

## **Imaging a Devonian - Carboniferous petroleum system beneath the Central North Sea, using Gravity, Magnetic & Seismic data**

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This paper will present a regional-scale synthesis of Devonian, Carboniferous and Early Permian basin development beneath the UK Central North Sea. In the east, the synthesis is based on interpretation of a mosaic of modern long-offset 2D and 3D seismic data, tied to the 117 wells that have drilled through the base of the Permian, and integrated with and validated by 3D inversion of potential field anomalies derived from dense grids of 2D gravity and magnetic data. In western areas of relatively sparse seismic data and limited well penetrations, the synthesis is largely based on potential field modelling, supported by calibrating our interpretation with the gravity signature of the equivalent Carboniferous structural elements of eastern Britain.

Our interpretations have confirmed that along the southern fringe of the Central North Sea, as in northern England, Lower Carboniferous basin development was strongly influenced by the disposition of granite-cored basement blocks – Farne Block, Dogger Block and Devil’s Hole High. Another previously unidentified WNW-ESE trending basement block, here termed the Auk-Flora Ridge, has exerted a profound control on the structural evolution of the south-Central North Sea from early Devonian to Mesozoic times. From the Flora Field, where it is overlain by a relatively thick mid-Devonian to earliest Permian succession, the sub-Permian relief of this block becomes progressively shallower towards the north-west. On its southern flank lies a parallel half graben, comparable in morphology to the Stainmore Trough in northern England, and interpreted as also containing several thousand feet of Lower Carboniferous strata. As in northern England, these strata are likely to include prolific source rocks, and these have been modelled as being fully mature for oil generation in Quadrant 29.

Potential field data suggest that Carboniferous to earliest Permian basin development in the remainder of the Central North Sea was strongly influenced by an underlying Scottish-Norwegian NE-SW trending Caledonoid structural fabric. An earliest Permian, Lower Rotliegend unit thickens southwards towards the Auk-Flora Ridge, and rests unconformably on one or more undrilled NE-SW trending Carboniferous basins. Red-bed fluvial facies akin to those at Flora are likely to dominate the substantial post-Dinantian fill of these basins, but significant thicknesses of Westphalian coal-measure source rocks may also be present locally. The Dinantian strata underlying a widespread mid-Carboniferous unconformity in these basins may contain local developments of oil-shale source-rock intervals similar to those of central Scotland.