THE ROLE OF GEOCHEMICAL BASELINES IN THE ASSESSMENT OF CONTAMINATED LAND.

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Introduction.

In the light of recent UK and European legislation there is a need to identify and quantify the potential hazard of contaminated land. The classification of affected areas requires the definition of 'safe levels' of Potentially Harmful Elements and Species (PHES), in some cases initial guideline values have proved to be less than satisfactory. For example, when the Council of European Communities (CEC) guideline for nickel was applied to regional geochemical baseline data in Finland, extensive areas of the north-west of the country were designated as contaminated. In the UK, many areas of naturally occurring elevated background arsenic concentrations are above the Inter-governmental Committee on Redevelopment of Contaminated Land (ICRCL) trigger values. It is clear that such guideline values are in need of modification. Geochemical baselines have a vital role in providing improved data for the provision of realistic guidelines. Geochemical baseline data is an essential tool for the identification of areas with concentrations of PHES in excess of the guideline values at national, regional and local scales.

An Integrated European Baseline.

Information on levels of background and elevated contamination in the surface environment already exists in most European countries, where information has been collected by organisations such as Geological Surveys, Soil and Agricultural Institutes. However, due to differing national priorities this information has not been collected systematically and data are based on a range of sample types and parameters determined by a range of analytical techniques. In order for these national data sets to be employed at the European scale a normalised baseline is required. The Forum of European Geological Surveys (FOREGS) are preparing a geochemical baseline for Europe to provide this normalised background which will enable contaminated land to be put into context. The FOREGS survey is based on the collection of stream sediment, stream water, soils, floodplain deposits and humus samples, to provide an integrated understanding of the geochemistry of the surface environment.

National Scale Assessment

The British Geological Survey (BGS) Geochemical Baseline Survey of the Environment (G-BASE) provides regional baseline data for stream sediment, stream water and soil in the UK. At present, data are available for Scotland, Wales and much of the North of England at a density of approximately 1 sample site per 2 km^2. These data provide a multi-element background geochemistry which enables the identification of broad scale patterns of elevated concentrations of PHES. Figure 1 shows copper concentrations measured in stream sediments across the north

of Britain. At this scale we can identify areas of elevated copper concentrations which can be attributed to three different factors:

- High Natural Background – Elevated copper values in stream sediments are found over the Tertiary Igneous Province of the Inner Hebrides.
- Anthropogenically Enhanced High Natural Background – Elevated levels of copper associated with mineralisation in the English Lake District have been enhanced by mining activity in the areas of Carrock and Coniston.
- Anthropogenic elevated levels – Increased copper concentrations around the urban fringes of Glasgow and Newcastle reflect anthropogenic contamination around population centres.

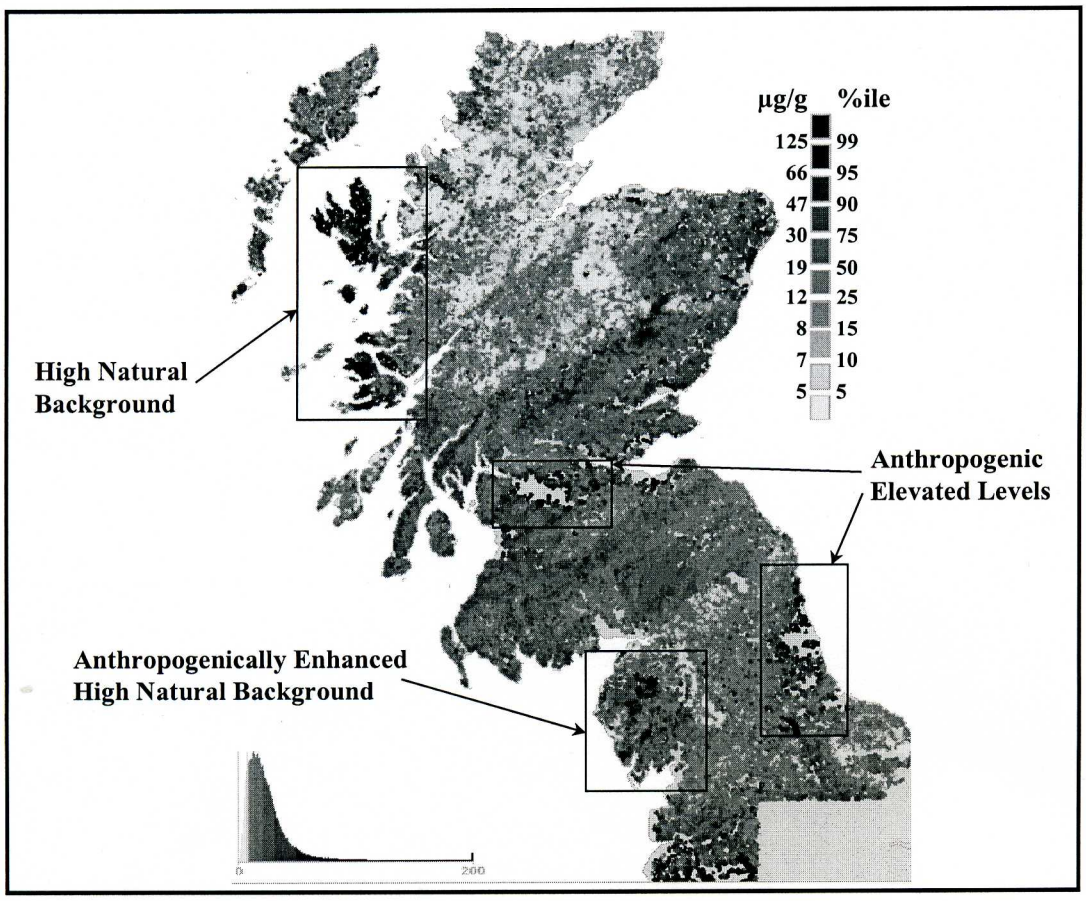

Figure 1: Copper in stream sediments showing areas of elevated concentrations, Northern Britain.

Regional Applications of Baseline Data.

Baseline data can be used to assess the extent of an area which will be affected by the application of a guideline value. The World Health Organisation (WHO) 'safe level' for uranium in drinking water is 2 ppb (parts per billion). The application of this guideline to the stream water baseline data for the English Lake District (shown in figure 2) enables an initial assessment of areas which may require surface water to be treated prior to its use as drinking water. In the area shown the majority of elevated concentrations are associated with the rocks of the Carboniferous Limestone formations.

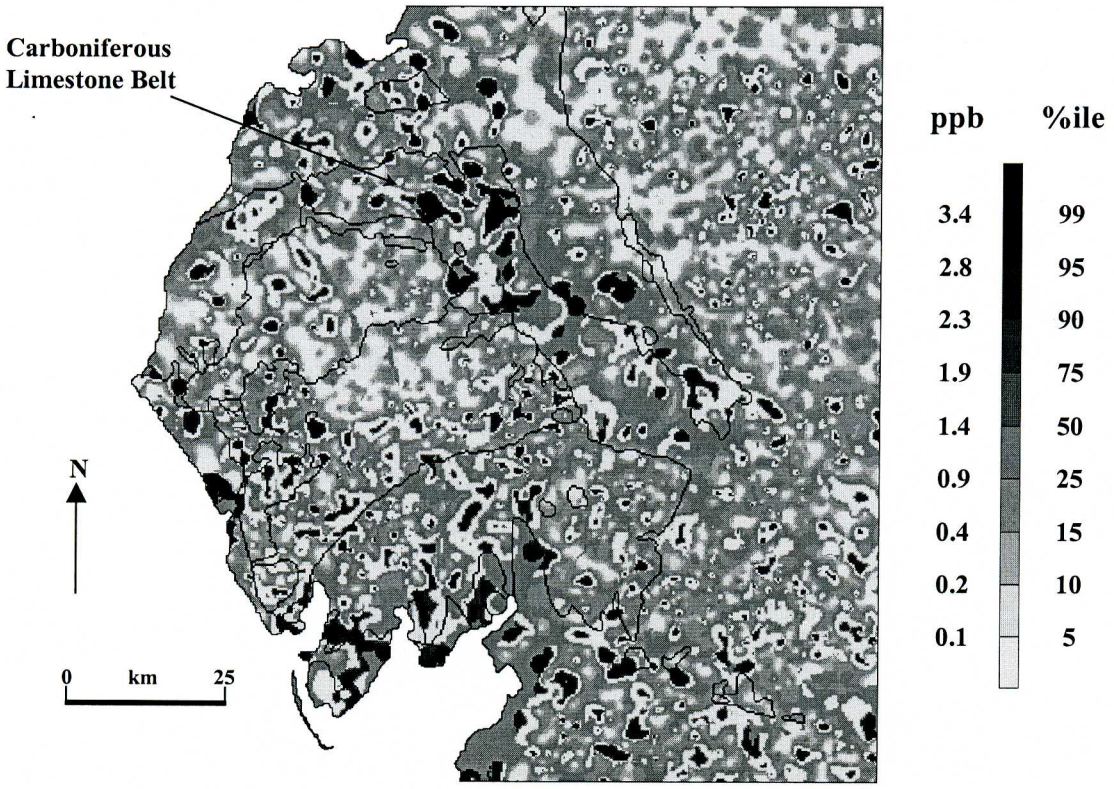

Figure 2: Uranium in water, English Lake District.

The interpretation of regional baseline geochemical data has enabled the identification of areas of previously unknown and undocumented contamination. For example, a documented area of landfill in peat fenland to the west of Manchester has a soil geochemical signature consistent with a history of 'street waste' and furnace waste disposal. The G-BASE survey identified a region to the north of Liverpool currently used for market gardening with a similar geochemical signature. This suggests an unrecorded history of land fill and potential contamination.

The Urban Baseline.

The G-BASE programme is also involved in a baseline survey of urban areas, this programme was initially developed in Wolverhampton in collaboration with Imperial College Centre for Environmental Technology. The urban baseline survey is based on soil samples collected at a density of 4 per km^2. Developments in this programme have seen the inclusion of major element chemistry and parameters such as soil pH and organic matter content in the data set, allowing a clearer understanding of the likely mobility of PHEs in the environment. This, coupled with the inclusion of other data such as land use, geology and hydrogeology in a Geographical Information System (GIS) enables a wider understanding of the sources, pathways and receptors of PHES. This integrated approach to urban geochemical interpretation is currently being applied to data from Stoke-on-Trent, an area which has a long history of industry based around the potteries. Work in this area in the future will increasingly focus on the issue of risk assessment.