

Strategic geological surveying is one of the BGS's core activities. **Ken Hitchen, Richard Holmes** and **Dave Long** describe some of the advances in geological knowledge being made at the margins of the UK's territory.

Britain's Atlantic margin

The offshore Atlantic margin of Britain is a natural laboratory for the study of passive, volcanic continental margins. We have been actively pursuing a programme of research in this region with relevance to many important issues, such as climate change, geological hazards and the search for sustainable and secure energy supplies.

To develop knowledge of this frontier area, we have conducted numerous geophysical surveys, and sampling and shallow drilling programmes, commonly with funding support from the oil industry. This work has helped us to work out the geological history of the various structural highs and sedimentary basins on the margin. Much of the research is currently being summarised in two, oil industry-sponsored, offshore regional reports, which are scheduled for publication within the next two years. Recent work in the Rockall Trough has included investigation of the crystalline basement rocks, the Quaternary deposits, the sea-bed morphology and geohazards

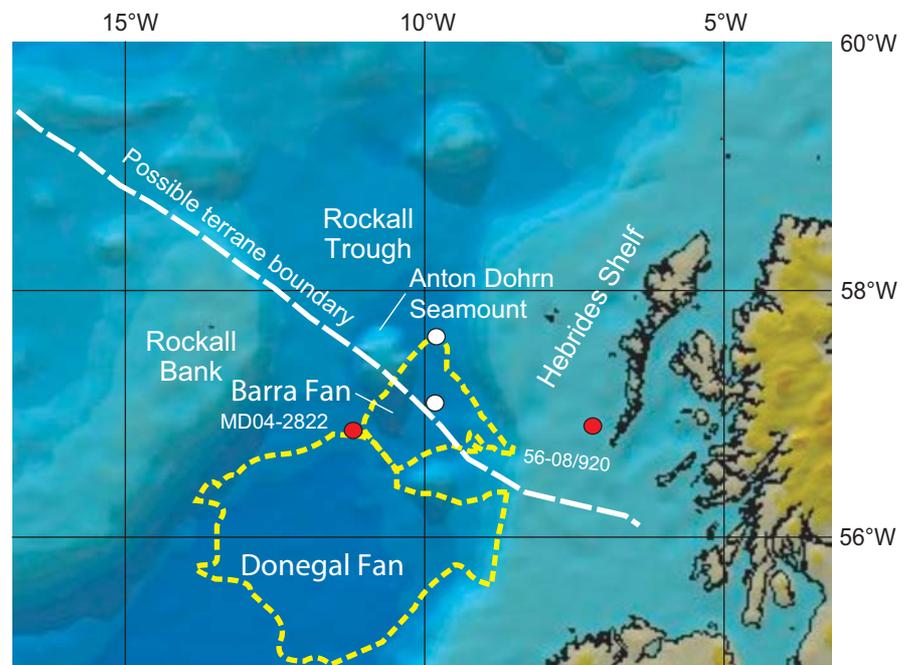
“a major crustal boundary appears to exist in the basement under the Rockall Trough”

Basement terranes

The rocks of north-west Scotland, the Outer Hebrides and the adjacent shelf are some of the oldest anywhere in the UK. However, rather than being a single large terrane, new BGS work has

confirmed that the area comprises a number of coalesced basement terrane blocks. The oldest rocks, west of the

Outer Hebrides, are approximately 2800 million years old. The southern part of the Hebrides Shelf, and Rockall Bank over 250 km to the west, comprise much younger Proterozoic basement rocks approximately in the range 1795 to 1745 million years old. A major crustal boundary, running north-west to south-east between the Archaean and



Bathymetric map of the Atlantic margin region west of Scotland, showing the location of the illustrated basement core (56-08/920), and of an inferred basement terrane boundary. The approximate outlines of the Barra and Donegal fans (yellow dashed lines), core MD04-2822, and two other available long cores (white dots) are also indicated.

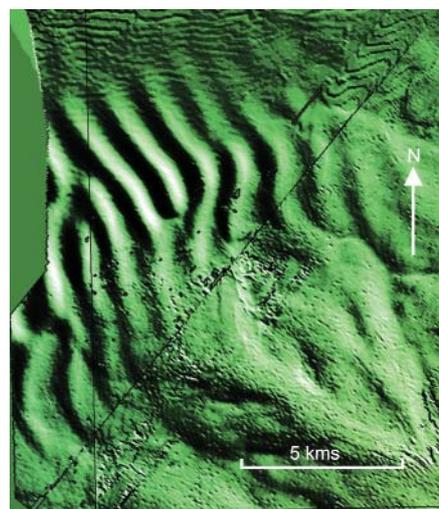


Example of Archaean rock obtained from the Hebrides Shelf, 20 km west of Barra (southern Outer Hebrides). This sea-bed core (number 56-08/920) comprises a banded dioritic gneiss of quartz, plagioclase, biotite and amphibole. It has been dated at approximately 2710 million years old.

Proterozoic terranes, appears to exist in the basement under the Rockall Trough and may have influenced subsequent segmentation of the rift basin.

Quaternary research

During June 2004, a team of UK and French scientists (including staff from the BGS and the University of St Andrews) aboard the RV *Marion Dufresne*, recovered a giant piston core (MD04-2822) from the deep-water margins of the Barra Fan in the Rockall Trough. Stratigraphical investigations of this core are being undertaken. They will determine the effects of climate forcing on the Quaternary sedimentary record, and the associated British ice sheets, within the north-east Atlantic over at least two full glacial cycles. Evidence for changes in sedimentary facies and quantitative estimates of the sediment



Sediment waves in the north-east Rockall Trough, partly buried by debris flows from the south-east.

flux to the core site will be investigated through detailed age-depth modelling, supported by radiocarbon age dating and oxygen isotope stratigraphy studies. The provenance of sediments delivered across the glaciated margins will be determined through radiogenic isotope studies. The isotopic composition of both planktonic and benthic foraminifera will be measured as a proxy for surface- and deep-water conditions. The research findings will be combined with data from other core sites to provide a detailed reconstruction of events across the Hebridean and Rockall Bank margins of the Rockall Trough. The various cores are tied by an existing BGS network of high-resolution seismic reflection data joining the deep water to the continental shelves on the east and west margins of the Rockall Trough. Additional seismic and multibeam bathymetry data were acquired in 2005 to help understand the long-term mechanisms that have delivered sediments from source to sink and influenced the sedimentary compositions and rates of sediment deposition at the core sites.

Sea-bed morphology

The RRS *Charles Darwin* cruise in August 2005 gathered seismic profiles and multibeam data from the Rockall Trough. Although the data are currently in the early stages of processing they have already revealed many interesting features of the sea bed. As well as large sediment failures, extending from the Barra Fan, these include a distinct moat around the Anton Dohrn Seamount except on its western flank where a sediment drift fills it in. This drift leads southwards to an area of large sediment waves south-west

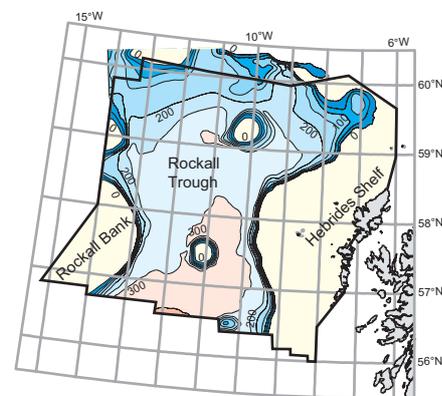
of the seamount. These features are typically 5 km in length, one to two kilometres wide and 20 m in height, orientated north-east to south-west. Dramatic sea-floor morphology in the Rockall Trough is nothing new. Integration of datasets in the north-east corner for the Western Frontiers Association has revealed an area of large sediment waves that have developed in the area since the Miocene.

Geohazards

In regional assessments of the Rockall Trough for resources and geohazards, the existence of methane hydrates has been considered. Methane can occur in an ice-like form with water at low temperatures and high pressures. As such, it potentially contains large volumes of the gas and has been studied globally as a future energy source. Methane hydrate can also pose a hazard, as it becomes unstable with increases in temperature or reductions in pressure. The release of methane as free gas would disturb the seafloor and also contribute to greenhouse gases in the atmosphere. No unequivocal evidence for hydrates has been found in the Rockall Trough, but modelling has shown that extensive areas are potentially favourable to its formation. A programme to examine the diverse seismic data from the area is planned.

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Depth, in metres below sea bed, to the base of the methane hydrate stability zone within the Rockall Trough. Image created for the Western Frontiers Association.