The FOREGS Geochemistry Task Group 1994-1996.

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The Forum of European Geological Surveys (FOREGS) includes geological surveys from 33 European countries and is responsible for co-ordinating geological survey activities in Europe. The FOREGS Geochemistry Task Group was established in 1994 as part of the programme, to supervise European geochemical mapping policy following the recommendations of IGCP Project 259 'International Geochemical Mapping'. The task group comprises representatives from five countries charged initially with the compilation of an inventory of geochemical data within FOREGS countries.

In the global context, the preparation of a European Geochemical Baseline will contribute to a World Geochemical Atlas and the maps are to be prepared according to the recommendations of IGCP 259/360 which are being implemented by the IUGS Working Group on Continental Geochemical Baselines.

The long-term aim of the group is to produce standardised European Geochemical Maps, to provide a sound basis for environmental legislation and policy-making on levels of potentially Harmful Elements and Species (PHES). Throughout Europe, public concern about the environment is growing. In response, national governments and the EU are attempting to develop policies, legislation and infrastructure, such as the European Environment Agency. Attempts are also being made to establish "Safe Levels" of PHES, but these are often based on limited and/or inadequate information. At the present time, knowledge of the geochemistry of the surface environment of Europe is based on different surveys of variable standards carried out by many different organisations in the public and private sectors. Systematic baseline environmental geochemical data standardised across national boundaries are required urgently as a basis for land-use planning and for monitoring future change in the environment.

Geological Surveys are uniquely well equipped to prepare the systematic environmental geochemical baseline databases required for Europe. They have expertise in sampling, sub-sampling and chemical analyses of surface environmental materials and they are familiar with the preparation, analysis and interpretation of multi-element geochemical maps, databases and GIS for rocks, soils, surface waters, groundwaters and stream sediments. Many geological surveys also have programmes concerned with landfill and nuclear waste repositories and thus have considerable knowledge of the interaction of natural and synthetic pollutants with the natural environment. This multi-disciplinary expertise is essential for the effective development and application of environmental geochemical baseline data.

Initially, an inventory of available geochemical data has been prepared based on information obtained using a questionnaire completed by geological surveys and similar organisations in FOREGS countries. The questionnaire was designed to establish the extent and types of surveys employed and information was collected on the area covered and the sample types, field sampling methods, sampling densities, size fractions, laboratory preparation procedures and analytical methods used and the availability of sample archive material and digital data.

The results show that a variety of sample types, sampling densities, size-fractions and analytical procedures have been deployed by different national surveys. The most extensive coverage of FOREGS countries has been based on stream sediment, surface water and soil and these sample types appear to offer the most valuable basis for the preparation of European Geochemical Maps.

Stream sediment surveys are by far the most extensive and have been carried out in 22 of the 33 countries, covering 26% of the FOREGS region. Most of the surveys have been carried out for a range of environmental and economic applications, although surveys carried out in France, Greenland and Spain were primarily for mineral exploration. Surveys using surface water (stream, and in some cases, spring or lake water) cover approximately one fifth of the FOREGS region and soil survey data for a variety of soil horizons are available for 16 of the 33 countries, covering 11% of the FOREGS region. Despite increased concern about radioactivity in the environment, only 18% of the area of FOREGS countries is covered by radiometric surveys.

A wide range of sampling densities have been employed across the FOREGS region, reflecting different objectives. Surveys carried out for mineral exploration have generally used high sampling densities (1 sample per <0.5 km^2 for stream sediments and 1 sample per < 1 km^2 for soils) whereas densities as low as 1 sample per 2000 km^2 for stream sediments and 1 sample per 3500 km^2 for soils have been used for rapid reconnaissance mapping. Nevertheless, most stream sediment surveys have used a density in the range of 1 sample per 1 km^2 to 1 sample per 5 km^2 with most soil surveys in the range 1 sample per 5 km^2 to 1 sample per 25 km^2. Surveys of surface water have used densities ranging from relatively high (< 1 sample per 2.5 km^2) to very low (1 sample per 2000 km^2).

The size fractions analysed for the different stream sediment surveys range from < 63 µm (BSI 240 mesh) to < 1000 µm (BSI 16 mesh). Most stream sediment surveys have, however, been based on the collection and analysis of < 177 to $<$ 200 µm (BSI 85 to 76 mesh) size fractions. All of the filtered surface water analyses carried out in the FOREGS region have been based on a filter size of 0.45 µm. The range of grain-size fractions collected for soil surveys is bimodal. Some countries have collected size fractions in the range of < 100 to <180 µm (BSI 150 to 85 mesh) to integrate with stream sediment surveys, while others have followed traditional soil survey practice and used < 1000 or < 2000 µm (BSI 16 or 8 mesh) fractions.

A range of different analytical techniques including XRF, ICP-AES, ICP-MS, DC-Arc ES, Flame AAS and NAA have been employed in FOREGS countries

and the range of elements determined appears to reflect the type of analytical method available rather than the economic or environmental aims of each survey. Elements such as Sr and Zr which are readily determined by rapid, high-productivity, cost-effective methods have therefore been included in more surveys than elements such as Au and U which are potentially of greater economic significance. There are few data for elements of environmental importance which are difficult to determine by automated analytical methods. Iodine has been determined in only one water survey, for example, and only four countries have data for Se in stream sediments, surface waters or soils.

Most FOREGS countries retain sample archives for stream sediment and soil samples, although only one country stores surface water samples. Stream sediment sample archives are available for 14% of the area of FOREGS countries, and
soil archive material for 6%. Digital data are available for 21% of the FOREGS region for stream sediments, 6% for surface waters and 8% for soils.

It is anticipated by the task group that ongoing surveys are likely to continue to employ their present techniques to maintain national continuity. The future strategy of the task group will be to increase compatibility between national geochemical surveys and to develop methods of integrating available data in the compilation of European geochemical maps. In terms of national mapping programmes, it is recommended that FOREGS organisations collect a stream sediment and/or soil and one surface water sample if possible at each sample site, in addition to samples such as till, rock or biological material which they may require for their national purposes. A minimum density of 1 site per 100 km^2 is recommended (where higher density surveys are available these can be sub-sampled using computer-based methods).

The integration of existing datasets will be greatly aided by collection and analysis of the Global Reference Network (GRN) samples recommended by the final report of IGCP 259 (Darnley et al. 1995). The network comprises a predetermined sampling grid covering all of the land areas of the globe. The collection and analysis of the GRN samples in Europe will rely on the co-operation of FOREGS geological surveys and geological surveys will be asked to collect the GRN samples in addition to samples required for their national programmes.

In summary, experience in Europe has shown that progress in International Geochemical Mapping can be achieved with co-operation between survey organisations. Compilation of an inventory of available geochemical data is a valuable first step and helps to establish a network of contacts in different survey organisations. The inventory provides data on the current status and capabilities of geochemical surveys as a basis for the development of an international geochemical mapping strategy.

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. UNESCO. Paris