Energy resources

Seabed imaging

Identification of hazards

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The BGS has been working with consortia of oil companies for the past decade to improve our understanding of continental margin development. We have placed particular emphasis on communicating to the industry the benefits of an integrated regional approach to problem solving and risk assessment in frontier exploration areas. Knowledge of the underlying geological controls and history of margin development is crucial to the assessment of, and planning for, any potential geohazards that may affect offshore facilities. Thus, by combining data held by the BGS and industry, a regional context can be established that provides an understanding of the seabed and shallow geological setting being explored, for a fraction of the cost of a stand-alone site survey. Furthermore, site surveys and site investigations can be better planned and focused on assessing the geohazards.

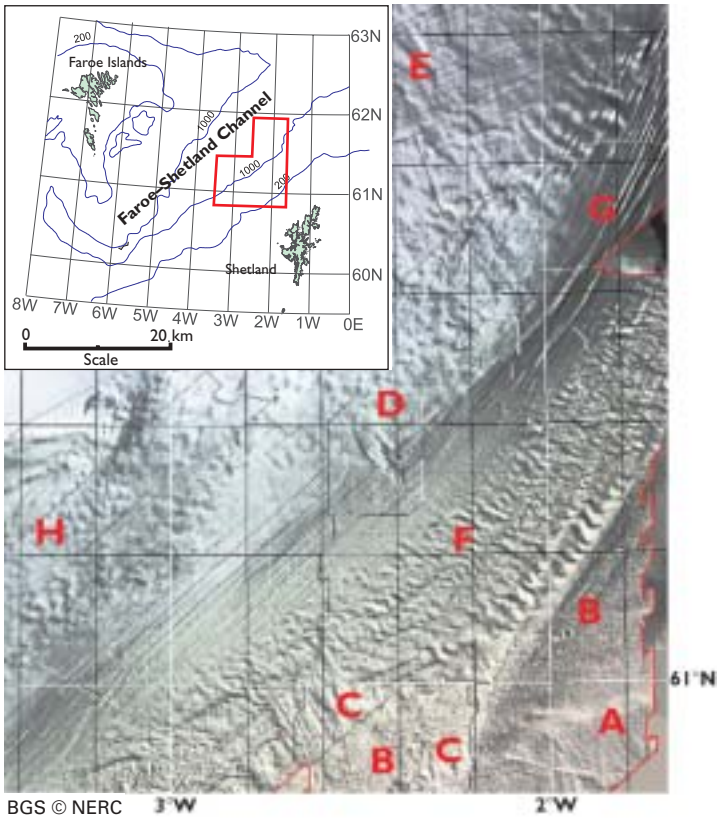
West of Shetland, work for the Western Frontiers Association consortium has involved the interpretation of first returns from 3D exploration seismic-profile data to create images of seabed morphology. These images reveal a wide range of geological features preserved at the present-day seabed, reflecting both relict and modern sedimentary processes, some of which pose potential constraints to exploration and development. The image *(right)* shows the seabed from the shelf break to about 1600 metres water depth in the centre of the Faroe–Shetland Channel, and shows a number of features of interest (A–H) described below.

The West Shetland Shelf is a relict glaciated terrain, characterised at seabed and shallow depth by hard ground with abundant boulders. A glacial moraine (A) indicates the former extent of Pleistocene ice sheets. On the upper slope, the former reworking of seabed sediments by icebergs is shown by several large along-slope troughs and a generally turbated appearance (B). Within this area lithological and geotechnical properties can be extremely variable requiring high-resolution profiling for anchor-holding and spud-in assessments.

Sediment transport down the slope is revealed by debris flows (C). These have accumulated on specific parts of the slope located at the outlet of palaeo-ice-streams, where the former ice-sheet was most active. The debris flows exhibit a variable morphology that can be used to estimate or extrapolate the geotechnical properties of the shallow soils. Modern downslope transport is demonstrated by slope failure, such as the Afen Slide (D), where retrogressive failure has displaced 200 million cubic metres of sediment. Former sediment failures can be resolved as subtle seabed changes above debris lobes 100 to 200 metres below seabed (E).

Active or ongoing processes include the development of sediment waves (F) and ridges (G), which form part of a major sediment-drift complex in the Faroe–Shetland Channel formed in response to contour-following deepwater currents. The development and geometry of these deposits is important in burial and scour assessments. Deep basin fluid-flow processes are evident by the polygonal patterning (H) locally seen at the seabed. This reflects fluid migration at depth, instigating faulting that extends to the seabed and creating conduits by which the fluids may leak, providing clues on the hydrocarbon history of the basin.

The interpretation of this seabed morphology image is integrated with wider studies such as the BGS offshore mapping programme and projects, such as STRATAGEM and COSTA, supported by the EU and oil industry Joint Industry Projects. The integrated effort can influence exploration and development site selection, survey planning, top-hole drilling and environmental monitoring studies.



Seabed morphology of the Faroe–Shetland Channel. Water depth increases from 200 metres to 1600 metres. Sun illumination is from the north-east.