Journal of Geochemical Exploration 154 (2015) 1–5

Contents lists available at ScienceDirect

Journal of Geochemical Exploration

journal homepage: www.elsevier.com/locate/jgeoexp

Editorial

Continental, regional and local scale geochemical mapping

1. Introduction

This special issue on "*Continental, Regional and Local Scale Geochemical Mapping*", with most of the papers directly or indirectly related to soil, is devoted to the International Year of Soils (IYS). On the 24th of April 2013 at the 146th Council meeting of the Food and Agriculture Organisation (FAO) of the United Nations, and in the framework of the Global Soil Partnership (GSP), the request from the Kingdom of Thailand to proclaim 2015 as the International Year of Soils 2015 was endorsed (http://www.fao.org/globalsoilpartnership/iys-2015/en/). Subsequently, the 68th United Nations General Assembly (20 December 2013) approved the FAO decision (A/RES/68/232; 07/02/2014; http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/68/232). The aim of the IYS 2015 is to act as a platform for raising awareness of the importance of soil for food security and essential eco-system functions (http://www.fao.org/soils-2015/en/).

The UN Secretary, General Ban Ki-moon's message (SG/SM/16388-OBV/1414; 3/12/2014; http://www.un.org/press/en/2014/sgsm16388.doc.htm) for World Soil Day and the launch of the International Year of Soils (5 December 2014) was: "Today marks the first observance of World Soil Day and the launch of the International Year of Soils (2015). Without healthy soils, life on Earth would be unsustainable. Soils are the foundation of agriculture. They provide vital ecosystem services and the basis for food, feed, fuel, fibre and medical products important for human well-being. Soil is also the largest pool of organic carbon, which is essential for mitigating and adapting to climate change. In an era of water scarcity, soils are fundamental for its appropriate storage and distribution. However, soil degradation is a rapidly increasing problem in all parts of the world. Some 33 per cent of global soils are already degraded through urbanisation. Soil erosion, nutrient depletion, salinity, aridification and contamination are additional threats. For too long the world has taken soils for granted. But soil is a natural resource that is not easily renewed. Sustainable soil management should be a priority for all. I welcome the establishment of the Global Soil Partnership by the Food and Agriculture Organisation of the United Nations (FAO). FAO's World Soil Charter recommends a number of key measures to encourage investment in sustainable soil management as a sound and affordable alternative to restoration and rehabilitation. On World Soil Day, let us pledge to do more to protect this important yet forgotten resource. A healthy life is not possible without healthy soils."

Applied Geochemists all over the World sample soil for different purposes, i.e., the delineation of prospective areas for mineral exploration, assessment of the quality of agricultural and grazing land soil, and last but not least the quality of urban soil. Therefore, applied geochemists have a considerable amount of data on the chemical quality of soil, and they should take this opportunity, given by the IYS 2015 platform, to make their work known, and to assist the global effort in the assessment of the quality of our productive soil, and the urban soil that we are in direct contact with.

This special issue on "*Continental, Regional and Local Scale Geochemical Mapping*" includes in total nineteen papers of which seven are on Continental-, eight on Regional- and four on Local-scale geochemical mapping. The effectiveness of geochemical mapping at different scales is, therefore, well demonstrated.

2. Geochemical mapping scales

Systematic geochemical mapping is considered to be the best available method to document changes in the levels of chemical elements in materials occurring at or below the Earth's surface, such as rock, soil, floodplain or overbank sediment, stream sediment, stream water, ground water and vegetation. Geochemical maps are the principal means of presenting the spatial distribution of chemical elements and compounds in the aforementioned sample media.

Geochemical mapping is performed at different sample densities and map scales depending on the objectives of the project, and the end product is always the interpretation of the spatial variation of chemical elements and compounds. In this Special Issue of the Journal of Geochemical Exploration there are examples of Global- or Continental-, Regional- and Local-scale Geochemical Mapping projects. In Table 1 the objectives and usage of the aforementioned mapping scales are tabulated.

In global- or continental-scale geochemical mapping surveys, the interest is the delineation of large-scale patterns, and the sampling density used in different projects varies from 1 sample site/1600 km^2 in the North American Soil Geochemical Landscapes Project of the United States of America (see Woodruff et al., this issue) to 1 sample site/8300 km^2 in the Environmental Geochemical Monitoring Network of China (see Liu et al., this issue). Some continental-scale geochemical surveys are also considered as national-scale, because they cover the whole country, e.g., Australia, China and the United States of America (see Liu et al.). In national-scale geochemical mapping surveys the objective is to delineate regional-scale patterns, and the sampling density varies from 1 to 2 samples/km^2 to 1 sample/10–25 km^2. Hence, national-scale geochemical surveys are also classified as regional-scale, depending on the sampling density. In local-scale geochemical surveys the sample density increases considerably, i.e., from 5 samples/km^2 to thousands of samples/km^2. However, the sampling density in some local-scale projects does not adhere to any strict rules, as the decision depends on the objectives of the project and available funds.

The relationship between number of samples/km^2 and map scale can be estimated by using as a rule of thumb the constant of 1 data point/cm^2 on the topographical map at any scale, and to always plan the geochemical survey in a grid, even if the samples are not collected

http://dx.doi.org/10.1016/j.gexplo.2015.02.011

Table 1
Objectives and usage of global (continental), regional and local scale geochemical mapping projects for mineral exploration and environmental purposes.

Global or Continental	Regional	Local
Geochemical characteristics of different sample media (bedrock, soil, sediment and water) at the global- or continental-scale	Geochemical characteristics of different sample media (bedrock, soil, sediment, water and bio-indicators), which are representative of a specific large region or a geochemical province or even a country (national scale)	Geochemical characteristics of individual metallogenic provinces or of a small area using different sample media (bedrock, soil, sediment, water, bio-indicators (vegetation); in addition, for environmental surveys house dust, road sediment/dust, PM2.5, PM10, and attic dust are used)
(a) Mineral exploration		
Geochemical data are used to evaluate the deviation of regional geochemical variables from the continental geochemical background*, and to delineate anomalous* areas with a mineral potential	Geochemical data are used to evaluate the deviation of local geochemical variables from the regional geochemical background, and to delineate anomalous areas with a mineral potential	Geochemical data uninfluenced by mineralisation processes describe the local geochemical background variation, and the anomalous results provide targets for assessment of mineral potential by drilling
(b) Environmental survey		
Geochemical data are used to evaluate the deviation of regional geochemical variables from the continental baseline* variation, and to delineate anomalous areas caused by human activities	Geochemical data are used to evaluate the deviation of local geochemical variables from the regional geochemical baseline variation, and to delineate anomalous areas caused by human activities	Geochemical data uninfluenced by human activities describe the local geochemical baseline variation, and delineate the anomalous results in areas that have been contaminated by human activities, and are targets for rehabilitation

*Definitions:–*Geochemical background*: The normal element concentration in a particular unmineralised sample type determined by a particular analytical technique; it is a fluctuating surface rather than a given value.–*Geochemical anomaly*: "An abnormally high or low content of an element or element combination, or an abnormal spatial distribution of an element or element combination in a particular sample type in a particular environment as measured by a particular analytical technique" (Govett, 1983, p.30).–*Geochemical baseline*: "A geochemical baseline is the concentration at a specific point in time of a chemical parameter (element, species or compound) in a sample of geological material", determined by a particular analytical technique. "It is a fluctuating surface rather than a given value" (Johnson and Demetriades, 2011, p.18).

at the grid nodes, but are randomly distributed within each grid cell (Table 2). For example, if the sample density is:

- 1 sample/100 km^2 (a grid of 10 × 10 km), and on the map there is 1 data/cm^2, the map scale is 1:1,000,000 (i.e., 10 km × 1000 m × 100 cm = 1,000,000 cm);
- if the sample density is 1 sample/km^2 (a grid of 1 × 1 km) and on the map there is 1 data/cm^2, the map scale is 1:100,000 (i.e., 1 km × 1000 m × 100 cm = 100,000 cm);
- 1 sample/100 m^2 (a grid of 100 × 100 m), and on the map there is 1 data/cm^2, the map scale is 1:10,000 (i.e., 100 m × 100 cm = 10,000 cm);
- 1 sample/10 m^2 (a grid of 10 × 10 m), and on the map there is 1 data/cm^2, the map scale is 1:1000 (i.e., 10 m × 100 cm = 1000 cm).

The nineteen contributions of this Special Issue are grouped according to mapping scale into (i) Continental-, (ii) Regional- and (iii) Local-scale

Table 2
Sample density related to sampling grid and map scale, and examples from different projects and papers in this Special Issue. The vertical bars show some overlap between the Regional and Local scale geochemical mapping.

Nominal sample density	Sampling grid	Map scale	Map classification/mineral exploration stage (examples)
1 sample/10,000 km^2	100 x 100 km		Continental
1 sample/6400 km^2	80 x 80 km[a]	1:10,000,000	Continental (e.g., FOREGS, EGMON; see Liu et al.; Buccianti) Continental (e.g., CGB; see Liu et al.; Wang and CGB Sampling Team; Wang et al.)
1 sample/5200 km^2	≈72 x 72 km		Continental (e.g., NGSA; see Liu et al.)
1 sample/2500 km^2	50 x 50 km	1:5,000,000	Continental (e.g., GEMAS; see Albanese et al.; Ladenberger et al.)
1 sample/1600 km^2	40 x 40 km		Continental (e.g., NASGLP; see Woodruff et al.)
1 sample/100 km^2	10 x 10 km	1:1,000,000	Regional (e.g., Birke et al.; Cicchella et al.; Lancianese et al.; Ohta et al.; Shuguang et al.; Kuzmenkova and Vorobyova; Zuo et al.); or reconnaissance phase in mineral exploration (e.g., Sadeghi et al.)
1 sample/1 km^2	1 x 1 km	1:100,000	
1 sample/250,000 m^2	500 x 500 m	1:50,000	
1 sample/62,500 m^2	250 x 250 m	1:25,000	Regional (or follow–up phase in mineral exploration)
1 sample/10,000 m^2	100 x 100 m	1:10,000	
1 sample/2500 m^2	50 x 50 m	1:5000	Local (e.g., Bavec et al.; Papadopoulou–Vrynioti et al.; Levitan et al.); or Detailed phase in mineral exploration (e.g., Yuan et al.)
1 sample/625 m^2	25 x 25 m	1:2500	Local (or Mining/Ultra detailed phase in mineral exploration)
1 sample/100 m^2	10 x 10 m	1:1000	
1 sample/25 m^2	5 x 5 m	1:500	

Notation: NGSA — National Geochemical Survey of Australia (de Caritat and Cooper, 2011a,b); FOREGS — Forum of European Geological Surveys, Geochemical Atlas of Europe (De Vos et al., 2006; Salminen et al., 2005); EGMON — Environmental Geochemical Monitoring Networks, China (Xie et al., 1997, 2012); CGB — China Geochemical Baselines; GEMAS — Geochemical Mapping of Agricultural and grazing land Soil (Reimann et al., 2014a,b). NASGLP — North American Soil Landscapes Project (Smith et al., 2013, 2014).
[a] Quadrant of the Global Geochemical Reference Network (GRN) of 160 × 160 km (Darnley et al., 1995).

geochemical mapping, and a summary of the salient points of each contribution is given.

3. Continental-scale geochemical mapping

Comparison of datasets obtained by global-scale geochemical sampling in Australia, China and Europe by Xuemin Liu et al. is a review of the analytical results of global-scale geochemical projects carried out in Australia (National Geochemical Survey of Australia), China (Environmental Geochemical Monitoring Networks, EGMON) and Europe (Forum of European Geological Surveys, FOREGS), and demonstrate that out of all elements determined only the results of twenty-six elements (Ba, Ce, Co, Cr, Cu, Mo, Nb, Ni, Pb, Rb, Sr, Th, V, Y, Zn, Zr, Al_2O_3, CaO, Fe_2O_3 (total), K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, TiO_2) are comparable among the three continental-scale projects. It is a good comparison of three global- or continental-scale projects that were carried out in three different continents. The approach is useful for the future comparison of other continental-scale projects. The authors also mention the problems of such a comparison, and especially the absence of common reference materials. Therefore, it is important for continental-scale projects to include in their analytical batches reference samples used in other continents.

China geochemical baselines: Sampling methodology by Xueqiu Wang and The CGB Project Team describes the sampling methodology used in the different landscape terrains of China (plain, hilly, mountainous, karst, desert, semi-desert) in order to produce high-resolution and harmonised baseline data. Apart from the collection of top and bottom sediment (floodplain, overbank, lake) and alluvial soil samples at the same site, an important addition in this project is the taking of representative bedrock samples, which provide direct information about the geogenic sources of chemical elements. It also describes the sample preparation, quality control and analytical procedures used in the China Geochemical Baselines project, which follows very closely the recommendations of IGCP 259 '*International Geochemical Mapping*' (Darnley et al., 1995; http://www.globalgeochemicalbaselines.eu/). It also provides information about other continental-scale projects in Australia, Europe and the United States of America, and maps showing the hitherto global sampling coverage, and the Global Reference Network (GRN) grid of 160 × 160 km covering the terrestrial surface of the Earth.

Concentration and distribution of mercury in drainage catchment sediment and alluvial soil of China by Xueqiu Wang et al. is a follow-up of the previous paper and uses Hg to demonstrate the effectiveness of the sampling methodology developed in the China Geochemical Baselines project. It describes the analytical and quality control procedures, and the distribution of Hg in (a) the eight tectonic units, (b) the ten geomorphological landscape terrains, (c) the thirty-two major drainage basins, and (d) the seventeen major soil types of China, and demonstrates the relationship with lithology, mineral resources and human activities. Other important information regards the in-house software Geoexpl2009®, which can be downloaded from http://www.drc.cgs.gov.cn/GeoExplGeoMDIS/.

The distribution of selected elements and minerals in soil of the conterminous United States by Laurel G. Woodruff et al. describes the soil sampling, sample preparation, quality control procedure and analysis of the continental-scale North American Soil Geochemical Landscapes Project performed in the United States of America. An important aspect of this continental-scale geochemical survey is the determination of the mineralogy in soil samples, which is very important in the interpretation of the analytical results. The report and analytical data are freely available for downloading at http://pubs.usgs.gov/ds/801/; the interpolated maps showing the spatial distribution for each element and mineral and statistical summaries of all data are available as a published report at http://pubs.usgs.gov/of/2014/1082/pdf/ofr2014-1082.pdf, and through an interactive web page http://mrdata.usgs.gov/soilgeochemistry/#/summary.

GEMAS: Indium in agricultural and grazing land soil of Europe — Its source and geochemical distribution patterns by Anna Ladenberger et al. describes the spatial distribution of indium in the two sampling media used in the EuroGeoSurveys' project of the Geochemical Mapping of Agricultural and grazing land Soil, which is known with the acronym GEMAS (http://gemas.geolba.ac.at/). The paper summarises the chemical and physical properties of In, its occurrence in the Earth's crust, ore deposits, soil and water, its production and recovery, its industrial demand, its toxicity and environmental impact. Explanations are given for all the delineated In anomalous patterns in European agricultural and grazing land soil.

GEMAS: Cobalt, Cr, Cu and Ni distribution in agricultural and grazing land soil of Europe by Stefano Albanese et al. is the second paper about the EuroGeoSurveys GEMAS project. It describes concisely the natural and anthropogenic sources of Co, Cr, Cu and Ni in the environment, and their chemical properties. Explanations are given for most of the delineated anomalies. Environmental risk is evaluated for only Cu and Ni, using the established limits for the use of sewage sludge in agriculture (EU Directive 86/278/EEC). It shows that such guideline values must take into consideration the variable natural background element concentrations in agricultural and grazing land soil, and that it is quite inappropriate to set one guideline value to be applied in all European countries.

The FOREGS repository: Modelling variability in stream water on a continental scale revising classical diagrams from CoDA (compositional data analysis) perspective by Antonella Buccianti is a somewhat different and interesting contribution in the interpretation of stream water analytical results. The innovation is the substitution of the original coordinates of the Gibb's diagram with chemical balances obtained by applying the isometric log-ratio transformation for compositional data. The new Gibb's diagram is used to investigate the chemistry of stream water from the harmonised database of the FOREGS Geochemical Atlas of Europe (http://weppi.gtk.fi/publ/foregsatlas/; http://weppi.gtk.fi/publ/foregsatlas/ForegsData.php). The stream water data are statistically discriminated in distinct groups by using robust discriminant methods. The dominance of different geochemical processes (dilution due to precipitation and runoff, evaporation/fractional crystallisation, rock weathering) are identified, and plotted on European-scale maps. It, thus, provides a convenient tool that can be used to compare statistically the chemistry of new data.

4. Regional-scale geochemical mapping

How robust are geochemical patterns? A comparison of low- and high-density geochemical mapping in Germany by Manfred Birke et al. provides an overview of all the regional- or national-scale projects carried out in Germany using different sample densities, and the German data of the FOREGS Geochemical Atlas of Europe. The comparison of all these results clearly demonstrates that the use of low sample density geochemical mapping is possible and appropriate to determine the element distribution of regional-, national- or continental-scale trends and patterns controlled by natural geochemical processes (geology, metallogenic zones, climate). It concludes that low sample density mapping (i) is extremely useful for determining the regional or national background or baseline values for different elements at considerably reduced cost, and (ii) cannot be used for environmental geochemistry projects in industrial regions and urban areas to identify local contamination.

GEMAS: Spatial distribution of chemical elements in agricultural and grazing land soil of Italy by Domenico Cicchella et al. uses the EuroGeoSurveys GEMAS project's Italian results, and provides a detailed national interpretation by distinguishing anomalous patterns due to geogenic and anthropogenic sources. It concludes that element distribution patterns identify clearly the presence of major geolithological structures and lineaments, even by using a very low sampling density grid.

Different spatial methods in regional geochemical mapping at high density sampling: An application on stream sediments of Romagna Apennines, Northern Italy by Valerio Lancianese et al. describes and discusses a fairly detailed regional stream sediment geochemical survey (1 sample/ 5 km^2) in an area of 4125 km^2 in the Romagna Apennines, which has a complex geology, with urban centres, agricultural and industrial activities. It uses cluster analysis for the grouping elements, and cumulative probability plots to distinguish the three palaeogeographical domains, Ligurian, Padano-Adriatic and Tosco-Umbrian. Various mapping techniques were used for the computer processing of the data, e.g., Exploratory Data Analysis (EDA), Inverse Distance Weighted (IDW) interpolation and Sample Catchment Basin (SCB), and an assessment is made of their effectiveness in interpretation. The data analysis was carried out in R open source software, which can be downloaded free from http://cran.r-project.org. The DASplusR package, used for data elaboration, non-parametric tests and graphics, can be downloaded from http://www.statistik.tuwien.ac.at/StatDA/DASplusR/. Whereas the geochemical maps were produced with Quantum GIS, which is again a free and open source geographical information system software downloadable from http://www.qgis.org/.

The spatial distribution of multiple elements in the Kanto region of Japan: Transport of chalcophile elements from land to sea by Atsuyuki Ohta et al. discusses the distribution of CaO, total Fe_2O_3, K_2O, As, Bi, Cd, Cu, Hg, Mo, Nb, Ni, Pb, Sb, Sn, Yb and Zn in marine and stream sediment samples, collected at an average density of 1 sample/80 km^2 and 1 sample/100 km^2, respectively; it also provides data on another 6 major and 29 trace elements in different grain-size fractions. The Kanto region includes large-scale mines, and an urban centre, Tokyo, with its associated densely populated and industrial areas. Analysis of variance, factor analysis and multiple comparison interpretative techniques are used. A geological interpretation of the geochemical patterns, observed in stream and marine sediments, is given for the chalcophile elements. The enrichment of Cr, Ni, Cu, Zn, As, Cd, Sn, Sb, Hg, Tl, Pb and Bi in the marine sediments of Tokyo Bay is ascribed to anthropogenic activities. It is an interesting paper, because it relates the geochemical distribution of elements in the terrestrial and marine environments.

Exploratory data analysis and singularity mapping in geochemical anomaly identification in Karamay, Xinjiang, China by Zhou Shuguang et al. is an interesting contribution by comparing exploratory data analysis (EDA) and singularity mapping (SM) in the interpretation of stream sediment data for the delineation of Au prospective areas. Apart from Au, other elements that are associated with the mineralisation, such as Ag, As and Sb, were used. The singularity mapping technique is combined with principal component analysis (PCA). In this case, EDA was not found suitable for identifying potential Au anomalies, whereas the SM technique is able to identify reliably geochemical anomalies, especially when integrated with PCA. Therefore, this paper provides a useful interpretative technique that could be applied to other mineral exploration programmes.

Analysis and mapping of soil geochemical anomalies: Implications for bedrock mapping and gold exploration in Giyani area, South Africa by Martiya Sadeghi et al. is another mineral exploration orientated paper for the delineation of potential Au mineralisation using soil as the sampling medium. It covered an area of approximately 2700 km^2 at a density of 1 sample/km^2. The lack of having a reliable lithological map, because of the regolith cover and scarcity of outcrops is overcome by information obtained from major and trace element soil geochemistry, and multivariate treatment of centred log-ratio transformed data by principal component analysis to produce an interpretive bedrock map. Since, the Au mineralisation is hosted in specific lithologies, the compiled bedrock map can be used to indicate potential Au-bearing areas. It is indeed an interesting approach for use in other areas where there is a scarcity of outcrops.

Landscape-geochemical mapping of the North-West of Kola Peninsula by Natalia V. Kuzmenkova and Tatiana A. Vorobyova describes the landscape geochemical technique that was developed at Moscow State University by the Chair of Landscape Geochemistry and Soil Geography of the Department of Geography under the guidance of M.A. Glazovskaya (1968) and A.I. Perelman (1972), and is very popular among Russian geochemists. The interested reader is advised to consult a good review paper of landscape geochemistry by John A.C. Fortescue (1992), and a recent one by Klos et al. (2014). The present study discusses in detail the migration and accumulation of ^{137}Cs in the southern tundra of the Kola Peninsula. It shows the patchy character of radioactive fallout from industrial facilities, and that these are mostly located in areas where soil has developed on extrusive and metamorphic rocks. It concludes that landscape-geochemical mapping is a useful tool for geoecological evaluation of areas around nuclear and hazardous radiation industries in tundra and tundra forest belts of the Kola Peninsula. It will indeed be very interesting to use landscape-geochemical mapping techniques in other contaminated areas.

Identification of weak anomalies: A multifractal perspective by Renguang Zuo et al. describes a rather more powerful multifractal technique to identify weak anomalies by using a modified algorithm for the estimation of singularity index. The refined technique is tested in an area that is a potential source of Fe–Cu polymetallic deposits. As concealed mineralisation is becoming more difficult to locate, such techniques that are able to delineate weak anomalies are useful. The interested reader should consult the published papers in the Special Issue of the Journal of Geochemical Exploration on *Fractal/Multifractal Modelling of Geochemical Data* (vol. 122, p.1–122).

5. Local-scale geochemical mapping

Geochemical investigation of metals in urban soil of Idrija (Slovenia) by Špela Bavec et al. describes the contamination caused by over 500 years of Hg mining and ore processing. It is a fairly detailed survey with a sample density of 9 soil samples/km^2. Ten potentially harmful elements (As, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Zn) were determined on the collected soil samples, but only Hg has shown extremely high concentrations that vary in topsoil from 8 to 1210 mg/kg, with a median of 60 mg/kg, and in subsoil from 7 to 1550 mg/kg, with a median of 50 mg/kg. As expected such high concentrations of Hg in the soil of Idrija are of concern, especially when soil is used for vegetable gardening.

The contribution of karstic rocks to soil quality, Ioannina plain (Epirus, Hellas) by Papadopoulou-Vrynioti et al. is a somewhat different paper, because it discusses the quality of agricultural soil of the closed Ioannina basin, with its homonymous lake, in terms of $CaCO_3$, water extractable and exchangeable Ca^{2+} and Mg^{2+} cations, bicarbonate (HCO_3^-), Cation Exchange Capacity (CEC), and pH. The Ioannina basin is considered to be part of a large karstic system (polje), and the surrounding carbonate rocks, and especially the limestone of Mitsikeli mountain, supply the necessary amounts of calcium carbonate for the development of a good quality soil for agricultural use. The sample density is approximately 1 sample/km^2, which places it at the regional scale, but because of its small area extent (100 km^2) is classified as a local-scale project.

Statistical analysis of soil geochemical data to identify pathfinders associated with mineral deposits: An example from the Coles Hill uranium deposit, Virginia, USA by Denise M. Levitan et al. is a mineral exploration oriented paper with the objective of finding pathfinder elements that are associated with a U deposit. The approach is quite interesting and, especially, the use of available USGS national soil survey data as a background reference set in order to determine the anomalous elemental concentrations in soil, which are due to the Coles Hill U deposit. This is an approach that should also be used in the assessment of anthropogenic contamination. Compositional data analysis (log-ratios) and multivariate statistical techniques (Principal Component Analysis) are used in the treatment of the soil geochemical data set. Enrichment factors in relation to Al show that there is a definite increase in U, light rare earth elements (La, Ce) and Nb.

Multifractal modelling-based mapping and identification of geochemical anomalies associated with Cu and Au mineralisation in the NW Junggar area of northern Xinjiang Province, China by Feng Yuan et al. is a very well documented mineral exploration oriented paper. It uses a combined singularity mapping, multifractal kriging and spectrum-area fractal modelling approach for the delineation of soil geochemical anomalies. The follow-up ground-truthing verified the anomalous patterns by discovering several new Cu mineralised occurrences. It failed, however, to locate new Au prospects. As is pointed out by the authors further investigation is required to understand the spatial distribution of Au anomalies. The approach is quite interesting, and it is worth applying this methodology in other areas within and outside China.

Acknowledgements

We greatly appreciate the support of the following reviewers for the invaluable time they have devoted to review the quality of the submitted manuscripts: David B. Smith, Jurian Hoogewerff, Christopher C. Johnson, Reijo Salminen, David R. Cohen, Ilse Schoeters, Barry Smith, Marco Petitta, Karel Hron, Simon Pirc, Patrick O'Connor, Patrice de Caritat, Annamaria Lima, G.N. Nayak, Ebru Yesim Ozkan, Kim Harry Esbensen, Mélida Gutiérrez, Manfred Birke, Peter Bobrowsky, Changjian Li, Frits Agterberg, Anna Ladenberger, Simon Pirc, Hazim Hrvatovic, Arthur Rose, Eric Potter, Arianne Ford, Vera Pawlowsky-Glahn and Renguang Zuo. Paul Cumine (Publisher, Geophysics & Geochemistry Journals) is thanked for making the arrangements for the use of the logo of International Year of Soils 2015, and other management details, and Fiona Bottigliero (IYS 2015 Communication Specialist) for granting the permission to use the logo. We also acknowledge the technical assistance and support by Kreeti Saravanan (Journal Manager), Hou Yanping (Publishing Content Specialist) for keeping us informed about the reviewing process and other matters. Last but not least Robert Ayuso, Editor-in-chief of the Journal, is thanked for his patience and assistance.

References

Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steenfelt, A., Tauchid, M., Xie, X., Garrett, R.G., Hall, G.E.M., 1995. A global geochemical database for environmental and resource management. Final report of IGCP Project 259Earth Sciences 19. UNESCO Publishing, Paris (122 pp., http://www.globalgeochemicalbaselines.eu/wp-content/uploads/2012/07/Blue_Book_GGD_IGCP259.pdf).

de Caritat, P., Cooper, M., 2011a. National geochemical survey of Australia: the geochemical atlas of Australia. Geoscience Australia, Record 2011/20. Vol. 2 (557 pp., http://www.ga.gov.au/corporate_data/71973/Rec2011_020_Vol1.pdf; http://www.ga.gov.au/corporate_data/71973/Rec2011_020_Vol2.pdf).

de Caritat, P., Cooper, M., 2011b. National geochemical survey of Australia: data quality assessment. Geoscience Australia Record, 2011/21. Vol. 2 (478 pp., http://www.ga.gov.au/corporate_data/71971/Rec2011_021_Vol1.pdf; http://www.ga.gov.au/corporate_data/71971/Rec2011_021_Vol2.pdf).

De Vos, W., Tarvainen, T. (Chief Eds.), Salminen, R., Reeder, S., De Vivo, B., Demetriades, A., Pirc, S., Batista, M.J., Marsina, K., Ottesen, R.T., O'Connor, P.J., Bidovec, M., Lima, A., Siewers, U., Smith, B., Taylor, H., Shaw, R., Salpeteur, I., Gregorauskiene, V., Halamic, J., Slaninka, I., Lax, K., Gravesen, P., Birke, M., Breward, N., Ander, E.L., Jordan, G., Duris, M., Klein, P., Locutura, J., Bel-lan, A., Pasieczna, A., Lis, J., Mazreku, A., Gilucis, A., Heitzmann, P., Klaver, G., Petersell, V., 2006. Geochemical atlas of Europe. Part 2 — interpretation of geochemical maps, additional tables, figures, maps, and related publications. Geological Survey of Finland, Espoo, 692 pp., http://weppi.gtk.fi/publ/foregsatlas/.

Fortescue, J.A.C., 1992. Landscape geochemistry: retrospect and prospect — 1990. Appl. Geochem. 7, 1–53.

Glazovskaya, M.A., 1968. Geochemical landscapes and types of geochemical soil sequences. International Society of Soil Science, London, Transactions of the 9th International Congress on Soil Science, Adelaide. 4 pp. 303–312.

Govett, G.J.S., 1983. Rock geochemistry in mineral exploration. In: Govett, G.J.S. (Ed.), Handbook of Exploration Geochemistry. Vol. 3. Elsevier Scientific Publishing Co., Amsterdam (461 pp.).

Johnson, C.C., Demetriades, A., 2011. Urban geochemical mapping: a review of case studies in this volume. (Chapter 2). In: Johnson, C.C., Demetriades, A., Locutura, J., Ottesen, R.T. (Eds.), Mapping the Chemical Environment of Urban Areas. Wiley-Blackwell, Chichester, U.K., pp. 7–27.

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: Reimann, C., Birke, M., Demetriades, A., Filzmoser, P., O'Connor, P. (Eds.), 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, pp. 253–270.

Chemistry of Europe's agricultural soils — part A: methodology and interpretation of the GEMAS data set. In: Reimann, C., Birke, M., Demetriades, A., Filzmoser, P., O'Connor, P. (Eds.), Geologisches Jahrbuch (Reihe B 102), Schweizerbarth, Hannover (528 pp.).

Chemistry of Europe's Agricultural Soils — Part B: General Background Information and Further Analysis of the GEMAS Data Set. In: Reimann, C., Birke, M., Demetriades, A., Filzmoser, P., O'Connor, P. (Eds.), Geologisches Jahrbuch (Reihe B 103), Schweizerbarth, Hannover (352 pp.).

Perelman, A.I., 1972. Geochemistry of elements in the hypergenesis zone. Nedra, Moscow 288 pp, (in Russian).

Salminen, R. (Chief-Ed.), Batista, M.J., Bidovec, M., Demetriades, A., De Vivo, B., De Vos, W., Duris, M., Gilucis, A., Gregorauskiene, V., Halamic, J., Heitzmann, P., Lima, A., Jordan, G., Klaver, G., Klein, P., Lis, J., Locutura, J., Marsina, K., Mazreku, A., O'Connor, P.J., Olsson, S.Á., Ottesen, R.T., Petersell, V., Plant, J.A., Reeder, S., Salpeteur, I., Sandström, H., Siewers, U., Steenfelt, A., Tarvainen, T., 2005. Geochemical atlas of Europe. Part 1 — background information, methodology and maps. Geological Survey of Finland, Espoo, Finland, 526 pp., http://weppi.gtk.fi/publ/foregsatlas/

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., Fey, D.L., 2013. Geochemical and mineralogical data for soils of the conterminous United States. U.S. Geological Survey Data Series. 801 (19 pp., http://pubs.usgs.gov/ds/801/).

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, 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/).

Xie, X., Ren, T., Sun, H., 2012. Geochemical Atlas of China. Geological Publishing House, Beijing (135 pp., http://www.hceis.com/home/book_view.aspx?id=11611&ISBN=9787116077942&EnName=Geochemical+Atlas+of+China+).

Xie, Xuejing, Mu, Xuzhu, Ren, Tianxiang, 1997. Geochemical mapping in China. J. Geochem. Explor. 60 (1), 99–113.

Alecos Demetriades
Managing Guest Editor
Institute of Geology and Mineral Exploration, 1 Spirou Louis St., Olympic Village, 13677 Acharnae, Athens, Hellas
Corresponding author at: Institute of Geology and Mineral Exploration, P.O. Box 640 47, 157 10 Zografou, Athens, Hellas.
E-mail address: alecos.demetriades@gmail.com.

Manfred Birke
Guest Editor
Federal Institute for Geosciences and Natural Resources, Stilleweg 2, 30655 Hannover, Germany

Stefano Albanese
Guest Editor
Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli Federico II, Naples, Italy

Ilse Schoeters
Guest Editor
Rio Tinto, 2 Eastbourne Terrace, London, W2 6LG England, United Kingdom

Benedetto De Vivo
Guest Editor
Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli Federico II, Naples, Italy