Long-Offset Pre-Stack Depth Migration Seismic Data Improves the Regional Understanding of Sub-Basalt Geology of the West Shetlands-Faroes Margin.

Richard C. Whittaker, Consultant Geologist – GeoArctic Ltd, Calgary

Menno G. Dinkelman, Chief Geologist – BasinSPAN Programs, ION GX Technology, Houston

The interpretation of seismic data acquired by ION GX Technology in 2008 as part of their NE AtlanticSPAN survey has resulted in an improved understanding of the sub-basalt geology on the West Shetlands - Faroes area. The long-offset seismic data were processed using Pre-Stack Depth Migration (PSDM) to optimize seismic imaging below basalts. Acquisition utilised a deep tow source and receiver configuration that maximized penetration through the basalts and data was imaged to 30km in order to reveal the basin architecture and crustal structure of the margin. Modelling of gravity and magnetic data is an important component of the processing workflow. Potential field interpretations are used to constrain the seismic velocity for the deep crustal structural imaging and interpretation.

Six regional dip lines and two strike lines have been shot through the West Shetlands - Faroes area with one of the lines shot over the iSIMM line to compare data quality and to tie iSIMM Ocean Bottom Seismometer (OBS) data. The new data compare favourably with the iSIMM data and form a consistent regional dataset along the NE Atlantic Margin which allows comparison between plays in the Faroe-Shetland, Møre, Rockall and Porcupine Basins.

The new data clearly images Mesozoic strata and rotated fault blocks below the basalts and in areas affected by Cenozoic folding and inversion. Seismic data through the Wyville-Thompson and Ymir Ridges show inversion structures, reverse faulting and older rotated fault blocks below basalts. Potential targets are located at 2-3 km depth below basalt cover making this an attractive exploration area. Mesozoic faulting is interpreted beneath the Faroe-Munkagrunnur Ridge, with rotated fault blocks present along the margins of the ridge. In the northern part of the area two regional dip lines cross the Fugloy Ridge where tilted fault blocks are interpreted beneath basalts. In the northwest of the area Seaward Dipping Reflectors (SDRs) are present along the Atlantic margin and deep reflectors are interpreted as the Moho and lower crustal bodies. East of this area, Mesozoic tilted fault blocks pre-date volcanism in the area around the Lagavulin Structure and along the Corona Ridge trend.

Understanding the relationship between Mesozoic rifting and basin geometry, and structures related to Cenozoic faulting and inversion is key to the understanding of basin evolution and structural relationship between the conjugate East Greenland and the West Shetland - Faroes margins. Modelling of potential sandstone provenance from the Greenland and Jan Mayen margins using deformable plate modelling techniques could play an important part in future exploration success in the region. The presence of N-S trending palaeo-highs offset by NW-SE transfer zones resulting from Mesozoic rifting are likely to influence the distribution of basement-derived sandstone from the Greenland mainland, from those sandstones derived from the Faroes or Jan Mayen Ridge. The development of new palaeogeographic models using deep long-offset seismic data together with deformable plate reconstruction modelling can play an important role in understanding basin geometry during Mesozoic rifting and the potential sandstone source area in Greenland during the Cretaceous and Paleocene.