AAPG HEDBERG CONFERENCE
"Hydrocarbon Habitat of Volcanic Rifted Passive Margins"
SEPTEMBER 8-11, 2002, STAVANGER, NORWAY

Basalt Imaging on the NE Atlantic Margin: seeing through a glass, darkly.

Robert S White, Cambridge University

I discuss some of the new work we have done recently (see people listed below) on imaging through subsurface offshore basalts on the Atlantic margin using seismic profile data to offsets as large as 38,000 metres. It is notoriously difficult to image through basalt flows to underlying sediments using conventional seismic profiling techniques. The highly reflective top of the basalts, particularly where it is rough, scatters much of the seismic energy. Short-period ringing, simple and peg-leg multiples obscure weak sub-basalt reflections with similar move-out; the high-velocity basalt flows preferentially absorb the higher frequencies in the incident wavelet, degrading the achievable resolution of any sub-basalt arrivals; and strong ray-bending caused by large seismic velocity variations between the basalt and sediment may distort the seismic image.

However, all is not lost. By using very long streamers or two ships to synthesise large apertures and thus to record arrivals to much longer offsets than has conventionally been the norm, considerable extra information is gained from the diving waves (refractions) which are returned from the substructure, and also from the often high amplitude wide-angle reflections. These wide-angle arrivals can themselves be used to image the base-basalt and sub-basalt reflections, and have the huge advantage that the first-arriving wide-angle energy cannot be a multiple and is unpolluted by any other phases. The travel times and amplitude variations of these long-offset arrivals also allow good velocity models to be built of the subsurface, which in turn allow improved images to be produced by pre-stack depth migration of the entire dataset. A further bonus is that it may be possible to use mode-converted shear waves arrivals to supplement the p-wave arrivals.

I show examples of such imaging using data acquired over the Faroes Shelf under the FLARE project (Faroes Large Aperture Research Experiment) by Amerada Hess Ltd and its partners. Experience from this work has been incorporated in the acquisition design for the iSIMM (integrated Seismic Imaging and Modelling of Margins) project shot in summer 2002 over the NE Atlantic margins using 3 x 12,000 m Q-streamers, low-frequency, broad-band airgun arrays and 90 ocean bottom seismometers (see posters for details).

FLARE participants: B. Boslaugh, E. Cullen, M.M. Fliedner, J. Fruehn, W. Kirk, J. Maresh, J.R. Smallwood, R.S. White

iSIMM participants: P.A.F. Christie, N.J. Kusznir, Z. Lunnon, C.J. Parkin, A. Roberts, A.W. Roberts, L.K. Smith, R. Spitzer, R.S. White

References:

Fliedner, M. M. & White, R. S. (2001). Seismic structure of basalt flows from surface seismic data, borehole measurements and synthetic seismogram modeling. *Geophysics,* **66,** 1925–1936.

Fliedner, M. M. & White, R. S. (2001). Sub-basalt imaging in the Faeroe-Shetland Basin with large-offset data. *First Break,* **19.5** (May 2001), 247-252.

White, R. S., Fruehn, J., Richardson, K. R., Cullen, E., Kirk, W., Smallwood, J. R. & Latkiewicz, C. (1999). Faroes Large Aperture Research Experiment (FLARE): Imaging through basalts, **in** Fleet, A. J. & Boldy, S. A. R. (eds.), *Petroleum Geology of Northwest Europe: Proceedings of the 5th Conference,* Geological Society of London, pp. 1243-1252.

Richardson, K. R., White, R. S., England, R. W. & Fruehn, J. (1999). Crustal structure east of the Faroe Islands. *Petroleum Geoscience,* **5**, 161-172.