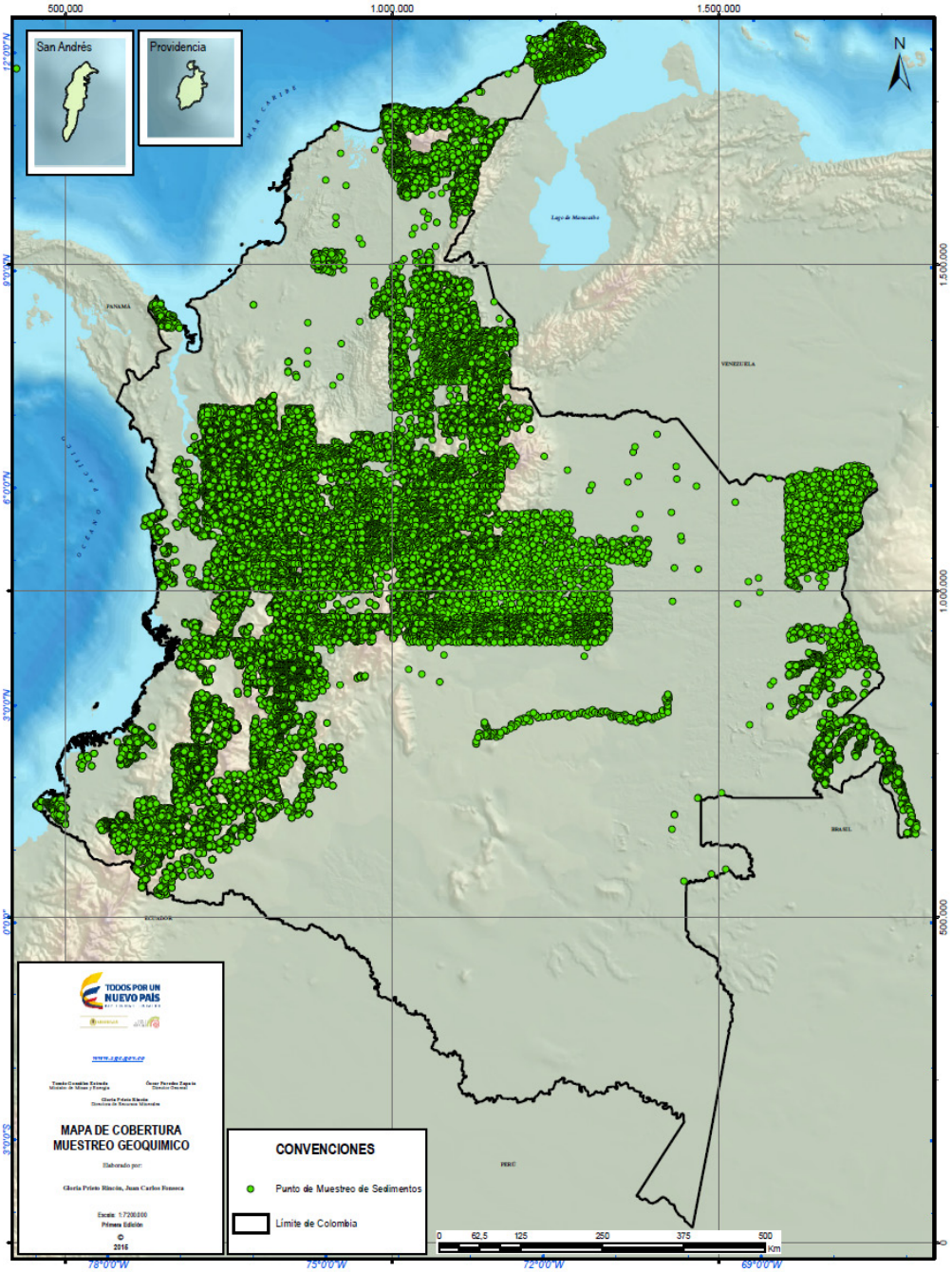

Figure 4. Geochemical sampling coverage of Colombia.

During the execution of the geochemical programme samples of stream sediment, panned concentrates and rocks were collected following standardised methodologies based on the recommendations of the Global Geochemical Baselines Project adapted to the Colombian conditions and landscape (Figure 5). In addition, geological reconnaissance campaigns and metallogenetic studies related to mineral exploration were carried out.

Figure 5. Stream sediment sampling in Colombia.

During 2015, the geochemical programme covered systematically 26,550 km^2 collecting 3900 samples of stream sediment at a density of one sample / 5 – 7 km^2. Geochemical analysis of the collected samples were carried out in the geochemistry laboratories of the Geological Survey of Colombia following standardised methodologies. Up to 60 elements were analysed using analytical methods, such as ICP-MS, ICP-AES, XRF, AAS, GFAAS. Selected elements in rocks and panned concentrates were analysed in commercial laboratories of Canada.

In order to improve the management of the data, a robust geodatabase, which includes geochemistry, geophysics and metallogenetic information is under construction.

Data processing is performed using statistics and geostatistics software (SPSS and Geosoft – geochemistry) and geochemical maps (dots and distribution) for each sampled region have been produced (Figure 6)

Studies related to acid rock drainage were initiated in 2014. During 2015, we completed geochemical baselines for water (Figure 7), soil and rock and the sampling programme was finalised. The study in the first region will be completed by 2016.

An airborne gamma-spectrometry programme is being carried out to cover part of the Andes Region and the Eastern Region of Colombia (Orinoquia – Amazonia) to establish U, K, and Th baselines. Currently, the programme has covered 652,000 km. This project will be completed in 2016 (Figure 8).

The Geological Survey of Colombia will continue its regional geochemical programme at different sampling densities to cover the country in order to achieve its goal of producing the geochemical atlas of Colombia. To celebrate its one hundredth anniversary in 2016, the Geological Survey of Colombia has the objective to produce geochemical maps for different regions of Colombia.

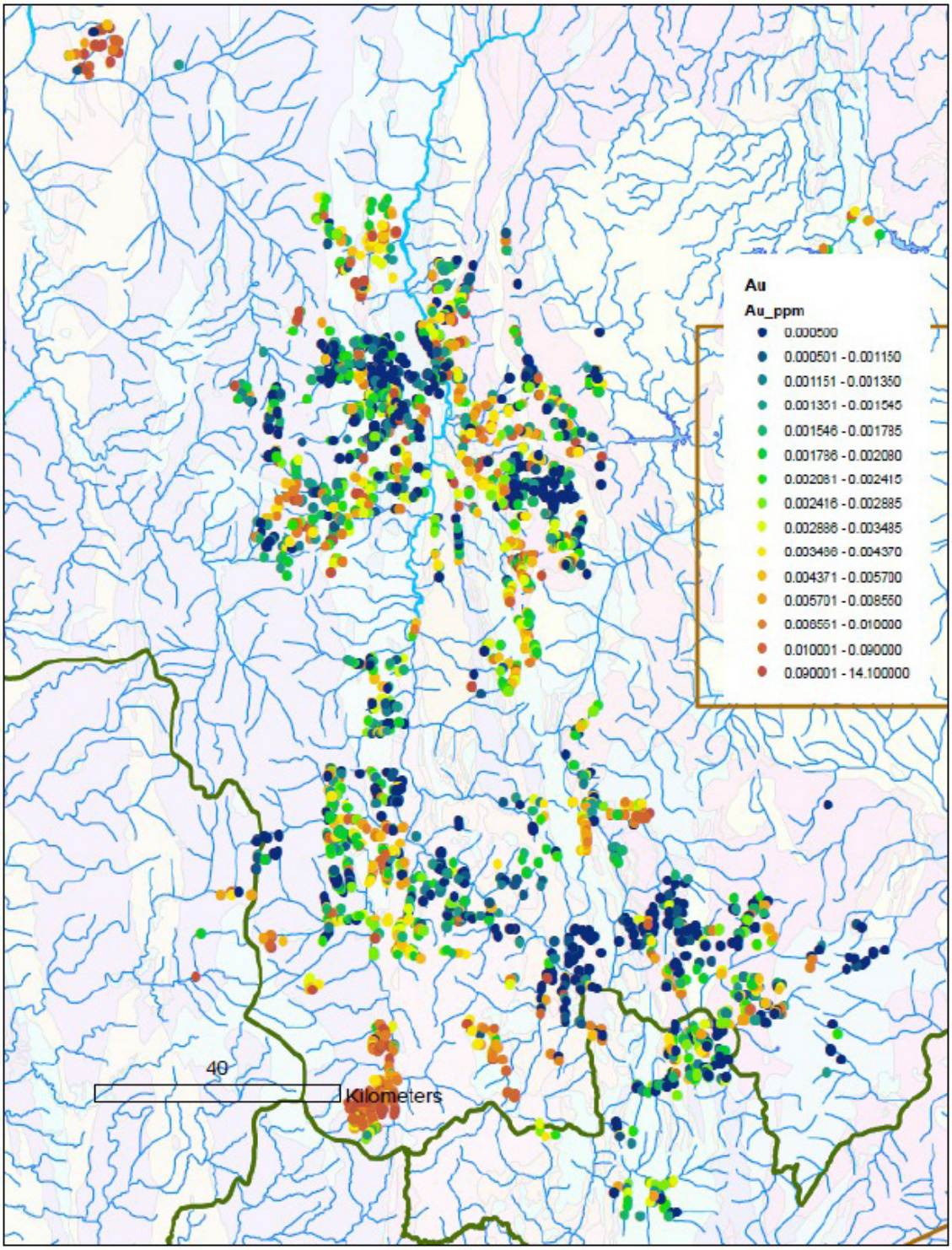

Figure 6. Concentration (dots) map of gold (Au) in Antioquia, Colombia.

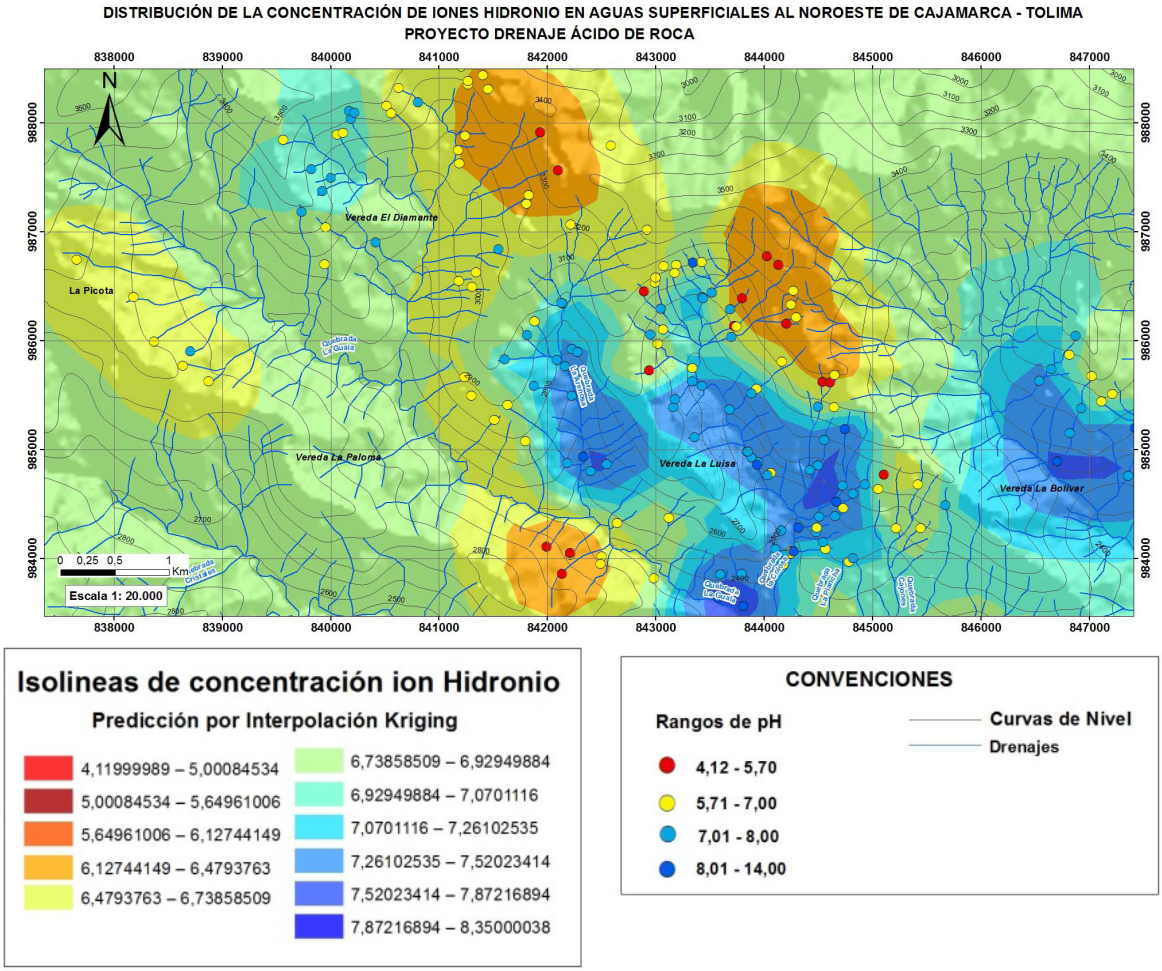

Figure 71. pH distribution in stream water of the study area (Cajamarca, Tolima, Colombia).

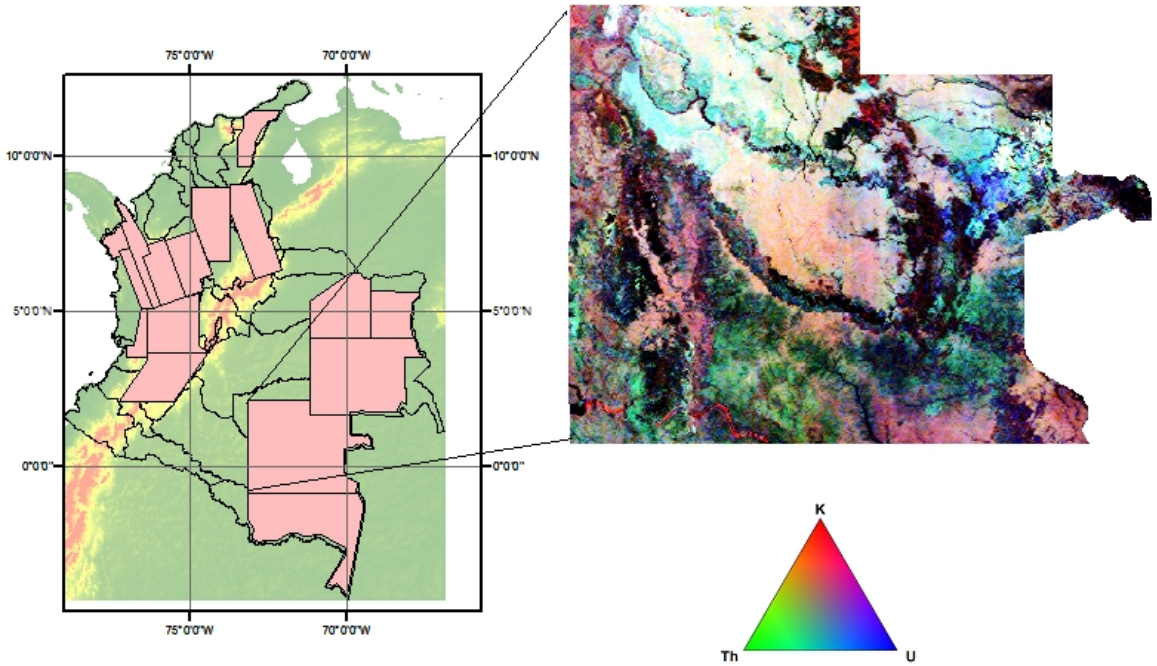

Figure 8. Gamma-spectrometry Programme along Colombia (survey lines each 500 - 1000 m; control lines each 5000 - 10000 m; altitude 100 – 300 m).

ASIA

China and other Asian countries (Xueqiu Wang, IGGE, China)

China Geochemical Baselines Projects

The China Geochemical Baselines Project (CGB) is a contribution to the IUGS/IAGC Task Group on Global Geochemical Baselines. Its purpose is to document China's nationwide geochemical baselines, spatial distribution and evolution of all elements. Each Global Reference Network (GRN) cell is divided into 4 CGB cells. Approximately 1,500 CGB cells cover the whole of China (9.6 million km^2). Soil samples for pedosphere and rock samples for lithosphere geochemical baselines were collected in each cell. At two sampling sites homogeneous samples of soil/overbank/floodplain sediments from each CGB cell were collected. At each site, two depth related samples were taken: 0-25 cm and >100 cm. Typical rock samples, representing different geological units, were concurrently collected in each CGB cell to interpret the geogenic sources of secondary geochemical patterns, and to explore the evolution of elements with geological time from Archaeozoic to Quaternary.

A 5-year term, from 2008 to 2012, was planned for covering the whole of China's mainland, and a 2-year extension term from 2013-2014 was devoted to data interpretation and publications. A one-year pilot study was conducted in 2008 to test and refine the recommended protocols, and to optimise field logistics for the geochemical sampling. After completion of the pilot studies, a total of 6617 soil/catchment sediment samples from 3382 sites were collected at 1500 CGB grid cells across the whole of China (9.6 million km^2), corresponding to a density of approximately one sample site per 3000 km^2. In addition, 11,943 rock samples were also collected to aid in the interpretation of geogenic sources of elements. Before chemical analysis, the soil and sediment samples were sieved to <10 mesh (2.0 mm) and a 1000 g sample was ground to <200 (74 μm) mesh in an agate or pure-aluminium-porcelain mill. A 500 g sample was sent to the lab for analysis. The remaining sample was bottled and archived. Seventy-six chemical elements plus 5 additional chemical parameters of Fe^{2+}, Organic C, CO_2, H_2O+ and pH) were determined under strict laboratory analytical quality control.

Internet-based software named Digital ChemicalEarth, similar to Google Earth, was developed, which can manage the geochemical database and allow everyone to access vast amounts of geochemical data and maps through the Internet.

Initial results show excellent correlations of element distribution with lithology, mineral resources and mining activities, industry and urban activities, agriculture, and climate. These results were presented at the 34th IGC in Australia in August, 2012, and the 26th IAGS in New Zealand in November, 2013, and published in the Journal of Geochemical Exploration. The China Geochemical Baselines Atlas is expected to be released in the Opening Ceremony of the UNESCO International Centre on Global-scale Geochemistry in 2016.

China and Mongolia Cooperation Geochemical Mapping Project

China is cooperating with Mongolia in geochemical mapping at a scale of 1:1,000,000 covering an area of approximately one million km^2 across boundary regions of the two countries. The project was launched in 2008 under an agreement issued by the China Geological Survey and the Mineral Resources and Petroleum Authority of Mongolia. The Institute of Geophysical and Geochemical Exploration helped with training in sample-collection protocols and provided free chemical analysis. The sampling methods

were developed specifically for the project landscapes of desert, Gobi, grassland and mountains. A total of 10,532 samples were collected across the boundary area of approximately 1,050,000 km^2 at a sample density of 1 per 100 km^2 before 2013. The project has extended into the whole Mongolia as from 2014. In total, 2000 samples were collected in 2014, and analysed in 2015. The analytical methods were principally ICP-MS, ICP-AES and XRF combined with an additional 10 methods. High-quality data were generated under strict quality control using standard reference materials. A geochemical atlas of 69 elements and organic carbon was published. The results showed that (i) regional geochemical patterns were identified for the first time across the world's largest REE ore deposit in Inner Mongolia; (ii) regional geochemical patterns of Ag-Pb-Zn have good correlation with the polymetallic province along the east part of the boundary region; (iii) regional geochemical patterns of Cu-Au-Mo have good correlation with the porphyry metallogenic province along the middle part of the boundary region. The first phase final report, analytical data and atlas were presented to Mongolia State Authorities in August 2012. Four scientists were awarded the Mongolian Medal of Honour, which is the highest-ranking honour for geologists, who have made a great contribution for Mongolian Geology and Mineral Resources. The results were presented at the China Mining Conference in China in November, 2013. The first phase geochemical atlas was completed in 2014. The second phase project began in 2015.

CCOP/ASEAN Geochemical Baseline Mapping Programme

As detailed in the 2012 Annual Report, the China Geological Survey has approved a proposal to provide financial and technical support for a Geochemical Baseline Programme within the member countries (China, Japan, Vietnam, Indonesia, Singapore, Cambodia, Thailand, Malaysia, Papua New Guinea, Philippines and Korea) of the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP).
The CCOP/ASEAN Seminar on Geochemical Mapping took placed in Nanjing, China in March 2012.

A workshop on "CCOP-ASEAN Geochemical Mapping" took place in Nanning (Guangxi Province), P.R. China from 3 to 8 September 2013.

A training course on field geochemical sampling took place in Papua New Guinea in 25-27 October, 2014.

A total of 146 global-scale soil/catchment sediment samples from 73 sites were collected across the whole of Laos (approx. 200,000 km^2), corresponding to a density of approximately one sample site per 3000 km^2 in 2014 and 200 stream sediment samples at density of 1 per 100 km^2 were collected in Laos.

Training Courses on Geochemical Mapping for Developing Countries in 2015

The following training courses in geochemical mapping were organised by China Geological Survey for:

- 73 participants from organisations under the auspices of the China Geological Survey in Shenyang, China, 17-22 July 2015.
- Ethiopia in Langfang, China, 17-21 August 2015.
- Pakistan in Chengdu, China, 13-17 October 2015.
- French-speaking African countries in Chengdu, China, 22-23 October 2015.
- Russian-speaking countries took in Chengdu, China, 27 October 2015.

The following training courses in geochemical mapping for mineral exploration were organised by China Geological Survey for:

- Southern Asian countries in Chengdu, China, 5-25 August 2015.
- Asian English-speaking countries in Beijing, China, 12-13 October 2015.

Japan *(Atsuyuki Ohta, Geological Survey of Japan, AIST, Tsukuba)*

The Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, developed a comprehensive geochemical map both in terrestrial and coastal sea area (https://gbank.gsj.jp/geochemmap/). The regional geochemical mapping project avoids anthropogenic contamination, because the project is intended to estimate a natural geochemical baseline. As a next stage, a higher density geochemical mapping project in an urban region has been preceded from 2010 to elucidate contamination processes of elements released through anthropogenic activity to stream sediment. About 1,500 stream sediment samples (one sample per 9 km^2) have been collected from Kanto region including the nation's capital Tokyo for such purpose. Kanto region is highly populated area with 40 million inhabitants and an important industrial area that was contaminated by pollution especially during the period 1960–1970s. The stream sediment samples were dried in air and sieved through a 83-mesh (180 μm) screen. Magnetic minerals were removed using a magnet to minimise the effect of their accumulation. The samples were digested using HF-HNO_3-$HClO_4$ mixed solution and 53 elements including toxic elements (*e.g.*, As, Cd, and Hg) were analysed, using ICP-AES, ICP-MS, and AAS. Analytical quality was confirmed using geochemical reference materials. The publication of the new geochemical database has been scheduled in 2015.

Kyrgyztan *(Rolf Tore Ottesen and Jim Bogen, NGU, Norway)*

The Kyrgyzstan regional geochemical mapping project is a part Norwegian CPEurasia programme for the period 2010-2014. The partners are: KG-Asanaliev's Kyrgyz Institute of Mining Technologies; Department of Geology, University of Tromsø; Norwegian University of Science and Technology; Geological Survey of Norway; Norwegian Water Resources and Energy Directorate. The estimated cost of the four year programme is NOK 4 M (~US$ 0.7 M). Overbank sediment samples (top and bottom) were collected from 500 sites, and were analysed for 40 elements in the ALS-laboratory in Kyrgyzstan. The Geochemical Atlas of Kyrgyzstan was presented to State Authorities in September 2014. The data are presently being processed, and the project team is working on the interpretation of results. The Geochemical Atlas of Kyrgyzstan should be ready for publication in 2016.

AFRICA

Madagascar

China cooperated with Madagascar in a low-density geochemical sampling programme across the whole territory using stream sediment at a density of about 1 sample per 100 km^2 from 2013-2014. The samples are in the process of laboratory preparation and analysis.

South Africa *(Jakobus Elsenbroek; Council for Geoscience; Pretoria, South Africa)*

Tugela

The Council for Geoscience conducted a baseline geochemical soil mapping programme in

the KwaZulu-Natal Province in the Nkandla area (see Tugela Figure 9). An area of 2500 km^2 was covered. Four soil samples of 5 kg each were taken on a square-kilometre grid (500 m spacing) yielding a total of 11,321 samples. Helicopter transport was utilised to take the samples on a preselected grid, and the sample positions were logged by using GPS. The samples were dried, sieved to minus 75 micron and analysed by X-ray fluorescence spectrometry (XRF) for SiO_2, TiO_2, Al_2O_3, Fe_2O_3(T), MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, As, Ba, Ce, Co, Cr, Cu, Ga, Hf, Nb, Ni, Pb, Rb, Sc, Sr, Th, U, V, W, Y, Zn and Zr at the Council for Geoscience laboratory in Pretoria, South Africa. Preselected samples were also analysed at Henan Laboratories in Peoples Republic China for trace elements As, Li, Mo, Te, Sb and Cd, Pt, Pd, Au and for the REE elements: Yb, Ce, Pr, Nd, Eu, Gd, Dy, Ho, Er, Tm, Lu.

Geochemical maps were compiled and interpreted together with geological-, economic- and geophysical data.

Pofadder

Sampling on the Pofadder 1:250,000 sheet started in March 2015 in the Northern Cape Province of South Africa where the total number of soil samples to be collected will approximately be 23,000. These samples are taken on a 1 sample per square-kilometre grid, covering an area of about 23,000 km^2 (see Figure 6). The samples are currently being dried and sieved to minus 75 micron and prepared for the analytical laboratory.

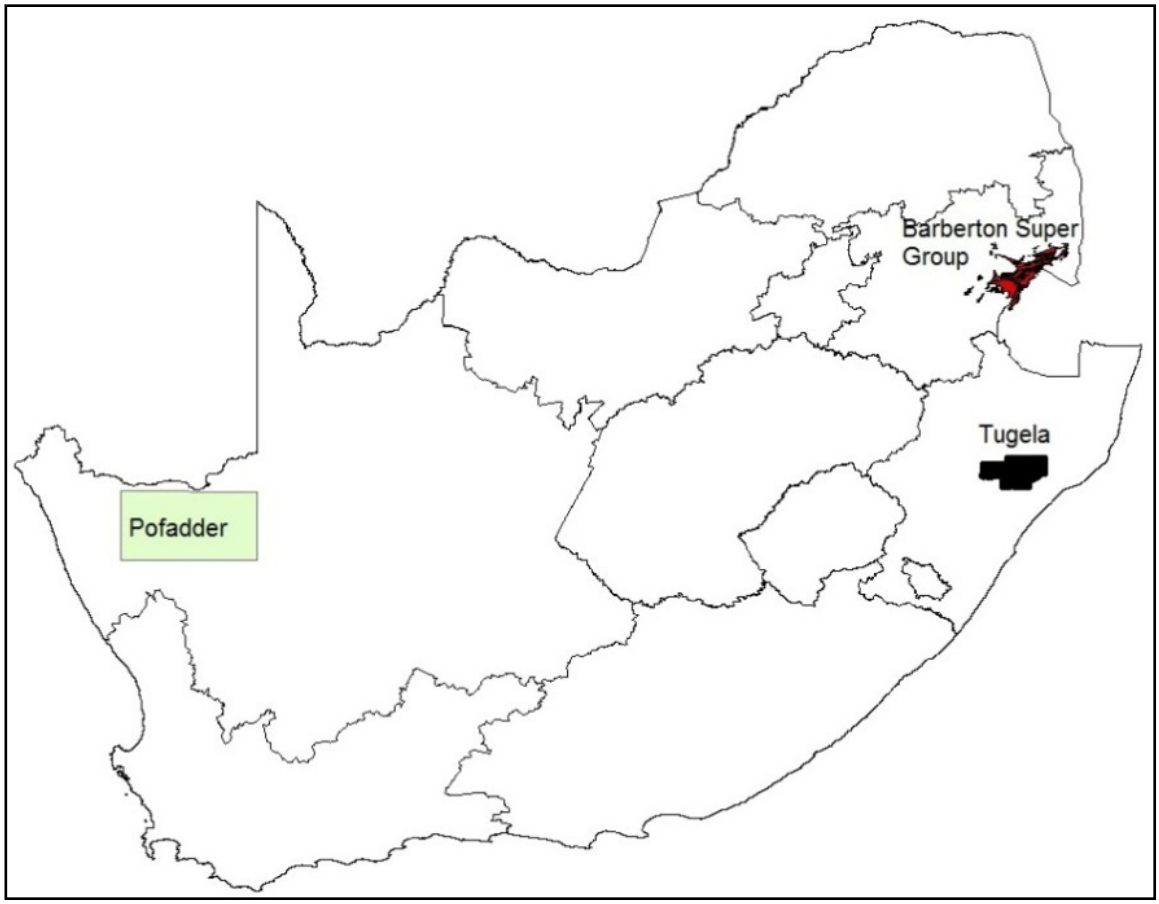

Figure 9. The current working areas for geochemical mapping in South Africa. Tugela being completed, Pofadder map currently being sampled and the Barberton Super Group to be sampled in future.

Barberton

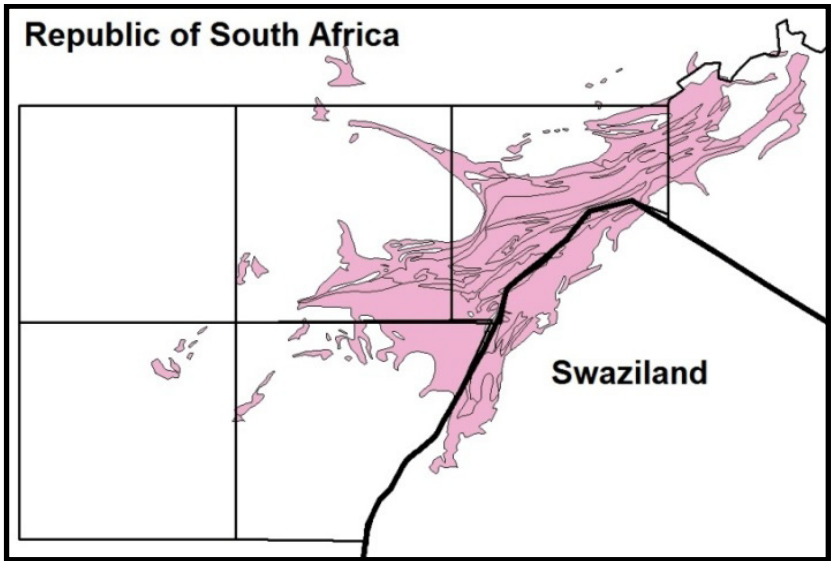

Figure 10. The distribution of the Barberton Super Group on the border between Swaziland and the Republic of South Africa.

It is envisaged that the geochemical mapping survey will be carried out during the field season of 2016, covering the lithologies of the Barberton Super Group (Figure 10). This survey will be carried out by taking one soil sample per square kilometre by means of helicopter supported transport.

Africa - general *(Theo Davies, Mangosuthu University, Durban, South Africa)*

The reporter considers that only the following three geochemical activities in Zimbabwe, South Africa and Uganda, respectively (given in Part I), have the potential to generate data that are usable in the 'Africa Geochemical Database Programme', with reference to sampling and analytical protocols adopted. These are in addition to ongoing or almost completed geochemical baseline campaigns in Sierra Leone, Nigeria and South Africa that were included in the 2013 'Report'.

PART I

1. Zimbabwe

Zhao *et al.* (2014)* reported on an ultra-low density regional geochemical survey over the surface area of Zimbabwe using stream sediment sampling of catchment basins. They give sampling methods, elements determined and analytical methods for the ultra-low density survey of Zimbabwe. Regional geochemical maps have been compiled based on the sample data and the features of the catchment basins (Zhao *et al.*, 2014)*.

*Zhao, G., He, F., Dai, X., Zhang, S., Yu., 2014. Ultra-low density geochemical mapping in Zimbabwe. Journal of Geochemical Exploration, 144, Part C, 552 - 571.

2. South Africa

The Council for Geoscience (South Africa) (CGS) is currently conducting regional soil sampling and analyses in the Poffader region of Namaqualand, Northern Cape. The

analytical data together with airborne magnetic and radiometric data (acquired between December 2013 and June 2014) will be used to support:

- Groundwater studies for water supply of various communities in the region;
- Environmental and eco-system studies for human, plant and animal health;
- Assessment of the country's mineral resources for sustainable development.

On 29 May 2012, the Petroleum Agency of South Africa (PASA) awarded the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd. (PetroSA) an Exploration Right for each of Licence Blocks 5/6 (ER #224) and 7 (ER #228) off the south-west coast of South Africa.

On 17 August 2012 PetroSA assigned 80% of its interest and obligations under the Exploration Rights to Anadarko South Africa (Pty) Ltd. and retained a 20% interest. As a result, Anadarko is now the operator of these blocks.

Anadarko is now proposing to undertake a seafloor geochemical sampling programme consisting of seafloor sampling (piston coring), seafloor heat flow measurements and a possible further multi-beam bathymetry survey.

3. Uganda

The Council for Geoscience (South Africa) (CGS) reported in 2012, the commencement of the earlier proposed Project '*Sustainable Management of Mineral Resources (SMMRP): Geochemical Survey in Selected Target Areas of Uganda*', including a comprehensive geochemical sampling programme.

The SMMRP is funded by the World Bank's International Development Association (IDA), the African Development Bank (ADB) and the Nordic Development Fund (NDF). The Project is being implemented by the Department of Geological Survey and Mines of Uganda.

The geochemical mapping programme involved initially, a systematic follow-up and verification of data generated by geological and geophysical surveys. The soil sampling campaign is being conducted at intervals of between 50 and 100m, but up to 500 m in some cases, depending on a number of factors (such as budget allocated, total number of samples to be handled, and the number of selected targets); each time, using the B soil horizon. The results are being compiled into regional geochemical maps of Uganda at scales 1:50,000; 1:100,000; and 1:25,000, depending on areal coverage.

PART II

SOIL GEOCHEMICAL SAMPLING AND ANALYSES IN MINERAL EXPLORATION PROGRAMMES

Several other soil geochemical sampling campaigns are ongoing or were completed all around Africa during the period under review (2012 - present), but these were designed for the purpose of detecting anomalies at specific exploration prospects; for example, sampling densities and analytical protocols used often do not fall anywhere near those recommended in the Darnley *et al.* (1995) '*Global Geochemical Baselines Report*' and modified for use in tropical terrains. Examples include:

4. Kenya

Africa Barrick Gold (ABG) acquired Aviva Mining Kenya Ltd (AMKL) from Aviva Corporation (Aviva) in October 2012, and thereby took over AMKL's interests in the 'West Kenya Project'.

The licenses occupy 2,800 km^2 of the highly-prospective Ndori Greenstone Belt in Kenya, which forms part of the Archaean Tanzanian Craton. Previous exploration of this part of the Belt identified significant potential for gold, as well as copper, lead and zinc.

2013 Highlights

- Extensive mapping and prospecting across the joint venture properties to validate targets.
- 15,656 soil samples collected for gold and multi-element analysis.
- 325 aircore holes were drilled to test gold-in-soil anomalies across the Kakamega Dome area with significant gold anomalies intersected including:
  - KDAC0074 3m @ 2.46 g/t Au from 5 m.
  - KDAC0125 3m @ 3.35 g/t Au from 29 m
  - KDAC0152 6m @ 30.9 g/t Au from 29 m
  - KDAC0161 3.5m @ 4.20 g/t Au from 47 m (ABG, 2012).

2014 Priorities

- Advance at least 20 targets across the Project to drill testing stage.
- Advance regional understanding of geology and structure throughout the project.
- Rationalise our land holdings to focus on the priority areas from our 2013/2014 exploration programmes.

5. Cameroon

Embui *et al.* (2013)* investigate the concentrations of gold and associated elements in stream sediment samples from the Vaimba-Lidi drainage system in northern Cameroon; a relatively remote area where alluvial gold is worked locally, and exploration activities are at an early stage. Fifty one active stream sediment samples were taken at various points within the drainage basin, defining an area of about 10.4 km^2.

*Embui, V., Omang, B., Che, V., Nforba, M. & Suh, E., 2013. Gold grade variation and stream sediment geochemistry of the Vaimba-Lidi drainage system, northern Cameroon (West Africa). *Natural Science*, **5**, 282-290. doi: 10.4236/ns.2013.52A040.

6. Zambia

(i) Denison Mines Corp. (DMC), a uranium exploration and development company operating in Zambia, undertook soil geochemical surveys and radon sampling programmes, which were completed during 2013, with several anomalies identified that were worthy of follow-up surveys. A 1,900 line-kilometre helicopter-borne electromagnetic geophysical survey was also completed and successfully mapped key rock types and faults on the property. In comparison, the Company completed 18,160 metres of exploration drilling at Mutanga East, Dibwe North and the Dibwe-Mutanga corridor in 2012.

The Company's Mutanga Uranium Project, which consists of 2 contiguous claims totalling 47,115 hectares situated in the Southern Province of Zambia, about 200

km south of Lusaka immediately north of Lake Kariba.

Soil geochemical surveys and radon sampling programmes started at Mutanga in February 2013 and were still in progress at the end of June 2013.

During the second quarter of 2014, the Company undertook another round of geological mapping, geochemical sampling and excavator trenching programmes in connection with the Company's Mutanga Uranium Project.

(ii) In 2013, Argonaut Resources NL completed a soil sampling survey comprising 332 soil samples at their Lumwana West Project (north-western Zambia), and discovered an anomaly coincident to the IP chargeability anomaly, indicating a strong correlation between data sets and steeply dipping interpreted mineralisation. Soil samples were analysed by handheld XRF analyser. The soil anomaly was in single west-northwest trending lobe. The peak Cu anomaly in soil was 556 ppm.

In their Annual Africa Report for 2013, "First Quantum Minerals Ltd" (FQM) noted that exploration drill programmes continued at Trident and Kansanshi in Zambia. Acquisition of a large extension of tenure immediately to the east of Kansanshi has been finalised and a programme of geochemical sampling is now underway in this area.

In their Annual Report in January 2014, FQM stated that soil geochemical sampling carried out over their licences in their Trident Project (located in the Solwezi District of Northwestern Province, Zambia; and comprising five prospecting large scale licences), amounted to 20,652 samples. The Company also carried out airborne magnetic, radiometric and time domain electromagnetic surveys and geological mapping over all licences.

7. Mali

The Falea uranium project is located in Mali within the Falea – North Guinea – Senegal Neoproterozoic Basin, overlying older Biriminan metasedimentary and metavolcanic rocks.

The project is located approximately 80 km from Areva's Saraya East uranium deposit. Denison Mines Corporation is carrying out exploration activities in Felea; but these were minimal during the first quarter of 2014. A field programme consisting of geological mapping and surficial geochemistry orientation surveys was completed during the second quarter of 2014.

8. *Tanzania*

Datlaa Gold Project East Africa Resources Limited ("East Africa" or "the Company") (ASX: EAF) announced the commencement in 2014, of field exploration at its prospective Datlaa Gold Project, located in the Eastern Rift, Tanzania. The Company (East Africa) will be undertaking further field reconnaissance, trenching/costeaning, mapping and geochemical sampling of the Project to prepare for phase 1 drilling campaign planned for the next quarter. It is reported that an exploration programme of geochemical sampling of extensions to the gold mineralised trends would be mounted to add definition to anomalous areas where sampling is on a wide reconnaissance spacing.

9. *Ghana*

In November 2013, Xtra-Gold announced the identification of Two New Gold Targets

on its Kwabeng Concession in located in the Kibi-Winneba greenstone belt in Ghana, West Africa. The Kwabeng concession is located approximately 10 km north-northwest of Xtra-Gold's flagship Kibi Gold Project. Scout soil geochemical sampling yielding gold-in-soil values attaining 2,230 ppb, 1,150 ppb, and 606 ppb spatially associated with a 275 m long by 20 m to 60 m wide cluster of mineralised argillite floats and/or subcrops (Bomaa Target).

10. ***Democratic Republic of the Congo (DRC)***

"Mwana Africa" has a 100% interest in 33 exploration licences covering about 4,721 km² in the Katanga copper belt region of south-eastern DRC. The Hailiang Joint Venture, signed in February 2013, covers 27 licence areas, with a commitment by Hailiang to spend US$25 m over a four-year period.

Ongoing mapping and soil geochemical surveys commenced towards end of June 2011.

Africa-general (Keith Shepherd, World Agroforestry Centre (ICRAF), Nairobi, Kenya)

The Africa Soil Information Service (AfSIS), through ISRIC - Soil Information, has released soil property maps of Africa at a spatial resolution of 250 m. The maps are based on soil profile legacy data combined with new a new probability sample taken under AfSIS. A related publication is available at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0125814

The ability of total element analysis using total X-ray fluorescence spectroscopy (TXRF) and mid-infrared diffuse reflectance spectroscopy (MIR) to predict extractable soil nutrients was evaluated for Africa soil types. Apart from some outliers, there was strong complementarity between the two spectroscopic methods and those extractable tests that predicted poorly from MIR also predicted poorly from TRXF, which led us to question the efficacy of those tests. The paper reports total element concentration ranges for Africa soil and is available at: https://dl.sciencesocieties.org/publications/sssaj/abstracts/79/5/1375?search-result=1. See also: http://ac.els-cdn.com/S2352009415300018/1-s2.0-S2352009415300018-main.pdf?_tid=0929f7ce-6c1d-11e5-a4bf-00000aab0f26&acdnat=1444130946_0041e8f230ef5f4d00731496055c6f2e

AUSTRALIA

Australia (Patrice de Caritat, Geoscience Australia, Canberra)

This year saw the release of further publications on the National Geochemical Survey of Australia (NGSA) data set. Statistical analysis of the NGSA data continued, including the development of methods for analysing and representing compositional data. Presentations were made at several meetings (*e.g.*, the 24th Australian Society of Exploration Geophysicists (ASEG) International Conference, the 17th Annual Conference of the International Association for Mathematical Sciences (IAMG), the Centre of Excellence in Ore Deposits (CODES) Science Planning Meeting, the 2015 Leeds Annual Statistical Workshop, and the Society for Exploration Geologists (SEG) Conference).

Visible-shortwave infrared and thermal spectroscopic analysis of the NGSA

samples, which begun in 2013, continued during 2015 with approximately 80% of samples processed. The resultant data set is being uploaded in the Specchio spectral database. The southern Thomson region of northern New South Wales and southern Queensland was sampled in 2013, as part of a multi-disciplinary regional investigation, leading up to stratigraphical drilling in 2016. These results were worked up this year and a report will be published next year.

A higher resolution, second phase continental geochemical survey had started in 2014 with soil samples being collected on a grid pattern as part of a national geophysical (*i.e.*, magneto-telluric) survey that started in Victoria. Unfortunately this sampling project was abandoned due to funding and logistics difficulties. However, some samples were collected as part of this ongoing national magneto-telluric survey in areas of South Australia that had not been sampled during NGSA, providing some hope that a complete coverage of Australia may one day be achieved.

The Geological Survey of Western Australia has collected approximately 1020 regolith samples in the Kimberley region, as part of the Kimberley Science and Conservation Strategy. The sample sites are located more or less on a 5 x 5 km grid pattern (Figure 11), and multi-element geochemical analysis is ongoing.

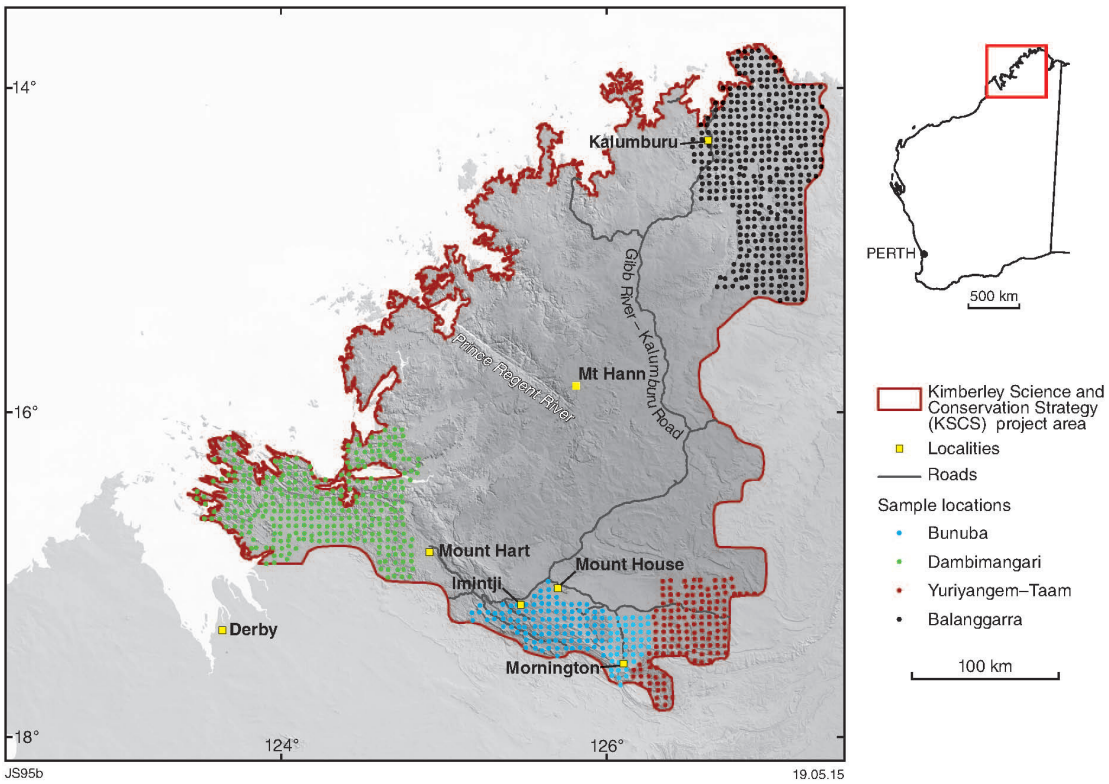

Figure 11. Sample sites for the Kimberley Science and Conservation Strategy project by the Geological Survey of Western Australia.

Results from the first programme in the Balanggarra area will be published this year, and all geochemical data are made web-available on receipt from the laboratory. Also a further four NGSA samples were collected in this region for potential future analysis and integration in NGSA. Results of work in the Kimberly region were presented at the 27th International Applied Geochemistry Symposium (IAGS) in Tucson, Arizona. Regolith sampling was also carried out over Phanerozoic

sedimentary rocks of the Amadeus and Canning Basins, where 650 regolith samples will be analysed for over 50 analytes.

A successful short course was held in October on "*Innovative approaches to geochemistry for regional scale exploration*" at the Australian Resources Research Centre (ARRC) in Perth, which focussed on regional to continental scale geochemical mapping methods.

In New Zealand, 360 soil samples were collected for a systematic, regional geochemical baseline survey over the southern end of New Zealand's South Island from A and B horizons at 8 km^2 centres (Figure 12). The geochemical atlas for this survey (Martin *et al.*, 2015)* and a report on the sampling methodology for this survey (Rattenbury *et al.*, 2014)* were published by GNS Science (GNS Science report 2014/62) and are freely available to download online. An example map from the geochemical atlas showing the distribution of arsenic is shown in Figure 9. The soil samples have been analysed for 65 elements determined by dilution-ICPMS and magnetic susceptibility, and a subset has been analysed by laboratory XRF for oxides, and for isotopic ratios of Sr, S, C and N. The undertaking of this survey has been promoted at national meetings (Martin *et al.*, 2014) and to the New Zealand geosciences community (Martin and Turnbull, 2014)* in 2014. This is a pilot study aimed at refining the methodology for a national survey. Future work will include interpreting the results of this pilot study, completing a complementary, urban-focussed soil geochemical baseline survey, collaborative research using the existing soil collection and planning for further regional survey work in New Zealand.

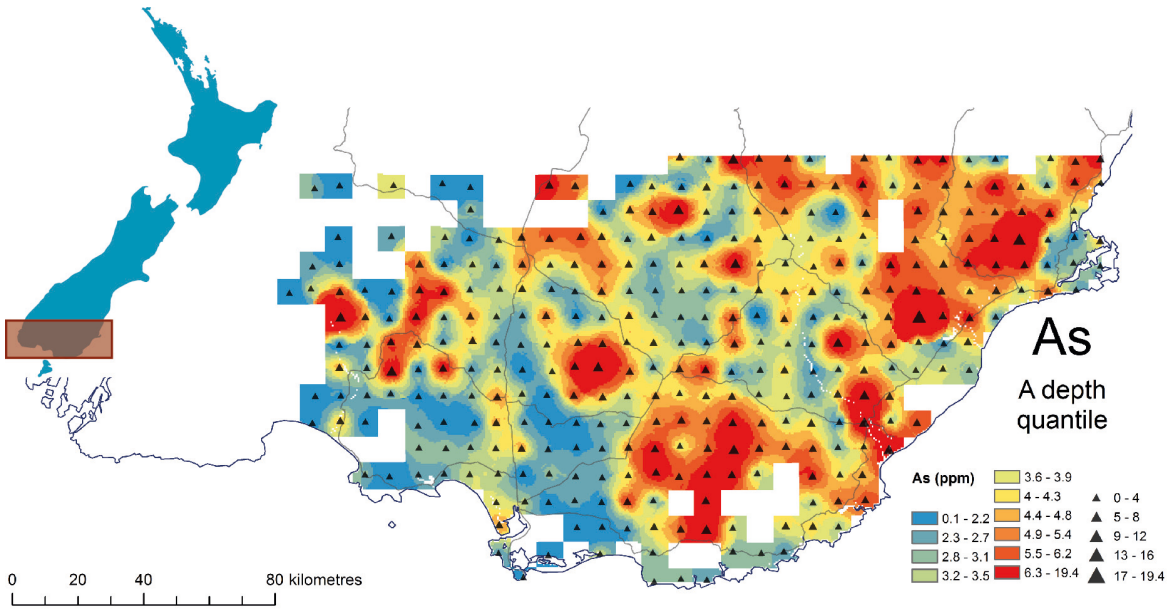

Figure 12. Map showing the sample locations (triangles) and arsenic abundance coloured by the quantile method, Southern New Zealand. The triangle symbol size variations depict the five-part, equal interval subdivision of the data: the value ranges are shown in the legend.

A geochemical mapping workshop with participants from Australia and New Zealand is going to be held in Canberra on 11-12 December 2015 to discuss various approaches to geochemical mapping, stakeholder engagement, applications of the

resulting data sets, and other relevant issues.

The contributions to this report by Paul Morris (Geological Survey of Western Australia), David Cohen (University of New South Wales), and Adam Martin (GNS Science, Dunedin, New Zealand) is acknowledged.

*Martin, A.P. & Turnbull, R.E., 2014. *Regional multi-element geochemical baseline survey of southern New Zealand*. Geoscience Society of New Zealand Newsletter, 14, 6-7; http://www.gsnz.org.nz/information/newsletter-i-12.html.

*Martin, A.P., Turnbull, R.E., Rattenbury, M.S., Baisden, W.T., Christie, A.B., Cohen, D.R., Hoogewerff, J.A. & Rogers, K.M., 2015. *Geochemical atlas of southern New Zealand. Lower Hutt, N.Z.*: GNS Science. GNS Science report 2015/26. vii, 221 pp.; http://www.google.com.au/url?url=http://www.gns.cri.nz/Home/Products/Publications/Science-Reports&rct=j&frm=1&q=&esrc=s&sa=U&ved=0CBQQFjAAahUKEwjr3vyujYfJAhUnHqYKHSmFAJ8&sig2=vyuJqogK2qCGtY9K7u3evQ&usg=AFQjCNEEBvTdCto-M9khePxrDZKNROFxeA.

*Rattenbury, M.S., Martin, A.P., Turnbull, R.E. & Christie, A.B., 2014. Sampling methodology for a regional multi-element geochemical baseline survey. Lower Hutt, NZ: GNS Science. GNS Science report 2014/62, 38 pp.; http://www.google.com.au/url?url=http://www.gns.cri.nz/Home/Products/Publications/Science-Reports&rct=j&frm=1&q=&esrc=s&sa=U&ved=0CBQQFjAAahUKEwjr3vyujYfJAhUnHqYKHSmFAJ8&sig2=vyuJqogK2qCGtY9K7u3evQ&usg=AFQjCNEEBvTdCto-M9khePxrDZKNROFxeA.

EUROPE

Europe *(Clemens Reimann, NGU, Trondheim, Norway)*

The two volumes of the FOREGS-EuroGeoSurveys Geochemical Atlas of Europe (Salminen *et al.,* 2005; De Vos, Tarvainen *et al.* 2006) are still proving to be very popular. Both volumes are available for free download from http://weppi.gtk.fi/publ/foregsatlas/. The complete European database of all field and geochemical data collected as part of this project and the related digital photo archive are also freely available at this website. The data that are of widest interest are the stream water data, since this is the only harmonised data set in Europe and complies to the specifications of the Directive on Infrastructure for Spatial Information in the European Community (INSPIRE: http://inspire.jrc.ec.europa.eu/), and to the Water Framework Directive 2000/60/EC (http://ec.europa.eu/environment/water/water-framework/index_en.html).

The EuroGeoSurveys Geochemistry Expert Group (GEG) published in April 2014 a two-volume set of the GEMAS project (GEochemical Atlas of Agricultural and Grazing land Soil) entitled "*Chemistry of Europe's Agricultural Soils*" at density of 1 sample site/2500 km^2 (http://www.schweizerbart.de/publications/detail/isbn/9783510968466). This was a cooperation project with industry, and was partly funded by the European Association of Metals (http://www.eurometaux.org/) for the provision of harmonised data for compliance with the European Commission's REACH Regulation (Registration, Evaluation and Authorisation of Chemicals – http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm).

To date the only activities for the 2015 UNESCO's International Year of Soils (http://www.fao.org/globalsoilpartnership/iys-2015/en/), were (i) a poster presentation "*Geochemical Mapping of Agricultural and Grazing Land Soil (GEMAS)*" by the EuroGeoSurveys Brussels office and the Geochemistry Expert Group at the 8th EUREGEO, 15-17 June 2015, Barcelona, Catalonia, Spain (http://www.igc.cat/web/ca/euregeo2015.html), and (ii) the "*Urban Topsoil Geochemical Mapping Manual (URGE II)*" (http://www.fao.org/soils-2015/resources/non-fao-resources/en/).

A two-day business meeting of the Group was held in Brussels, Belgium, on the 26th and 27th of October 2015 (Figure 13). Among the topics discussed were (1) New chemical analytical results (C, N, S), and geophysical results (magnetic properties) on the GEMAS project samples, (2) preparation of a GEMAS project e-book to be published in 2016; (3) other possible future work on the GEMAS samples include (a) Mineralogy (XRD), (b) additional "modern" isotope systems, such as Fe, Hg, Cu, U *etc.* isotopes, (c) Total dissolution (4 acid) on milled samples and ICP-MS determinations (for better comparability to the USGS soil geochemical landscapes project), (d) a "classical" weak extraction, *i.e.*, Ammonium Acetate or EDTA, (e) Radioisotopes, (f) Cl and I on pressed pellets by XRF, (g) Soil colour and (h) complete grain size analysis of all samples; (4) GEMAS-remote sensing project, (5) Lithogeochemistry of Europe; (6) Surface water, Spring water and tap water geochemistry at a sample density of 1 site/2500 km^2; (7) Forest soil geochemistry; (8) Geochemistry of the North Atlantic Basin; (9) Biogeochemistry; (10) Coal and oil geochemical data; (11) European mineral deposits geochemistry database; and (12) URGE-urban geochemistry – phase II for which a field manual has been written with the title: Urban Topsoil Geochemical Mapping Manual URGE II, and is available for downloading from: http://www.eurogeosurveys.org/wp-content/uploads/2015/06/EGS_Urban_Topsoil_Geochemical_Mapping_Manual_URGE_II_HR_version.pdf.

Figure 13. EuroGeoSurveys Geochemistry Expert Group, Brussels Annual meeting, 26-27 October 2015.

During the two-day meeting several presentations were delivered on on-going geochemical projects, carried out by each geological survey, and continuing work on the GEMAS data set.

The Task Group was represented by the Treasurer and Chair of the Sampling Committee, who reported the work that is being carried out at the global scale, and the progress made on the International Research Centre on Global-scale Geochemical Mapping in Langfang, China.

Public Relations Accomplishments (Alecos Demetriades)

The main priority of the Public Relations and Finance committee is to promote the project for the purpose of attracting sponsors that may be interested to finance the Global Geochemical Baselines project in different parts of the World, which is indeed a difficult task, and hitherto only one company has sponsored the Task Group's work.

One of the main priorities at the end of 2012 and beginning of 2013 was the reorganisation and update of the Task Group's website material. The website was reorganised and redesigned by a contract commercial company in collaboration with the public relation officer. The new website became operational in February 2013 (http://www.globalgeochemicalbaselines.eu/). A major update of the website will be done by the end of 2015.

The website hosting the Geochemical Atlas of Europe (http://weppi.gtk.fi/publ/foregsatlas/) is still very important for the promotion of the Global Geochemical Baselines project. Hotlinks have been established to the Atlas site from the sites of EuroGeoSurveys, many European Geological Surveys, and also professional organisations, *e.g.*, the Association of Applied Geochemists, International Medical Geology Association, and the Society of Environmental Geochemistry and Health.

Another important website, which is now in operation, concerns the GEMAS project of the EuroGeoSurveys Geochemistry Expert Group. The website is hosted by the Geological Survey of Austria (http://gemas.geolba.ac.at/) and the webmaster is Paolo Valera from Italy, and the Task Group's public relation officer has an active role in the compilation of the material that is uploaded to the GEMAS website. A novel idea is the uploading of two photographs from each sampling site to Google Earth – work that is done by Edith Haslinger (Austria) in her own time. Thus, interested people can fly directly to the sampling site and see a landscape and a soil profile photograph.

In 2010, the EuroGeoSurveys Geochemistry Expert Group decided to produce a GEMAS calendar for 2011, 2012, 2013, and 2014 for the promotion of the project, which have been designed by Peter Hayoz. The calendar for 2014 has been produced in electronic version (A4 size), and can be downloaded from the GEMAS website. Each calendar has 12 photographs from different countries, which display European agricultural and grazing land landscapes.

A novel idea was the design of the GEMAS Periodic Table of Elements of Agricultural soil (http://gemas.geolba.ac.at/Download/GEMAS_Periodic_Table_of_Elements_High_resolution.pdf), and the GEMAS Periodic Table of Mineralisation and Mineral Deposits (http://gemas.geolba.ac.at/Download/GEMAS_Mineralisation_Periodic_Table_Poster_high.pdf), where at the position of each element the corresponding geochemical and mineral deposit map is placed. Both Periodic Tables proved to be very popular at all international events that have been presented. The GEMAS Periodic Table of Elements of Agricultural soil has been revised in 2015, and a new GEMAS Periodic Table of Elements of Grazing land soil has been designed, and both will be uploaded in the next update of the project's website (Figures 14 & 15).

The CD of the FOREGS/EuroGeoSurveys Geochemical Atlas of Europe, which includes the two volumes of the Atlas, the analytical data, the field manual, the IGCP 259 Report "A *global geochemical database for environmental and resources management"* (Darnley *et al.,* 1995). More than 2500 copies have been distributed to date (1300 copies by EuroGeoSurveys office and over 1200 copies by the Public Relations and Finance Committee).

Another significant promotional activity has been the distribution of the memorial issue of the 2008 DVD in honour Arthur G. Darnley (1930-2006), which is still being distributed at international conferences, congresses and meetings. The DVD includes all the material from the Geochemical Atlas of Europe CD, all publications from 1988 to 2008 of the two IGCP programmes 259 *'International Geochemical Mapping*' and 360 *'Global Geochemical Baselines*', and copies of all papers from the *Arthur Darnley Symposium - Geochemical*

Mapping from the Global to the Local Scale - held at the 32nd IGC, Oslo, Norway. About 1500 copies of the DVD were made, and up to the end of October 2015, more than 1430 copies have been distributed at workshops, conferences, congresses and meetings, and also posted to interested university students and professionals.

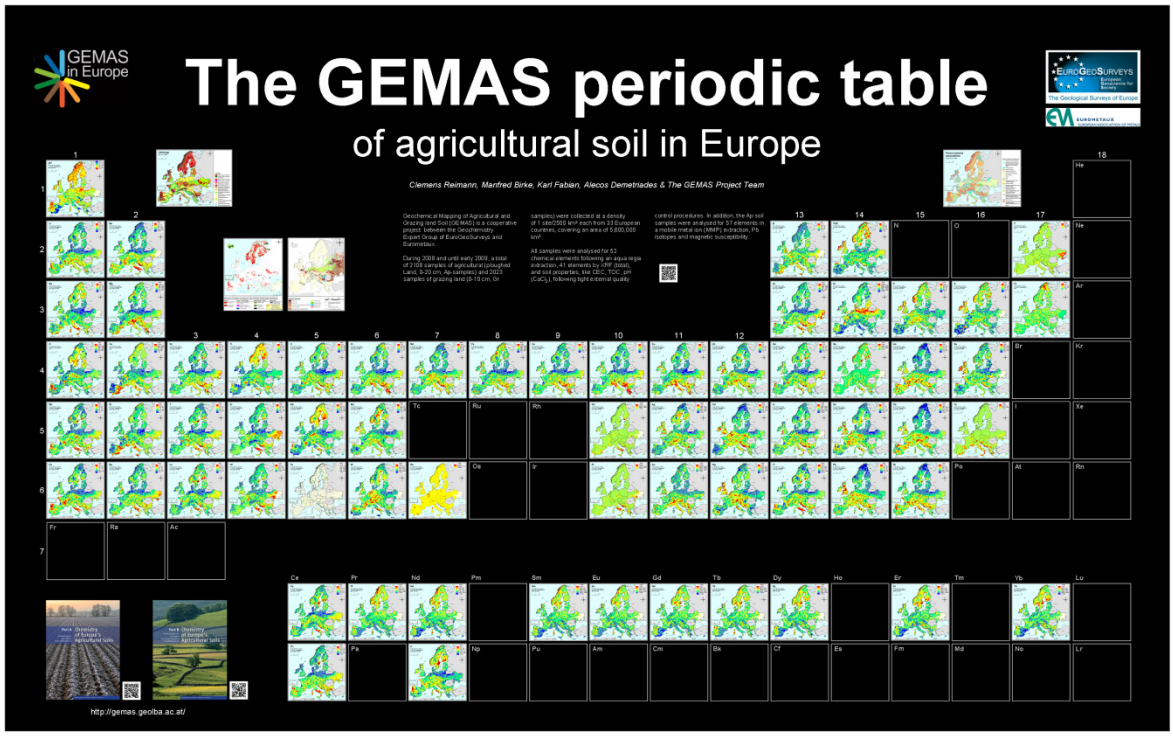

Figure 14. New GEMAS periodic table of agricultural soil in Europe.

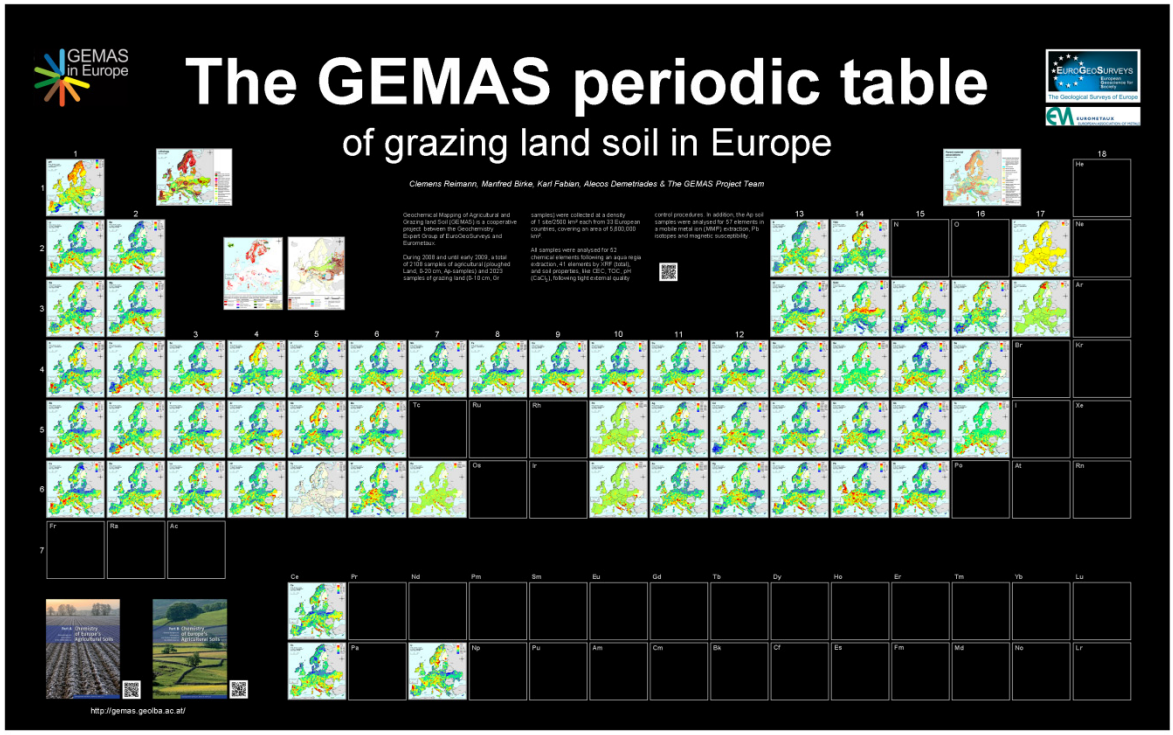

Figure 15. New GEMAS periodic table of grazing land soil in Europe.

In 2012, the Task Group published a paper in *Earth Science Frontiers* titled "T*he IUGS/IAGC Task Group on Global Geochemical Baselines*." This paper provided a summary of the history and accomplishments of the Task Group. See Section 9 for the complete reference.

The Task Group supported the travelling and part of the sustenance expenses of the Sampling Committee Chair to participate at the following events, following an official invitation from the organisers:

(i) the 1st International Geosciences Congress and 32nd National Symposium in Tehran (Iran) from the 16-19 February 2014, which was organised by the Geological Survey of Iran (http://nigc.conference.gsi.ir/en). A keynote presentation about the Global Geochemical Baselines project was delivered at the opening session of the congress on Sunday, 16th February 2014; more than 300 people were present at the opening session. On Saturday, 15th February 2014, a workshop on Global Geochemical Baselines was organised at the premises of the Geological Survey of Iran, and it was attended by 12 geologists and applied geochemists.

(ii) the 3rd Young Earth Scientists (YES) Congress 2014, which was held in Dar es Salaam (Tanzania) from the 11-14 August 2014, in conjunction with the 25th Colloquium of African Geology (CAG25). The 3rd YES Congress was organised by the Young Earth Scientists Network (http://www.networkyes.org/). The twp-day training workshop (12-13/8/2014) on "*International Geochemical Mapping and African Geochemical Baselines*" was attended by 59 registered geoscientists from mostly African countries, but also participants from Peru, Brazil, Canada, China and Europe. The attendees ranged from graduate and post-graduate students, to University lecturers and Professors, as well as professionals.

(iii) the IUGS Workshop on Resourcing Future Generations, which was held at the Gocheganas Wellness Village in Windhoek, Namibia, from 24-30 July 2015 (http://voices.nationalgeographic.com/2015/08/27/resourcing-future-generations/). A diverse group of geoscientists, environmental and social scientists and economists, drawn from a range of institutions with diverse private and public experience in exploration, mining and mineral policy, environmental protection, and sustainable development have participated in the Workshop (see Figure 16). Presently the report is in the process of finalisation.

Figure 16. Participants in the IUGS Workshop on Resourcing Future Generations, Gocheganas Wellness Village in Windhoek, Namibia.

Important outcomes

The Task Group is in the process of developing MoUs with the Geological Survey of Iran (GSI) from November 2013, and the Geological Society of Africa (GSAf) from September 2014 for training on Global Geochemical Baselines methods, with the latter starting from Ethiopia. The MoU with GSI was finalised in February 2014, and was going through the process of approval by the different Ministries and, finally an MoU was signed in 2015 with the China Geological Survey.

The text of the MoU with GSAf for training workshops in Africa was agreed in early 2015, but has not yet been signed, because GSAf is searching for sponsors to finance the first workshop in Ethiopia. An MoU was, however, signed between China Geological Survey and the Geological Survey of Ethiopia, and a capacity-building workshop is being planned.

International Centre on Global-scale Geochemistry approved by UNESCO

The Proposal for the establishment of the International Centre on Global-Scale Geochemistry in Langfang, China, under the auspices of UNESCO as a category II centre, was approved by the 37th session of UNESCO in Paris on the 13th November, 2013, and approved by China Government in September 2015.

Since the 1980s, in light of the importance of global geochemical baselines for recognition of global environmental changes, formidable efforts have been made by applied geochemists through the International Geochemical Mapping Project (IGCP 259), the Global Geochemical Baselines Project(IGCP 360), and the IUGS/IAGC Task Group on Global Geochemical Baselines. However, the progress is slow and limited. It is just like what Darnley *et al.* (1995), in the final report of IGCP Project 259, stated: "*Because of the number of organizational and technical steps involved it seems highly unlikely that any group of scientists convened under a non-government organization, however enthusiastic, could sustain or manage an international sampling activity (other than as a small test project in a sympathetic jurisdiction) over the period of time required for completion. . . . Assuming the importance of the geochemical information to be obtained is recognized by the international scientific community, there is a clear need for a single permanent agency to accept formal responsibility for securing funds, managing and coordinating these activities according to scientific guidelines determined by an external advisory committee*."

The past twenty years, experience and lessons have made it clear that there is an urgent need for the establishment of a single permanent agency to accept formal responsibility for securing funds, managing and coordinating these activities according to scientific guidelines determined by an external advisory committee.

In September 2009, Prof. Xie Xuejing (China), Dr. David Smith (USA) and Dr. Wang Xueqiu (China), forwarded a proposal to the China IGCP National Committee for establishing an International Research Centre on Global Geochemical Mapping (The name was changed to International Centre on Global-scale Geochemistry) under the auspices of UNESCO. The proposal had also been thoroughly discussed by the participants of the Global Geochemical Mapping Symposium held in Langfang China on Oct. 9-12, 2009. All participants expressed their support for establishment of an International Research Centre for Global Geochemical Mapping in the Institute of Geophysical and Geochemical Exploration (IGGE), Langfang, China.

The proposal has been supported by the Ministry of Land and Resources of P.R. China, the International Union of Geological Sciences (IUGS), the Association of Applied Geochemists (AAG), the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP), the IUGS/IAGC Task Group on Global Geochemical Baselines, the China Geological Survey (CGS), the Chinese Academy of Geological Sciences (CAGS), and the Geological Society of China.

In October 2010, the Ministry of Land and Resources formally requested the Director-General, through the Permanent Delegation of the People's Republic of China, that UNESCO carry out a feasibility study for the establishment of a category 2 centre in Langfang, located at same address of the Institute of Geophysical and Geochemical Exploration (State Research Institute). The IGCP Scientific Board reviewed the feasibility study report and made a resolution in support of the proposal at the 39th IGCP Scientific Board Meeting, 16 – 18 February, 2011. The decision was adopted by the UNESCO Executive Board at its 191st session in Paris on the 3rd June, 2013. Finally, the proposal was approved by the General Conference at its 37th session in Paris on the 13th November, 2013.

The centre will master knowledge and technology for documenting global-scale geochemical data and accompanying distribution maps, sustaining development for natural resources and the environment, and act as the platform for training and transferring up-to-date knowledge and technology between the developed and developing countries, and promote equal access to basic services in the field of global-scale geochemistry.

A Global Geochemical Mapping Programme via the Centre was approved by China Government through the China Geological Survey. The first phase of the programme from 2015 to 2020 will provide financial support for global geochemical baselines sample collection in developing countries and laboratory sample analysis for all the countries. Professor Wang Xueqiu (wangxueqiu@igge.cn, geochemistry@sina.com) is the project leader for the coordination of the programme. *Any countries that are interested to participate in the programme may contact him directly*.

An MoU on Global Geochemical Mapping of five year duration was signed by the IUGS and the CGS in Tianjkin (China) on the 22nd of October 2014. The IUGS has always given dynamic support for the global geochemical mapping through the IGCP 259 (1989-1993) and IGCP 360 (1994-1997) programmes, and the IUGS Task Group on Geochemical Baselines (1997 to present). According to Article 5 of the MoU, "*IUGS will communicate with its adhering Organisations and encourage them to provide necessary assistance for global sampling and experiments related to research and training projects jointly supported by CGS and IUGS under the framework of the International Research Centre on Global-scale Geochemistry and the IUGS/IAGC Task Group on Global Geochemical Baselines*." The co-operation between CGS and IUGS in global geochemical mapping may be effected by means of:

(1) To launch Global Geochemical Baselines Mapping Project - Chemical Earth, and to promote the establishment of a global network for the project and to develop partnerships with countries and organisations.

(2) To foster and support the implementation of global-scale geochemical mapping in developing countries;

(3) To provide consultation and training in the form of workshops and short courses for scientists, engineers and postgraduate students on the basis of up-to-date global-scale geochemical knowledge and mapping, and to provide technical assistance to developing countries;

(4) To organise periodic international symposia to foster communication among the geochemical mapping community, for instance at International Geological Congresses (IGC);

(5) To promote equal access to basic services and knowledge-sharing, and to develop a bridge between the scientific community, decision-makers and the general public in the field of geochemistry.

A 6-year term financial support for the Global Geochemical Mapping was submitted by the China Geological Survey via the Ministry of Land and Resources, and a budget of

approximately 500 million Yuan (approx. 79 million US$; ≈71.5 million Euro) per year was approved by the Ministry of Finance in 2015.

The Centre has been approved by the State Council-China Government (September 2015), and the final procedure is in the hands of the Ministry of Foreign Affairs of China to authorise and sign the agreement with China Geological Survey.

It is anticipated that the Centre will be fully operational in 2016.

The Executive Director of the Centre is Professor Xueqiu Wang, who is also the 2nd Chair of the Task Group.

Establishment of an IUGS Commission on Global Geochemical Baselines

The officers of the IUGS Executive Committee at their 68th sitting on the 28 January 2015 in Vancouver, Canada, judged positively the proposal for the establishment of an IUGS Commission on Global Geochemical Baselines (see Minutes http://iugs.org/uploads/Final%20version%20of%20the%20Minutes%20of%2068th%20EC%20Meeting%20-%20Vancouver%202014.pdf).

According to the decision, the proposed upgrading of the TGGGB within IUGS will need further implementation and refining before eventual approval. To our understanding the upgrading of the Task Group to Commission will be decided at the 69th meeting of the Executive Committee in January 2016.

According to the minutes of the 68th IUGS Executive Committee meeting:

- The Commission can run in parallel with the establishment of a Subcommission/ Working Group on Isotopes taking advantage of the now existing isotope group (TGIG).
- The establishment and design of the new Commission is compatible and should be synergic with the IUGS Resourcing Future Generations Initiative.
- Also in terms of synergy with the current activities of IUGS, it seems crucial and quite suitable that One Geology serves as visualisation platform for the new geochemical data base.
- Global Geochemical Baselines would be a suitable project proposal for the ICSU's Future Earth Initiative.

8. CHIEF PROBLEMS ENCOUNTERED IN 2015

The main problem still facing the project is the lack of funding that is required to achieve the aims and objectives of the project at the global scale. The geochemical baseline project in Europe was completed with funding by the participating European Geological Surveys. Work in North America, Australia, Brazil, China, Chile, Colombia, Cyprus, India, Kyrgyzstan, Nigeria, South Africa, Sweden, Uganda and Zimbabwe for example, are similarly funded by national geological surveys or other national scientific institutions. Some proposed activities, such as the international geochemical mapping project by the member countries of the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP), have been delayed because of a lack of available funding by the individual countries. Funds are required for training, transportation, additional analytical services and quality control. In addition, the Task Group is almost entirely dependent on funds from participating agencies for marketing activities, such as website development and workshops.

9. CHIEF PRODUCTS IN 2015

ARTICLES, PAPERS, ATLASES AND BOOKS

(1) Albanese, S., Sadeghi, S., Lima, A., Cicchella, D., Dinelli, E., Valera, P., Falconi, M., Demetriades, A., De Vivo, B. & The GEMAS Project Team, 2015. *GEMAS: Chromium, Ni, Co and Cu in agricultural and grazing land soil of Europe*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 81-93; http://www.sciencedirect.com/science/article/pii/S0375674215000138.

(2) Birke, M., Rauch, U. & Stummeyer, J., 2015. *How robust are geochemical patterns? A comparison of low and high sample density geochemical mapping in Germany*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 105-128; http://www.sciencedirect.com/science/article/pii/S0375674214003951.

(3) Buccianti, A., 2015. *The FOREGS repository: Modelling variability in stream water on a continental scale revising classical diagrams from CoDA (compositional data analysis) perspective*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 94-104; http://www.sciencedirect.com/science/article/pii/S0375674215000138.

(4) Cicchella, D., Albanese, S., Dinelli, E., Giaccio, L., Lima, A., Valera, P. & De Vivo, B., 2015. *GEMAS: Spatial distribution of chemical elements in agricultural and grazing land soil of Italy*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 129-142; http://www.sciencedirect.com/science/article/pii/S0375674214003781.

(5) Demetriades, A., Birke, M., Albanese, S., Schoeters, I. & De Vivo, B., 2015. Editorial: *Continental, regional and local scale geochemical mapping*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 1-5; http://www.sciencedirect.com/science/article/pii/S0375674215000412.

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(7) Janik, L., Forrester, S., Soriano-Disla, J.M., Kirby, J.K., McLaughlin, M.J., Reimann, C. & The GEMAS Project Team, 2015. *GEMAS: Prediction of solid-solution phase partitioning coefficients (Kd) for oxoanions and boric acid in soils using mid-infrared diffuse reflectance spectroscopy*. Environmental Toxicology and Chemistry, 34(2), 235-246; http://dx.doi.org/10.1002/*etc*.2821; http://onlinelibrary.wiley.com/doi/10.1002/*etc*.2821/abstract).

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Geochemical Exploration, 154, 61-80; http://www.sciencedirect.com/science/article/pii/S0375674214004221.

(9) Liu, X., Wang, X., Caritat, P. de & Salminen, R., 2015. *Comparison of datasets obtained by global-scale geochemical sampling in Australia, China and Europe*. In: A. Demetriades, M. Birke, S. Albanese, I. Schoeters & B. De Vivo (Guest Editors), Continental, Regional and Local scale Geochemical Mapping, Special Issue, Journal of Geochemical Exploration, 154, 6-16; http://www.sciencedirect.com/science/article/pii/S0375674215000679.

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(14) Reimann, C., Ladenberger, A., Birke, M. & Caritat, P. de, 2015. *Low density geochemical mapping and mineral exploration: application of the mineral system concept*. Special Issue, Thematic set: Tribute to Eion M. Cameron. Geochemistry: Exploration, Environment, Analysis, First published on August 13, 2015, http://dx.doi.org/10.1144/geochem2014-327.

(15) Sadeghi, M., Albanese, S., Morris, G., Ladenberger, A., Andersson, M., Cannatelli, C., Lima, A. & De Vivo, B., 2015. *REE concentrations in agricultural soil in Sweden and Italy: Comparison of weak MMI® extraction with near total extraction data*. .Applied Geochemistry, 63, 22-36; http://www.sciencedirect.com/science/article/pii/S0883292715300093.

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ORAL AND POSTER PRESENTATIONS

24th International Geophysical Conference & Exhibition, Australian Society of Exploration Geophysicists (ASEG) 2015 (Perth, WA, 15-18 February 2015):

Cracknell, M.J., Reading, A.M. & Caritat, P. de, 2015. *Geological knowledge discovery and minerals targeting from regolith using a machine learning approach.*

The Irish Geological Research Meeting (IGRM), Ulster Museum, Belfast, Northern Ireland, 21st February 2015:

O'Connor, P., 2015. *A new Geochemical Atlas of European Agricultural Soils.*

Workshop: Mineral content in forages in Scandinavia and its impact on equine ration formulation, Swedish University of Agricultural Sciences, Ultuna, Uppsala, 25 March 2015:

Andersson, M., 2015. *Content of major and trace elements in agricultural and grazing land soils.*

5th Seminar of the Faculty of Geology and Geoenvironment, 3 April 2015, National and Kapodistrian University of Athens, Hellas.

Demetriades, A., 2015. *Applied geochemistry: The science that has direct relationship with the quality of life of the population and not only* (Note: A seminar using data from the FOREGS, EGG and GEMAS atlases).

European Geosciences Union General Assembly 2015, Vienna, Austria, 12-17 April 2015. Session EMRP3.3: Soil, Sediments and Dust Magnetism (SOILEDUMA), 14 April 2015 (http://meetingorganizer.copernicus.org/EGU2015/session/17716):

Kuzinam, D. *et al.*, 2015. *GEMAS: Mineral magnetic properties of European agricultural soils*.

27th International Applied Geochemistry Symposium, Tucson, Arizona, USA, 20-24 April 2015, Hilton Tucson El Conquistador Tennis & Golf Resort, 10000 North Oracle Road, Tucson, AZ 85704, USA

Cannon, W.F., & Solano, Federico, 2015. *Quantitative mineralogy of soils of the conterminous United States.*

Cannon, W.F., Solano, Federico, Woodruff, L.G., & Smith, D.B., 2015. *Lead in soils of*

the conterminous United States – Natural vs. anthropogenic influences.

Demetriades, A., Reimann, C., Birke, M. & The GEMAS Project Team, 2015. *The GEMAS Periodic Table of mineralisation and mineral deposits in Europe.*

Morris, P.A., 2015. *Regolith geochemistry of the North Kimberley, Western Australia: a strong proxy for bedrock.*

Reimann, C., Birke, M., Fabian, K., Demetriades, A. & The GEMAS Project Team, 2015. *The GEMAS Periodic Table of agricultural soil in Europe.*

Smith, D.B., Woodruff, L.G., Cannon, W.F., & Solano, Federico, 2015. *Mapping the soil geochemistry and mineralogy of the conterminous United States — Evolution and successful completion of a continental-scale government-sponsored survey.*

Solano, Federico, Smith, D.B., Woodruff, L.G., & Cannon, W.F., 2015. *A new version of the interactive website for geochemical and mineralogical data for soils of the conterminous United States.*

Wang Xueqiu, 2015. *China Geochemical Baselines: a new contribution to global geochemical baselines*.

Woodruff, L.G., Smith, D.B., Cannon, W.F., & Solano, Federico, 2015. *Distribution of selected elements in soils of the conterminous United States.*

SETAC Europe 25th annual meeting, 3-7 May 2015, Barcelona, Spain (http://barcelona.setac.eu/?contentid=767):

Reimann, C., Birke, M., Ladenberger, A. & Schoeters, I., 2015. *GEMAS: An overview of the distribution of metals in agricultural soil at the continental (European) scale* (Note: this is the poster with the periodic table with maps of the elements).

23rd Panhellenic Meeting of ArcGIS users, 7-8 May 2015, Crowne Plaza Hotel, Athens, Hellas. Organised by Marathon Data Systems*:*

Demetriades, A., FOREGS, EGG & GEMAS Project Teams, 2015. *The geochemical mapping of Europe* (results of the FOREGS, EGG and GEMAS projects).

Centre of Excellence in Ore Deposits (CODES) Science Planning Meeting (Hobart, Tasmania, 2 June 2015):

Cracknell, M.J. & Caritat, P. de, 2015. *Integrated analysis of catchment-scale geochemical and geophysical data: a pilot study*.

12th International Conference on Mercury as a Global Pollutant, 14-19 June 2015, Jeju, Korea.

Ottesen, R.T., Gosar, M., Reimann, C., Birke, M. & The GEMAS project team, 2015. *GEMAS project: mercury in European agricultural and grazing land soils.*

LASR 2015 – Geometry-Driven Statistics and its Cutting Edge Applications: Celebrating Four Decades of Leeds Statistical Workshops (University of Leeds, UK, 30 June-2 July 2015)*:*

Scealy, J., Caritat, P. de, Grunsky, E., Tsagris, M. & Welsh, A., 2015. *Robust principal component analysis for power transformed compositional data*.

Australasian Institute of Mining and Metallurgy: 47th New Zealand Branch annual conference on exploration, mining and New Zealand's mineral resources: Kingsgate Hotel, Hamilton, New Zealand, 24-27 August 2014*:*

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Hron, K., Filzmoser, P. & Caritat, P. de, 2015. *Weighted balances for compositional data and their application to geochemistry*.

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Cracknell, M.J., Reading, A.M. & Caritat, P. de, 2015. *Uranium prospectivity mapping of the Australian continent via unsupervised cluster analysis of integrated remote sensing data*.

ECHA/EFSA: Topical Scientific Workshop – Soil risk assessment, 7-8 October 2015, Helsinki-Finland
(http://echa.europa.eu/view-article/-/journal_content/title/topical-scientific-workshop-on-soil-risk-assessment):

Oorts, K., Delbeke, K., Schlekat, C., Chowdhury, J., Stubblefield, B. & Schoeters, I., 2015. *Application of improved scientific approaches in support of risk assessment within the European REACH and Biocides Regulations - a case study on metals*.

Reimann, C., Birke, M., Ladenberger, A. & Schoeters, I., 2015. *An overview of the distribution of metals in agricultural soil at the continental (European) scale* (Note: this is the GEMAS periodic table with maps of the elements).

X Congresso Ibérico de Geoquímica & XVIII Semaa de Geoquímica, 19-23 October 2015, Lisbon, Portugal (http://xcig.lneg.pt/):

Prazeres, C., Martin, I., Batista, M.J., Locutura, J. & Bel-Ian, A., 2015. *Distribution of naturally radioactive elements (U, Th and K) in grazing land soils of the Iberian Peninsula and compared with total natural radiation*.

Martin, I., Prazeres, C., Locutura, J., Batista, M.J. & Bel-Ian, A., 2015. *Factorial analysis of geochemical data of Iberian soils from pan-european geochemical mapping project GEMAS (Eurogeosurveys)*.

Irish Geological Association meeting, 28 October 2015, Dublin, Ireland

O'Connor, P., 2015. *GEMAS: A new Geochemical Atlas of European Agricultural Soils*.

***EuroGeoSurveys Geochemistry Expert Group annual meeting, EuroGeoSurveys Office, 36-38, Rue Joseph II, 1000 Brussels, 26-28 October 2015**:*

Demetriades, A., Smith D. & Wang, X.: *2015 activities of the IUGS/IAGC Task Group on Global Geochemical Baselines and collaboration with EuroGeoSurveys*

Reimann, C.: *Additional work on the GEMAS atlas samples.*

Mackovych, D. & Lucivjansky, P.: *Collection, processing and homogeneity test of a Ap soil standard for a new European URGE II project*.

Flem, B.: *Geochemical Exploration revived at the Geological Survey of Norway*.

Gregorauskienė, V.: *Geochemistry in Lithuania: changes and challenges*.

Griffioen, J.: *A probabilistic 3-dimensional characterisation of the reactivity of the shallow subsurface of Zeeland, the Netherlands*.

Bel-lán Ballester, A.: *Geochemical activities at the Geological Survey of Spain during 2015*.

Tarvainen, T. & Jarva, J.: *National geochemical baseline database TAPIR*.

Ladenberger, A.: *Geochemical Atlas of Sweden and other activities at SGU in 2015*.

Kuzmenkova, N.: *Landscape geochemical mapping of regions around radioactive facilities (shipyards, NPP, uranium mining)*.

Kuzmenkova, N.: *Speciation and partitioning of radionuclides at contaminated sites*.

Petersell, V. & Karimov, M.: *The Estonian soil geochemical atlas*.

Kaminari, M.: *Geochemical activities at the Hellenic Institute of Geology and Mineral Exploration during 2014-2015*.

Birke, M.: *Current activities and selected results of urban geochemistry in the cities of Aschersleben and Berlin, Germany*.

10. SUMMARY OF EXPENDITURES IN 2015

The Task Group received in 2015 the sum of 5,000 US$ from IUGS. In 2015, the Task Group had the following expenditures totalling 5,357.54 US$:

(1) Travel and sustenance expenses for the Treasurer and Chair of Sampling Committee to participate at the Steering Committee meeting and 27th IAGC, Tucson, Arizona, USA	3,919.23 US$
(2) Some additional expenses of Treasurer and Chair of Sampling Committee to participate at the "*IUGS Workshop Resourcing Future Generations, Windhoek, Namibia*", 24-30 July 2015, as Task Group representative	93.35 US$
(3) Travel and sustenance expenses for Treasurer and Chair of Sampling Committee to represent the TGGGB at the annual meeting of the EuroGeoSurveys Geochemistry Expert Group, Brussels, Belgium.	982.36 US$
(4) Annual fee for the hosting of the Task Group's website	308.46 US$
(5) Web hosting – Google analytics cookies warning	54.14 US$

In addition to the expenditure of funds provided to the Task Group by IUGS, many Task Group goals are supported by various national Geological Survey organisations. The cost of the EuroGeoSurveys GEMAS programme over the past five years is estimated to be in excess of 6.25 million US$. The overall cost of the FOREGS/EuroGeoSurveys activities over the past fifteen years or so is difficult to estimate, as the work has been funded independently from each of the participating countries, but a conservative estimate is in excess of 12M US$. These funds were provided from the Geological Surveys of the participating countries within Europe. The cost of the soil geochemical mapping project in the conterminous United States during 2013 was approximately 750K US$. There has also been considerable expenditure within a range of countries worldwide, as indicated in Section 7.

11. WORK PLAN FOR NEXT YEAR

The next business meeting of the Task Group will tentatively take place in 2016. It will likely be timed to coincide with the annual business meeting the Geological Congress in Cape Town in South Africa or the EuroGeoSurveys Geochemistry Expert Group, scheduled for autumn of 2016 in Vienna (Austria).

For historical reasons it was decided to leave the FOREGS Geochemical Mapping Field Manual (Salminen, Tarvainen *et al.,* 1998) as it is, because it deals with sampling in Temperate and Mediterranean terrains. An additional field manual is under preparation by the Task Group, and although this was planned to be published in 2015, it will now be published in 2016. The field manual will include sampling instructions in (a) Karstic terrains, prepared by A Demetriades, S. Pirc, M. Bidovec and F. Sustersic with an input from Xueqiu Wang, (b) Desert terrains by X. Wang (first draft completed in 2010), (c) Tundra terrains by X. Wang, (d) Arctic terrains by R.T. Ottesen, and (e) Tropical terrains by A. Demetriades, W. Xueqiu, C.C. Johnson, R. Salminen and others.

Geochemical mapping projects will continue in many countries throughout the world as detailed in section 7.

In 2012, the Task Group received inquiries from Iran and Brazil about conducting training in geochemical mapping in those countries. Because of financial problems in most surveys no further action was taken during 2013 to 2015. New opportunities developed in 2014 with the invitation from the Geological Survey of Iran for a one-day workshop on Global Geochemical Baselines, and a keynote presentation at the plenary session of the 1st International Conference in Iran, and the intention to develop an MoU with the Task Group, which is at the moment waiting for State approval. Similarly, following the two-day workshop in Dar-es-Salaam (Tanzania) in 2014, the Geological Society of Africa (GSAf) would like to pursue the training in African countries in Global Geochemical Baselines methods, and although the contents of the MoU have been agreed, it was not signed, because GSAf has not yet found sponsorship. Therefore, it may be possible if GSAf finds the necessary funds from sponsors the first training workshop to be organised in 2016.

Organisation of the 3rd Arthur Darnley Symposium at the 35th International Geological Congress, and a two-day workshop on Global Geochemical Baselines Methods that will be jointly organised with GSAf.

Closer cooperation with China Geological Survey and the UNESCO International Centre on Global-scale Geochemical Mapping as detailed in the MoU, signed between IUGS and the China Geological Survey.

China will provide funding support for training courses and global-scale geochemical baselines mapping, particularly focused on silk road countries and African countries.

China Geological Survey has signed MoUs or agreements with the Geological Surveys (or Authorities) of Mongolia, Turkey, Iran, Pakistan, Laos, Indonesia, PNG, Madagascar, Tanzania, Ethiopia, Eretria, Mexico and Peru.

12. COMMUNICATION AND DISSEMINATION PLANS

The IUGS/IAGC Task Group and all the national- and international-scale geochemical mapping projects being carried out in many countries plan to continue active participation in national and international symposia, conferences and workshops for the promotion of the global-scale project. A technical session on Continental Scale Geochemical Mapping was organised during the European Geosciences Union General Assembly from the 12 to 17 April 2015 in Vienna, Austria (http://www.egu2015.eu/), and the Goldschmidt 2015 conference from the 16 to 21 August 2015 in Prague, Czech Republic (http://goldschmidt.info/2015/).

Communication will also be achieved through continued output of peer-reviewed scientific papers, oral presentations, posters and promotional materials.

In addition, the Task Group's website will be a key forum for communication and dissemination of information.

13. SUMMARY BUDGET FOR NEXT YEAR AND POTENTIAL FUNDING SOURCES OUTSIDE IUGS

The success of the IUGS/IAGC Task Group on Global Geochemical Baselines has been, to date, almost entirely dependent on funding from sources outside IUGS and IAGC. This funding has come primarily from national geological surveys and other scientific institutions in participating countries. We conservatively estimate that over the past ten years, 33 M US$ has been spent on broad-scale geochemical surveys conducted according to recommendations from the IUGS/IAGC Task Group and its predecessors.

Funding from IUGS has consisted of 1500 US$ per year for 2003-2008, 4000 US$ for 2009 and 2010, and 5000 US$ for 2011 and 2012, no funding for 2013, and 5000 US$ for 2014 and 2015. IAGC has provided funding of 2000 US$ on three occasions (2000, 2003, and 2004) over the past fourteen years to assist with travel expenses of Task Group members from developing countries to attend our business meetings. The Task Group currently has reserves of approximately 14,390.30 US$.

Taking into account the necessity to publish in 2015 the Field Manual for all the remaining terrain types, the need for field training courses and workshops in African and other countries, the organisation of the 3rd Darnley Symposium at the 35th International Geological Congress in Cape Town and a two-day training workshop on Global Geochemical Baselines methods, and sponsoring the registration fees of two students, and the production of the 2nd edition of the Arthur Darnley DVD, it is anticipated that the expenses for 2016 could reach 20,000 US$. *We are, therefore, requesting financial support in the order of 10,000 US$ from IUGS for 2016.*

14. CHIEF ACCOMPLISHMENTS 1998-2015

1998 Publication of Salminen *et al.* (1998) *FOREGS Geochemical Mapping Field Manual.* Geological Survey of Finland Guide Number 47.

1998 Release of the IUGS/IAGC Global Geochemical Baselines website, hosted by the British Geological Survey at www.bgs.ac.uk/IUGS.

1998 European GRN sampling programme commenced.

1999 Completion of pilot study for geochemical mapping carried out in Colombia.

2000 The Committee for Coastal and Offshore Geoscience Programmes (CCOP) agreed to act as a Regional Co-ordinator for their member countries (China, Japan, Vietnam, Indonesia, Cambodia, Thailand, Malasia, Papua New Guinea, Philippines, and Korea) in SE Asia.

2000 Symposium on geochemical baseline activities organised as part of the 31st International Geological Congress in Rio de Janeiro.

2001 Sampling and the majority of analysis completed in FOREGS countries. Preliminary maps of geochemical data for Europe prepared and preliminary interpretation begun.

2001 Meeting held with CCOP member countries during the Seminar on Regional Geochemical Exploration, Beijing, China to discuss their participation in the global project.

2002 Sampling and analysis completed in Southern India. Pilot studies partially completed within Colombia and Brazil.

2003 FOREGS poster, as the European contribution to IUGS/IAGC Working Group on Global Geochemical Baselines, and a two-page flyer prepared for promotional purposes.

2003 Launch of North American Soil Geochemical Landscapes Project.

2003 Launch of geochemical baseline mapping programme in India.

2004 Production of Part 1 of the FOREGS Geochemical Atlas of Europe, including background and introductory texts and geochemical maps for a wide range of sample media and chemical elements (Salminen *et al*., 2005).

2005 Production of Part 2 of the EuroGeoSurveys/FOREGS Geochemical Atlas of Europe, including interpretation, papers on specialised data treatment, and supplementary tables, and figures and maps (De Vos, Tarvainen *et al*., 2006).
2006 Launch presentation of the Geochemical Atlas of Europe to the European Commission in Brussels on 21 September 2006.
2006 Completion of pilot studies for the North American Soil Geochemical Landscapes Project.
2006 Launch of the Geochemical Mapping Project across China and Mongolia.
2007 Launch of the Geochemical Atlas of Europe in Athena, Hellas, on the 23rd April 2007
2007 Initiation of soil sampling for the soil geochemical survey of North America, under the north American Soil Geochemical Landscapes Project.
2007 Completion of provisional soil geochemical mapping in India.
2007 National Geochemical Survey of Australia approved for funding by the Australian Government's "Onshore Energy Security Initiative".
2007 Publication of Geochemical Atlas of 76 Elements in south-western China.
2008 Compilation of the Arthur G. Darnley memorial DVD with published material of the "Global Geochemical Baselines" project, and distribution of more than 500 copies.
2008 Publication of a special issue of the journal *Geochemistry: Exploration, Environment, Analysis* [Vol. 8, 3/4] with the title *"Thematic set in honour of Arthur G. Darnley (1930-2006)"*.
2008 Organisation of the Arthur Darnley Symposium entitled *"Geochemical Mapping from the Global to the Local Scale"* at the 32nd IGC, Oslo, 9 August 2008.
2008 Organisation of session entitled *"Soil Geochemistry: Databases and Applications at Regional to Continental Scales"* for the joint meeting of the Geological Society of America, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, and Gulf Coast Association of Geological Societies, 5-9 October 2008, Houston, Texas (USA).
2008 Launch of the China Geochemical Probe Project (China All-Elements Scope Project).
2009 Publication of the Geochemical Atlas of Italy using the FOREGS/EGS data.
2009 Launch of Task Group's new website at http://www.globalgeochemicalbaselines.eu/.
2009 Launch of the International Commission for the Danube River's (ICPDR) website at http://hantken .mafi.hu/icpdr/. 2009 Organisation of the *"Global Geochemical Mapping symposium"* in Langfang (China), 10-12 October 2009.
2010 Completion of soil sampling at approximately 4800 sites in the conterminous United States as part of the North American Soil Geochemical Landscapes Project.
2011 Release of the National Geochemical Survey of Australia (NGSA) results and atlas (www.ga.gov.au/ngsa).
2011 Completion of the Cyprus Soil Geochemical Atlas project, and publication in July 2011 of the “Cyprus Geochemical Atlas” and four technical reports.
2011 Publication of the EuroGeoSurveys Urban Geochemistry Book project “*Mapping the Chemical Environment of Urban Areas*” (April 2011).
2011 Publication of Multi-purpose Regional Geochemical Atlas of the Reaches of Yangtze and Huai River, Anhui Province, 2011, Geological Publishing House, Beijing.
2011 Publication of Multi-purpose Regional Geochemical Atlas of Hainan Island, Hainan Province, 2011, Geological Publishing House, Beijing.
2012 CGS-CCOP-IUGS/IAGC Seminar on CCOP Geochemical Mapping, Nanjing, China, 28 March 2012.
2012 Organisation of the 2nd Arthur Darnley Symposium entitled *"Global geochemical mapping: understanding chemical Earth"* at the 34th IGC, Brisbane, Australia, 8 August 2012.
2012 Participation in the IUGS Ad Hoc Review of the Task Group. Financial support provided for two graduate students to attend the 34th IGC.
2013 CGS-CCOP-ASEAN-IUGS/IAGC Workshop on Geochemical Mapping, Nanning, Guangxi Province, P.R. China, 3-8 September 2013.

2013 Release of geochemical and mineralogical results for the conterminous United States, 25 October 2013.
2013 Launch of the European Geochemical Atlas of Agricultural and Grazing Land Soil (GEMAS) on World Soil Day (5 December 2013) at FAO premises in Rome.
2013 GEMAS Workshop at FAO premises in Rome, 5 December 2013.
2014 Global Geochemical Baselines workshop, Tehran, Iran, 15 February 2014.
2014 Publication of the two-volume Geochemical Atlas of Agricultural and Grazing Land Soil (GEMAS) in April 2014.
2014 Publication of the Geochemical and mineralogical maps for soils of the conterminous United States in May 2014.
2014 Global Geochemical Baselines workshop, Dar-es-Salaam, Tanzania, 12-13 August 2014.
2015 A training course on geochemical mapping for 73 participants from organisations under the auspices of China Geological Survey took place in Shenyang, China, 17-22 July 2015.
2015 Contribution to the IUGS initiative on Resourcing Future Generations workshop, Windhoek, Namibia, 24-30 July 2015.
2015 A training course on geochemical mapping for Ethiopia took place in Langfang, China, 17-21 August 2015.
2015 A training course on geochemical mapping for mineral exploration for Southern Asia countries took place in Chengdu, China, 5-25 August 2015.
2015 A training course on geochemical mapping for mineral exploration for Asian English-speaking countries took place in Beijing, China, 12-13 October 2015.
2015 A training course on geochemical mapping for Pakistan took place in Chengdu, China, 13-17 October 2015.
2015 A training course on geochemical mapping for French-speaking African countries took place in Chengdu, China, 22-23 October 2015.
2015 A training course on geochemical mapping for Russian-speaking countries took place in Chengdu, China, 27 October 2015.

15. REFERENCES

Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steenfelt, 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. Freely available at: http://www.globalgeochemicalbaselines.eu/wp-content/uploads/2012/07/Blue_Book_GGD_IGCP259.pdf.

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Respectfully submitted, 25 November 2015

Dr. David B. Smith and Professor Xueqiu Wang
Co-Leaders

Dr. Patrice de Caritat
Scientific Secretary

EurGeol Alecos Demetriades
Treasurer

APPENDIX 1

IUGS/IAGC TASK GROUP ON GLOBAL GEOCHEMICAL BASELINES
Executive Committee meeting,
22 April 2015,
Hilton Tucson el Conquistador Golf & Tennis Resort, Tucson, Arizona
Venue of the 27th International Applied Geochemistry Symposium

Participants:

- Dave Smith (DS) – 1st Co-chair
- Xueqiu Wang (XW) – 2nd Co-chair
- Alecos Demetriades (AD) – Treasurer and Chair of Sampling Committee

1. New IUGS Commission

At the 68th IUGS Executive Committee Meeting in Vancouver it was recommended to upgrade the Task Group on Global Geochemical Baselines to Commission (see: http://iugs.org/uploads/Final%20version%20of%20the%20Minutes%20of%2068th%20EC%20Meeting%20-%20Vancouver%202014.pdf). Henceforth for the sake of brevity the Task Group on Global Geochemical Baselines will be referred to as either "Task Group" or "Commission", depending on sentence structure.

There are some outstanding issues that need clarification:

(i) DS: Need of the different Task Group Committees in relation to the new *UNESCO International Centre on Global-scale Geochemistry* in Langfang (China) – referred to henceforth as "International Centre". AD: As we do not yet know about the concurrent existence and responsibilities of the International Centre and the new Commission, decisions will have to be differed until the Task Group is upgraded to Commission, and the International Centre is fully operational.

(ii) Training courses: DS: *Is the Commission or International Centre responsible for training? If the International Centre arranges a training course is the Commission also a co-sponsor (and vice versa)? If some countries come to the Commission asking for training, do we refer them to the International Centre?* XW clarified that the International Centre will provide financial support for capacity-building, including short training courses and workshops, for developing countries hosted in China or for Chinese scientists to go to other countries for activities, but not provide financial support for capacity-building or training courses and workshops held in other countries; the latter activity will be the responsibility of the Task Group.

(iii) DS: *What will be the roles of the Commission upon the operation of the International Centre?* XW clarified that the International Centre and Commission will be complimentary bodies, as the International Centre will be operating according to Chinese State rules. For example, the funds for the operation of the International Centre are for all running costs incurred in China. The International Centre funds can be used for capacity building or training and workshops held in China, but the Commission funds can be used for such activities held in other countries. The International Centre's funds can be used for payment of salaries of employees and foreign experts that will be working in the International Centre on contract basis, but cannot be used for paying the expenses of foreign experts for capacity building courses held in other countries. The International Centre's

funds can be used for meetings of the Governing Board and Scientific Committee held in China. The International Centre will provide funds for Global-scale sampling, sample laboratory analysis, and data management for developing countries which have signed MoUs or agreements.

(iv) DS: It appears that some Commissions have their own Task or Working Groups. So, we may want to consider Working Groups for Africa, Europe, South America, North America, Australasia, South-east Asia, Middle East, *etc.* AD: We need similar Working Groups as the EuroGeoSurveys Geochemistry Expert Group in Europe, which has always been the most active since the establishment of IGCP 259 "*International Geochemical Mapping*" in the late 1980's. The Task Group already proposed the formation of a South-east Asian Working Group, which was approved at different levels, but there is as yet no information about its operation.

2. New Task Group Scientific Secretary

Shaun Reeder is no longer able to serve as Scientific Secretary, he asked to be replaced. Patrice de Caritat has been asked to take over the post, and we are at present waiting for his answer.

3. Sampling medium for global-scale geochemical mapping

The sampling medium for global-scale geochemical will be overbank sediment (or floodplain sediment, catchment outlet sediment or alluvial soil).

4. Field Manual

AD: The FOREGS Geochemical Mapping Field Manual (Salminen, Tarvainen *et al.*, 1998) covers Temperate and Mediterranean terrains, and we should keep it as it is. A field manual is needed to cover the following terrains:

- Karst terrains is ready, and follows the structure of the FOREGS field manual;
- Tropical (AD will prepare the first draft, and then ask for help);
- Desert (XW is almost ready);
- Tundra (XW will prepare the first draft, but needs help);
- Arctic (Rolf Tore Ottesen – AD to get in touch with him), and
- Savannah (XW it will be considered under desert, as it is similar to semi-desert grassland).

AD: The sampling medium for the global-scale geochemical mapping is overbank sediment, we must decide if we are going to write field instructions for the other terrains to cover all sample types, as recommended in the Blue Book, even though will not be used in the global project, i.e, samples from the small drainage basin: stream sediment, stream water, overbank sediment (top & bottom), residual soil (top & bottom).

5. Reference Samples

XW: China has prepared 12 stream sediment reference samples. We will select 4 samples from the 12, and also collect 6 new overbank sediment and soil samples. After preparation the samples will be distributed to world-leading class laboratories for analysis in order to estimate reference values for 76 elements, and these will be the international

reference standards for Global Geochemical Baselines.

6. Global-scale sample archive

XW: China will be responsible for the safe storage of global-scale geochemical baseline samples pending the approval of the country of origin.

7. Analysis of global-scale samples

DS: China will be responsible for the analysis of global-scale samples free of charge from developing countries. If this policy holds, then there is a serious issue for the analysis of samples from developed countries. We will end up with an inconsistent database; one set of protocols for developing countries and other protocols for the developed countries. A preferred solution would be to have all chemical analyses performed in Langfang.

DS: The Institute of Geophysical and Geochemical Exploration (IGGE) in Langfang has developed analytical methods according to "Blue book" specifications. It would be to the great benefit of the goals of the Task Group and of the International Centre if we could arrange for all chemical analyses to be performed in Langfang. A less desirable solution would be to have Langfang write an analytical methods manual to be used by all other participating laboratories. Of course, there are many parts of the world (Europe, USA, Mexico, Australia) where the analyses have already been completed by methods other than those developed by the IGGE.

XW: Charge (free , partly free or not free) for the analysis of global-scale samples from developed countries will depend on agreements and MoUs, because China government financial sponsorship via the UNESCO agreement is mainly used for developing countries.

8. Who makes judgement if data are appropriate for the global-scale database?

AD: Commented that there is already a Task Group database committee chaired by Timo Tarvainen (GTK). Thus, there should be an international quality control committee for judging the quality and suitability of data to be entered in the global-scale database.

XQ: The Task Group should set the criteria for the data quality. The International Centre will operate a software Chemical Earth similar to Google Earth to manage and present the global geochemical data. (*Chemical Earth*, an abbreviated name for Digital Earth of Chemical Elements, is a virtual globe of harmonised geochemical data and maps of all natural occurring chemical elements in the periodic table, which will be freely accessible through the internet. The global-, national- and local-scale geochemical maps will be digitally presented on the globe similar to Google Earth allowing anyone to freely access through an internet-based software named Chemical Earth, which has been developed for this purpose. The Chinese version is being tested for the past 3 years, and is being presently updated to the English version).

9. IUGS Resourcing Future Generations Workshop in Namibia

DS: The Task Group was invited to send a representative to the IUGS Resourcing Future

Generations workshop in Namibia, and to submit comments on the White paper "*Resourcing Future Generations: Mineral Resources and Future Supply*" (see https://www.geolsoc.org.uk/~/media/shared/documents/RFG/White%20Paper%20pdf.pdf?la=en). AD to represent the Task Group, and to compile first draft of comments.

10. Development of MoUs by the Task Group with other Institutions

AD reported:

- The MoU text developed in collaboration with the Geological Society of Africa (GSAf) has been accepted by Councillors with a minor modification, but not signed yet, because of the commitment of GSAf to finance the first Workshop in Ethiopia. GSAf is searching for sponsors.
- MoU that was being developed with the Geological Survey of Iran (GSI) at its request in early 2013 has made some minor progress towards the end of 2014, but now is on hold. According to the information we have from Parisa Piroozfar (our contact point at GSI), there is a long process. According to Parisa if the MoU is signed, then there is a chance of other neighbouring countries to follow.

XW reported that MoUs have been signed between China Geological Survey and (a) the Geological Survey of Ethiopia, and (b) Geological Survey of Iran. A capacity-building course is planned in Ethiopia for 2015.

AD commented that better coordination is required as China Geological Survey (CGS) is discussing the organisation of a capacity-building course in Ethiopia with the Geological Survey of Ethiopia, whilst the Task Group is discussing the organisation of a workshop with the Geological Society of Africa (GSAf). In fact, the Task Group initiated discussions with the GSAf for the development of an MoU from September 2014, and has not been signed yet, because GSAf was unable to find sponsors.

XW stated that CGS will cover the expenses of two Chinese scientists for the Ethiopian capacity-building course.

AD commented that CGS should be collaborating with the Task Group in the co-organisation of the capacity-building course in Ethiopia. In such a case, the Task Group will co-sponsor the capacity-building course.

11. 35th International Geological Congress in Cape Town in 2016

The Task Group will be organising in collaboration with the GSAf the 3rd Arthur Darnley Symposium, and a two-day workshop on Global Geochemical Baselines. The first day will be covered by lectures delivered by DS, XW and AD, and the second day will be a field-training excursion. All expenses of the second day will be covered by the Task Group, *i.e.*, coach hire, light lunch, and refreshments. The Congress organisers have set a fee at 120 USD, minimum, for the one day workshop. The Task Group will sponsor people that would like to attend, but have difficulty in paying the fee.
It was decided to make a 2nd Edition of the Arthur Darnley DVD, which will include all the material of the 1st Edition, plus all publications until mid-2016, and the geochemical atlases of North America, Australia, China and if possible India.

12. MoUs

XW informed that China Geological Survey has signed MoUs or agreements with the geological surveys of the following countries:

- Asia: Mongolia, Iran, Kyrgyzstan, Laos, Indonesia, Papua New Guinea, and Turkey.
- North America: Mexico
- Africa: Ethiopia, Kenya, Madagascar, Sudan, Zambia.
- South America: Peru

It is in the process of developing an MoU with Serbia and Cambodia.

DS: Qiu could you please clarify how these MoUs are related to the work of the International Centre and how the Task Group will be involved?.

XW: China government via the International Centre will provide financial and technical support for capacity building through sampling, laboratory, and software training for global-scale sampling and laboratory analysis, and partly for national-scale sampling and laboratory analysis. The Task Group will send scientists to give lectures in the training courses.

13. International Centre

XW explained that the process for the establishment of the International Centre on Global-scale Geochemistry, which has to be approved by the related Ministries and the Central Government of China, is time-consuming.

The establishment of the International Centre was approved by the Ministry of Land and Resources, Ministry of Science and Technology, Ministry of Education, Ministry of Foreign Affairs and Ministry of Finance.

All necessary documents, *i.e.*, ministerial approvals, were submitted to the State Council (Central Government) for final approval.

A 6-year term financial support for Global Geochemical Mapping was submitted to the Ministry of Finance by the China Geological Survey via the Ministry of Land and Resources. A 6-year budget of 500 million Yuan (approx. 79 million USD; 71.5 million Euro) per year was approved at the Annual Meeting of the National Congress in March 2015.

The International Centre should next be approved by the State Council-China Government at its sitting in September 2015, and subsequently the China State Council to authorise the Minister to sign the agreement with UNESCO.

It is anticipated that the International Centre will be fully operational in 2016.

The relationship of the International Centre with Institutions within and outside China is shown in Figure A1.

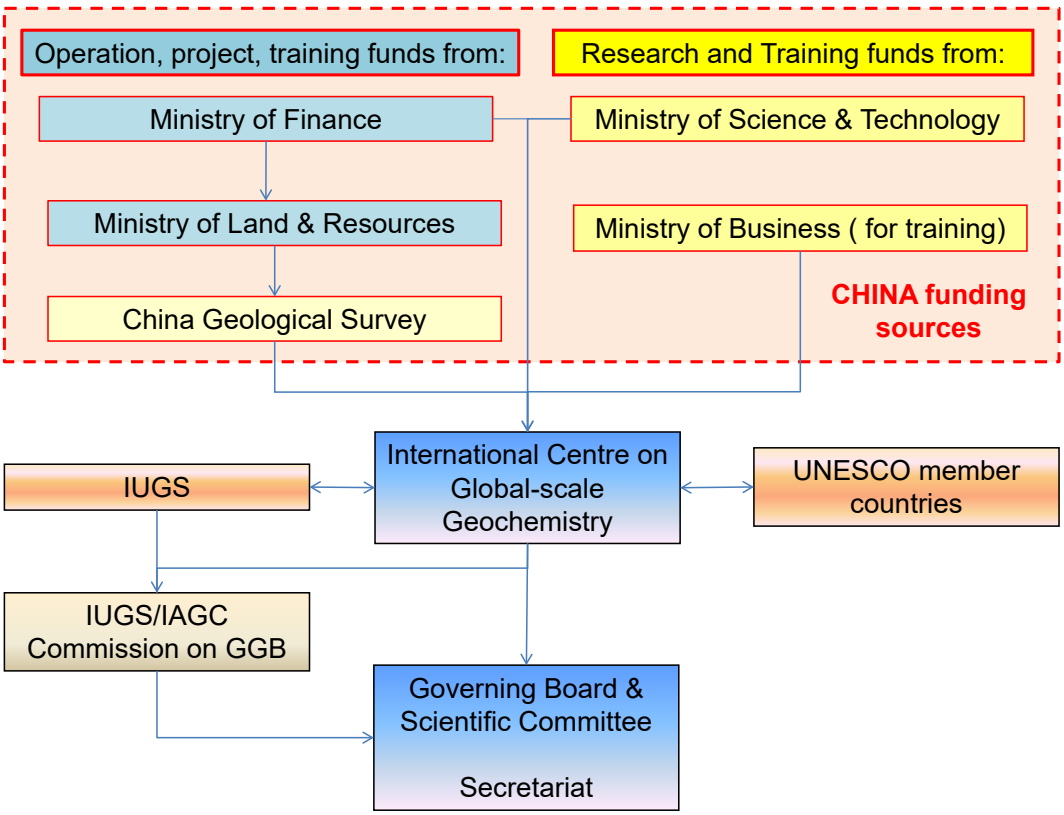

Figure A1. Relationship of International Centre on Global-scale Geochemistry with Chinese Ministries and Institutions, and International bodies.

13.1. Foreign applied geochemists working at the International Centre

The salary of junior and senior scientists working at the International Centre on a contract basis will be 15,000 US$/year and 50,000 US$/year, respectively.

13.2. Organisation of an international symposium in Langfang

When the International Centre is finally ready for operation, DS proposed the organisation of an international symposium to celebrate its formal opening, and to request IUGS funding for this activity. XW commented that the funding will be provided by the International Centre.