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Compositional Basin Model of Lower Fars Reservoir, Northern Fields, Kuwait

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SUMMARY
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The Lower Fars reservoir of N. Kuwait are shallow reservoirs containing important amount of heavy oil, with varying viscosities (of the order of 700 to 1500 cp) and densities (11° to 19°)

A basin model of the petroleum system leading to these heavy oil accumulations has been built, with the objective to predict the oil quality (API° and viscosity).

The level of biodegradation was evaluated through biomarker analyses. They confirmed that all oils have the same origin (Lower Cretaceous), but that they underwent different biodegradation depending on their migration pathway.

A regional basin model allowed identifying the residence time of the migrated oil depending on the source location. This residence time is limited (a few My) and oil migration seems to be active still at present day.

In order to match the present day SARA composition with a biodegradation model, it appeared necessary invoke a continuous supply of fresh unbiodegraded oil, mixing with the biodegraded oil.
The figure above shows the biodegradation sequence from saturated HC being biodegraded first to final biodegradation (NSO, asphaltenes remaining only).

The distribution of relatively lighter oil is therefore controlled by the distance to the HC migration outlet from the kitchen, and the channel sands distribution. Less permeable layers are systematically charged by lower API⁰ viscous oils, because of a longer migration and residence time.

The temperature history does not seem to impact the biodegradation, as long as the oil is brought to T < 50°C while reaching the reservoirs.

References