

3D Petroleum Systems Modelling in the Central North Sea: New Petroleum Systems in a Mature Basin

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In a basin which is mature as far as exploration is concerned, several observations did not fit the generally accepted view of a single active petroleum system. Geochemical analysis of oils from the same stratigraphic reservoir level across a large area showed two distinct marine oil families which were geographically separate. In addition many fields had excess gas not consistent with the maturity level of the assumed source rock. And finally the majority of the fields required long distance migration in view of the maturity level of the assumed source rock.

These apparent inconsistencies led to an exhaustive investigation of possible multiple source rock levels aimed at defining alternative petroleum systems. Given that only a few detailed geochemical analysis were available from the source rock and that only few wells penetrated the deeper part of the stratigraphy, 3D modelling was used to support the investigation.

The geochemical fluid analysis enabled two major oil families to be delineated geographically. The detailed source rock study led to the identification of four intervals with significant source potential, stratigraphically distinct and with clear differences in source rock properties. 3D modelling then enabled a comprehensive integration of the data leading to the understanding of a likely relation between observed fluid types and identified source rock intervals.

3D petroleum systems modelling allowed generated hydrocarbons from each of these source rock intervals to be traced to the accumulations and compared to the geochemical character seen in the analyses. Two source rocks appeared to be present and as a result, two petroleum systems were identified capable of explaining the two geographically distinct oil families. Fluid compositional modelling furthermore suggested that the majority of the gas originated from deeper source rocks.
