

MINEO

Helping to manage mine pollution in Europe

by Stuart Marsh & Claire Cotton, *Keyworth*

Europe has a history of mining activity that dates back to prehistoric times. Whole regions are affected by the results of this activity, and also by the more recent industrialised phase of mine development. Increasingly, a key issue being addressed by European geological surveys is how to manage the waste products of mining activity, rather than exploration for new prospects. Can we detect the most important materials, monitor their dispersion and predict how they will affect the environment? Will they affect the local population, or influence the type of industrial activity that can be undertaken safely in the area?

There is an increasing need for rapid and cost-effective gathering of data to inform decision-making in former and present mining areas. The collection of relevant data in the field is time-consuming and expensive, and so the EuroGeoSurveys are investigating the potential of airborne remote sensing to provide some of the data required.

The technology that offers the most potential for identifying specific

minerals on the ground by remote methods is known as hyperspectral remote sensing. This extends laboratory spectrometry, an established tool for the identification of minerals, to airborne and ultimately to spaceborne acquisition. This technology was developed to assist with mineral exploration, but can also be applied to the subsequent problem of waste management.

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There are challenges to be met in doing this, and also in applying the technology, which was developed for application in arid areas where minerals are exposed at the surface, to the typical European scenario, where rocks are obscured by vegetation and cultural features. The BGS is therefore partici-

pating in MINEO as part of its Pollution and Waste Management Programme

MINEO sees seven European geological surveys collaborating with two mining companies, an environmental research institute and the EC's Space Applications Institute to test hyperspectral remote sensing in a variety of European environments. The project is co-funded by the European Commission, who need to know whether this technology can work in the European environment, and solve the problems facing a mature, post-industrial economy. Six mine sites are being studied, representing a range of environments, mine-types and stages in development. They range from a former base metals mine in the Arctic environment of Greenland, to an operational lignite mine in the Alpine environment of Austria. The UK site is in the former tin-mining district of Cornwall in south-west England. France has overall management responsibility for the project, and the other six nations manage the national test sites. In addition, each country is responsible for a technical aspect of the project across all six sites. For example, Denmark co-ordinated the airborne campaign, whereas the UK is responsible for terrain modelling.

The UK site in Cornwall covers two hundred square kilometres from Falmouth to Camborne. Tin mining activity dates back to the Bronze Age. Regulation began in the twelfth century and the industry continued at a moderate level until a massive expansion occurred in the eighteenth century. This period also marked the development of copper alongside tin. Production peaked in the late nineteenth century. At various times lead, silver, zinc, arsenic, tungsten,



True-colour 'Quick look' image of a 20km long HyMap flight-line covering the United Downs and Wheal Jane mines. The iron-rich tailings at Wheal Jane are clearly visible in red.



Stuart Marsh, BGS © NERC

Waste dumps at South Crofty, near Camborne in Cornwall as they are today.

cobalt, bismuth, uranium and antimony were also produced. In the twentieth century, international competition led to a decline. This was arrested briefly after the Second World War, but the market dictated the industry's ultimate demise, with the last mine closing in the 1990s.

This activity has bequeathed a legacy of potentially contaminated sites with a variety of histories and variable surface expression. Some sites are long abandoned and have been reclaimed by vegetation. Other sites are more recent

and are either untouched, with waste materials exposed, or revegetated to a greater or lesser degree.

There are attempts at reuse of certain sites, typically as a public amenity or as a site for light industrial development. There is an urgent need to understand what materials are present at all these sites, in order to facilitate their redevelopment or rehabilitation. This will be a key factor in the promotion of newer industries such as tourism, which will be vital in the regeneration of the region's economy.

The sensor used to gather the data is known as HyMap. It is operated on a commercial basis by HyVista, who work out of Australia and South Africa. The MINEO Consortium purchased approximately one month of HyMap operations to cover the six test sites. The UK test site was originally scheduled to be the final acquisition, but the weather had other ideas! Due to the poor weather prevalent at all other European test sites, the UK site became the first acquisition on 21st July 2000. The data covering two hundred square kilometres were acquired in four hours and 'quick looks' were on the Internet that evening! At the same time, British and German researchers were deployed in the field area to acquire ground-based calibration data. The BGS geologists also took the opportunity to show their German colleagues the range

of sites under study in the UK test area, and discuss the problems that may be encountered during the life of the project. Immediately following the UK acquisition, part of the Austrian site was acquired, and all six sites had been successfully acquired by the end of the European Hymap campaign in mid-August 2000.

The project has three more phases to complete over the next two and a half years. Data from the individual test sites will be processed and analysed during the coming months to determine what can be achieved in each mining environment. Following this phase, the consortium will develop generic processing tools that can be applied at all six test sites to produce data that are useful to planners and decision makers. This will be followed by a final phase during which the findings of the research will be publicised and disseminated via papers, reports and workshops. Representatives of the European mining and environmental industries, identified during the consultation phase of the project, will be the focus for this phase. Any companies or individuals who are interested should either visit the web site at: www.brgm.fr/MINEO or contact the author at the BGS.

For further details contact:

Stuart Marsh,

Tel: 0115 936 3452

Fax: 0115 936 3318

E-mail: shm@bgs.ac.uk

MINEO consists of the geological surveys of Austria, Denmark, Finland, France, Germany, Portugal and the UK; Mondo Minerals; DSK; the Danish Natural Environment Research Institute; and the EC's Space Applications Institute.

