

**Mike Young** describes how a new and detailed survey of Northern Ireland is providing vital information — and some unexpected discoveries.

# Tellus

The Geological Survey of Northern Ireland (GSNI) recently completed the most concentrated integrated mapping project undertaken in the United Kingdom, producing a range of geoscientific data that will promote the sustainable development of natural resources and inform environmental management.

It is self-evident that almost everything we need to sustain modern life comes from the natural resources of the Earth. Most of our food grows upon its thin, fragile skin of soil; our water passes over and through the Earth in the hydrological cycle; mines and quarries yield industrial and construction materials; and hydrocarbons provide most of our energy and an ever-increasing range of plastic products. The demand on these resources is growing and as we extract more so we need to dispose of more waste, some of it toxic or radioactive. Despite recycling, we still return most of our waste into the Earth, where it remains a potential source of pollution into the future.

To manage the development of resources and waste disposal we need the best available information about geology and the physical and chemical characteristics of rocks, soils, and waters. The GSNI's Tellus Project set out to collect this information and in 2007, after an intensive three-year survey programme, delivered new series of detailed geophysical and geochemical maps of Northern Ireland.

The BGS, in partnership with the Geological Survey of Finland (GTK), who provided technical and operational support, flew a detailed low-level airborne geophysical survey over the country. The aircraft, one of several scientific aircraft owned by the NERC,

flew 86 000 kilometres at a height of just 56 metres and collected magnetic field, electrical conductivity and terrestrial gamma-radiation measurements. On the ground, GSNI and BGS teams collected nearly 30 000 soil, stream-sediment, and stream-water samples for analysis, at a nominal interval of one soil and one stream site for every two square kilometres.

The geophysical results provide new insights into Northern Ireland's geology, particularly where bedrock is obscured by glacial cover and peat. Delineation of faults, dykes and the major volcanic

complexes has been greatly improved. The complementary images from magnetic, electrical conductivity and radioactivity surveys facilitate the mapping of soils and rock types. The geochemical results provide a new and consistent baseline standard for some 55 elements and compounds across rural Northern Ireland and in the main metropolitan centres.

These data are a major resource for industry, regulatory authorities, and researchers. The improved geophysical mapping and new regional geochemical maps have prompted renewed interest in mineral prospecting. New anomalies in gold, platinum group elements, and base metals have been mapped and the characteristics of known mineralised trends are further defined. The GSNI has already licensed Tellus data to mineral



*Tellus sampled the soils of Northern Ireland at sampling interval of one site per 2 km<sup>2</sup>. Here, a sampler prepares to take a sample in the grounds of the Parliament Buildings, Stormont.*



*The NERC Twin Otter aircraft, equipped with upgraded electromagnetic survey equipment, in operation during the TELLUS airborne geophysical survey project in Northern Ireland.*

exploration companies, resulting in the issue of new prospecting permits for precious and base metals. Northern Ireland also provides much of the aggregates used in the UK and the Tellus airborne survey has mapped the characteristics of electrical conductivity and magnetisation sometimes associated with these resources.

The highest geothermal gradients on the whole of the island occur in Northern Ireland. Improved mapping by airborne magnetics and gamma-ray spectrometry has encouraged a new interest in the potential for geothermal resources. Granitic components of the radioactive Palaeogene intrusive complexes in the south-east show potential for radiogenic heat production.

Planning and monitoring the sustainable development of resources is a key role of government. To this end, the extensive range of geochemical maps of soils and streams provide new baseline data. These results provide a standard against which to monitor change and a means of identifying abnormally depleted or potentially toxic levels of key elements or compounds. With this information government can identify areas for remediation or control, particularly in the context of the DEFRA Soil Guideline Values which define safe levels of certain toxic elements.

Tellus is a detailed multiparameter dataset that provides a rich resource for health research. The data have provided an improved means of mapping the potential distribution of the naturally occurring gas radon, a principal cause of lung cancer (see *Earthwise* issue 21). By statistical analysis of the airborne gamma radiation results and digital geology the BGS has produced a more precise estimation of the risk than had previously been possible. The first map of the distribution in Northern Ireland of the artificial radionuclide, Caesium-137, has also been generated, showing current levels of historical radioactive fall-out from global nuclear accidents and weapons-testing.

Tellus also provides tools for mapping the contamination from terrestrial activities. The airborne systems have mapped changes in the electrical conductivity, magnetisation and radioactivity over man-made structures, landfills, and industrial sites. These signals arise

partly from the site itself and partly from contamination of nearby surface waters or groundwater. The system offers a rapid method of screening such sites, in conjunction with high-resolution aerial photography.

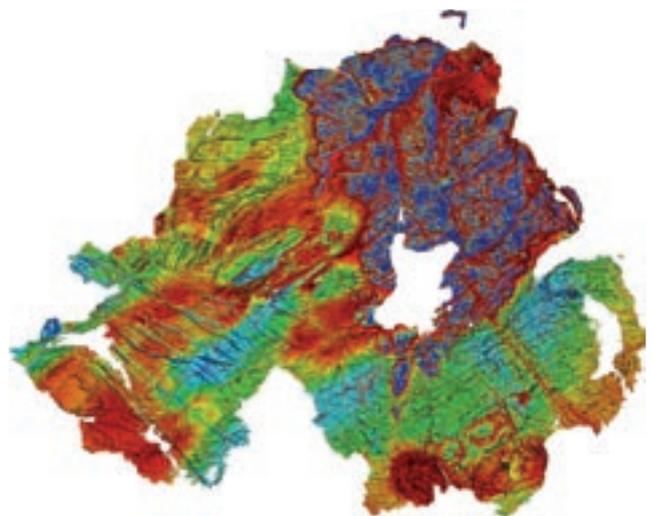
The Tellus Project has succeeded in encouraging economic development by promoting investment in mineral exploration. It has provided contextual, baseline geoscientific information for managing development sustainably, and has stimulated research into a range of applied geological issues as well as agricultural, environmental, land-use and health topics.

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*The new magnetic field image defines the geological structure of Northern Ireland in great detail.*