ANNUAL REPORT FOR THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS) WORKING GROUP ON GLOBAL GEOCHEMICAL BASELINES 2001

1. TITLE OF CONSTITUENT BODY

IUGS/IAGC Working Group on Global Geochemical Baselines.

2. OVERALL OBJECTIVES

To prepare a global geochemical database, and its representation in map form, to document the concentration and distribution of chemical elements and species in the Earth's near-surface environment. The database and accompanying maps can then be used to create a geochemical baseline against which future human-induced or natural changes to the chemistry of the land surface may be recognised and measured. In the short to medium term, this involves implementation of the recommendations given by Darnley *et al.* (1995), namely:

- collection and analysis of a series of multi-media geochemical samples - the Global Reference Network (GRN);
- design and publication of a Field Manual detailing sampling methods for collection of the GRN samples;
- design and production of an Analytical Manual detailing methods for analysing the GRN samples.

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 Working 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).

4. ORGANISATION

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

Steering Committee

Honorary President	Dr Arthur Darnley	Geological Survey of Canada
Co-Leaders	Prof Jane Plant	British Geological Survey
	Dr David Smith	US Geological Survey
Scientific Secretary	Mr Shaun Reeder	British Geological Survey
Treasurer	Dr Tony Reedman	British Geological Survey

Analytical Committee

Chair	Ms Gwendy Hall	Geological Survey of 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 Prof Reijo Salminen Geological Survey of Finland
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 Geological Survey of Finland
Supervises sampling strategy, co-ordinates the sampling progress of the participating countries, manages the database of sample information and analytical results.

Regional Co-ordination
Chair Prof Reijo Salminen Geological Survey of Finland
Co-ordinates project activities of groups of neighbouring countries and reports back to Steering Committee.

Public Relations and Finance Committee
Chair Mr Alecos Demetriades IGME, Greece
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.

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

The project does not have any other source of direct funding. However, within Europe, National Geological Surveys and associated Institutes have provided staff time and support to the project to complete the preparation of the European GRN as part of the FOREGS programme. A few other countries, including China, Russia, Colombia and Brazil, have provided funds through their National Geological Surveys or related institutes for pilot studies on establishing the GRN.

6. INTERFACE WITH OTHER INTERNATIONAL PROJECTS

This project is closely associated with the work of the FOREGS Geochemistry Working Group. In addition, the INCO-COPERNICUS project, a laboratory standardisation project involving Western European and former Soviet Block countries, is associated with this project. The project also has links with the IAEA and potential links with GTOS, the Global Terrestrial Observing System. The Working Group has also established closer links with the EuroGeoSurveys "Soils and Land use Policy Sector" and the European Soil Bureau over the past few years.

7. CHIEF ACCOMPLISHMENTS IN 2001

On the global scale, the most significant progress has been made in India and by the member countries of the CCOP.

Sampling has commenced in Southern India within the last year. Funding had been secured from the Indian Government for 12 cells – about one tenth of the total for the country as a whole.

A presentation on "Environmental Geochemistry at the Global Scale" was given at the Seminar on Regional Geochemical Exploration, Beijing, China, May 20-26 2001. A separate meeting of CCOP delegates, chaired by Mr Chen Shick Pei and Prof Xie Xuejing, was convened during the Seminar to discuss the CCOP member countries' participation in the Global Geochemical Baselines Project. The minutes of the meeting are given in

Appendix 1 of this report. Dr Dave Smith of the USGS subsequently met with Mr Chen Shick Pei in Washington DC in August to discuss CCOP acting as a coordinating body for a "FOREGS-like" effort in southeast Asia. The CCOP is currently conducting an inventory of existing geochemical data in the member countries before proceeding with any new sampling.

The Public Information and Finance Committee have sought advice from a management consultant on how to set up the International Committee's structure. These ideas will be discussed initially by the core group, consisting of Alecos Demetriades (Chair), Andrew Grosz and Ignace Salpeteur, before a final decision is made of how to proceed.

Within Europe, work has been continuing on the FOREGS contribution to the project according to the schedule agreed at the last business meeting held in Athens in November 2000 (see Appendix 2).

Sampling has been completed within all countries participating in the FOREGS program. Analysis is due to be completed by the end of the year and data compilation and management processes are already underway. Meetings of the Analytical Working Group and the Data Management Working Group were held in Finland in March and June 2001 respectively. Minutes of these meetings are given in Appendices 3 and 4 respectively (as separate files). Preliminary maps of geochemical data for Europe have been prepared and preliminary interpretation has begun.

In addition, sampling has recently commenced in Ukraine and has been ongoing in north-western parts of Russia as part of the BARENTS Ecogeochemistry project since 1999. Data from both will ultimately be included in the FOREGS programme.

8. CHIEF PROBLEMS ENCOUNTERED IN 2001

The main problem encountered by the project was the lack of funding required to achieve the aims and objectives of the project at the global scale. Although the baseline project in Europe continues to make significant progress through the participation of the European Geological Surveys involved, it is still considered unlikely that the global programme will go ahead without funding. Funds are required for training, transportation, additional analytical services and quality control.

Mr Alecos Demetriades of IGME, Greece, in his role as chair to the Public Relations and Finance Committee, has specific responsibility for carrying out marketing initiatives in an effort to secure funding.

9. CHIEF PRODUCTS IN 2001

Presentations

Alecos Demetriades presented an oral paper at the 9th International Congress of the Geological Society of Greece with Emphasis on the Contribution of Geosciences to Development, which was held in Athens between 26-28 September 2001.

Jane Plant presented a keynote lecture entitled "Environmental Geochemistry and Health" at the Science Forum & Workshop, Seoul, Korea, September 2001.

Shaun Reeder presented an invited paper by J A Plant, S Reeder, R Salminen, B Smith, D Smith, T Tarvainen and J Wragg entitled "Environmental Geochemistry at the Global Scale" at the Seminar on Regional Geochemical Exploration, Beijing, China, May 20-26 2001.

Dave Smith presented a keynote lecture entitled "Multipurpose Applications of Multi-element Geochemical Surveys" at the VIII Brazilian Geochemical Congress and the I Geochemical Symposium of the MERCOSUL Countries in Curitiba, Brazil on 24 October 2001.

Papers and Abstracts

Demetriades A. 2001. Global Geochemical Baselines for Environmental Management in the New Millennium. Bulletin of the Geological Society of Greece, XXXIV (3), 1093-1100 (paper in Greek with an English abstract).

Ferreira A, Inacio M M, Morgado P, Batista M J, Ferreira L, Pereira V and Pinto M S. 2001. Low-density geochemical mapping in Portugal: *Applied Geochemistry*, **16**, 1323-1331.

Gustavsson N, Bolviken B, Smith D B and Severson R C. 2001. Geochemical landscapes of the conterminous United States--New map presentations for 22 elements: US Geological Survey Professional Paper 1648 (in press).

Holmes D C, Plant J A and Shaw R. 2001. Radioactive waste management - providing geoscience information to help the people decide. Proceedings of the Environmental Science Forum & Workshop, Seoul, Korea, September 2001.

Minerais do Parana S A. 2001. Atlas Geoquimico do Estado do Parana (Geochemical Atlas of the State of Parana, Brazil), 80 pp (in Portuguese).

Plant, J A, Smith D, Smith B and Williams L. 2001. Environmental geochemistry at the global scale. *Applied Geochemistry*, **16**, 1291-1308.

Plant J A, Reeder S, Salminen R and Tarvainen T. 2001. The Application of Geochemical Baselines to Environmental and Epidemiological Studies. Abstract for the 11th International Conference on Metals in the Environment, Vilnius, Lithuania, September, 2001

Plant J A, Reeder S, Salminen R and Tarvainen T. 2001. The Application of Geochemical Baselines to Environmental and Epidemiological Studies. Abstract for the Third Asia Pacific Symposium on Environmental Geochemistry, Guangzhou, China, November 2001.

Xie X and Cheng H. 2001. Global geochemical mapping and its implementation in the Asia-Pacific region. *Applied Geochemistry*, **16**, 1309-1321.

Other Deliverables

Preliminary maps of European geochemical data have been prepared and circulated for preliminary discussion and interpretation.

10. SUMMARY OF EXPENDITURES IN 2001

The Working Group has received no funding from IAGC this year.

The cost of the FOREGS programme over the past year is estimated to be in excess of US $0.5M. These funds were provided from the Geological Institutes of the participating countries within Europe. There has also been considerable expenditure within India, China, Brazil and the CCOP countries.

11. WORK PLAN FOR NEXT YEAR

The remaining analyses from all countries in Europe that have agreed to participate in the FOREGS programme will be completed early in 2002. The geochemical database will be populated with all sample location information and geochemical data and preliminary maps will be prepared. Reports of analytical methods, data quality, and data processing methods will be prepared. Introductory sections to the Geochemical Atlas of Europe will be drafted and preliminary interpretation of the geochemical maps will continue according to the schedule given in Appendix 2.

Countries outside Europe will be encouraged to observe the work done by the FOREGS Geochemistry Working Group, and to try to formulate similar working relationships and sampling programmes. Particular attention will be paid to supporting the recent developments made by the Asia-Pacific countries. The Public Relations and Finance Committee will continue in their plan of marketing initiatives in an effort to secure funding.

12. CRITICAL MILESTONES TO BE ACHIEVED NEXT YEAR

- Preparation of various sections and appendices of the Baseline Geochemistry of Europe Atlas according to the schedule agreed in Athens in November 2001 (see Appendix 2).

13. ANTICIPATED RESULTS/PRODUCTS NEXT YEAR

- Compiled database of all FOREGS GRN samples, including statistical analysis and preliminary maps.
- Report on FOREGS analysis methods, quality control and uncertainty of measurement.
- Drafts of the introductory sections, preliminary interpretation chapters and appendices of the Baseline Geochemistry of Europe Atlas.

14. COMMUNICATION PLANS

The next Annual Meeting of the Working Group will take place in Orlèans, France in the spring of 2002. The meeting will coincide with the 3nd International Conference on Environmental Geochemical Baseline Mapping in Europe.

Technical committees and less formal groups of country representatives will meet throughout the year to ensure that the schedule of work agreed in Athens in November 2000 is maintained.

15. SUMMARY BUDGET FOR NEXT YEAR &
16. POTENTIAL FUNDING SOURCES OUTSIDE IUGS

The European countries that are committed to interpretation of the FOREGS data and preparation of the "Geochemical Atlas of Europe" are likely to continue to fund this work from internal sources. The combined cost of these efforts is likely to be about US$ 0.5M.

Without securing substantial financial contributions from external sources, it will be very difficult for the project to achieve its global objectives. It is hoped that the progress made with the European Atlas will be useful in marketing and helping to secure funds over the next year. The Public Relations and Finance Committee will be taking a proactive role in trying to secure funds for the global project from a wide variety of potential sources.

Any support from IUGS/IGCP towards the advancement of this project in developing countries would be most welcome.

17. CHIEF ACCOMPLISHMENTS 1997-2001

1997 Publication of the FOREGS Geochemistry Task Group Inventory and recommendations for European Geochemical Maps: Plant J A, Klaver G, Locutura J, Salminen R, Vrana K and Fordyce F M. (1997) *Forum of European Geological Surveys Geochemistry Task Group 1994-1996 Report*. British Geological Survey Technical Report WP/95/14. [Paper published in the Journal of Geochemical Exploration (JGE) in June 1997].
1997 Project endorsed by the UN Natural Resources Committee.
1997 FOREGS/IGCP 360 meeting held in Portugal.
1997 FOREGS Field Workshop held in Slovakia, and involved detailed demonstrations of the field methods to be adopted in Europe.
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 Annual Meeting was held in Naples, Italy (1-3 October 1998) in conjunction with the FOREGS Geochemistry Working Group Annual Meeting.
1998 European GRN sampling programme commenced.
1999 Completion of pilot study for geochemical mapping carried out in Colombia.
1999 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 was organised as part of the 31st International Geological Congress in Rio de Janeiro.
2000 First draft of promotional papers to possible sponsors prepared and sponsorship campaign commenced.
2000 Annual Business Meeting held in Athens, Greece (14 to 17 November).
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.
2001 Sampling commenced in Southern India

18. ANTICIPATED OBJECTIVES AND WORK PLAN 2002-2006

The work plan for the next year, detailed in section 11 of this report, will culminate in the production of the Geochemical Atlas of Europe, scheduled for release in 2004. A summary of scheduled activities is given in Appendix 2.

In conjunction with this work, ongoing efforts will be made to increase the extent of the participation in the global GRN project for countries outside of Europe.

19. REFERENCES

Darnley A G *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.

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, 49p.

NAME: Mr Shaun Reeder
POSITION: Scientific Secretary
DATE: 6 December 2000

ADDRESS: British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
United Kingdom
NG12 5GG
TELEPHONE: +44 (0)115 936 3523
FACSIMILE: +44 (0)115 936 3261
E-MAIL: s.reeder@bgs.ac.uk

APPENDIX 1:

MINUTES OF CCOP MEETING TO DISCUSS PARTICIPATION IN IUGS GLOBAL GEOCHEMICAL BASELINES PROJECT

Seminar on Regional Geochemical Exploration
Beijing, China
24 May 2001, 19:00 – 20:30

Co-Chairs: Mr Chen Shick Pei
Prof Xie Xuejing

1. Background and aims

About 2 years ago, the CCOP Steering Committee first agreed that its member countries ought to participate in the IUGS Global Geochemical Baselines project. The meeting in Beijing on Regional Geochemical Exploration gives the ideal opportunity for the CCOP members to decide on a way forward.

The aim of the project with regard to the CCOP countries is three-fold. First, to establish geochemical baselines for purposes of mineral exploration; this may attract increased investment in the member countries. The second purpose is to provide environmental background data, to allow assessment of potential health risks to humans, animals and the environment. The low-density sampling is not best suited for detailed geochemical exploration, but it will enable orientation studies; examples from China have already shown that the data can agree very well with those from much more intense, and hence expensive, studies. Thirdly, participation will allow all member countries, including those with limited experience of geochemical baseline mapping, to become trained and more familiar with best practices to be established throughout the CCOP countries – and in line with the FOREGS countries in Europe and other countries world-wide.

About 200 GRN cells (each 160 km^2) cover the whole of the CCOP area (excluding China). Concerns were expressed from some member countries about the low sampling density of the IGCP 259 recommendations. Prof Xie suggests that it might make sense to consider collecting samples using a more dense protocol, e.g. each 80 km^2, 40 km^2 or even 20 km^2 – perhaps by starting at the GRN scale and working successively to more dense schemes depending on the situation in each country. Large countries could use a less dense sampling scheme, and smaller countries more dense. Other concerns were expressed about funding and geo-politics!

2. Status Report for each CCOP Member Country

Participants from all CCOP countries represented at the meeting gave a brief status report on their experiences of geochemical mapping programmes.

Cambodia – There has been collaboration with other countries as part of technical co-operation activities, e.g. SINOPAC of China. Total area is 181035 km^2.

China – As well as its detailed geochemical exploration programme, China has also participated through the EGMON project. Sampling has been conducted in line with IGCP 259 requirements although, because of cost and logistic implications, some cells in the West of China have not yet been collected. The intention is still to do so in the future. The full suite of IGCP determinands have been analysed, with very good data quality and limits of detection.

Indonesia – Samples from the whole of Sumatra (N and S) and Sulawasi Island have already been collected (22000 samples at a density of 1 in 15 km^2). Total area is 1904443 km^2. Sampling in Eastern Indonesia has just started. The programme is limited to between 15 and 17 elements, using AAS and colorimetric analysis. Insufficient funds and equipment are available to determine more elements. All samples are stored and available for re-analysis.

Japan – Geochemical mapping is underway. The total number of stream sediments samples will be more than 3000; over 2200 are already collected and a further 800 are planned over the next 3 years. Total area is 3777800 km^2. A total of 48 elements are determined by ICP-AES, ICP-MS and GF-AAS. Plan to collect soils as well. Not known if the samples are collected in line with IGCP 259 recommendations, but data density is very high and data quality thought to be very good.

Korea – "National Geochemical Mapping for the Environment" project initiated in 1996. Mainly stream sediments collected using <150 μm fraction. About 45% completed, mainly in West Korea. Over 40000 km^2 coverage to date out of a total of 99237 km^2. Density of sampling is 1 in 3.5 km^2 but density is less in the western part of Korea. Total of 36 elements analysed by XRF, ICP-AES and NAA. Collected according to IGCP 259 where possible, although quality control of data cannot be matched because instrumentation is not always capable of meeting requirements. All samples are stored and available for re-analysis. The first maps have been produced and the first atlas is in the process of being published. Hydrochemical sampling started in 1993. About 50% of Korea covered (about 50000 km^2). Aim to complete study by 2010.

Malaysia – Coverage of Penninsular Malaysia is about 90% complete and Eastern Malaysia is about 40% complete. Total area is 329758 km^2. Some of this coverage is in conjunction with mineral exploration and mapping programmes. Sampling density is 1 in 2 km^2. Stream sediment samples have been collected conventionally and by wet sieving. 40 elements have been determined by AAS and ICP-AES. Most samples are stored and available for re-analysis.

Papua New Guinea – Limited resources are available. Land mass is 1750000 km^2. No experience in geochemical sampling, except for a few random samples collected as part of localised studies carried out by mineral exploration companies.

Philippines – Several geochemical surveys have been undertaken in conjunction with the United Nations Development Program; JICA for mineral exploration; and Korea. Rapid geochemical surveying has been carried out at density of 1 in 500 m^2. The extent of coverage is not known. Total land mass is 299700 km^2.

Thailand – Total area of Thailand 513115 km^2. Samples have already been collected in the South of Thailand (about 30% of total area) as part of a reconnaissance survey at 1 in 10 km^2, and a semi-detailed survey at a scale of 1 in 2 km^2. Stream sediments and pan concentrates collected. Analysis is for only 10 elements. No sample has been retained. A database project using GIS and Microsoft Access is established.

Vietnam – Geochemical exploration began in 1960. Survey has covered 120000 km^2 of land out of total of 329556 km^2, as well as significant off-shore sampling (about 100000 km^2). Density of sampling is highly variable. Many projects are carried out with external agencies. Rocks, soils, stream sediments, vegetation and waters have been collected. Laboratory capability includes a team of experienced analysts; modern analytical equipment is now used, including ICP-AES, AAS. POL, COL and AFS. ArcInfo and Mapinfo are used for data processing and map production.

3. Discussion on Way Forward

Mr Samai suggested that CCOP should arrange for a workshop to be held to consider all member countries' existing geochemical data holdings, and to develop a strategy for determining sample density in each country, approved analytical methods, required determinands, data processing techniques, etc. Other participants agreed that it would be a good idea to hold a separate meeting to discuss the fine details of how to proceed. Mr Reeder referred to the FOREGS project in which 22 countries are participating. This project is analogous to the CCOP situation and many meetings have been necessary to discuss common experience and decide on the details of the way forward. As a result of these meetings, and the chance to agree on collaboration and distribution of responsibilities, real progress has been made towards the geochemical atlas of Europe.

Mr Wang suggested that, to conform with IGCP 259 recommendations, all countries should aim to collect samples at the recommended density (1 in 160 km^2) as a minimum. Depending on the size of the country, and availability of funds and timeframe, denser sampling could be undertaken either at the same time or later. The advantage of collecting more highly dense samples later is that methods will already be validated and confidence in the sampling, analysis and data processing will therefore be better assured.

Because the information given above is incomplete, and also perhaps inaccurate, it was agreed that all member countries will provide up-to-date information on their status of geochemical mapping using a standard questionnaire to be prepared and distributed by Mr Chen. Mr Reeder is to provide Mr Chen with a copy of the questionnaire used during the early stages of the IUGS project for guidance.

In conclusion, all participants were in agreement that the project was a very good idea, and that every possible effort should be made to make further progression within the CCOP countries.

Shaun Reeder
25 May 2001

APPENDIX 2: FOREGS **WORK SCHEDULE 2000 TO 2004**

	Jan 2001 – Sept 2001 – Jan 2002 – 2003	Responsibility
1.	---------- agreement with publisher ----------	P. Klein
2.	Invitation to Gro Bruntland to write forward	A. Darnley, R.Salminen
	---------- preliminary forward ----------	
3.	---------- provisional preface ----------	A. Darnley
4.	---------- provisional introduction ----------	R. Salminen
5.	---------- geology ----------	J. Plant A. Demetriades B. de Vivo
6.	---------- landscape ----------	I. Salpeteur and J. Locutura
7.	---------- minerals ----------	W. De Vos & others
8.	----------mineral workings ----------	
9.	---------- human impacts ----------	P. O'Connor
Appendices		
10.	---------- organisation of programme ----------	R. Salminen & others
11.	---------- sampling ----------	R. Salminen & others
12.	---------- sample preparation ----------	K. Marsina & others
13.	---------- analysis ----------	H. Sandstrom, G. Hall S. Reeder & others
14.	------ quality control and quality assurance ------	H. Sandstrom, G. Hall, S. Reeder, T. Tarvainen, C. Ashveld & others
15.	---------- preliminary data processing & statistical analysis ----------	T. Tarvainen & others
16.	---- preliminary statistical analysis to evaluate applications of individual databases ----	I. Salpeteur
17.	---- preliminary data interpretation; limitations and assumptions ----	J. Plant, A. Demetriades, B. de Vivo & others
18.	---------- preliminary map production & distribution ----------	T. Tarvainen
19.	---------- agreement on interpretative teams ---------- (1) Environment, (2) Resources, (3) Crustal evolution and landscape	All participants
20.	--------- preliminary interpretation by small international/national groups [involving derived maps] ----------	All participants
21.	Issue Related Interpretation: Environment	W. De Vos – J. Plant
22.	Resources	
23.	Crustal Evolution & landscape	
	2004 Publication date	

APPENDIX 3
AGREED MINUTES
OF THE
FOREGS BASELINE MAPPING PROGRAMME
LABORATORY WORKSHOP

13 to 15 March 2001

Geological Survey of Finland, Espoo, Finland

Participants

Andras Bartha	MAFI
Hyacinta Vitkova	GSCR
Ludmila Dempirova	GSCR
Hana Mjartanova	GSSR
Pavol Lucivjansky	GSSR
Ulrich Siewers	BGR
Irena Jaron	PIG
Shaun Reeder	BGS
Eeva Kallio	GTK
Maija-Leena Hagel-Brunnström	GTK
Leena Heiskanen	GTK
Timo Tarvainen	GTK (13/14 March only)
Reijo Salminen	GTK (13 March am only)
Harry Sandström	GTK
Nils Gustavsson	GTK (14 March pm only)
Christer Ahlsved	GTK (15 March am only)
Lars-Martin Westerberg	GTK (13/14 March only)

Introductions

1. Harry Sandström welcomed all workshop participants to Finland and presented a brief overview of the organisation and role of GTK.

2. Reijo Salminen presented an overview of the history of the FOREGS programme, and summarised the current status of the project.

Sample Preparation

3. Hana Mjartanova presented an overview of the current situation regarding sample preparation. A total of 2892 samples have been processed since the first samples were received by GSSR in 1998. Samples from Spain (67 in total), the Netherlands (31) and Portugal (80) have been processed but not yet distributed to the analytical laboratories. Samples from Sweden (204 in total) have been received at GSSR but not yet processed. It was hoped that these would be prepared by the end of March and distributed with the other samples. No samples have yet been received from Greece (**ACTION Harry Sandström** to contact Alecos Demetriades). Approximately 300 further samples are outstanding from Germany, Spain, Italy and Sweden.

4. Hana Mjartanova confirmed that, to the best of her knowledge, all stream sediment samples had been wet sieved. It was agreed that the optional over-bank samples should be prepared using the same protocol as for floodplain samples.

5. Harry Sandström thanked Hana and her colleagues at GSSR for carrying out the sample preparation work within their laboratories so effectively.

Progress with Chemical Analysis

6. Harry Sandström presented an overview of the current situation of the chemical analysis. Laboratory participation had been established initially in Naples in 1998, and analytical protocols had been agreed in Bratislava in 1999. The agreed programme of analysis within the participating laboratories is as follows:

Waters

Survey	*Method*
BGR	ICP-MS/ICP-AES
BGS	IC
BGS	DOC
NGU	Hg

Humus

Survey	*Method*
GSSR	Sample Preparation
NITG	ICP-MS
MAFI	Hg

Top and Sub Soils

Survey	*Method*
GSSR	Sample Preparation
NITG	Granulometry/TOC
BGR	XRF
GTK	ICP-MS
PGI	AR/ICP-AES
MAFI	Hg

Flood Plain and Stream Sediments

Survey	*Method*
GSSR	Sample Preparation
GSSR	TOC
BGS	XRF
BRGM	ICP-MS
GTK/PGI	AR/ICP-AES
MAFI	Hg

7. The total number of samples of each type due for analysis is now estimated to be 827. Some samples are still missing from a number of countries, including Albania, Germany, Greece, Hungary, Iceland, Italy, Sweden and Spain. **ACTION Andras Bartha** to let Harry Sandström know the name of the contact in Albania. Harry Sandström reminded all laboratories that invoices for the analysis of Swedish samples should be sent to GTK.

8. Between 600 and 700 of the water analyses have been completed for analysis of metals and anions. No water samples have been received from Norway, even though they should have been collected (**ACTION Harry Sandström** to contact Børre Davidsen). Nearly all of the 300 humus samples and 1200 stream and floodplain sediment samples have been analysed. About 330 of the 540 soils have been analysed. **ACTION Andras Bartha** to check that all Hungarian samples have been correctly distributed.

9. In summary, Harry Sandström concluded that progress was quite acceptable and that analysis should be completed according to the schedule agreed in Athens. **ACTION all laboratories** to release to GTK as much data as are available in time for the meeting of the Data Management Group at the end of May.

Data Management

10. Timo Tarvainen gave a presentation on FGBMP data management and its requirements for analytical QC of data.

11. Field data was still unavailable from a number of countries, including: Albania, Croatia, Germany, Greece, Iceland, Italy (some districts), the Netherlands, Norway, Slovenia, Spain and Sweden. Only sample co-ordinates were available from Ireland. **ACTION Timo Tarvainen** to chase responsible countries so that field data are submitted to GTK in time for the meeting of the Data Management Group at the end of May.

12. At the next meeting of the Data Management Group, issues to be discussed will include: requirements for further background data (geology, vegetation, land-use, etc); approach for treatment of outliers; and the design of the ArcView maps. Provisional point maps will be issued to each participating country to check for anomalies.

Principles of QC Data Analysis

13. Nils Gustavsson gave a presentation on the requirements for QC of data. The approach that was agreed should be used is the 2-level ANOVA method, based on the sampling and analysis protocol agreed in Bratislava (Figure 1).

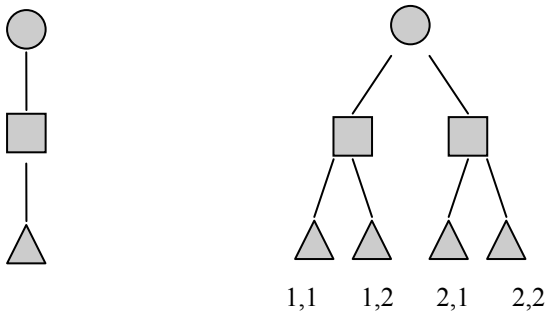

Figure 1. Schematic diagram of duplicate sampling and analysis protocol

14. All ANOVA analysis will be performed at GTK. To assist in the processing of the data, all laboratories are asked to submit duplicate data in the following format:

	Aluminium				Arsenic				etc.			
Sample	1,1	1,2	2,1	2,2	1,1	1,2	2,1	2,2	1,1	1,2	2,1	2,2

QC Routines of the Participating Laboratories

15. The different QC protocols used for each analytical method were discussed by all participating laboratories. A summary of the different protocols applied is given in Annex 1. All laboratories have comprehensive internal QC procedures. The protocols used by NGU, NITG and BRGM, who were not represented at the Workshop, were unknown (**ACTION Harry Sandström** to contact Børre Davidsen, Nikolaj Walraven and Alain Batel for details).

16. Unfortunately, not all laboratories have carried out analysis according to the 2-level ANOVA protocol agreed in Bratislava. It was agreed that all laboratories who have not done so would retrospectively analyse all analysis duplicates so that the 2-level ANOVA may still be performed (**ACTION all laboratories** to submit outstanding data to Harry Sandström by the end of April). Duplicate analyses should also include any laboratory preparation, e.g. two separate XRF pressed pellets/fused beads or two separate digestions for ICP-MS should be prepared from each duplicate.

Agreed QC Protocols: General

17. Three main reasons were agreed for documenting QC data: (i) the Data Management Group need to be able to interpret results, and make decisions on which "outliers" might be eliminated; (ii) the validation data is needed for inclusion in the Analytical Methods Report and the Appendix to the Geochemical Atlas; and (iii) there will be opportunities to publish the data in the scientific literature. **ACTION all participating laboratories** to comply with the arrangements discussed in the following sections of these minutes.

Agreed QC Protocols: Drift

18. The criterion suggested in Athens was that the drift should be acceptable within ±10%. It was agreed that no drift correction need be applied if this condition was met. All laboratories need to be able to demonstrate the observed drift for all determinands over time intervals relating to the full analysis period. Data should not be used from analytical runs that have failed routine internal control checks. Where possible, monitoring data should be compared with the normal reproducibility of the method. Evidence should be taken from all available internal QC data and CRMs, as well as the monitoring samples (ISE 982 and 921). Where possible, data should be presented in the form of Shewart charts.

19. If drift is greater than 10%, the laboratory needs to justify whether they still consider it acceptable to use the data (some determinands in certain sample types at certain levels may still be acceptable if drift is >10%). Recommendations should be sent to the Data Management Group for agreement. Possible outcomes may include: data are still considered acceptable; data should not be used, data require drift correction before use, analysis should be repeated.

Agreed QC Protocols: Accuracy

20. Accuracy should be based on the laboratory's long-term validation data using evidence taken from CRMs, inter-laboratory comparisons, etc. The laboratory procedures for determining estimates of accuracy should be described in the method validation. Data should also be included from Monitoring Samples (ISE 982 and 921, etc). These data should be displayed for each monitoring Sample as a graph of element v relative % error calculated from consensus values. The %RSD for analysis of the monitoring sample over the full analysis period should also be included on the graph. **ACTION Harry Sandström** to supply agreed consensus values for each of the Monitoring Samples.

21. Accuracy data greater than an acceptable % difference (based on the laboratory's expertise, but no greater than 10%) require justification and agreed action with the Data Management Committee as detailed in Item 19.

Agreed QC Protocols: Repeatability

22. The laboratory procedures for determining repeatability should be described in the method validation. Where possible, data should be presented in the form of Shewart charts. RSD data for Monitoring Samples should be included as described in Item 20. It was also agreed that those laboratories who did not follow the 2-level ANOVA protocol agreed in Bratislava would repeat these analyses (see Items 13 to 16).

Agreed QC Protocols: Detection Limits

23. It was agreed that each laboratory's validated method DLs should be used. The method of calculation of the DL should be given in the validation data. The Data Management Group will determine what "value" is to be used for purposes of interpretation: 0.5 DL, 0.66 DL, etc.

24. It was proposed that "periodic tables" giving detection limits and estimated standard deviations (orRSDs) for all elements should be prepared.

Agreed QC Protocols: Contamination

25. Ulrich Siewers presented some data on the characterisation of blank levels in the three bottle types used, and on potential contamination caused by the filters used to filter the water samples. Some variation was observed for a number of elements, including Al, B, Cr, etc,

although the level of contamination for the majority of elements was considered insignificant compared to levels in the samples. The exceptions are Hg, which is observed at levels of up to 0.25 ppb when using certain bottle types, and Sn, which is observed at levels of up to 0.04 ppb when using certain bottle types and up to 1.7 ppb when using certain filters.

26. The contamination problem is exacerbated by uncertainties about whether the recommended sample bottles were used for each sub-sample type by all countries. **ACTION Harry Sandström** to contact Børre Davidsen about which bottle types were used by each country for Hg preservations. **ACTION Ulrich Siewers** to carry out some additional tests to study potential Hg contamination. It was agreed that improved protocols for collection of blanks need to be included into subsequent revisions of the "Blue" and "Green" Books.

27. Details of results for reagent blanks also need to be documented in method validation reports. Potential problems elements need to be identified, both for the information of the Data Management Group and for raising general awareness.

Agreed QC Protocols: Inter-laboratory Comparisons

28. The XRF data for stream and floodplain sediments analysed initially by the BGS and subsequently by BGR show very good agreement for most samples. **ACTION Shaun Reeder** to check sample-labelling anomalies and arrange for repeat testing of any samples that are still in poor agreement. **ACTION Shaun Reeder** to arrange for XRF comparison of the 40 BGR soil samples to be carried out at BGS as a matter of priority.

29. The comparison between MAFI Hg data and analyses carried out by GSC was generally good, but showed that GSC data were systematically higher than MAFI data. Also GSC analyses of MAFI samples were systematically higher than for equivalent samples supplied by BGS. **ACTION Harry Sandström** to confirm sample identification with Gwendy Hall. **ACTION Harry Sandström** to arrange for 20 of the samples at GSC (10 equivalent MAFI/BGS pairs) to be sent to BGR for further comparison by digest/ICP.

30. Inter-laboratory comparison data are still outstanding for XRF of soils (**ACTION BGS**) and ICP-MS of soils and sediments (**ACTION GTK and BRGM**). It was agreed that the comparison should be extended to include major and trace elements in waters (**ACTION BGR** to send 20 to 40 samples to GTK for analysis).

Reporting of QC Protocols

31. **ACTION All laboratories** to report outstanding QC data to Harry Sandström before the Data Management Meeting of 29 May 2001, and preferably by the end of April.

32. It was agreed that quality data are not to be made public yet, and are only for use of the FOREGS Working Group until in an agreed final status.

IUGS/IAGC Working Group on Global Geochemical Baselines

33. Shaun Reeder gave a brief presentation on the background to the global geochemical baseline project, and explained the importance of the FOREGS' contribution to the global programme.

Publication of the "Analytical Manual"

34. The requirements for, and publication format of, the Analytical Manual were discussed in detail. It was agreed that the Analytical Manual was different from the Sampling Manual, in that it needed to describe what *had* been done, rather than give recommendations for what *should* be done on the global scale.

35. Harry Sandström distributed the current draft copy of the Analytical Manual, which is available on the GTK web-site. It was agreed that, with some extension to its scope, this should still form the basis of the main analytical publication and that, in its final form, it should still be made available on the web. A condensed version of the Analytical Manual would be prepared for inclusion as an Annex to the Geochemical Atlas of Europe, according to the schedule agreed in Athens.

36. All methods should be described in the same, or similar, format, based on the headings agreed in Bratislava. In addition, new sections would be added for each analytical method on: detection limits, instrument parameters (both in tabular form), QC protocols and method validation (both as described earlier in these minutes). **ACTION all laboratories** to check through the current version of the Manual and report any corrections to Harry Sandström as a matter of priority. **ACTION all laboratories** to prepare and report new sections to Harry Sandström by the end of April.

37. Ulrich Siewers suggested that it might be possible to publish more detailed descriptions of the analytical protocols used for FOREGS in a special edition of *Geochemistry: Exploration, Environment, Analysis*. **ACTION Ulrich Siewers and Harry Sandström** to discuss with Gwendy Hall, and to determine the possible size of the special volume, publishing turn-around times, etc.

38. It was suggested that the special volume should include introductory papers on the IUGS/IAGC Global Geochemistry Baselines Project, and background to the FOREGS programme. It would also provide an ideal opportunity to update the Sampling Manual and the current "Blue Book" recommendations on chemical analysis, QC protocols, etc. Extra scientific papers on the inter-laboratory comparison data could be included within the special volume, or published elsewhere.

Any Other Business

39. Andras Bartha inquired about the Inco Copernicus web-site that had been set up by Doug Miles In particular he was keen to know whether the site was still active, and who now had responsibility for its upkeep. **ACTION Shaun Reeder** to investigate.

Meeting Closure

40. Harry Sandström thanked everyone for their participation during the week, and reminded everyone of the importance of keeping to the schedules that had been agreed. In return, Ulrich Siewers thanked Harry and his GTK colleagues for their hospitality.

Shaun Reeder
20 April 2001