

For its size, Northern Ireland has an incredibly diverse geology, providing the architecture beneath a beautiful landscape, and also the potential for rich mineral resources, as **Garth Earls** and **Michael Young** explain.

North American liaisons

Not only are there strong cultural connections between Northern Ireland and North America, but much of the geology of Northern Ireland is related to its shared history with the eastern seaboard of Canada and the USA. Even the opening of the Atlantic Ocean and the parting of North America from Europe left the Giant's Causeway as a legacy. Events like this over geological time have given Northern Ireland a greater geological diversity than any similar-sized area on Earth and have provided opportunities to explore for minerals, to understand how we can manage groundwater sustainably and to enthuse generations about the mysteries of our landscape.

The Tellus project

Between 2004 and 2007, the Geological Survey of Northern Ireland (GSNI), staffed by geoscientists from the BGS, collected detailed airborne geophysical measurements and sampled soils and streams at 10 000 sites over the region. Northern Ireland is now the most comprehensively geo-environmentally sampled country in the world. This project (called Tellus after the Roman goddess of the Earth) has been central to what amounts to a geological revolution in Northern Ireland. The Tellus project is influencing policy, promoting inward investment and engaging the public. The project has won national and international awards for encouraging mineral exploration, for innovation in geographical information systems and for communicating science.

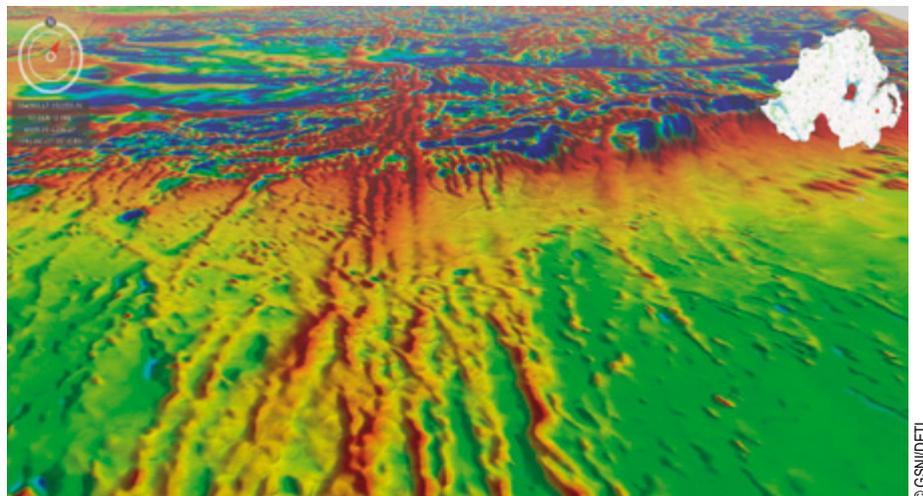
Although many scientific disciplines are using the Tellus data, two of the most valuable fields of research are for the extractive industries and the environmental sector. This diversity of application illustrates the need and value of geoscientific data in apparently disparate areas.

Exploration for minerals

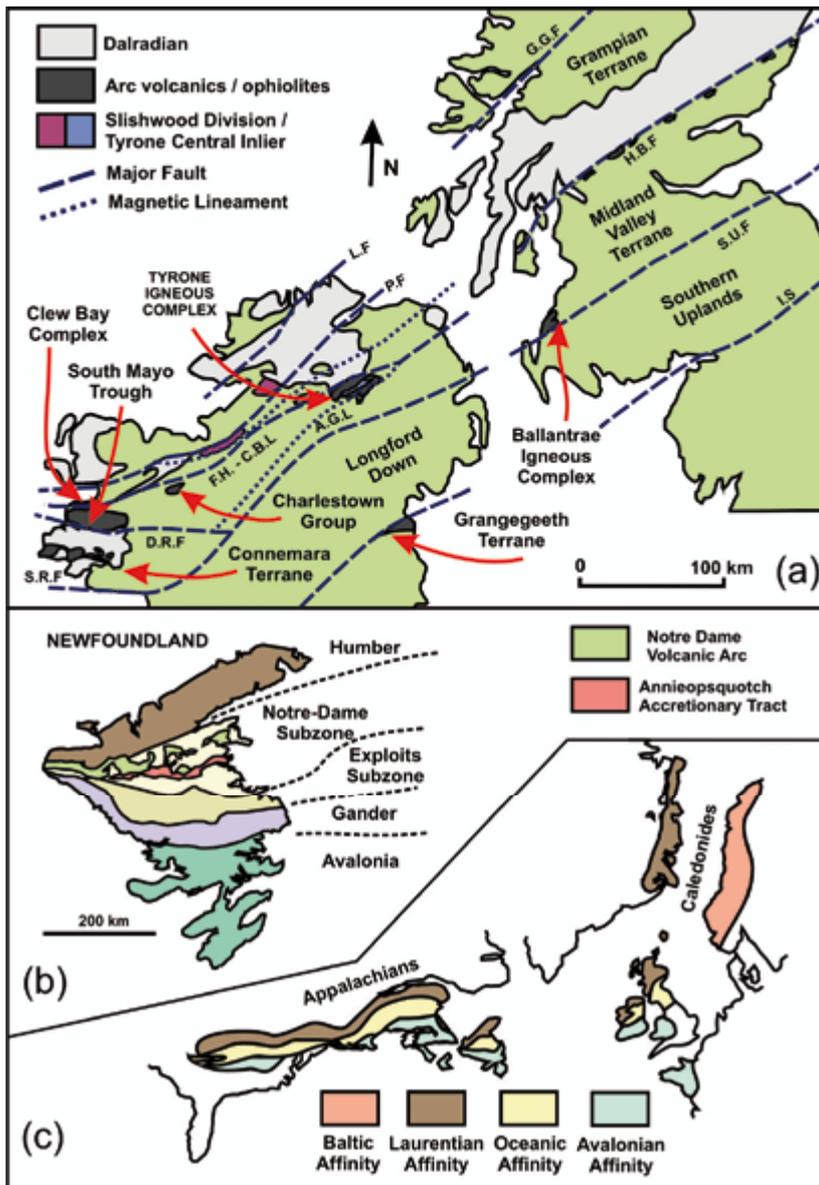
Before the Tellus project commenced, 15 per cent of Northern Ireland was under licence for natural resource exploration, but when the data were released more than 70 per cent of the country became licensed. Research partnerships were established with universities and companies to assess the metallogensis of the region. This has resulted in an

increase in exploration expenditure from less than £1 million to in excess of £20 million and represents a return on investment of greater than 300 per cent in four years. The geological setting and genesis of Northern Ireland's gold deposits is becoming better understood through interpretation of the airborne geophysics and collaborative research is providing detailed correlation of mineral occurrences in County Tyrone with the major mining areas of Eastern Canada.

The same rock formations that are host to world class copper–zinc deposits in New Brunswick and Newfoundland have long been known to occur in parts of Northern Ireland. However, much of the area where these rocks occur in County Tyrone is



Oblique view of magnetic map showing a swarm of vertical dykes in Lagan Valley.



Geological correlations between North America and the British Isles.

covered in glacial sands and peat deposits, making bedrock interpretation difficult. Detailed geological mapping of the sparse outcrops, allied with the new geochemical and geophysical data has facilitated conceptual modelling of the geological history of the region and is helping focus exploration into specific horizons.

Belfast's groundwater

The Greater Belfast area is host to some 40 per cent of the population of Northern Ireland and mostly lies within the Lagan Valley. The Sherwood Sandstone bedrock of the Lagan Valley represents the best aquifer in Northern Ireland and historically, water supplies from these sandstones have contributed to both

industrial and population growth. Before the Tellus project, the groundwater model of the Lagan Valley was considered to be relatively uncomplicated with few, if any, barriers to groundwater flow. However, the new magnetic map suggests that this is not the case.

North-west to south-east trending mark dykes vertical 'walls' of basalt that crystallised from magma when North America split from Europe some 55 million years ago. The basalt dykes in the Lagan Valley range in thickness from several centimetres to several metres and divide the bedrock into distinct 'compartments'. Armed with this new concept, the asymmetrical shape of the groundwater

depletion zone as evidenced by pump tests becomes easier to explain. In most cases it appears that there is little groundwater connectivity between boreholes on either side of a basalt dyke, but boreholes within the same 'compartment' have excellent groundwater connectivity. This new model, defined by information from the Tellus project, will provide scientists with increased confidence in regulating groundwater abstraction in Greater Belfast.

Geology and tourism

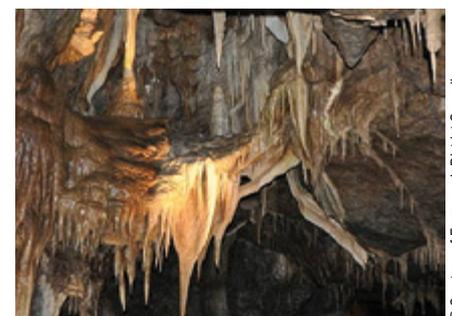
In the 1980s, GSNI in association with the Geological Survey of Ireland initiated a programme of landscape interpretation to enhance the visitor experience in the North of Ireland. In these early days this was achieved through publications designed for walkers, drivers and general tourists.

Although this work still continues, Geoparks are now at the forefront of geoscientific outreach. Geoparks are a UNESCO accreditation and the only joint international Geopark straddles the border between counties Fermanagh and Cavan. The Marble Arch Caves Global Geopark has over 50 000 visitors annually and integrates the story of geology with heritage, culture, biodiversity and human history.

Although the rocks of the Geopark formed when Canada and the USA were joined to Europe, a visit to Marble Arch Caves allows North American visitors to experience the many changes that have taken place since our enforced separation.

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The Marble Arch Caves Global Geopark is at the forefront of geotourism in Northern Ireland.