2014 ANNUAL REPORT FOR THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)/ INTERNATIONAL ASSOCIATION OF GEOCHEMISTRY (IAGC) TASK GROUP ON GLOBAL GEOCHEMICAL BASELINES

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

1. TITLE OF CONSTITUENT BODY

IUGS/IAGC Task Group on Global Geochemical Baselines.

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	Dr David Smith	US Geological Survey
	Dr Xueqiu Wang	IGGE, China
Scientific Secretary	Mr Shaun Reeder	United Kingdom
Treasurer	Mr Alecos Demetriades	Hellas

Analytical Committee

Chair Dr 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 Mr 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 Dr 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 Mr 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.

Regional Representatives

South America:
Carlos Alberto Lins; CPRM - Geological Survey of Brazil; Recife - PE, Brazil
João H. Larizzatti; CPRM – Geological Surfvey 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

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

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

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

Australia:
Patrice de Caritat, Geoscience Australia, Canberra

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

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

North America:
David Smith, United States Geological Survey, Denver, USA
Francisco Moreira Rivera, Servicio Geológico Mexicano, San Luis Potosí, SLP, Mexico
Andy Rencz, Geological Survey of Canada, Ottawa

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 field sampling; sample preparation and analytical costs exceed 2 million Euro (>2.5 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 US$ 4,262,800 in sampling, and about US$ 888,200 in the analysis of samples. The Geological and Mining Survey of Chile was funded from 2011-2014 for geochemical mapping with about US$ 2,000,000. 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 thousand 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 million 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.

In 2014, the China Government provided funding of approximately 600,000 US$ for sampling and chemical analyses for the ASEAN/CCOP Geochemical Mapping Project.

6. INTERFACE WITH OTHER INTERNATIONAL PROJECTS

This project is closely associated with the work of the EuroGeoSurveys Geochemistry Expert Group (previously the Forum of European Geological Surveys, FOREGS Geochemistry Expert Group). 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. 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.

7. CHIEF ACCOMPLISHMENTS IN 2014

Scientific Accomplishments

There has been continued and significant progress in a number of areas during 2014, including:

AMERICA

North America (David B Smith, USGS; Francisco Moreira Rivera, 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 web site (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 web site 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. Figures 1 and 2 below are examples of the geochemical and mineralogical maps produced by this project.

The SGM completed sampling in Mexico (1,327 sites; 3,526 samples) in 2012 and in 2014 plans to complete chemical analysis (total elemental content) for these samples.

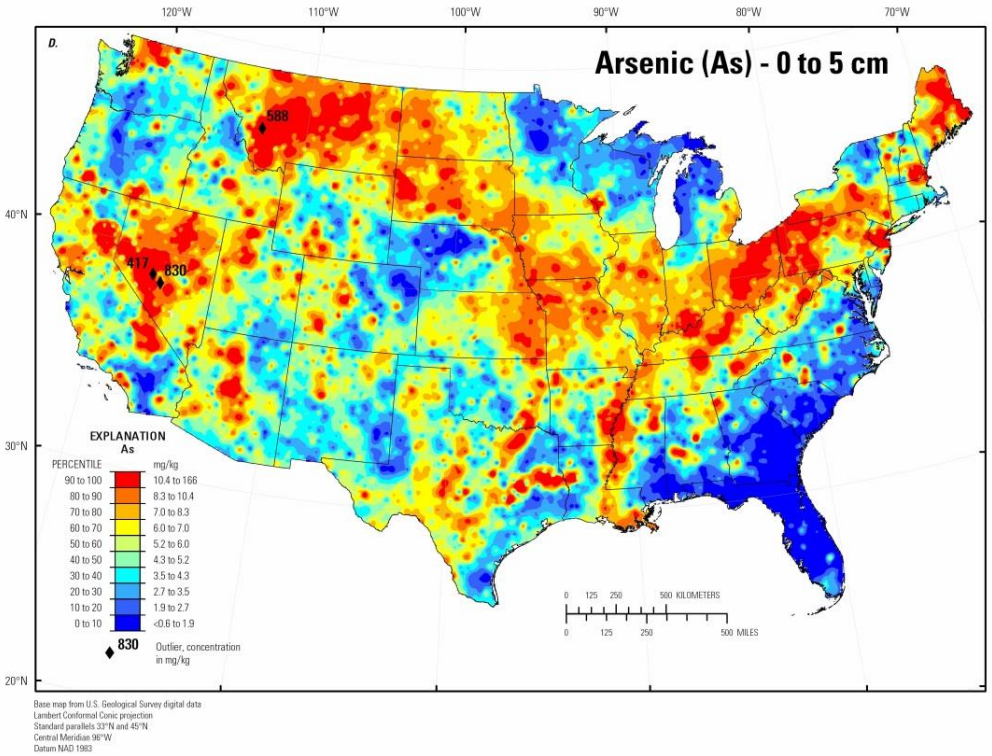


Figure 1. Map of the conterminous US showing the distribution of arsenic in surface soil (0-5 cm).

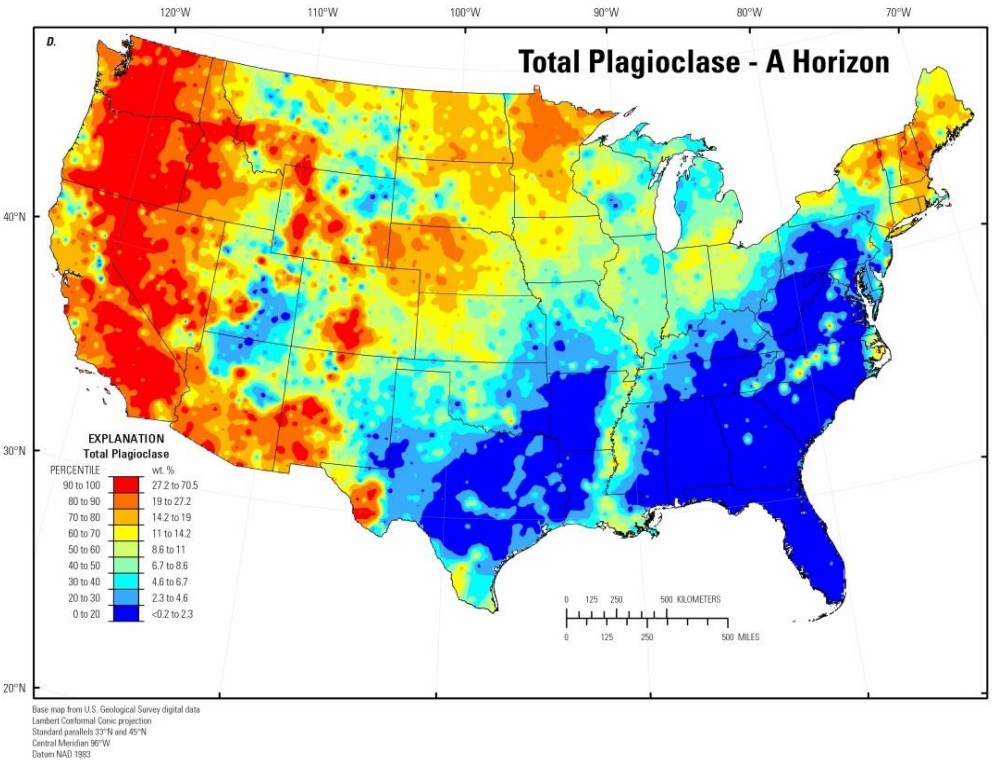


Figure 2. Map of the conterminous US showing the distribution of total plagioclase in the soil A-horizon.

South America

Brazil (João Larizzatti, CPRM - Geological Survey of Brazil, Rio de Janeiro)

In the last two years, CPRM, Geological Survey of Brazil, has been conducting regional geochemical mapping surveys from Santa Catarina (South) to Roraima States (North); and from Rondônia (West) to Pernambuco (East). It is also conducting marine sediment sampling off the north-eastern coast of the country. The focus is on regional geochemical mapping, geochemical exploration, and environmental geochemistry. Geochemical maps and atlases generated by CPRM are composed of maps and databases providing regional coverages for a given sampling medium (soil, stream sediment, heavy-mineral concentrates, surface water). They often cover a large region or 1:100,000-scale map sheets. These data are available free of charge or at a low cost (www.cprm.gov.br).

During 2013 and 2014, a total of 4,130 soil samples and 20,523 stream-sediment samples were collected in continental Brazil. During the same period of time, marine-sediment samples were collected from the continental shelf. These samples are analysed by multielement techniques (XRF, ICP-OES, ICP-MS) using various digestion methods. CPRM also collected 19,742 heavy-mineral concentrate samples; these samples were analysed semi-quantitatively for mineralogical composition. For more details, see Figures 3 to 5.

CPRM is investigating the mineral potential of the Brazilian continental shelf. Geological, geophysical, and geochemical data are being collected and integrated. The Brazilian Navy and some Brazilian universities are working together on this project. These geological, economic, and environmental data will be used by decision makers to develop policies for the safe use of marine resources. See Figure 6 below for details.

The Brazilian government, through CPRM and its Geology and Mineral Resources Directory invested R$ 10,657,000 (about US$ 4,262,800) in sampling and R$ 2,220,500 (about US$ 888,200) in analysis for surveys of the Brazilian mainland.

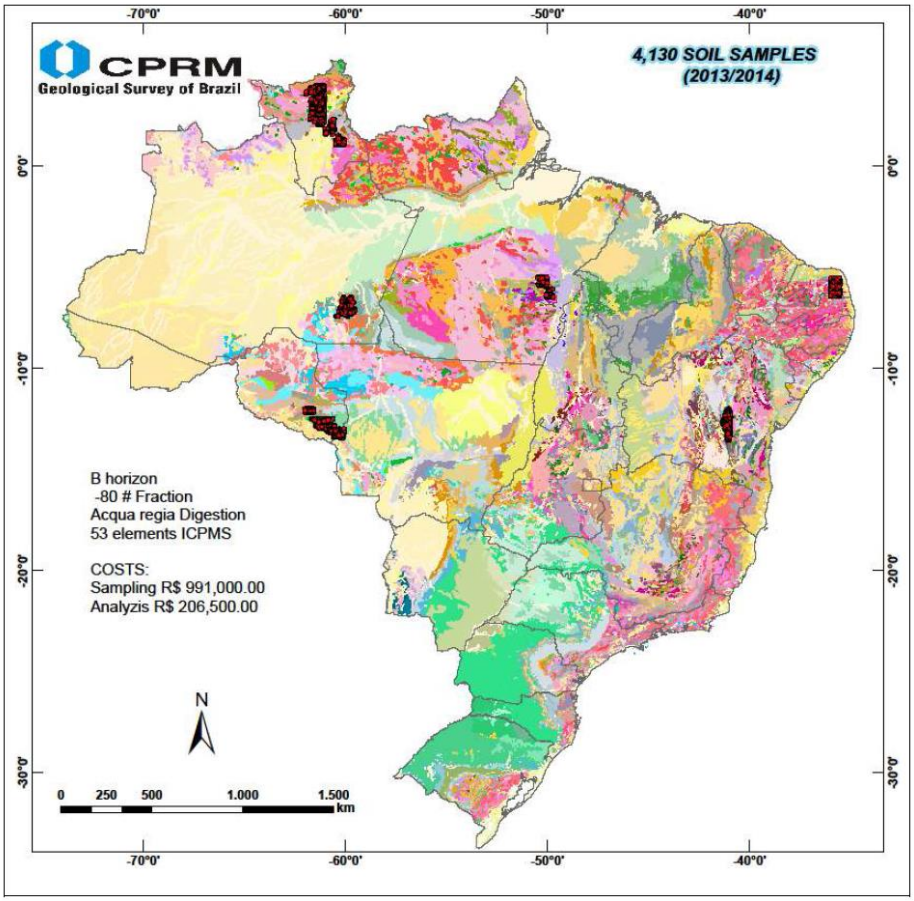


Figure 3. Soil samples collected during 2013 and 2014 in Brazil.

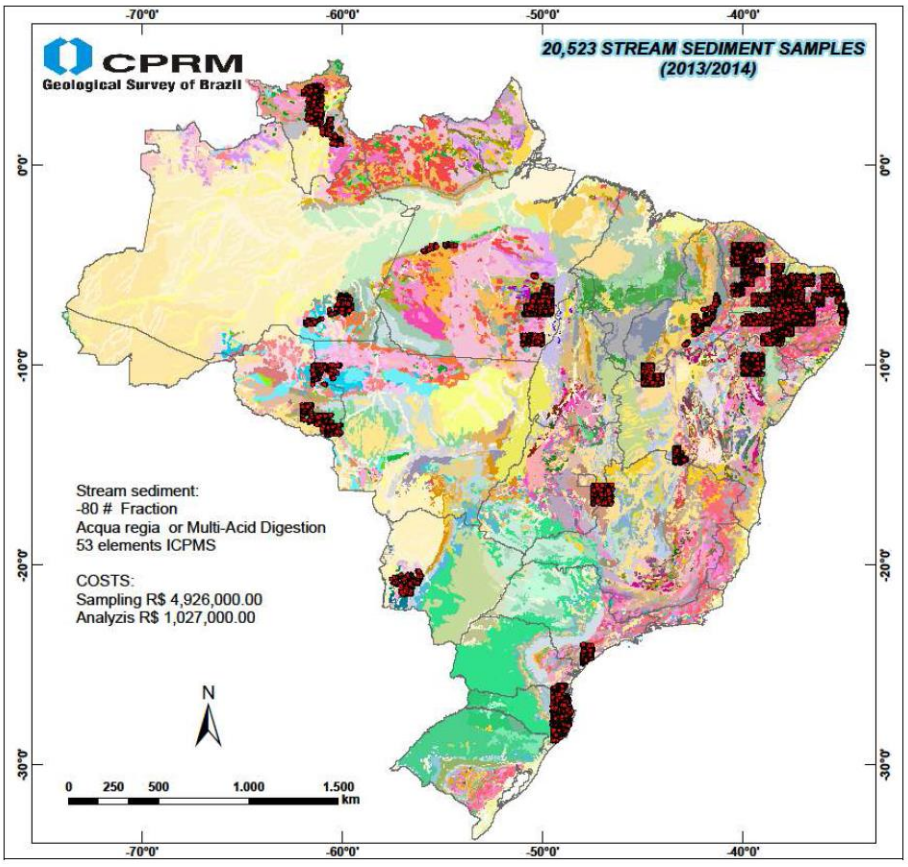


Figure 4. Stream-sediment samples collected during 2013 and 2014 in Brazil.

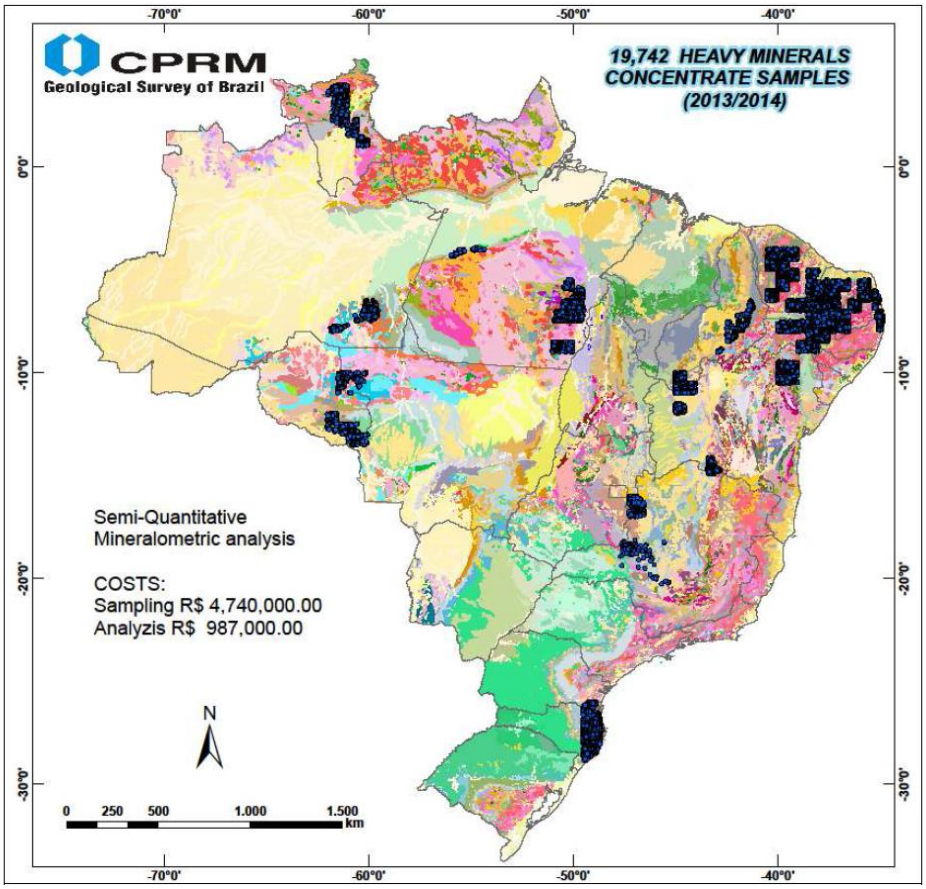


Figure 5. Heavy-mineral-concentrate samples collected during 2013 and 2014 in Brazil.

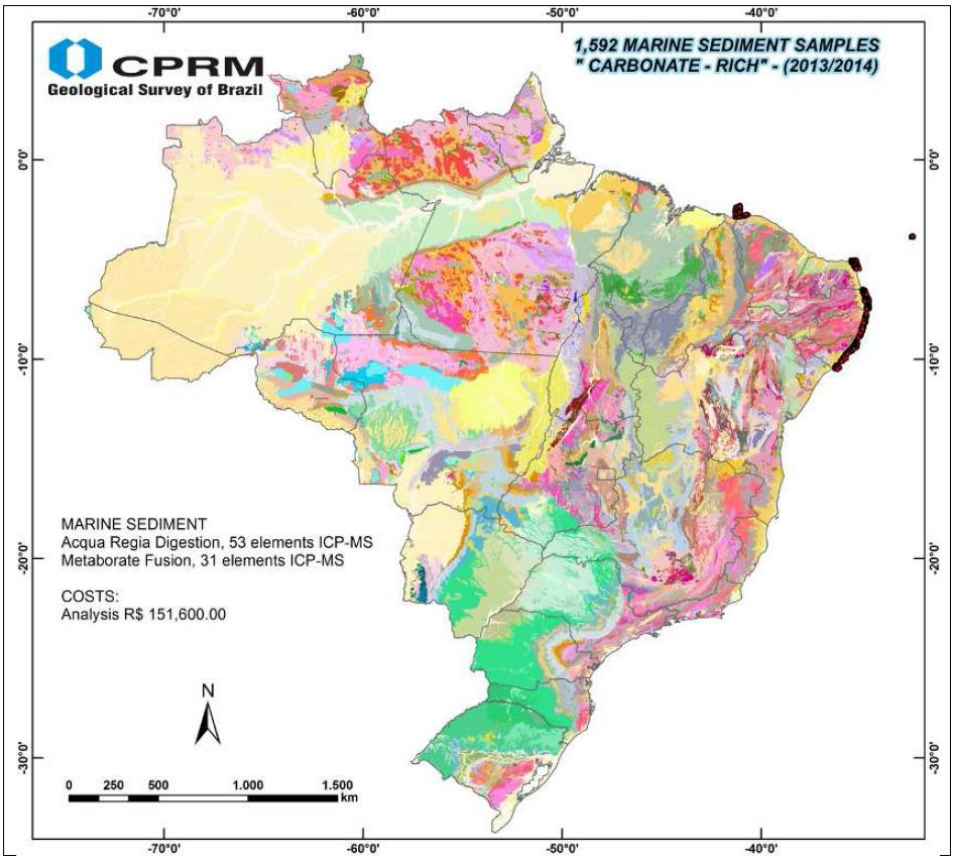


Figure 6. Marine sediments collected during 2013 and 2014 in Brazil.

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 growing of Chile by: (1) the definition of geochemical baselines, and (2) the identification of mineral resources.

From 2011-2014, the Government of Chile has provided funding of approximately US$ 2,000,000 for fieldwork, sampling, sample preparation, chemical analyses and staff salaries.

Between 2011 and 2014, the programme has been focused in the northern part of Chile (Figure 7). During this period an area of approximately 90,000 km^2 has been sampled with a density of 1 sample site per 20 km^2.

The sample types include stream and surface sediment (soil) samples. The samples are prepared in the laboratory of SERNAGEOMIN. This process involves the drying, sieving, and agate grinding of the samples to collect a fraction of <180 μm, which is analysed through ICP (AcmeLabs), in order to obtain the concentrations of 59 chemical elements and compounds.

The geochemical data have been used to produce 1:250,000-scale geochemical maps, each corresponding to an active PDF file that allows the combinations of distinct layers of the geochemical information in a simple and practical manner from any computer. As a complement, the active PDF file includes geographical information, geological and mining information, and basic statistics of the geochemical data. The visualization of these geochemical maps allows the identification of areas with anomalous concentrations of elements or compounds of economic or environmental interest (Figure 8).

Additionally, the geochemical data of each 1:250,000 geochemical map are compiled in an Excel spreadsheet. This geochemical database also includes georeference information and geological observations associated with each sample.

During 2013, the first 1:250.000 geochemical map of Chile was published (Iquique sheet; Figure 7). During 2014, two geochemical maps (Arica and Pisagua sheets) and three geochemical databases (Arica, Pisagua and Iquique sheets) have been under edition. Also, during this year, fieldwork and geochemical sampling of the El Salvador and Taltal 1:250,000 sheets (Figure 7) have been carried out.

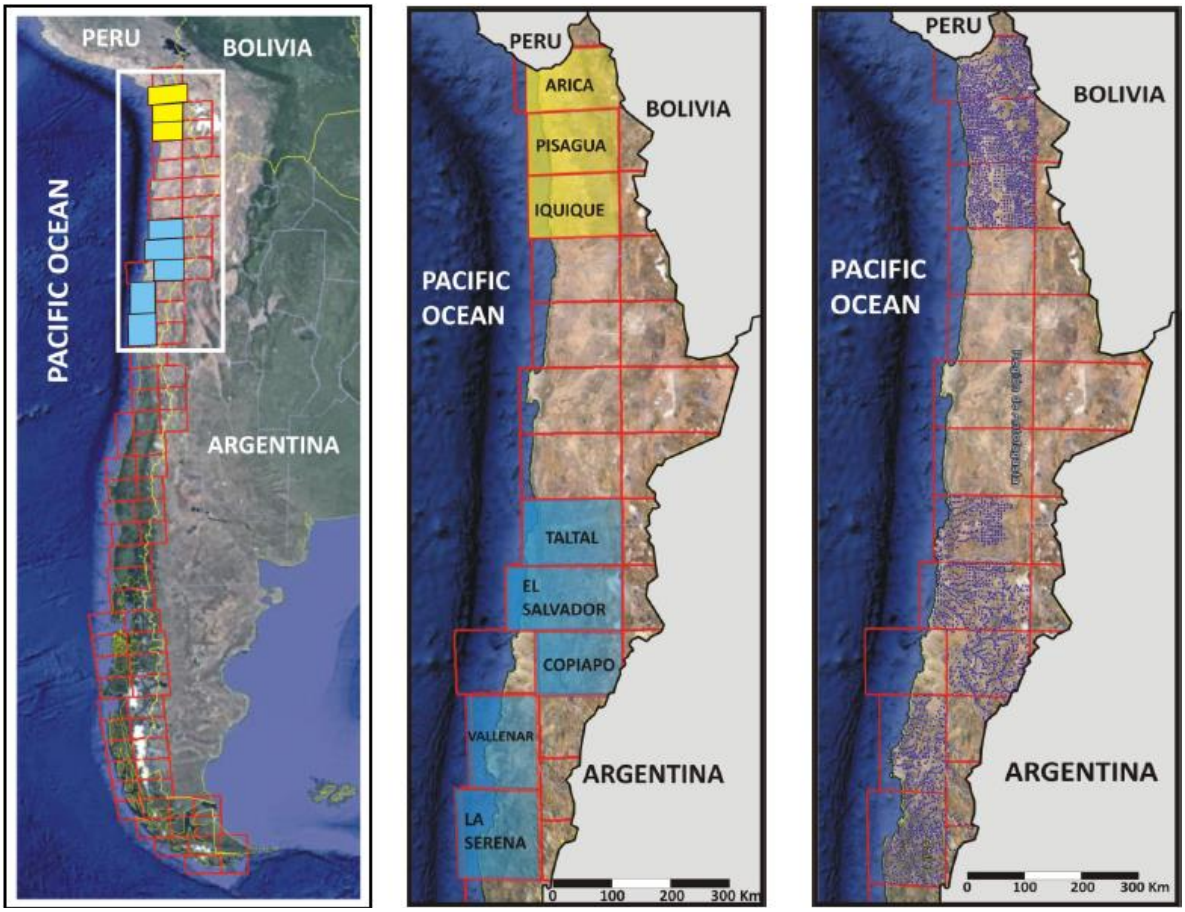


Figure 7. Map showing the location of sampling sites (blue dots) in the northern part of Chile (between 18-30° Lat. S). It represents approximately 5000 stream sediment and soil samples. The red lines show the limits of the 1:250.000 scale sheets (unit area for the geochemical map). The yellow sheets correspond to the more advanced geochemical maps and databases (already published or finishing their edition process). The blue sheets correspond to geochemical maps and databases that have not started their edition process yet.

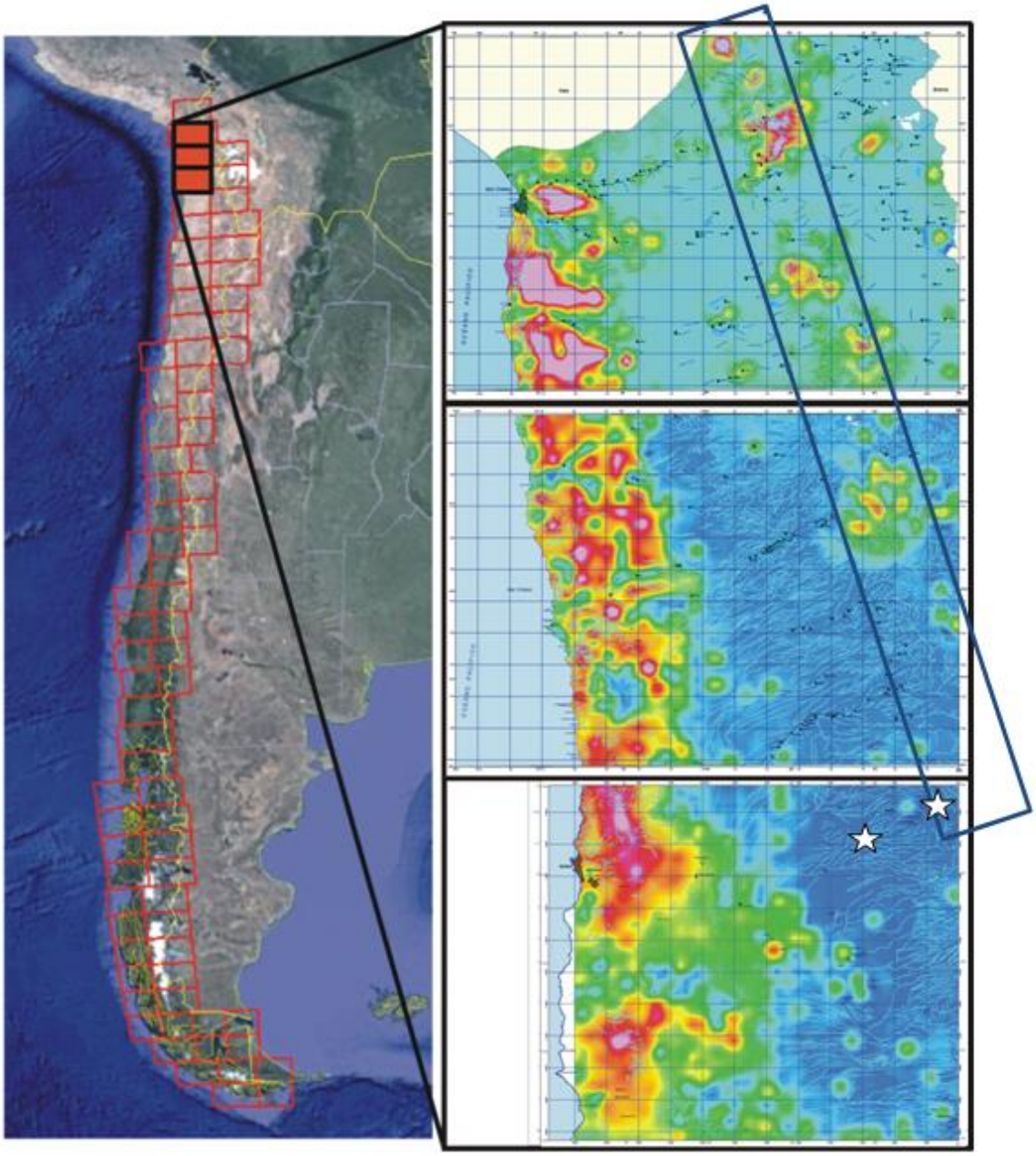


Figure 8. Geochemical maps showing the distribution of the concentrations of selenium (Se) in northern Chile, resulting after integrating the geochemical maps of the Arica, Pisagua and Iquique sheets. For each sheet, the interpolation maps of concentrations were developed after the processing of the original data through kriging and using a spherical model. High concentrations are represented by '*hot*' colours (magenta, red and orange), whereas low concentrations are represented by '*cold*' colours (green, light blue and blue). High values of Se are typical of the coastal geomorphological domain, which reflect a strong influence of marine aerosol, and the prevalence of hyper-arid conditions. The stars show the position of major Cu deposits in this area.

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

The Geological Survey of Colombia continues conducting systematic geochemical sampling at different densities throughout the country (Figure 9).

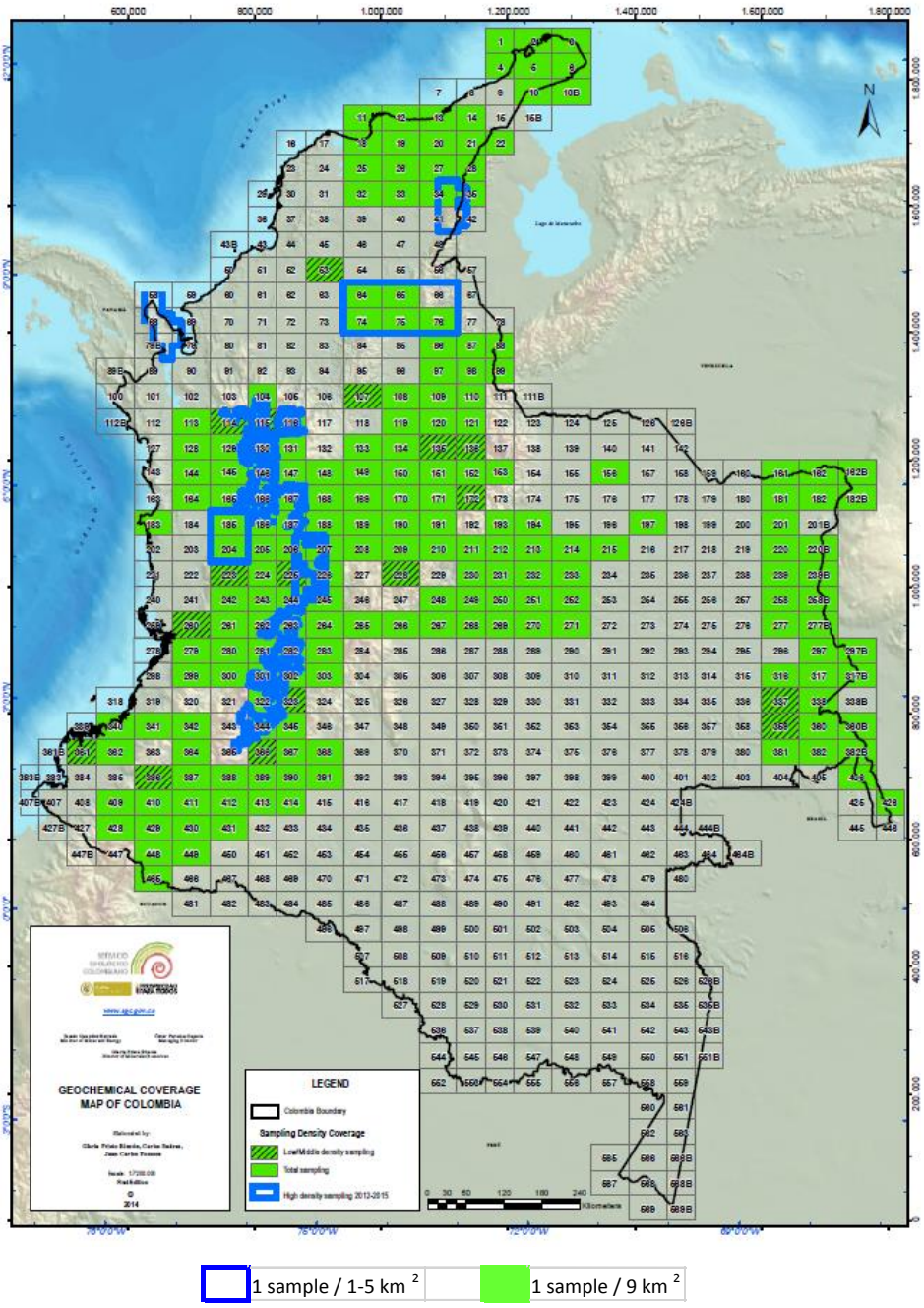


Figure 9. Geochemical sampling coverage of Colombia.

During 2014, geochemical sampling was continued in areas declared as strategic for the national government. These areas comprise the Andean region and the Eastern part of Colombia (Figure 9 in blue).

At each sample site samples of stream sediment, panned concentrate, and rock were collected following standardised methodologies, based on the recommendations of the Global Geochemical Baselines Project adapted to the Colombian conditions and landscape (Figure 10).

Figure 10. Stream-sediment sampling in Colombia.

During 2014, a total of 6765 km^2 was covered collecting 1 sample/3 km^2 in areas located in the Western and Central Cordillera belonging to the Andean region (Figure 9 in blue). In each sampled zone, geological reconnaissance and mineralogical studies were also carried out for the purpose of mineral exploration. Other smaller areas (1000 km^2) were sampled collecting 1 sample/1-3 km^2.

Last October, another sampling programme was initiated to cover 28,000 km^2 with 4000 samples at a density of 1 sample/5 km^2. This programme will be completed during the first quarter of 2015.

As a result of the geochemical sampling programme a total of 10378 stream sediment, 200 panned concentrate, and 500 rock samples were collected.

The collected samples have been analysed in the geochemistry laboratories of the Geological Survey of Colombia, following standardised methodologies for 60 elements, using analytical methods, such us ICP-MS, ICP-AES, XRF AAS, and specific methodologies for gold and mineral studies.

The geochemical data are organised, and stored in the geochemical database of the Geological Survey. All the data are processed using statistics and geostatistics software (SPSS and Geosoft – geochemistry) in order to produce geochemical maps (dots and colour surface) (Figure 11).

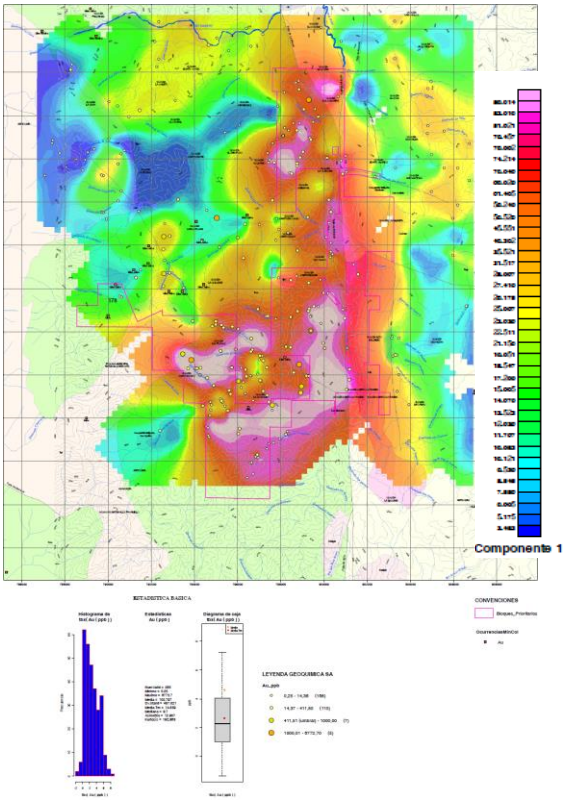


Figure 11. An example of a colour surface element distribution map produced for sampled areas.

In order to contribute to the Colombian mining sector, the Geological Survey has initiated a project to establish geochemical baselines in a region where a new gold deposit was discovered. This study will evaluate the potential for generation of acid rock drainage in this area.

To complement the geochemical knowledge of the territory, an airborne Gamma-spectrometry programme was initiated covering 438,000 km^2 in the Andes Region and in the Orinoquia – Amazonia region of Colombia. This effort will map U, K, Th domains (production lines each 500 - 1000 m, 5000 - 10000 m control lines, altitude 100 – 300m). This project will be completed in 2015 (Figure 12).

The Geological Survey of Colombia will continue to carry out its regional geochemical mapping programme at different sampling densities during 2015 to cover new zones located in the Andean, Caribbean and Eastern Regions in order to accomplish its goal of producing the geochemical atlas of Colombia.

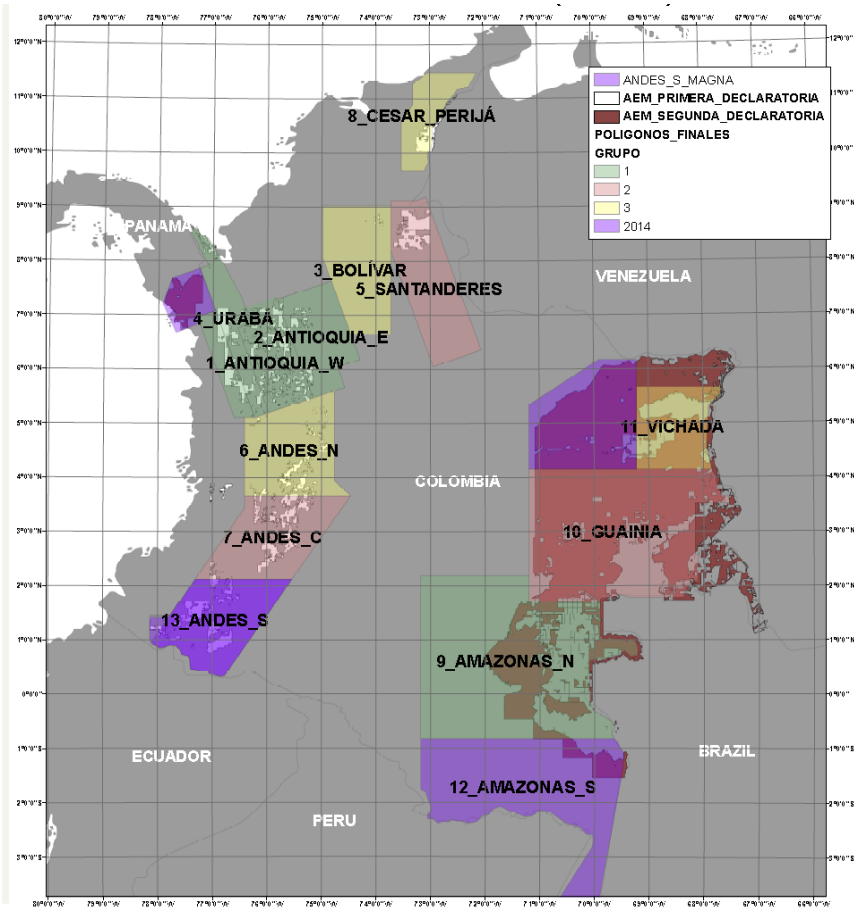


Figure 12. Areas for airborne Gamma-spectrometry programme (U, K, Th) in Colombia.

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 published in 2015.

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. 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 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 geochemical atlas will be published in 2014.

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 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.

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 published in 2014, and presented to State Authorities in September 2014.

AFRICA

Africa *(Erick Towett, World Agroforestry Centre (ICRAF), Nairobi, Kenya)*

Although soil is recognised to be critically important, our knowledge of the concentration of naturally-occurring elements in soil is limited, especially for many sub-Saharan Africa

landscapes. The globally integrated Africa Soil Information Service (AfSIS) project (www.africasoils.net) was established to address the need for accurate up-to-date and spatially referenced soil information to support agriculture in Africa. A baseline probability sample of soil has been analysed for total element concentrations and soil mineralogical composition. The sample consists of 60 sentinel sites of 10 x 10 km each that are statistically representative of the variability in climate, topography and vegetation of ~17.5 million km^2 of continental sub-Saharan Africa (SSA), an area that encompasses more than 90% of Africa's human population living in 42 countries. The Topsoil (0-20 cm) and subsoil (20–50 cm) samples were taken from 160 randomised locations within each sentinel site. Total element analysis was conducted using total X-ray fluorescence spectroscopy on a stratified random sample of 10% of the total sample set. We also obtained mid-infrared diffuse reflectance spectra, extractable elements, mineralogy, organic carbon, and physical parameters on the same samples. We expect to make the full data set available in 2015, but in the meantime a subset of the data was presented in a Kaggle data mining competition in 2014 (http://www.kaggle.com/c/afsis-soil-properties).

Africa *(Theo Davies, Mangosuthu Univeristy of Technology, Umlazi, South Africa)*

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).

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: (a) Ground water studies for water supply of various communities in the region; (b) Environmental and eco-system studies for human, plant and animal health, and (c) Assessment of the country's mineral resources for sustainable development.

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 m and 100 m, 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 soil B-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.

AUSTRALIA

Australia *(Patrice de Caritat, Geoscience Australia, Canberra)*

This year has seen the release of a few more publications on the National Geochemical Survey of Australia (NGSA) data set. Multivariate statistical analysis of the NGSA data continues. Presentations on NGSA have been made at several meetings (e.g., Third ARGA Conference in Western Australia; GES 10; GeoMap 2014 Workshop in the Czech Republic).

Visible-shortwave infrared and thermal spectroscopic analysis of the samples, which begun with a test batch of 200 samples or so in 2013, has been on hold this year due to funding cuts, but is expected to resume in 2015. Several follow-up, regional scale surveys (e.g., on the Cape York Peninsula of northern Queensland; and in the southern Thomson region of northern New South Wales and southern Queensland) were carried out in 2013 to follow up NGSA anomalies or as part of multi-disciplinary regional investigations expected to be leading up to stratigraphic drilling. These results were worked up in 2014 and will be published next year (Figure 13).

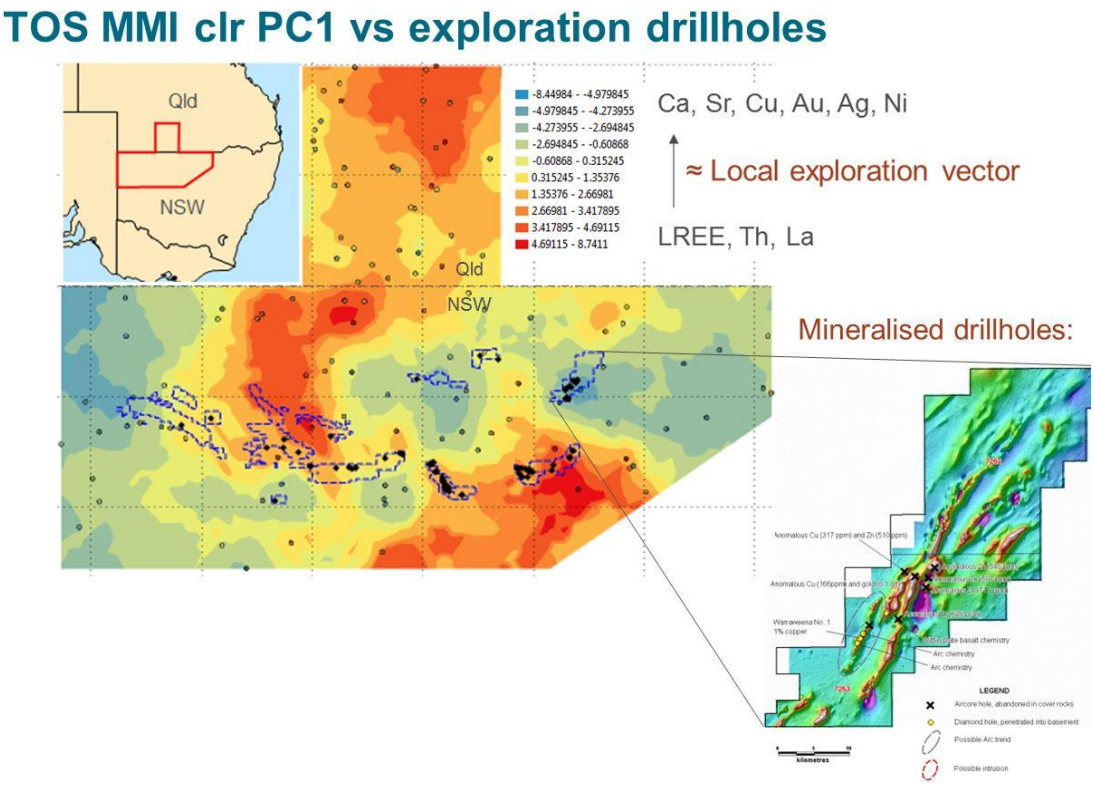


Figure 13. Map of the first Principal Component (PC1) of the Mobile Metal Ion® concentrations in catchment outlet surface samples (0-10 cm depth, open circles) from the Southern Thomson regional geochemical survey. Negative PC1 values compositionally correspond to an empirical exploration vector developed by one exploration company in the region (low REEs and high Ca, Sr, Au). Spatially, negative PC1 values coincide with mineralised intersections encountered by another explorer who drilled magnetic structures (closed circles).

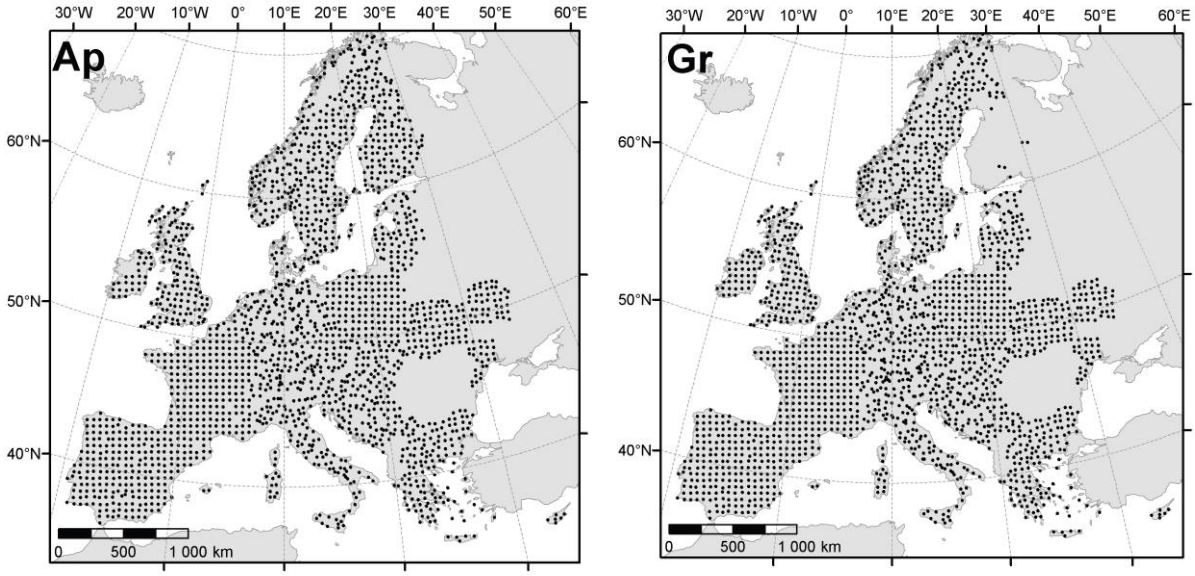
Also a higher resolution, second phase continental geochemical survey has started with soil samples being collected on a grid pattern at sites where geophysical (e.g., magneto-telluric and seismic) surveys are being deployed. This is expected to take several years, and only the first one hundred sites or so have been sampled to date.

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), under the chairmanship of Clemens Reimann of the Geological Survey of Norway, continues to be active in developing new initiatives throughout the European geochemical community. The scientific achievement of the GEG this year is the publication in April of the two-volume set of the Geochemical Atlas of Agricultural and Grazing land soil entitled "*Chemistry of Europe's Agricultural Soils*" at density of 1 sample site/2500 km^2 (Figures 14 & 15). The GEMAS project (GEochemical Mapping of Agricultural Soil) was partly funded by the European Association of Metals (http://www.eurometaux.org/) for the provision of 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).



(a) (b)

Figure 14. GEMAS project sample locations (a) agricultural soil (0-20 cm), and (b) grazing land soil (0-10 cm) according to REACH regulation specifications.

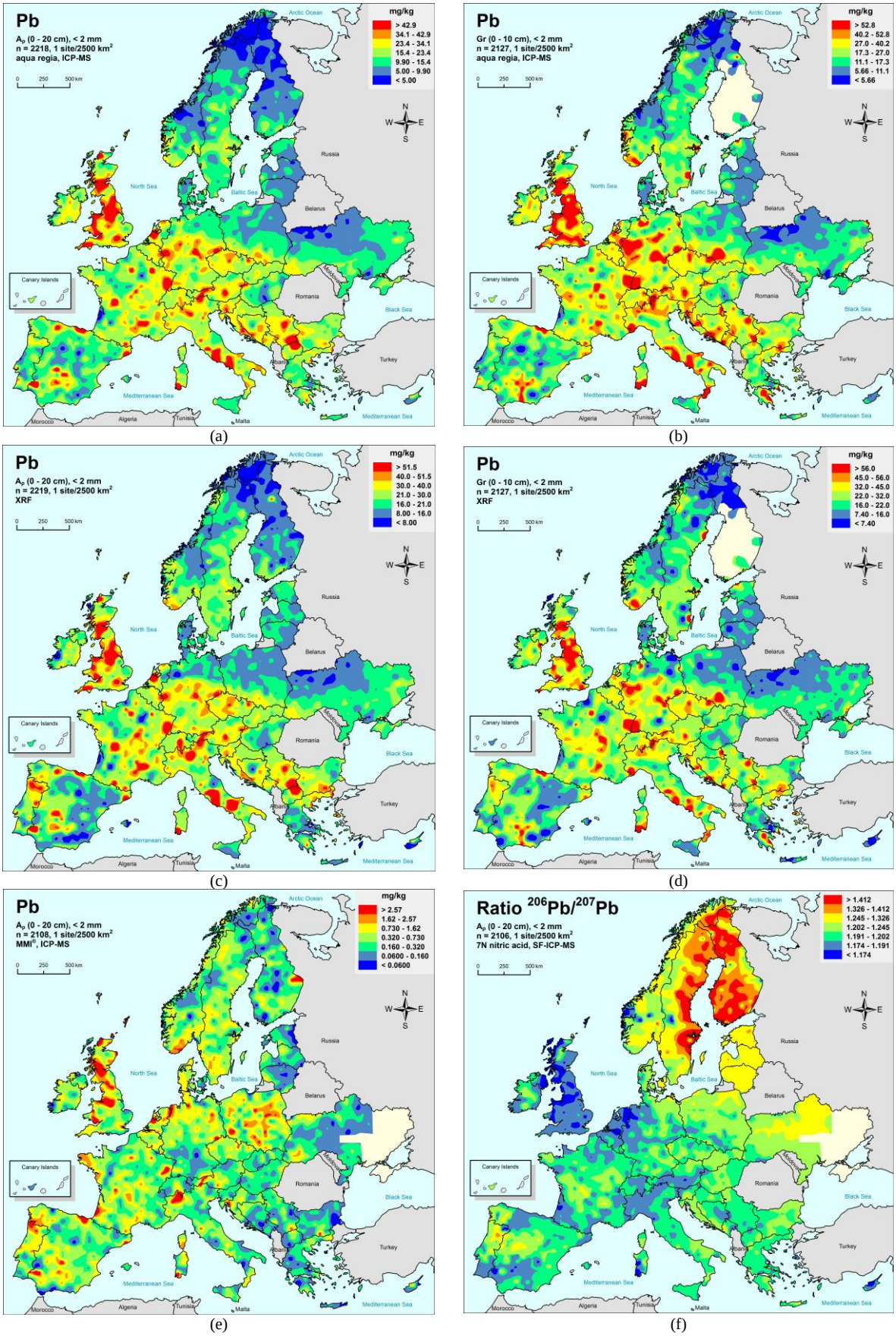


Figure 15. Distribution of Pb in Europe: (a) in agricultural (Ap) soil after an aqua regia extraction; (b) in grazing land (Gr) soil after an aqua regia extraction; (c) in agricultural soil determined by XRF; (d) in grazing land soil determined by XRF; (e) in agricultural soil after MMI® extraction, and (f) 206Pb/207Pb ratio in agricultural soil.

A three-day business meeting of the Group was held in Dublin, Ireland, from the 16th to 18th of September 2014, which was the discussion on new opportunities for future pan-European projects. Among the topics discussed are (i) Modern isotope systems on GEMAS data; (ii) Lithogeochemistry of Europe; (iii) Spring water and tap water geochemistry; (iv) Forest soil geochemistry; (v) Geochemistry of the European shelf; (vi) Geochemistry of the Atlantic Basin; (vii) Biogeochemistry; (viii) Coal and oil geochemical data; (ix) European mineral deposits geochemistry database; (x) GEMAS Follow-up projects; (xi) GEMAS-remote sensing project, and (xii) URGE-urban geochemistry – phase II.

A topic that has been discussed is the 2015 UNESCO's International Year of Soils (http://www.fao.org/globalsoilpartnership/iys-2015/en/), and the participation of EuroGeoSurveys member surveys during next year in the promotion of the work that has been carried out on soil from the continental to the local scale.

During the two-day meeting several presentations were delivered on on-going geochemical projects that are carried out by each geological survey, and continuing work on the GEMAS data set. Quality control results were presented from the Urban Geochemistry project of major European cities (URGE project); all urban soil samples were analysed at the same commercial laboratory that was used for the analysis of the GEMAS project samples. The first analyses were performed in December 2010 and the last in December 2013. The conclusion was that there are distinct differences in the analytical results of all elements among the cities, and that the results cannot be compared. Hence, it was decided that each city should submit its individual report, and a new URGE II project should start in 2016, but with a strict sampling, sample preparation and laboratory analysis schedule.

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.

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.

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/).

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 in her own time. Thus, interested people can fly directly to the sampling site and see a landscape and a soil profile photograph.

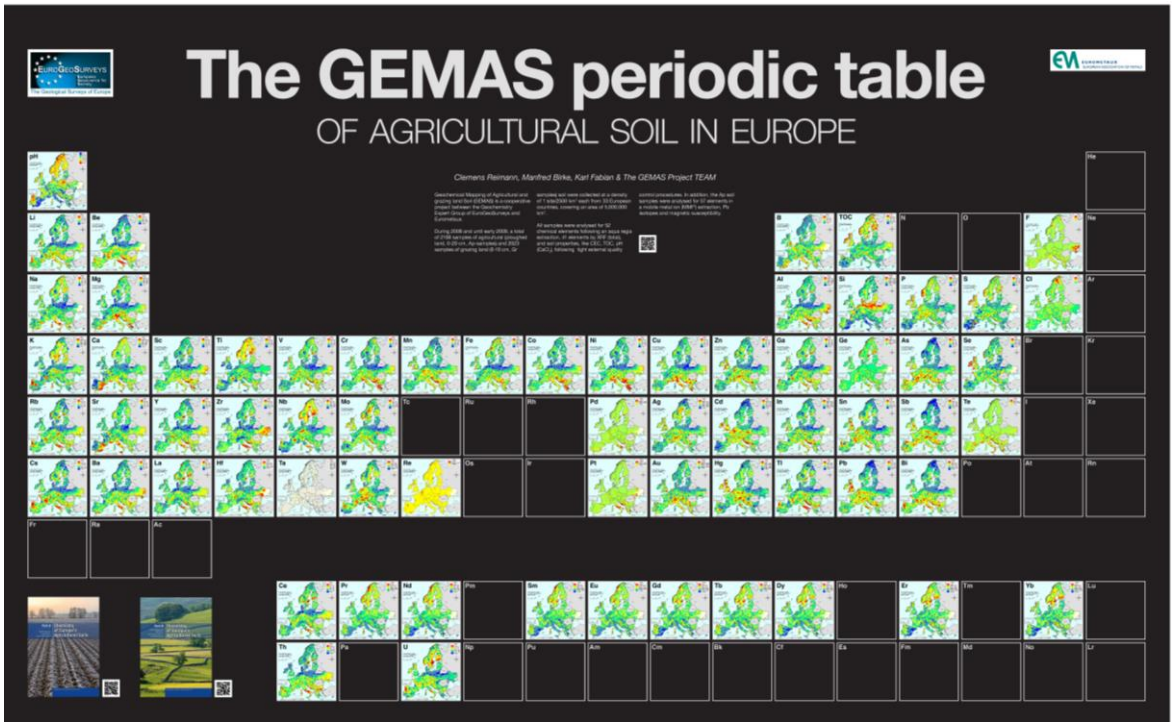


Figure 3. The GEMAS periodic table of agricultural soil in Europe (http://gemas.geolba.ac.at/Download/GEMAS_Periodic_Table_of_Elements_High_resolution.pdf).

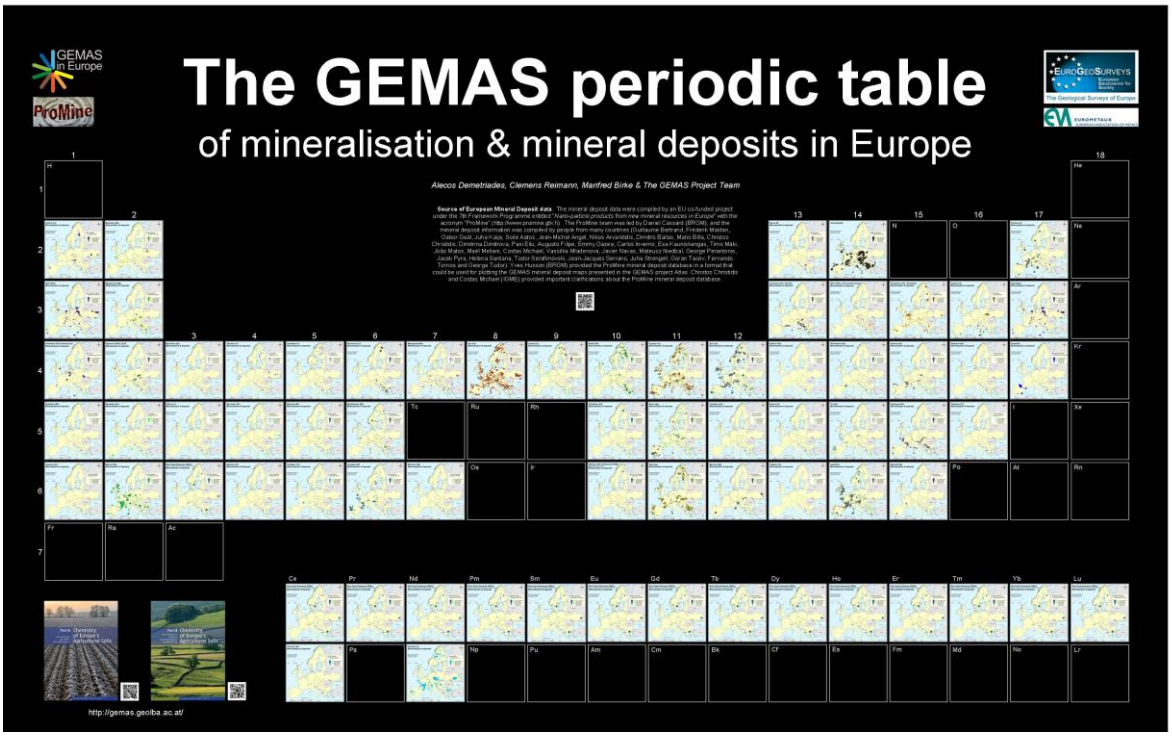


Figure 4. The GEMAS periodic table of mineralisation and mineral deposits in Europe (http://gemas.geolba.ac.at/Download/GEMAS_Mineralisation_Periodic_Table_Poster_high.pdf)

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 (Figure 16), and the GEMAS Periodic Table of Mineralisation and Mineral Deposits (Figure 17), 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 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), and other useful information, is still being distributed at international conferences, congresses and meetings. 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 DVD to honour Arthur G. Darnley (1930-2006). 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 2014, more than 1400 copies have been distributed at workshops, conferences, congresses and meetings, and also posted to interested university students and professionals.

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.

Important outcome

The Task Group is in the process of deveoping MoUs with the Geological Survey of Iran (GSI), and the Geological Society of Africa (GSAf) for training on Global Geochemical Baselines methods.

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.

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.

8. CHIEF PROBLEMS ENCOUNTERED IN 2014

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 2014

ARTICLES, PAPERS, ATLASES AND BOOKS

1. Andreas Scheib, A., 2014. *Distribution of Aeolian Deposits in Europe and Their Influence on Soil Geochemistry*. Chapter 9 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 161-168.
2. Andersson, M., Carlsson, M., Ladenberger, A., Morris, G., Sadeghi, M. & Uhlbäck, J., 2014. Geochemical Atlas of Sweden. Geological Survey of Sweden (Printed by: Elanders Sverige AB; ISBN 978-91-7403-258-1), 208 pp.
3. Baritz, R., Ernstsen, V., & Zirlewagen, D., 2014. *Carbon Concentrations in European Agricultural and Grazing Land Soil*. Chapter 6 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 117-129.
4. Birke, M., Reimann, C. & Karl Fabian, K., 2014. *Analytical Methods Used in the GEMAS Project*. Chapter 5 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part A . Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 41-46.
5. Birke, M., Reimann, C., Rauch, U., De Vivo, B., Halamić, J., Klos, V., Gosar, M. & Ladenberger, A., 2014. *Distribution of Cadmium in European Agricultural and Grazing Land Soil*. Chapter 5 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 89-115.
6. Cicchella, D., Albanese, S., Birke, M., De Vivo, B., De Vos, W., Dinelli, E., Lima, A., O'Connor, P.J., Salpeteur, I. & Tarvainen, T., 2014. *Natural Radioactive Elements U, Th and K in European Agricultural and Grazing Land Soil*. Chapter 8 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 145-159.
7. Demetriades, A., Reimann, C. & Filzmoser, P., 2014. *Evaluation of GEMAS project quality control results*. Chapter 6 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils. Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 47-60.
8. Ellefsen, K.J., Smith, D.B. & Horton, J.D., 2014. *A modified procedure for mixture-model clustering of regional geochemical data*. Applied Geochemistry, 51, 315-326, http://www.sciencedirect.com/science/article/pii/S0883292714002431

9. Fabian, C., Reimann, C., Fabian, K., Birke, M., Baritz, R., Haslinger, E. and the GEMAS Project Team, 2014. *GEMAS: Spatial distribution of the pH of European agricultural and grazing land soil*. Applied Geochemistry, 48, 207-216. http://www.sciencedirect.com/science/article/pii/S0883292714001802

10. Griffin, D.W., Silvestri, E.E., Bowling, C.Y., Boe, T., Smith, D.B. & Nichols, T.L., 2014. *Anthrax and the geochemistry of soils in the contiguous United States*. Geosciences 4(3), 114–127, doi:10.3390/geosciences4030114, http://www.mdpi.com/2076-3263/4/3/114

11. Janik, L.J., Forrester, S., Kirby, J.K., McLaughlin, M.J., Soriano-Disla, J.M. & Reimann, C., 2014. *Prediction of Metal and Metalloid Partitioning Coefficients (Kd) in Soil Using Mid-Infrared Diffuse Reflectance Spectroscopy*. Chapter 11 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 183-188.

12. Klos, V., Birke, M., Akinfiev, G. & Amashukeli, Y., 2014. *Geochemical Characteristics of Ukrainian Soil Using Landscape-Geochemical Regionalisation Based on the GEMAS Data.* Chapter 15 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 253-270.

13. Ladenberger, A., Uhläck, J., Andersson, M., Reimann, C., Tarvainen, T., Morris, G., Sadeghi, M., Eklund, M. & Filzmoser, P., 2014. *Elemental Patterns in Agricultural and Grazing Land soil in Norway, Finland and Sweden: What Have We Learned from Continental-Scale Mapping?* Chapter 14 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 235-251.

14. Liu, X., Wang, X., Caritat, P. de & Salminen, R., 2014. *Comparison of datasets obtained by global-scale geochemical sampling in Australia, China and Europe. Special issue on Continental, Regional and Local scale geochemical mapping*. Journal of Geochemical Exploration, http://www.sciencedirect.com/science/article/pii/S0375674213002501

15. Mackovych, D. & Lucivjansky, P., 2014. *Preparation of GEMAS Project Samples and Standards*. Chapter 4 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part A . Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 37-40.

16. Mann, A., Reimann, C., Caritat, P. de & Nicholas Turner, N., 2014. *Mobile Metal Ion Analysis of European Agricultural Soil*. Chapter 13 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 203-231.

17. Mueller, U., Lo, J., Caritat, P. de & Grunsky, E., 2014. *Structural analysis of the National Geochemical Survey of Australia data*. Mathematics of Planet Earth. Proceedings of the 15th Annual Conference of the International Association for Mathematical Geosciences. Lectures Notes in Earth System Sciences, Springer: 99-102.

18. Oorts, K. & Schoeters, I., 2014. *Use of Monitoring Data for Risk Assessment of Metals in Soil under the European REACH Regulation*. Chapter 12 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 189-202.

19. Poňavič, M. & Scheib, A., 2014. *Distribution of Selenium in European Agricultural and Grazing Land Soil*. Chapter 7 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 131-144.

20. Reimann, C. & Cornelia Kriete, C., 2014. *Trueness of GEMAS Analytical Results - the Ring Test.* Chapter 7 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part A . Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 61-65.

21. Reimann, C. & Ladenberger, A., 2014. *EuroGeoSurveys' geochemical soil mapping of Europe.* Géosciences, BRGM's journal for sustainable Earth, Special Issue: Les sols, No. 18, 90-91.

22. Reimann, C., Birke, M., Demetriades, A., Filzmoser, P. & O'Connor, P. (Editors), 2014. *Chemistry of Europe's agricultural soils – Part A: Methodology and interpretation of the GEMAS data set*. Geologisches Jahrbuch (Reihe B 102), Schweizerbarth, Hannover, 528 pp. http://www.schweizerbart.de/publications/detail/isbn/9783510968466

23. Reimann, C., Birke, M., Demetriades, A., Filzmoser, P. & O'Connor, P. (Editors), 2014. *Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set*. Geologisches Jahrbuch (Reihe B 103), Schweizerbarth, Hannover, 352 pp. http://www.schweizerbart.de/publications/detail/isbn/9783510968473/Geologisches_Jahrbuch

24. Reimann, C., Demetriades, A., Birke, M. & Schoeters, I., 2014. *The GEMAS Project - Concept and Background.* Chapter 1 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils. Geologisches Jahrbuch (Reihe B), Schweizerbarth, Hannover, 23-25.

25. Reimann, C., Demetriades, A., Birke, M., Filzmoser P., O'Connor, P., Halamić, J., Ladenberger, A. & the GEMAS Project Team, 2014. *Distribution of elements/ parameters in agricultural and grazing land soil of Europe.* Chapter 11 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part A . Geologisches Jahrbuch (Reihe B102), Schweizerbarth, Hannover, 103-474.

26. Saaltink, R., Griffioen, J., Mol, G., Birke, M., The GEMAS Project Team, 2014. *Geogenic and agricultural controls on the geochemical composition of European agricultural soils*. Journal of Soils and Sediments, 14(1), 121-137. http://link.springer.com/article/10.1007%2Fs11368-013-0779-y

27. Salminen, R., Birke, M., Reimann, C., Gregorauskiene, V. & Wang, X., 2014. *Distribution of Boron, Chlorine and Fluorine in European Topsoil and Subsoil (based on samples from the FOREGS project).* Chapter 10 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of

the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 169-180.

28. Scheib, A.J., Birke, M., Dinelli, E., GEMAS Project Team, 2014. *Geochemical evidence of aeolian deposits in European soils.* Boreas, 43(1), 175-192. http://onlinelibrary.wiley.com/doi/10.1111/bor.12029/abstract
29. Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, F., Ellefsen, K.J., 2014. *Geochemical and mineralogical maps for soils of the conterminous United States*. U.S. Geological Survey Open-File Report 2014-1082, 386 pp., http://pubs.usgs.gov/of/2014/1082/
30. Tarvainen, T., Birke, M., Reimann, C., Poňavič, M. & Albanese, S., 2014. *Arsenic Anomalies in European Agricultural and Grazing Land Soil.* Chapter 4 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 81-88.
31. Verougstraete, V. & Ilse Schoeters, I., 2014. *REACH and GEMAS*. Chapter 2 In: C. Reimann, M. Birke, A. Demetriades, P. Filzmoser & P. O'Connor (Editors), Chemistry of Europe's agricultural soils – Part B: General background information and further analysis of the GEMAS data set. Geologisches Jahrbuch (Reihe B103), Schweizerbarth, Hannover, 27-29.
32. Zhao, G., He., F., Dai, X., Zhang, S. & Yu, R., 2014. *Ultra-low density geochemical mapping in Zimbabwe*. Journal of Geochemical Exploration 144, part C, 552-571, http://www.sciencedirect.com/science/article/pii/S0375674213002203

ORAL AND POSTER PRESENTATIONS

11th Finnish Geochemical Meeting, 5-6 February 2014, Geological Survey of Finland, Espoo:

Tarvainen, T., Reimann, C., Eklund, M. & The GEMAS Project Team: *Euroopan maatalousmaiden ja laidunmaiden geokemia (GEMAS)*. Page 10 in Pertti Sarala (Editor) 11. Geokemian Päivät – 11th Finnish Geochemical Meeting, 5.-6.2.2014 GTK, Espoo. Vuorimiesyhdistys, Sarja B, 97, 43 p.

Third Australian Regolith Geoscientists Association (ARGA) Conference, Bunbury, Western Australia, 6-7 February 2014:

Thomas, M., Cudahy, T., Caritat, P. de, Laucamp, C., Lau, I.C., Cacetta, M., Ong, C., Ribeiro, L. & Pejcic, B.: *Validating the Australian ASTER geoscience maps using the National Geochemical Survey of Australia surface regolith samples*. Abstract in Proceedings, 32-34.

1st International Specialised Congress on Geoscience, and the 32nd National Symposium and the 16-19 February 2014, Geological Survey of Iran, Tehran, Iran (http://nigc.conference.gsi.ir/en):

Keynote presentation: Demetriades, A., Wang, X. & Reeder, S.: *Global Geochemical Baselines for environmental and mineral resource management*.

Workshop on Continental-scale Geochemical Mapping, 15 February 2011, Mineral exploration Department, Geological Survey of Iran:

Demetriades, A.: *Sampling at the continental scale (FOREGS & GEMAS).*

Demetriades, A.: *FOREGS laboratory scheme.*

Demetriades, A.: *FOREGS quality control scheme.*

Demetriades, A.: *Geochemical data management and map generation.*

Demetriades, A.: *Application of geochemical mapping for mineral exploration and environmental assessment.*

Demetriades, A.: *Organisation and management of European geochemical projects (FOREGS & GEMAS).*

First Joint EARSeL LULC - NASA LCLUC Workshop "Frontiers in Earth Observation for Land System Science", Berlin, Germany, 17-18 March 2014 (https://www.geographie.hu-berlin.de/labs/geomatics/events/earsel-en/workshop):

Cudahy, T., Caccetta, M., Bihong, F., Pilong, S., Linyan, B., Thomas, M., Caritat, P. de, Caccetta, P., Collings, S., Chia, J., Abrams, M., Kato, M., Ninomiya, Y., Ong, C., Guerschaman, J.P. & Mitchell, R.: *Global mapping and monitoring dryland desertification (clay loss) using SWIR+TIR EO data*.

European Geosciences Union General Assembly 2014, Vienna, Austria, 27 April - 2 May 2014 (http://www.egu2014.eu/):

Oral Session, 28 April 2014: SSS11.7/ESSI3.4/GI3.8 - GEMAS - Geochemical mapping of agricultural and grazing land soil in Europe (http://meetingorganizer.copernicus.org/EGU2014/orals/14793)

Reimann, C., Birke, M., Demetriades, A., Filzmoser, P. & O'Connor, P.: *GEMAS: Geochemical Mapping of the agricultural and grasing land soils of Europe.*

Mol, G., Saaltink, R., Griffioen, J., Manfred Birke, M.: *Geogenic and agricultural controls on the geochemical composition of European agricultural soils.*

De Vivo, B., Cicchella, D., Albanese, S., Dinelli, E., Giaccio, L., Lima, A. & Valera, P.: *The geochemical atlas of Italian soils.*

Oorts, K. and Schoeters, I.: *GEMAS: Use of monitoring data for risk assessment of metals in soil.*

Birke, M., Reimann, C., Demetriades, A., Dinelli, E., Halamić, J., Rauch, U., Gosar, M., Ladenberger, A., Klos, V., De Vivo, B. & the GEMAS Project Team: *GEMAS: Geochemical Distribution of Cadmium in European Soil.*

Ottesen, R.T., Birke, B., Gosar, M., and Reimann, C.: *GEMAS: Mercury in European agricultural and grazing land soils - sources and environmental risk.*

Ladenberger, A., Sadeghi, M., Demetriades, A., Reimann, C., Birke, M., Andersson, M., Jonsson, E. & the GEMAS Project Team: *GEMAS: Concentrations and origin of indium in agricultural soil of Europe.*

Sadeghi, M., Andersson, M., Ladenberger, A., Uhlbäck, J., Mann, A. & Turner, N.: *REE contents in agricultural soil of Sweden (GEMAS): Comparison of weak MMI® extraction with near total concentrations.*

Ernstsen, V., Ladenberger, A., Wragg, J. & Gulan, A.: *GEMAS - Soil geochemistry and health implications.*

UN Danube Convention, Bratislava, Slovakia, 8 - 9 April 2014. 20th Pressures and Measures Expert Group (PM EG) Meeting:

Jordan, G.: *Geochemical mapping: Supporting ICPDR.*

NOTE: Promoting GEMAS for direct EU WFD and other EU legislation implementation in the Danube Basin.

European Geosciences Union General Assembly 2014, Vienna, Austria, 27 April - 2 May 2014 (http://www.egu2014.eu/):

Poster Session, 28 April 2014: SSS11.7/ESSI3.4/GI3.8 - GEMAS - Geochemical mapping of agricultural and grazing land soil in Europe

Albanese, S., Sadeghi, M., De Vivo, B., Lima, A., Cicchella, D., Dinelli, E. & The GEMAS Team. *Nickel, Cobalt, Chromium and Copper in agricultural and grazing land soils of Europe*.

Batista, M.J., Filipe, A., Reimann, C. & the GEMAS Team. *GEMAS - Tin and Tungsten: possible sources of enriched concentrations in soils in European countries*.

De Vivo, B., Cicchella, D., Albanese, S., Birke, M., Demetriades, A., De Vos, W., Dinelli, E., Lima, A., O' Connor, P.J., Salpeteur, I., Tarvainen, T. & The GEMAS Team. *Uranium, Thorium and Potassium concentrations in agricultural and grazing land soils of Europe*.

Demetriades, A., Birke, M., Reimann, C., Mann, A., Kaminari, M. & the GEMAS Project Team. *GEMAS: Geochemical Distribution of Thallium in European Soil.*

Demetriades, A., Reimann, C., Birke, M., Mann, A., Eilu, P., De Vivo, B., Cicchella, D., Kaminari, M. & Rothenbacher, K.. *GEMAS: Geochemical distribution of precious metals in European soil.*

Dinelli, E., Birke, M., Reimann, C., Demetriades, A., DeVivo, B., Dee Flight, D., Ladenberger, A., Albanese, S., Cicchella, D., Lima, A. & the GEMAS Project Team. *GEMAS: issues from the comparison of aqua regia and X-ray fluorescence results.*

Dusza-Dobek, A., Pasieczna, A. & Kwecko, P. *GEMAS: Distribution of major elements in Polish agricultural soil.*

Fabian, C., Reimann, C., Fabian, K., Baritz, R. & Haslinger, E. *GEMAS: The continental scale influences on the pH of European agricultural and grazing land soil*.

Fabian, K. & Reimann, C. *GEMAS: A unique data set to define magnetic susceptibility variability of European agricultural soil*.

Haslinger, E., Jordan, G., Slaninka, I., Sorsa, A., Gulan, A., Gosar, M., Hratovic, H. & Klos, V. *GEMAS results from the Pannonian Basin - geochemical signatures in a transnational geological structure*.

Ladenberger, A.K., Uhlbäck, J., Andersson, M., Reimann, C. Tarvainen, T., Sadeghi, M., Morris, G. & Eklund, M. *GEMAS: The Fennoscandian perspective*.

Negrel, P., Martiya Sadeghi, M., Ladenberger, A., Birke, M. & Reimann, C. *Geochemical fingerprinting and source discrimination in soils at the continental scale*.

Petrosino, P., Sadeghi, M., Andersson, M., Albanese, S., Dinelli, E., Valera, P., Ladenberger, A., Morris, G., Uhlbäck, J., Lima, A. & De Vivo, B. *Comparing REE*

distribution in GEMAS agricultural soils and FOREGS topsoils-subsoils in Italy and Sweden.

Reimann, C., Négrel, P., Flem, B., Fabian, K., Birke, M., Ladenberger, A. & Hoogewerff, J. *GEMAS: a new view of the lead isotopic soil landscape at the European continental scale.*

Smith, D., Woodruff, L., Reimann, C. & Flem, B.. *Variations in Pb concentrations and Pb-isotope ratios in soils collected along an east-west transect across the United States*.

Tarvainen, T., Reimann, C., Albanese, S., Birke, M., Poňavič, M., Ladenberger, A. & the GEMAS Project Team. *European GEMAS mapping of agricultural soils: Arsenic results*.

Institute on Lake Superior Geology, 2014 Annual Meeting, Hibbing, Minnesota, USA, 15-16 May 2014:

Woodruff, L.G., Cannon, W.F., Solano, F. & Smith, D.B.: *Soil geochemistry and mineralogy of glacial soils in the Upper Midwest.*

21st Panhellenic Meeting of ArcGIS users, 23 & 24 May 2014, Crowne Plaza Hotel, Athens, Hellas. Organised by Marathon Data Systems:

Demetriades, A., Kaminari, M., Reimann, C., Birke, M., Filzmoser, P., O'Connor, P., & The GEMAS Project Team. *GEMAS: The first public presentation in Hellas of the two-volume soil geochemical atlas of agricultural and grazing land soil of Europe and accompanying DVD.*

Poster: *GEMAS Periodic Table of Elements*

Raw Materials University Day: Future, needs and opportunities. Megaron - The Athens Concert Hall, Room Banquet, 19 June 2014. Organised by the National Technical University of Athens and the National and Kapodistrian University of Athens:

Presentation of two posters:

- *The GEMAS Periodic Table of Elements*
- *The GEMAS Periodic Table of Mineralisation & Mineral deposits*

First International Workshop on Practical Aspects of Geochemical Exploration and Mapping with Logratio Techniques, Olomouc, Czech Republic, 17-20 July 2014:

Ellefsen, K.J. & Smith, D.B.: *Quantifying uncertainty in maps of element concentrations.*

3rd Young Earth Scientists (YES) Congress: "Bridging Geo-Generations into Global Earth Sciences Integration", 11-14 August 2014, Julius Nyerere International Convention Centre (Bagamoyo Room, 2nd Floor), Dar es Salaam, Tanzania
(http://www.yescongress.org/2014/;

http://www.cag25.or.tz/downloads/Third%20Circular%20for%20YES%20&%20CAG25_2014.pdf):

TW3: International Geochemical Mapping and African Geochemical Baselines Workshop, 12-13 August 2014

Demetriades, A.: *Introduction to applied geochemistry*.

Wang, X.: *Geochemical mapping: Principles and methodologies*

Wang, X.: Global-scale geochemical mapping - Global Geochemical Baselines

Demetriades, A.: *Sampling at the continental scale*.

Demetriades, A.: *FOREGS laboratory scheme*.

Demetriades, A.: *FOREGS quality control scheme*.

Wang, X.: *Regional/National geochemical mapping*

Demetriades, A.: *Geochemical data management and map generation*.

Demetriades, A.: *Application of geochemical mapping for mineral exploration and environmental assessment*.

Demetriades, A.: *Application of geochemical mapping for environmental assessment*

Wang, X.: *A proposal for geochemical mapping in Africa*

Tenth International Symposium on the Geochemistry of the Earth's Surface (GES-10), Paris, France, 18-22 August 2014:

Wilford, J., Caritat, P. de & Bui, E.: *Predictive mapping of critical zone geochemistry* (poster).

MTT Agrifood Research Finland scientist meeting, MTT headquarters, Jokioinen, Finland, 2 October 2014:

Tarvainen, T., Reimann, C., Eklund, M. & The GEMAS Project Team: *Euroopan maatalousmaiden ja laidunmaiden geokemia (GEMAS)* (in Finnish).

EuroGeoSurveys Geochemistry Expert Group annual meeting, Geological Survey of Ireland, Lambay Hall, Chartered Accountants House, 47-49 Pearse Street, Dublin 2, Ireland, 16-18 September 2014:

Demetriades, A.: *Geochemistry put into the global perspective: Report from IUGS/IAGC Task Group on Global Geochemical Baselines*.

Demetriades, A.: *Historical outline of the WEGS, FOREGS and EuroGeoSurveys Geochemistry Group 1986-2014*

Eggen, O. & Reimann, C.: Recent *experiences with quality control on ACME results*

Cave, M.: *Lead in London soil and its relationship to regulatory guidelines*

Batista, M.J.: *Drill-hole geochemistry and gravity inversion with data from Neves Corvo mining area*

Tarvainen, T.: *Sampling and analysis in the ASROCKS project: Aggregated production in As rich areas*

Jordan, G. (other co-authors not present at the meeting: P. Völgyesi, D. Zacháry, Cs, Szabó, A. Bartha, J. Matschullat, M. Gosar & M. Miler): *Attic dust reflects long-term airborne contamination of an industrial area. Chemistry, mineralogy and spatial analysis*

Ladenberger, A. & Uhlbäck, J. (other co-authors not present at the meeting: Madelen Andersson, George Morris, Sten-Åke Ohlsson, Mikael Carlsson, Martiya Sadeghi): *On-going projects at SGU: Geochemical Atlas of Sweden and regional mapping of the Swedish Arctic.*

Ernstsen, V.: *Status of applied geochemistry at GEUS - Iodine in the hydrological cycle in Denmark: implications for human health*

Philippe, N.: *Geochemical fingerprinting and sources discrimination in soil at the continental scale*

Jordan, G. (other co-authors not present at the meeting: K.Zs. Szabó, A. Horváth, Cs. Szabó): *Mapping the geogenic radon potential: methodology and spatio-temporal analysis*

Demetriades, A.: *URGE status report and presentation of results so far*

Philippe, N.: *Calcium and Sr isotopes as tracers of silicate weathering in small catchments: new insights in soil and sediments from basaltic and granitic catchments*

Mateja, G. & Tamara, T.: *Anthropogenic mercury loads in stream sediments affected by ancient ore roasting sites, Idrija area, Slovenia*

Reimann, C.: *Recent experiences with biogeochemistry in Norway*

Scanlon, R.: *The Tellus Border Project*

Scanlon, R. & Knights, K.: *The Tellus North Midlands Project*

Batista, M.: *Promine Project in Portugal*

EuroGeoSurveys Geochemistry Expert Group, Dublin, Ireland, 16th September 2014

Geological Society of America Annual Meetings, Vancouver, B.C., Canada, 19–22 October 2014:

Smith, D.B., Woodruff, L.G., Cannon, W.F. & Solano, F.: *Distribution of Pb, Cd, Cr, Cu, Zn, Ni, and Ba in soils of the conterminous United States.*

30th Annual International Conference on Soils, Sediments, Water, and Energy, University of Massachusetts, Amherst, Massachusetts, USA, 20–23 October 2014:

Smith, D.B., Woodruff, L.G., Cannon, W.F. & Solano, F.: *Distribution of Pb, Cd, Cr, Cu, Zn, Ni, and Ba in soils of the conterminous United States*.

Woodruff, L.G., Smith, D.B. & Cannon, W.F.: *Phosphorus in soils of the Upper Midwest, United States.*

Smith, D.B., Woodruff, L.G., Cannon, W.F. & Solano, F.: *Arsenic in soils of the conterminous United States—Results from the new national-scale soil geochemical study by the U.S. Geological Survey.*

Soil Science Society of America Annual Meeting, Long Beach, CA, USA, 2 –5 November 2014:

Ma, L., Xia, K., Williams, M.A. & Smith, D.B.: *Patterns of hydrolysable amino acids in soils of north-south and west-east transects of continental United States*.

Briefings on Soil Geochemical Survey of Conterminous United States given by D.B. Smith to Government Officials, Washington, D.C.:

19 May 2014: Assistant Secretary of the Interior for Water and Science.
20 May 2014: Association of American State Geologists
21 May 2014: Senate Committee on Energy and Natural Resources.
21 May 2014: House Committee on Natural Resources.
27 June 2014: White House Office of Science and Technology Policy.

10. SUMMARY OF EXPENDITURES IN 2014

The Task Group received in 2014 the sum of 5,000 USD from IUGS. In 2014, the Task Group had the following expenditures totalling 3,401.48 USD:

(1) Travel expenses for Alecos Demetriades to participate at the "1st International Geosciences Congress and 32nd National Symposium", Tehran, Iran and one-day Workshop on Global Geochemical Baselines	968.04 USD
(2) Travel expenses for Alecos Demetriades to participate at the "3rd Young Earth Scientists (YES) Congress 2014", Dar es Salaam, Tanzania, and a two-day Workshop on Global Geochemical Baselines	2,085.83 USD
(3) Annual fee for the hosting of the Task Group's website	347.61 USD

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 $2.5 million USD. 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 US $11M. 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 US $750K. 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 2015. It will likely be timed to coincide with the annual business meeting of the EuroGeoSurveys Geochemistry Expert Group, scheduled for autumn of 2015 in Brussels (Belgium).

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, and will be published in 2015 by the Task Group to 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 Xueqiu Wang (first draft completed in 2010), (c) Tundra terrains by Xueqiu Wang, (d) Arctic terrains by Rolf Tore Ottesen, and (e) Tropical terrains by Alecos Demetriades, Wang Xueqiu, Chris Johnson, Reijo 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. However, this year opportunities have developed with the invitation from the Geological Survey of Iran for the one-day workshop on Global Geochemical Baselines, and the 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), the Geological Society of Africa would like to pursue the training in African countries in Global Geochemical Baselines methods, and we are in the process of developing an MoU. Therefore, it is possible that such training could occur in 2015, since we are in direct contact with the Geological Survey of Iran and the Geological Society of Africa.

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. Technical sessions on Continental Scale Geochemical Mapping will be 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, US $33 M 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 US$ 1500 per year for 2003-2008, US$ 4000 for 2009 and 2010, and US$ 5000 for 2011 and 2012, no funding for 2013, and US$ 5000 for 2014. IAGC has provided funding of US$ 2000 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 US$ 14,778.56. 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 the CCOP and other countries (Iran, Ethiopia, etc.), we are requesting financial support in the order of US$ 10,000 from IUGS for 2015.

14. CHIEF ACCOMPLISHMENTS 1998-2014

1998 Publication of Salminen R, *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.
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.
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.

15. REFERENCES

Darnley AG, *et al.* 1995. *A Global Geochemical Database for Environmental and Resource Management: Recommendations for International Geochemical Mapping.* Final Report of IGCP Project 259. Earth Sciences 19, UNESCO, Paris, 122 pp.

International Union of Geological Sciences Strategic Planning Committee. 2000. *International Earth Science in the 21st Century. Science and Organisational Strategy for the International Union of Geological Sciences.* Trondheim, Norway, International Union of Geological Sciences, 49 pp.

Salminen R *et al.* 1998. FOREGS Geochemical Mapping. Field Manual. Geologian tutkimuskeskus - Geological Survey of Finland, Opas - Guide 47, 42 pp. Also available at http://arkisto.gtk.fi/op/op47/op47.pdf.

Salminen R, *et al.* 2005. FOREGS Geochemical Atlas of Europe: Part 1 - Background information, Methodology and Maps. Geological Survey of Finland, 525 pp. Also available at http://weppi.gtk.fi/publ/foregsatlas/.

De Vos W, *et al.* 2006. FOREGS Geochemical Atlas of Europe: Part 2 - Interpretation of Geochemical Maps, Additional Tables, Figures, Maps, and Related Publications. Geological Survey of Finland, 690 pp. Also available at http://weppi.gtk.fi/publ/foregsatlas/.

Respectfully submitted, 28 November 2014

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