CONSTRAINING THE OIL CHARGE HISTORY OF A HEAVY OILFIELD USING A NOVEL MATURITY ASSESSMENT APPROACH: MASS FRACTION MATURITY

R. Algeer[1,2], H. Huang[1], S. Larter[1]

[1] University of Calgary, Canada, [2] Saudi ARAMCO, Saudi Arabia

Introduction & Methods

Predicting composition and properties of petroleum throughout and across reservoirs within a heavy oilfield is vital for production optimization. Heavy oil reservoirs are characterized by the large compositional gradients and high asphaltenes content which negatively impact production. It is therefore, crucial to understand controls over asphaltenes distribution and whether gradients in oil composition are related to oil charging or/and post-trapping alteration processes.

Reservoired petroleum often represents a mixture of successive oil pulses with varying compositions. Assessing the oil charge history of an oilfield using the classical maturity parameters might lead, in many cases, to a false interpretation (Li et al.,1995; Wilhelms & Larter, 2004). These parameters usually measure the changes in relative abundances between two compounds which are not only determined by the diagenesis and catagenesis processes of a source rock, but also are affected by several other processes, that take place after petroleum expulsion (i.e. migration, mixing and-post trapping alteration effects). Hence, making it unrealistic to use a single value to describe the overall signature of a complex mixture with evolving and altering compositions overtime.

In this study, we applied a novel maturity assessment approach called the Mass Fraction Maturity (MFM) to a thick carbonate heavy oilfield. The MFM is a multi-parameter based model which interprets the distribution of source temperature in a received oil charge, versus total mass of petroleum components. The main objective of this study is to assess whether petroleum charging and inefficient mixing in the trap are controls on the formation of these heavy oils and tar mats.

We specifically measured component concentrations of molecular biomarkers and aromatic ratios of these heavy oils, and compared to MFM models that were constructed by our group, at the University of Calgary, for different basins. The profiles of the studied heavy oils show a striking similarity to the profiles that generated the models for the basins studied by this new methodology.

Results and Conclusions

This study has demonstrated that MFM approach clearly revealed varying trends in maturity between the eastern western flanks of this heavy oilfield. However, these variations in maturity trends have not been detected by using conventional maturity ratios as described in the literature. The MFM approach combined with detailed geochemical interpretations of polar and non-polar species of petroleum is an effective tool to enhance oil filling history resolution in complex heavy oilfield scenarios.

References

Li, M., Larter, S.R., Taylor, P., Jones, D.M., Bowler, B., and Bjorøy, M. (1995). Biomarkers or not biomarkers? A new hypothesis for the origin of pristane involving derivation from methyltrimethyltridecylchromans (MTTCs) formed during diagenesis from chlorophyll and alkylphenols. Organic Geochemistry, 23(2), 159-167.

Wilhelms, A., and Larter, S.R (2004). Shaken but not always stirred. Impact of petroleum charge mixing on reservoir geochemistry. Geological Society, London, Special Publications, 237(1), 27-35.