

Geological Controls on Petroleum Fluid Property Heterogeneities in Carbonate Bitumen and Heavy Oil Reservoirs from Northern Alberta

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Abstract

A combined geochemical, geological and microbiological analysis of an actively biodegrading oil column has been carried out on core from the Peace River oil sands. Consistent with numerous investigations of oil columns, gradients are seen in the viscosity and hydrocarbon composition data which respond to diffusion fed gradients within the oil column due to the zone below the oil column referred to as the oil-water transition zone (OWTZ) where enhanced microbial abundance is recorded. Gradients may be perturbed by the presence of shales which are seen offsetting the viscosity and geochemical profiles. While bioreactive compounds are seen responding to biodegradation, the bioresistant compounds such as the mono-aromatic steroids possess unique distributions that may be used to recognize source information even in these severely biodegraded oils. The compositions appear remarkably uniform across significant shale barriers suggesting the reservoirs were charged above and below the shales with a uniform oil composition. The shales often compartmentalize the reservoirs such that biodegradation systematics may differ above and below the shales. Meanwhile, low conversion rates detected amongst molecular maturity parameters and lack of diamondoids suggests the original source(s) were likely exposed to the early oil window stage of petroleum generation.