WHERE ARE THOSE LOWER CRETACEOUS SANDS? GEOBODY DETECTION IN A DEPOCENTRE

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131 Central North Sea wells have encountered sandstone or traces of sandstone of Early Cretaceous age, providing grounds for optimism that the proven Devil's Hole/Scapa and Kopervik deepwater sandstone fairways extend beyond their Moray Firth heartland into parts of the Central Graben. By analogy with the Moray Firth, these basin-floor sandstones are likely to be concentrated in the largely undrilled Lower Cretaceous depocentres as hanging-wall fans adjacent to active or residual fault scarps, as on-slope ponded mini-basin fill sequences, or as detached basin-floor fans.

Central Graben exploration of the Lower Cretaceous play has so far concentrated on using basin geometry to identify the optimum sites for sandstone development (Milton-Worssell *et al.,* 2006). Initial drilling of some of the depocentres has been disappointing, with no trace of sandstone in 29/1c-4 (6,366 feet Lower Cretaceous shale drilled) or 21/1b-17 (3,993 feet shale). In this talk we describe an attempt at detecting geobodies using image processing techniques on a 3D seismic dataset to highlight the differences in sediment fill patterns within two previously identified Central Graben Lower Cretaceous depocentres.

The geobody detection relies on skeletonising the wavelet peaks and troughs to create a bipolar bedform attribute as a means of visualising individual seismic events. The resultant 3D volume highlights features such as pinchouts, onlaps, clinoforms, mounds, and channels. The bedform morphologies have been further enhanced by shading the individual layers with the values taken from an instantaneous frequency attribute volume. This combination of bedform and frequency enables rapid identification of pinchouts and channels due to multiple visual perception characteristics. 3D geobodies were subsequently extracted from the attribute using a combination of density and frequency to isolate pinchouts and high frequency mounds and channel features.

Both Central Graben depocentres lie adjacent to a potentially active fault system. In the northern depocentre, initial screening of the bedform-frequency volume revealed a concentric pattern of basin fill with no anomalous features that might indicate the presence of basin-floor fans. Its fill is prognosed to be as mudstone-prone as at 29/1c-4 and 21/1b-17.

By contrast, the sub-Fischschiefer late Ryazanian to Barremian section in the southern depocentre was observed to contain locally mounded bedforms on one shoulder of the basin, and lenticular and wedge-shaped packages of high-frequency data at various stratigraphic levels. These observations were used to guide further processing aimed at resolving 3D geobodies within the dataset. One set of geobodies was observed to transcend stratigraphy near the base of the Cretaceous, suggesting repetition of seismic and sedimentary facies during the early stages of basin fill. These geobodies are unlikely to define discrete reservoir units. A second set of four geobodies was resolved at a consistent stratigraphic level between 20-70 ms two-way time beneath the Fischschiefer (Fig. 1), providing encouragement that they are indeed imaging discrete sediment bodies deposited within a limited time interval.

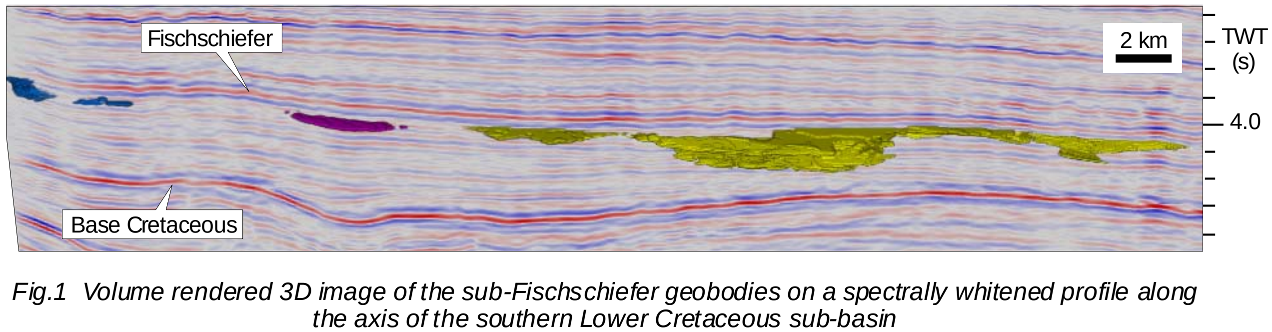

Fig.1 Volume rendered 3D image of the sub-Fischschiefer geobodies on a spectrally whitened profile along the axis of the southern Lower Cretaceous sub-basin

Three of these geobodies appear to emanate from an embayment at one end of the basin (Fig. 2) to orientate along its axis before pinching out against an intrabasinal saddle. This embayment is interpreted to have served as a sediment entry point to the basin. The fourth geobody emanated from an adjacent fault scarp. The post-Fischschiefer basin had relatively subdued relief. Its Aptian-Albian geobodies have a significantly greater areal extent, and are unlikely to include potentially discrete reservoir units.

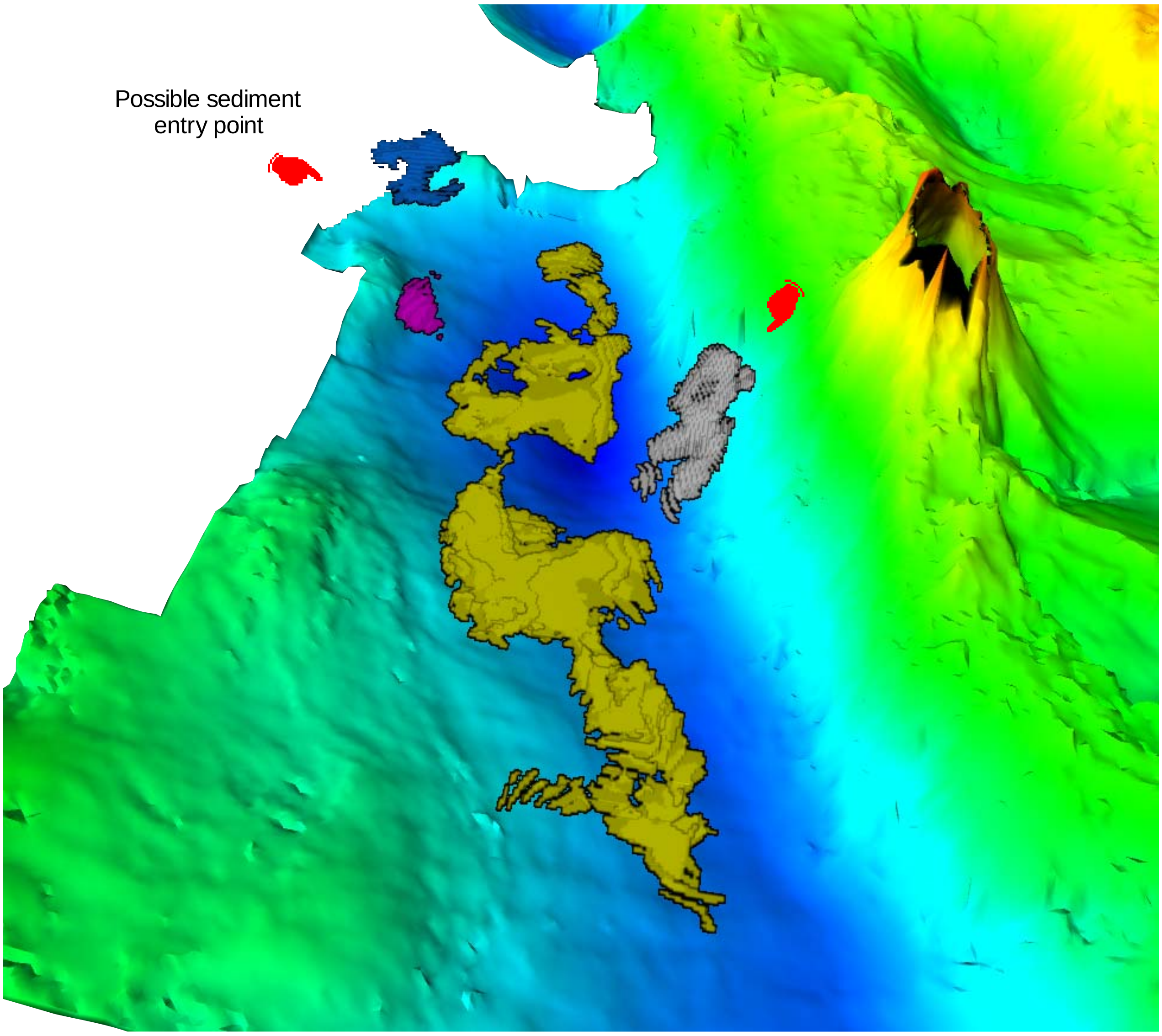

Fig. 2 Sub-Fischschiefer geobodies located above a 3D image of the base of the Cretaceous

None of the sub-Fischschiefer geobodies are resolved on seismic amplitude displays (Fig. 3). Moray Firth experience has shown that, even where proven by drilling, the Lower Cretaceous deepwater sandstones are notoriously difficult to image on traditional seismic data. Our analyses suggest that frequency-density attributes could provide a viable alternative method for mapping sediment body distribution in those basins in which Lower Cretaceous sedimentary patterns are otherwise poorly resolved.

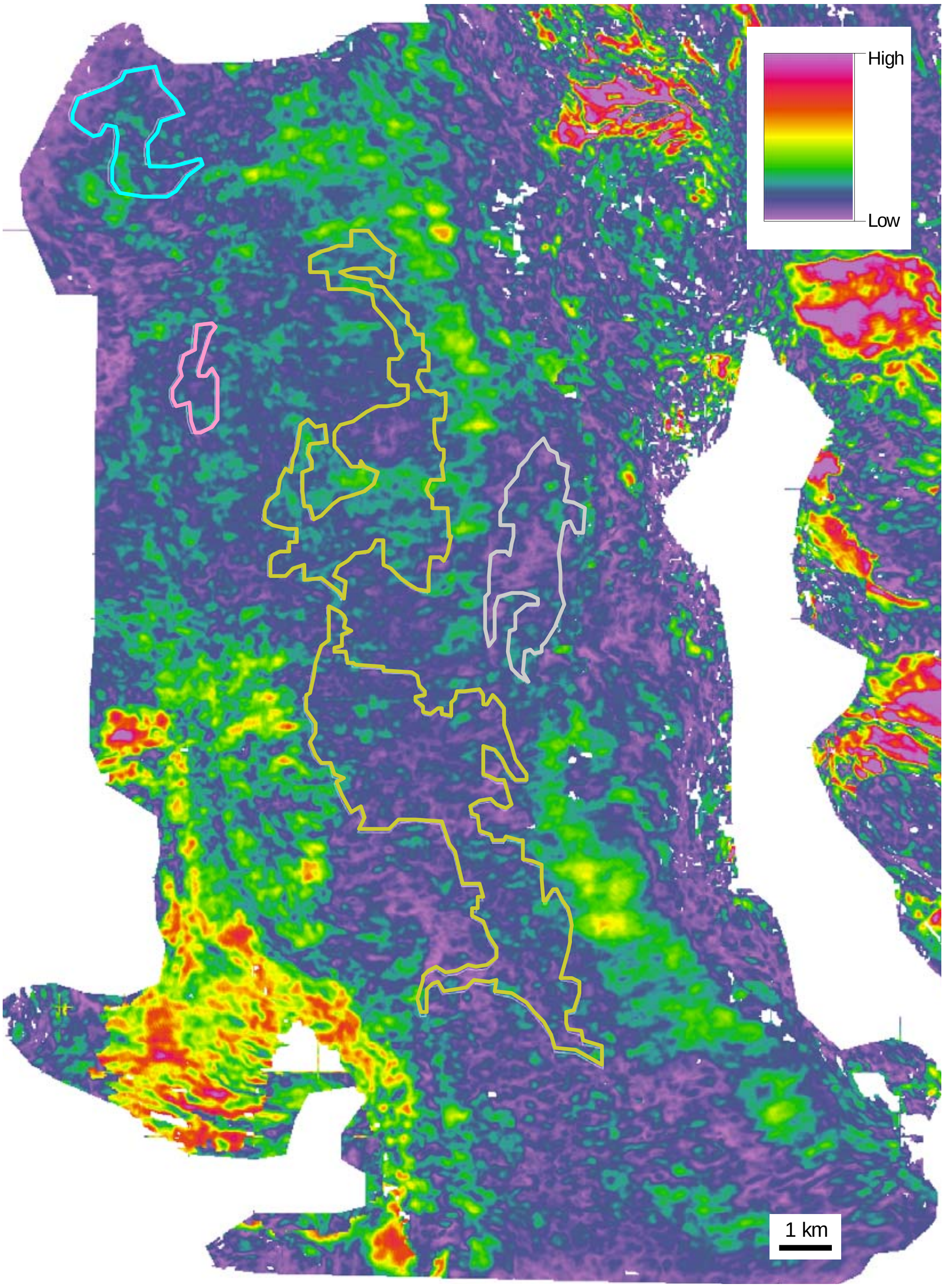

Fig. 3 Maximum positive amplitude extraction within a window from 20-70 ms two-way time below the Fischschiefer event, with locations of geobodies

As a cautionary note, it should be pointed out that the science of calibrating frequency content in seismic data with sediment type is in its infancy. Nevertheless, this powerful new tool has the potential to enable a rapid three-dimensional understanding of the extent and distribution of potential reservoir units in a basin ahead of, or in conjunction with a conventional seismic interpretation.

Reference

Milton-Worssell, R.J., Stoker, S.J. and Cavill, J.E. 2006. Lower Cretaceous sandstone plays in the UK Central Graben. In Allen, M.R., Goffey, G.P., Morgan, R.K. and Walker, I.M. (eds) The Deliberate Search for the Stratigraphic Trap. Geological Society, London, Special Publications 254, 169-186.