

## **Oil Mixing Versus Biodegradation as a Control on Oil Properties - A Study from the W. Canada Heavy Oil Belt**

Fay, Mathew C.<sup>1</sup>; Larter, Steve<sup>1</sup>; Bennett, Barry<sup>1</sup>; Snowdon, Lloyd<sup>1</sup> (1) Geoscience, University of Calgary, Calgary, AB, Canada.

Heavy oils with 8 to 25 degrees API gravity occur throughout the world and commonly result from anaerobic hydrocarbon biodegradation in the deep subsurface. Such heavy oils are observed in Mississippian to Cretaceous aged formations in Alberta and Saskatchewan, Canada. Highly variable oil quality and fluid properties are interpreted to result from a combination of heavy to severe in-reservoir hydrocarbon biodegradation of a primary oil charge and in mixing of a secondary lighter oil charge and continued degradation. This study is based on 51 produced oil samples analysed for viscosity, density, bulk composition, sulfur and quantified molecular geochemistry using internal standards. Biodegradation levels range from light alteration to complete removal of gc resolvable low molecular weight saturated and aromatic hydrocarbons due to microbial degradation. Late stage oil charge is evident by the abundance of low molecular weight compounds when heavier homolog compounds are absent. The input of fresh oil charge into severely biodegraded heavy oil reservoirs results in fluid properties in the region ranging from dead oil viscosities of 130 to 98,300 cP viscosity (@ 20 degrees C) and API gravities from 8.2 to 21.8 degrees API (@ 60 degrees F). Biodegradation of late stage oil is also suggested for some reservoirs by the decrease in some oils of nC17/Pr and nC18/Ph ratios relative to the high ratios associated with oils mixed with late stage charge. Molecular marker absolute concentration data confirms that late stage, higher maturity oil charge has occurred, and the 20S/(20S + 20R), C29/(C29 + C29Ts), aromatic steroid hydrocarbons and absolute diamondoid concentrations were especially useful to distinguish oil maturity in the region. The biomarker indicators that defined source rock facies type and paleo-environment of source deposition include St/(St + Hop), tricyclic terpanes, C34/C35 and C33/C35 homohopane ratios. Initial oil charge in the region is interpreted primarily as from the Exshaw and Exshaw-Ostracod oil families, but it is difficult to assess what oil family the high maturity oils belong to, due to low biomarker concentrations associated with the high maturity oils, and to the lack of compound concentration data from previous studies in the region examining oil-source correlations.