ORGANIC AND ISOTOPE GEOCHEMISTRY OF A HYBRID PETROLEUM SYSTEM

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The Montney Formation, in the Western Canada Sedimentary Basin (WCSB), is one of the major tight reservoirs worldwide, with a marketable potential of 449 Tcf gas, 14.5 billion barrels of natural gas liquids (NGL; C\textsubscript{2}-C\textsubscript{3}), and 1.13 billion barrels of oil (National Energy board, 2013). In 2018, the production of Montney exceeded 1.3 million BOE/D; it dominates hydrocarbon production in the region (Hayes, 2018). However, the same Formation lacks a comprehensive petroleum geochemistry assessment that can explain the distribution and abundance of petroleum fluids, particularly light oil and condensate, as well as the multi-zone potential of the reservoirs. Some hydrocarbon migration has occurred within the Montney Formation and/or from adjacent rocks, which makes it a hybrid petroleum system containing in-situ and migrated hydrocarbons; this also increases the difficulty for petroleum system analysis. Fundamental organic geochemistry studies of the Montney Formation were conducted back in the 90’s when only its conventional potential was exploited. Furthermore, recent studies are restricted to bulk parameters such as rock-eval and total organic carbon analyses (e.g. Egbobawaye, 2017). The total organic carbon content (TOC) varies from 0.16 to 3.83 % with an average of 0.8 % (Ibrahimbas and Riediger, 2004; Rokosh et al., 2012), and the kerogen ranges from type II/III to III/IV and IV (Riediger, 1997; Crombez et al., 2017; Egbobawaye, 2017). The Lower Triassic Montney Formation is in the oil window (e.g. Rokosh et al, 2012) but very unlikely produced oil (low TOC). This source rock, however, seems to have generated gas, which later mixed with oil that migrated from other sources.

Our contribution to the petroleum geochemistry assessment of the Montney play relies on the geochemical screening of natural gas and condensate. In certain areas, the condensates show characteristics of gas wash although evidence of residual oil has not been found (except for the presence of solid bitumen, previously interpreted as a thermal alteration product). Additionally, the condensates lack biomarkers; therefore, the assessment has been based on the analysis of light aliphatic and light aromatic hydrocarbons. Source rock candidates include the Middle Triassic Doig Formation and the Early Jurassic Gordondale Member of the Fernie Formation. Identifying the source of liquid hydrocarbons will improve the estimations of the amount of migrated oil and the expected locations (within the Montney Formation) to find it. Also, the stable carbon isotopic composition of methane, ethane, and propane, confirms gas generation within the Montney Formation as well as thermal maturity within the oil window. More mature gas likely migrated from the deepest parts of the Formation up to the Middle and Upper Montney intervals. Ultimately, this study is expected to be applied on similar low-permeability reservoirs from the WCSB that currently produce a significant amount of light oil and condensate.

References


