

Reservoir Modeling of In-Reservoir Biodegradation Explains Composition of Mixed Oil

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A suite of petroleum reservoir extracts from a North Sea reservoir were analysed to investigate the effects of biodegradation on petroleum composition. The extracts show a mixed 19° API oil composed of a lightly biodegraded oil with a suite of n-alkanes superimposed on a heavily biodegraded oil with a large unresolved complex mixture hump and suite of 25-norhopanes. Small compositional differences were observed in both the bulk fractions and biomarker parameters with depth.

The Paleocene reservoir comprises unconsolidated uniform turbiditic sands that are distal deposits of submarine fan structures. The 60 m thick reservoir unit, with a 53 m oil column, lies at a depth of 1733 m below the seabed. The reservoir sand quality is very good with average porosity and permeability of 34.5% \pm 2.5% and 6000mD \pm 3200mD respectively. The reservoir has not been affected by diagenetic processes and the reservoir temperature is 67°C, and thus below the temperature range (80°C) for the inhibition of hydrocarbon-degrading bacteria.

Modelling of the geochemical processes that have occurred in the reservoir using geological data combined with removal of oil components by biodegradation at the oil/water contact, has shown how the interactions between the geological burial history, filling, mixing and biodegradation have resulted in the oil composition found in the reservoir today. The results show that there is ongoing biodegradation and charging to the reservoir to produce the observed gradients in composition. They also show that the 'mixed' signature can be the result of a continuum of filling rather than discrete filling events.