

**ANNUAL REPORT FOR THE  
INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)  
WORKING GROUP ON  
GLOBAL GEOCHEMICAL BASELINES  
2003**

**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*  
*Co-Leaders*

Dr Arthur Darnley  
Prof Jane Plant  
Dr David Smith

Geological Survey of Canada  
British Geological Survey  
US Geological Survey

*Scientific Secretary*  
*Treasurer*

Mr Shaun Reeder  
Mr Alecos Demetriades

British Geological Survey  
IGME, Greece

**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 as an input to the IUGS/IAGC Global Geochemical Baselines project. A few other countries, including China, Russia, Colombia, India 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 Expert Group' and the European Soil Bureau over the past few years, and is actively involved in European Commission's 'Soil Thematic Strategy Group' for the preparation of the EU's Soil Protection Document. The EuroGeoSurveys Secretary General is trying to link the project to other European Commission projects, such as the GMES Forum (Global Monitoring of Environment and Security), and INSPIRE (Infrastructure for Spatial Information in Europe).

**7. CHIEF ACCOMPLISHMENTS IN 2003**

**Scientific Progress:** On the global scale, there has been significant progress within a number of countries over the past year. Within Southern India, sampling has been completed on 12 cells – about one tenth of the total for the country as a whole. The data have recently been published and have attracted considerable attention. Dr David Smith of the USGS spent November 16-22 in India participating in a workshop organised by the main regional co-ordinator in India, Dr. Pradip Govil and holding various discussions on the GRN sampling in India. Minutes of this meeting are appended. Proposals have been

submitted for sampling to begin in Kenya, Uganda and Tanzania. A field training course for the East African sub project will be arranged in Tanzania in July 2004. Some of the most significant developments are still occurring within the 11 CCOP countries of SE Asia. A geochemical mapping project, to be co-ordinated through the CCOP, has been approved by all member countries through the CCOP Steering Committee. An inventory of data is nearing completion and a series of training sessions, to be led by the Chinese, are planned. An Expression of Interest (appended) has recently been submitted to the IUGS/IAGC as part of the recent call, with the intention of running workshops in India and China to help promote activities in these and the other CCOP countries.

The minutes of the IUGS/IAGC Working Group's recent Business Meeting, held in Edinburgh on 9 September 2003, are appended. Work has also been progressing on updating the 'field manual' (Salminen *et al.*, 1998) to include advice on sampling in terrains not original covered, including mountainous, tropical and karstic terrains.

Within Europe, work has been continuing on the FOREGS contribution to the project. Sampling was completed within all countries participating in the FOREGS programme in 2001, although there are now plans to extend the sampling in Iceland. All analyses have been completed over the past year, and all necessary quality control checks have just been completed. Data compilation and management processes are well underway, and the first set of final maps will be ready by the end of January 2004 for interpretation. Significant progress has been made in writing some of the introductory and background texts for the Geochemical Atlas of Europe. The minutes of the Working Group's Annual Business Meetings, held in Dublin in March 2003 and Edinburgh in September 2003 are appended. Also appended are minutes of the meetings of the Quality Control Group and the Interpretation Group held in Helsinki in May 2003 and Edinburgh in September 2003, respectively.

**Public Relations and Finance Committee:** The new structure for the Committee agreed at the 2002 Annual Business Meeting (Chair: Alecos Demetriades; Deputy Chair: Andrew Grosz, three committee members, and affiliated members from each participating country) has not yet been activated, because it is important to firstly organise a section in the IUGS Website for the Global Geochemical Baselines project. The intention is for this web page to represent a forum for information exchange and promotional activities with products from the FOREGS and other pilot projects.

The Committee continued its activities for the promotion of the global programme, including discussing the raising of funds with marketing and public relations consultants, and with senior staff from mining companies. Other discussions with marketing experts are being planned for 2004 on issue of the FOREGS Geochemical Baselines Atlas of Europe, which is considered as the spearhead of the promotional activities. It is stressed that significant funding (in the order of £75K to £100K) is required just to start making progress with the marketing and fund-raising initiatives. The suggestion of the first marketing consultant to raise the public image of the fund raising campaign by having a celebrity figurehead or patron will be pursued

Financing the global project with EU funds, as part of the EU Commission's Global Monitoring of Environment and Security Forum, was discussed with the Director of DG Environment (June 2003). Although this initiative concerns the future role that the EU wants to play in global affairs, according to the present situation of EU funding, this is not possible. However, as from 2005/6, there will be a possibility of funding directly projects of European or global concern. This information is, in fact, very encouraging, and has been passed on to the EuroGeoSurveys Secretary General, who has direct contact with the EU commission.

Discussions with DuPont to fund the CCOP contribution to the Global Geochemical Baselines project, and with the Greek Orthodox Churches of Western Europe for financial assistance, which have started in 2002 will be pursued further. During 2003, contacts have

been made with senior staff of Greek and international mining companies, who are supportive of the Global Geochemical Baselines project, but their advice, before approaching the management of companies is to have something to show, apart from reports and publications. So, their recommendation for a successful fund raising campaign is to wait until the FOREGS atlas is available, and the project's website is set up. They also stressed the significance of personal contact. No company will be handing out money without being convinced about the project. Hence, the importance of seed money for the fund raising campaign for the IUGS Global Geochemical Baselines project.

## 8. CHIEF PROBLEMS ENCOUNTERED IN 2003

The main problem still facing the project is the lack of funding, which is required to achieve the aims and objectives of the project at the global scale. Although the geochemical baseline project in Europe continues to make significant progress, through funding by the participating European Geological Surveys, it is still considered unlikely that the global programme will go ahead without significant funding from all possible sources, including IUGS. Funds are required for training, transportation, additional analytical services and quality control. It is hoped that some funding might be supplied through IUGS/IAGC in response to the recent Expression of Interest discussed in the previous section.

Mr Alecos Demetriades of IGME, Greece, and Dr Andrew Grosz of USGS, in their roles as chair and deputy chair of the Public Relations and Finance Committee, have specific responsibilities for carrying out marketing initiatives in an effort to secure funding. In order to carry out these initiatives more successfully, assistance is requested from the IUGS committee in the form of:

- (i) seed money for promotional purposes,
- (ii) supply of addresses of all Geological Surveys in the World for the purposes of promoting the global project in these countries, and the development of contact points, and
- (iii) designing an Internet section dedicated to the project within the IUGS Website in collaboration with the IUGS Web Master. In this section, it is proposed that all project material will be stored and all Geological Surveys will have hot links to this page. It is stressed that this is a very important promotional activity, not only for providing information to scientists and the public in general, creating an exchange platform with contact points all over the world, but also for fund raising.

## 9. CHIEF PRODUCTS IN 2003

### *Presentations, Posters and Abstracts*

Demetriades A. 2003. Global Geochemical Baselines for Environmental Management: An international project for better quality of life in the new millennium. 2<sup>nd</sup> Ministerial Conference on the Environment of the European Mediterranean Partnership. Hellenic Ministry of Environment, Planning and Public Works, Athens, Greece, 20 February 2003.

Demetriades A. 2003. 2003. "Geochemical Baseline Mapping of Europe – The European contribution to IUGS/IAGC Working Group on Global Geochemical Baselines. European Commission's "Global Monitoring of Environment and Security" Forum (GMES), Athens, Greece, 4 to 6 June 2003.

Demetriades A. 2003. Geochemical Baseline Mapping of Europe – The European contribution to IUGS/IAGC Working Group on Global Geochemical Baselines. Management Meeting of the EU financed project 'Network Oriented Risk-assessment by In-situ Screening of Contaminated sites', Budapest, Hungary, 26-27 June 2003.

Demetriades A *et al.* 2003. Global Geochemical Baselines for Environmental Management: An IUGS/IAGC/FOREGS/EUROGEO SURVEYS international project for better quality of life in the new millennium. 7<sup>th</sup> Biennial Meeting of the Society for Geology Applied to Mineral Deposits 'Mineral Exploration and Sustainable Development', Athens, Greece, 24-28 August 2003.

Demetriades A. 2003. Geochemical Baseline Mapping of Europe – The European contribution to IUGS/IAGC Working Group on Global Geochemical Baselines. Conference on 'From vision to practice: Integrated and multidisciplinary approach to site investigation in Europe', Cologne, Germany, 21 November 2003.

Ferreira A; Batista M J, Martins L and Serrano Pinto M. 2003. Regional and FOREGS Portuguese Baseline Mapping. Fourth European Congress on Regional Geoscientific Cartography and Information Systems: geoscientific information for spatial planning, Bologna (Italy), June 17th-20th.

Plant J A, Reeder S, Salminen R, Smith D, Tarvainen T and Petterson M G. 2003. The Distribution of Uranium over Europe: Environmental and Geological Significance. IAEA Meeting

Plant J A, Demetriades A, De Vos W, Klaver G, Ottesen R-T, Salminen R, Reeder S, Siewers U, Tarvainen T, deVivo B and de Almeida Farinha M. 2003. The geochemistry of Europe: some preliminary findings of the FOREGS Geochemical Baseline Project. 6th International Symposium on Environmental Geochemistry, Final programme and book of abstracts, p. 31. University of Edinburgh.

Reeder S, Sandström H, Bartha A, Davidsen B, Gadalia A, Kallio E, Klaver G, Markovich D, Marsina K, Paslawsky P and Siewers U. 2003. European-wide regional geochemical mapping: Lessons learnt from the FOREGS project. Geoanalysis 2003. Book of abstracts pp. 75-76. Geological Survey of Finland and the International Association of Geoanalysts.

Reeder S, Sandström H, Bartha A, Davidsen B, Gadalia A, Kallio E, Klaver G, Markovich D, Marsina K, Paslawsky P and Siewers U. 2003. Overview of sample preparation and analytical procedures used for the FOREGS geochemistry mapping project. 6th International Symposium on Environmental Geochemistry, Final programme and book of abstracts, p.205. University of Edinburgh.

Salminen R. 2003. Geochemical Atlas of Europe – do the new maps reveal risky areas? Fourth European Congress on Regional Geoscientific Cartography and Information Systems, Bologna, Italy, June 2003. Proceedings, vol 2, 635 – 636.

Salminen R. 2003. Geochemical Baseline Mapping of Europe – The European contribution to IUGS/IAGC Working Group on Global Geochemical Baselines. Fourth European Congress on Regional Geoscientific Cartography and Information Systems, Bologna, Italy, June 2003.

Salminen R and Gregorauskiene V. 2003. Environmental Geochemical mapping in Europe. International workshop Geosciences for urban development and environmental planning, September 13-18, 2003, Vilnius, Lithuania. Extended abstracts, pp. 78-81. ISBN 9986-623-40-5.

Salminen R, Batista M J, Bidovec M, Demetriades A, De Vivo B, De Vos W, Duris M, Gilucis A, Gregorauskiene V, Halamic J, Heitzmann P, Jordan G, Kivisilla J, Klaver G, Klein P, Lis J, Locutura J, Marsina K, O'Connor P J, Olsson S Å, Ottesen R-T, Plant J A, Reeder S, Salpeteur I, Siewers U and Steenfelt A. 2003. FOREGS geochemical baseline mapping – a new European wide database and geochemical atlas. Geoanalysis 2003, Book of abstracts pp. 152-153. Geological Survey of Finland and the International Association of Geoanalysts.

Salminen R, Batista M J, Bidovec M, Demetriades A, De Vivo B, De Vos W, Duris M, Gilucis A, Gregorauskiene V, Halamic J, Heitzmann P, Jordan G, Kivisilla J, Klaver G, Klein P, Lis J, Locutura J, Marsina K, O'Connor P J, Olsson S Å, Ottesen R-T, Plant J A, Reeder S, Salpeteur I, Siewers U and Steenfelt A. 2003. FOREGS geochemical baseline mapping – a new European wide database and geochemical atlas. Fourth European Congress on Regional Geoscientific Cartography and Information Systems, Proceedings, vol 2, 655 – 656.

Salminen R, Batista M J, Bidovec M, Demetriades A, De Vivo B, De Vos W, Duris M, Gilucis A, Gregorauskiene V, Halamic J, Heitzmann P, Jordan G, Kivisilla J, Klaver G, Klein P, Lis J, Locutura J, Marsina K, O'Connor P J, Olsson S Å, Ottesen R-T, Plant J A, Reeder S, Salpeteur I, Siewers U and Steenfelt A. 2003. FOREGS geochemical baseline mapping – a new European wide database and geochemical atlas. . 6th International Symposium on Environmental Geochemistry, Final programme and book of abstracts, p.207. University of Edinburgh.

Smith D. 2003. IUGS Global Geochemical Baselines project. IAEA Meeting, Colorado, USA, June 2003.

Smith D. 2003. Global Scale Geochemical Baselines: A Strategic Program for Assessing and Monitoring the Composition of the Earth's Land Surface. Workshop on Global Geochemical Baselines for Environmental Management in India. National Geophysical Research Institute, Hyderabad, India, November 19-20, 2003.

Tarvainen T, Ahlsved C, Reeder S, Lima A, Zuccolini M, Bel-Ian A, Locutura J and Lampio E. 2003. Overview of database management procedures used for the FOREGS geochemistry mapping project. 6th International Symposium on Environmental Geochemistry, Final programme and book of abstracts, p.211. University of Edinburgh.

#### *Other Deliverables*

The second set of preliminary maps of European geochemical data have been prepared and circulated for preliminary discussion and interpretation. First drafts of introductory and background chapters for the 'Geochemical Atlas of Europe' were returned to the coordinators with comments. This is an ongoing process until the finalisation of all chapters and appendices during 2004.

## **10. SUMMARY OF EXPENDITURES IN 2003**

The Working Group has received only fifteen hundred US dollars (1500 USD) for 2003. Since, the amount was very small for the promotional activities, and even for assistance to developing country participants, it was decided to keep it for use in the promotional activities of 2004, and in the hope that IUGS will be approve the requested amount. It is mentioned that the amount requested for 2003 was ten times more, so during the transcribing a significant zero was somehow dropped. The matter was discussed with the IUGS secretary, but unfortunately nothing could be done. It should be mentioned that assistance was requested from people to attend the Edinburgh symposium in September 2003, but the amounts required exceeded considerably the available financial resources.

The cost of the FOREGS programme over the past year is estimated to be in excess of US \$0.2M. 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 FOREGS programme will be completed by the end of 2004. The geochemical database will be completely populated with all geochemical data, final maps will be prepared, interpretation completed and texts finalised for inclusion in the Geochemical Atlas of Europe.

The 'launch' of interpreted data and other significant findings from the FOREGS project, and reports of progress with the project on the global scale, will take place at the IUGS/IAGC/FOREGS Working Group's workshop (DW016) at the 32<sup>nd</sup> International Geological Conference, Florence, Italy, 20-28 August 2004.

The FOREGS Geochemical Mapping Field Manual (Salminen *et al.*, 1998) will be revised to include new details on sampling in karstic terrains prepared by A Demetriades, S Pirc, M Bidovec and F Sustersic, and other key terrains, such as tropical, desert and arctic.

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. Significant developments are likely if the Expression of Interest discussed earlier is followed up by a fully funded project.

The Public Relations and Finance Committee will continue in its plan of marketing initiatives in an effort to secure external funding. However, seed money is required from the IUGS to proceed with the fund raising campaign.

## 12. CRITICAL MILESTONES TO BE ACHIEVED NEXT YEAR

Production of the Geochemical Atlas of Europe.

Continued progress with the global project including, should funding be made available, preparation of a Workshop on geochemical sampling to take place in Bangkok and, subsequently, China.

## 13. ANTICIPATED RESULTS/PRODUCTS NEXT YEAR

- Compiled database of all FOREGS GRN samples, including statistical analysis and maps.
- Final report on FOREGS analysis methods, quality control and uncertainty of measurement.
- Geochemical Atlas of Europe, available on CD-ROM
- Revised FOREGS Geochemical Mapping Field Manual with the addition of all the necessary appendices for sampling in different terrains, such as tropical, desert and arctic.
- Significant number of oral presentations, posters and promotional materials.

## 14. COMMUNICATION PLANS

The IUGS/IAGC/FOREGS Working Group also plans to host a workshop (DW016) at the 32<sup>nd</sup> International Geological Conference, Florence, Italy, 20-28 August 2004.

Technical committees and less formal groups of country representatives will meet throughout the year to ensure that the schedule of work agreed in Edinburgh (September 2003) 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\$ 0.2M.

Without securing substantial financial contributions from external sources, it will be very difficult for the IUGS 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.

As indicated earlier, an Expression of Interest was submitted to the IUGS/IAGC in response to its recent call (appended). The timescale for submitting formal proposals is not clear, and no feedback has yet been received. It is hoped that funds (50,000 USD were identified in the EoI) will be secured through this opportunity, which would give us the clearest opportunity yet to make significant progress with the project in developing countries at the global scale.

Any other support from IUGS/IAGC towards the advancement of this project in developing countries would be most welcome. In particular, the Public Relations and Finance Committee is requesting seed money for travel and promotional purposes in the order of **Twenty thousand** US dollars (20,000 USD).

## 17. CHIEF ACCOMPLISHMENTS 1998-2003

- 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](http://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 of the IUGS/IAGC and FOREGS Working Groups 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.
- 2002 Annual Business Meeting of the IUGS/IAGC and FOREGS Working Groups held in Svincice, Czech Republic (22 to 25 April 2002).
- 2002 Sampling and analysis completed in Southern India. Pilot studies partially completed within Colombia and Brazil. A major new campaign under the auspices

- of the Coordinating Committee for Geoscience Programmes in East and Southeast Asia is currently in the planning stages.
- 2003 Annual Business Meeting of the FOREGS Working Group held in Dublin, Ireland (18 to 21 March 2003).
- 2003 Quality control of the analytical results of the FOREGS project completed.
- 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 Annual Business Meeting of the IUGS/IAGC and FOREGS Working Groups held in Edinburgh, Scotland (9 September 2003).

## 18. ANTICIPATED OBJECTIVES AND WORK PLAN 2004-2008

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 electronic form at the end of 2004, and in printed form in 2005.

The FOREGS Geochemical Mapping Field Manual will be extensively revised to cover all terrain types. Similarly, a FOREGS Analytical Manual will be released in 2004 with details of all the analytical procedures used in the analysis of European samples, including quality control procedures, etc.

A popular, well illustrated, version of the FOREGS atlas will be prepared in 2005. It will be aimed at decision makers, but also the general public and educational institutions.

To aid in the training of field sampling teams, an illustrated version of the Field Manual showing, in picture form, all stages of sampling will be produced as a PowerPoint presentation to be distributed on CD-rom or downloaded from the Working Group's website.

Ongoing efforts will be made to increase the extent of the participation in the global GRN project for countries outside of Europe.

## 19. REFERENCES

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

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