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Analysis of hydrocarbon and polar species from highly compositionally graded oil reservoirs to refine reservoir process models

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Summary

Heavy oil reservoirs are commonly characterized by the large fluid compositional and physical properties gradients. Compositional gradients in heavy oil columns can be produced by a variety of mechanisms including oil charging, biodegradation, and phase changes and gravitational segregation in the oil column (Hirschberg, 1984; Wilhelms and Larter, 1994; 1995; Larter et al., 2003). Numerous attempts have been made to model oil compositional gradients and phase behaviour of heavy oil columns, including some sophisticated recent models (Mullins et al., 2011), but often, there is insufficient molecular level compositional information available to fully resolve gradient forming processes. In some heavy oil columns, multiple processes contribute to the fluid property variations and compositional segregation observed. Unraveling these complexities requires sophisticated analysis of the fluid columns using both traditional gas chromatography-mass spectrometry (GC-MS), and more advanced compositional tools such as Fourier transform ion cyclotron resonance-mass spectrometry FTICR-MS.

Here we report a study of a heavy oil column. In this study, we analyzed reservoir rock extracts and oils using reservoir geochemical methods, such as GC-MS and also FTICR-MS (APPI and ESI-n ion modes) to assess the variations in polar species composition throughout the studied oil column. We compare and contrast the various compositional gradient forming models and processes with the realities of observations of fluid columns compositions obtained using geochemistry.

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