Mineral resources

Geochemistry in UK mineral exploration

The role of baseline geochemical mapping

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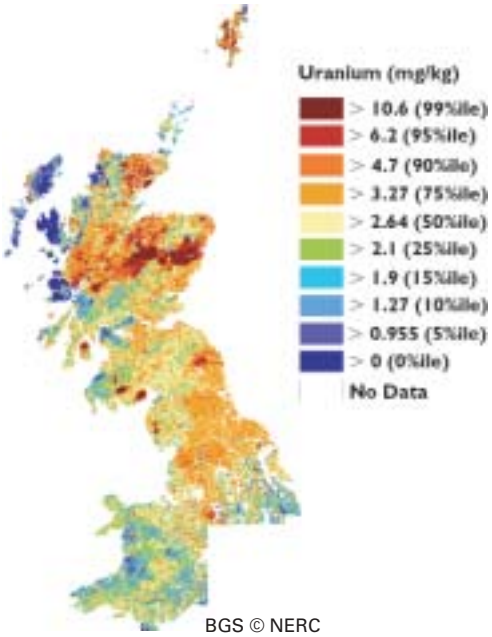
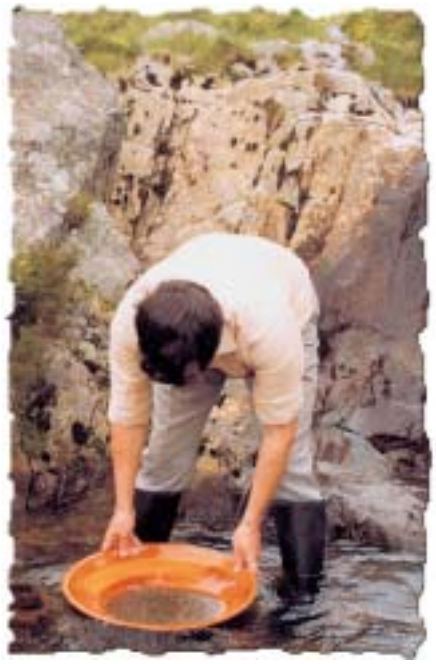


BGS © NERC

Geochemical map based on G-BASE data and indicating the concentration of uranium in stream sediments in Scotland, Wales, and northern England.

The BGS has been actively involved in geochemical mapping since the 1960s, when its geochemists were engaged in reconnaissance exploration for uranium, supported by the UK Atomic Energy Authority. Our expertise has been developed over more than thirty years through a number of programmes where geochemistry has been the prime Earth science discipline, including the Mineral Reconnaissance Programme (MRP) (1972–96) and the Geochemical Baseline Survey of the Environment (G-BASE).



Don Cameron, BGS © NERC

Collecting a panned concentrate sample for the G-BASE project. These samples give an indication of any mineralisation present or anthropogenic contamination that will lead to anomalously high geochemical results.

The BGS commenced systematic regional geochemical sampling in 1968, and has now covered approximately 80 per cent of the British mainland with high-resolution geochemical mapping *(see top right)*. The data resulting from the G-BASE programme have many uses, and are increasingly applied to environmental issues. However, the data and archived samples continue to be used in the active exploration of Britain's mineral resources. For example, some 12 000 stream sediment samples from Scotland were recently reanalysed for antimony, arsenic and bismuth, and the data have been used in a multidisciplinary study, funded by the DTI, to evaluate the mineral potential of the Northern Highlands, a region of Scotland where there has been little systematic mineral exploration.

The application of geochemistry to locate mineral deposits by the BGS has been mainly through the Mineral Reconnaissance Programme. Geochemistry, combined with geophysics, detailed geological mapping and drilling has successfully identified new mineral deposits in many areas of Britain. Notable successes, which have attracted significant commercial investment, include discoveries of gold in Devon and the Ochil Hills, baryte near Aberfeldy, and base-metals and platinum in Shetland. The G-BASE project produces regional overviews of the geochemistry in the form of its geochemical atlas series, and geochemical anomalies that may be of interest for more detailed exploration are highlighted. In the past, follow-up investigations of anomalies were carried out as part of the Mineral Reconnaissance Programme, but this is now left to private companies and consultants who use the BGS data under licence. Expertise in regional geochemical exploration developed by the BGS in Britain has been utilised in many parts of the world. Staff from the BGS have been involved in major international geochemical reconnaissance mapping projects such as those in the Anti Atlas Mountains of Morocco, the Andes in Ecuador, and Sumatra, Indonesia.

How is geochemistry used in mineral exploration?

A mineral deposit will produce a chemical signature in the rocks or over-

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burden that surrounds it. The chemical elements are dispersed away from the deposit by weathering processes, migration in groundwater or in gases, often providing a chemical response which indicates the presence of mineralisation that is not observed at the surface. The elements can be chemically or mechanically transported into the drainage system and the chemical signature may be detected over long distances along stream channels. Systematic collection of surface samples, particularly from drainage channels, can be used to find areas with potential for mineralisation. Careful interpretation of the data can distinguish between 'new' unworked mineralisation and contamination due to mine waste.

What samples are collected?

Under the G-BASE project, the following samples are collected:

- Stream sediment: the fraction finer than 150 micrometres is collected by wet sieving at site.
- Panned heavy mineral concentrates.
- Filtered and unfiltered stream water samples.
- Surface soils (0–15 centimetres depth) and profile soils (40–50 centimetres depth).

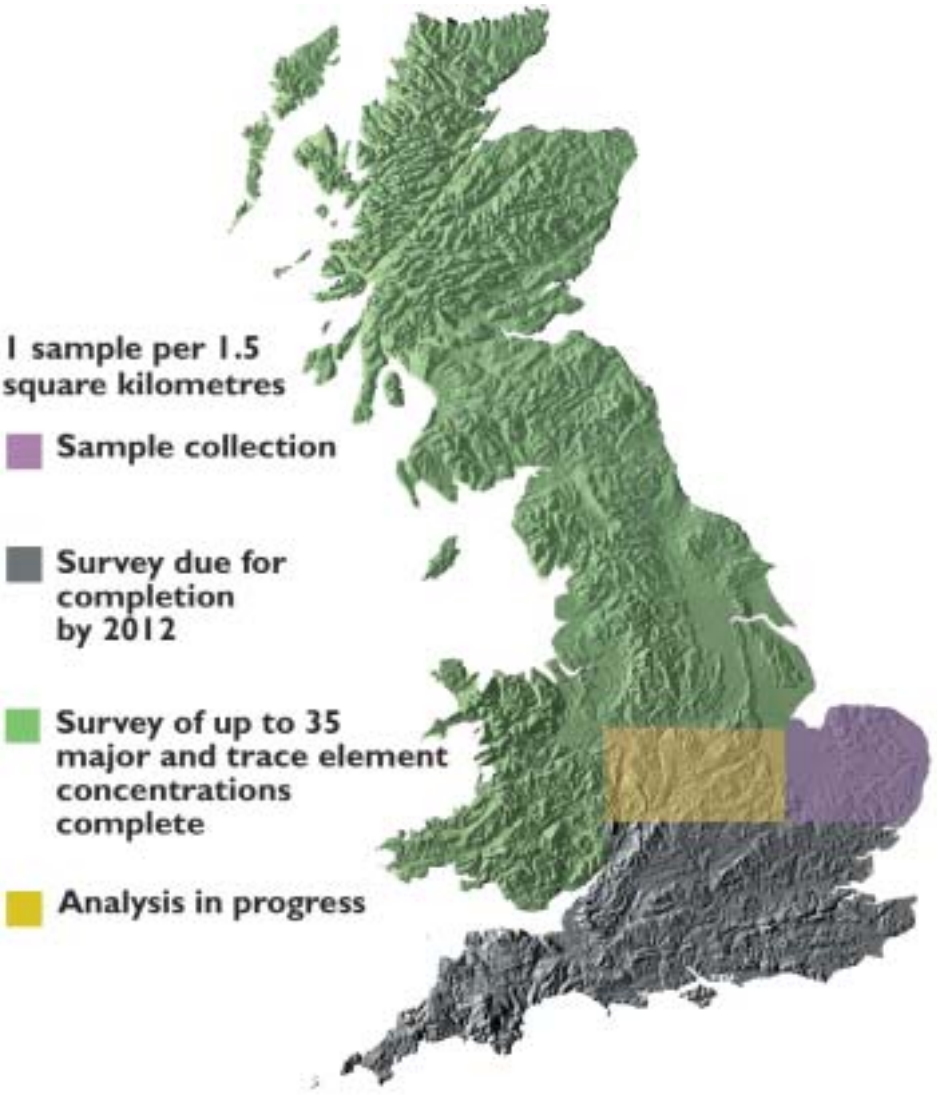
"... a mineral deposit will produce a chemical signature in the rocks or overburden that surrounds it ..."

The principal sampling medium for the G-BASE project has been stream sediments collected at an average density of one sample every 1.5 square kilometres from first- and second-order streams. The use of panning to concentrate heavy minerals, such as gold, tin and tungsten minerals, is one of the oldest methods of prospecting for ore deposits. Panned-concentrate samples provide important evidence of mineralisation or contamination that can be identified visually in the field. G-BASE is now working in lowland Britain where drainage systems are less suitable for sampling (such as East Anglia). In these areas, soil samples are collected at a density of one sample every two square kilometres and are becoming increasingly important for environmental and land use issues. Recent advances in analytical chemistry have meant that very low levels of elevated metal content in water can also help locate mineralisation.

Availability of geochemical results

The location of all geochemical sample sites is given on the BGS Geoscience Data Index web site: http://www.bgs.ac.uk/geoindex/ along with a list of the elements determined. All geochemical results are stored in the corporate BGS geochemistry database.

For the G-BASE project, data have been standardised so as to give seamless geochemical maps for the British mainland. The data are available under licence to consultants or companies and are often provided as part of a geodata package for use in Geographical Information Systems. The geochemical data represent an important strategic resource that underpins mineral exploration and development activities in Britain. When linked with other digital data-sets, such as geology and geophysics, they provide a powerful tool for identifying new target areas and for research studies related to the origin of mineral deposits.



Map showing the progress of stream sediment geochemical mapping by the G-BASE project. One sample was collected for each 1.5 square kilometres.