The isotope fingerprint of hydrocarbons from hybrid accumulations

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In the Western Canadian Sedimentary Basin (WCSB), shales are the most common type of sedimentary rock. The development and production of shale gas in this region, however, do not have a long history. The first application of horizontal drilling and multi-stage hydraulic fracturing took place in 2004, within the Lower Triassic Montney Formation. The Montney hydrocarbon resource represents 145 years of Canada's 2012 natural gas consumption; it is one on the largest tigh gas play in the world, and one of the most economic plays in Canada. The development of this play is due not only to favorable reservoir properties but also the high natural gas liquid (C_2-C_4) and condensate (C_5-C_{12}) content. The condensate adds a significant value to well production, which increases our interest in understanding its special distribution and abundance.

The complexity of lithofacies distribution in the Montney Formation leads to the presence of closed and semi-closed systems where hydrocarbons have been generated or otherwise hosted after migration, and thermally degraded. Such conditions result in isotope anomalies in C_1-C_3 compounds after thermal cracking of heavier molecules. We have investigated these kinetic isotope effects (sometimes normal distribution, sometimes reversals) in order to define reservoir compartments, methane intraformational leakage, thermal maturation stage of the rock, and fluids mixing.

Our understanding of fluid dynamics in the Montney Formation is a fundamental tool for the evaluation of similar hybrid systems such as the Duvernay Formation, also in the WCSB. The isotopic evidence of closed systems in Upper Triassic and Jurassic strata also increases the probability of fluids yet to be located within those sequences. Ultimately, characterising the isotope fingerprint of hydrocarbons from hybrid plays in the WCSB is essencial to address environmental concerns about thermogenic gas migrating into the shallow hydrosphere.