Paleo-migration of crude oil into Montney siltstone; its thermal evolution and effects on reservoir quality

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Abstract

This presentation provides the results of a multi-year research on the Triassic Montney tight gas siltstone play in the Western Canadian Sedimentary Basin. The vast majority or entire present time organic matter in the Montney tight gas siltstone is regarded as once being a crude oil migrated from the overlying organic-rich Doig source rock (Sanei et al., 2015). Thermal evolution of migrated crude oil has resulted in fractionation of a series of organic compounds with different chemical and physical properties, which define the present time reservoir quality of Montney tight gas play. A multi-modal fractionation of organic matter (OM) using organic geochemical and petrographic methods provides information on evolution of OM within the Montney tight gas corridor with respect to thermal maturity. Quantitative fractionation of OM provides volume percentage of various types of OM in the rock with different physical attributes and potentially important implications in reservoir quality.

The results of our study has shown that the majority of the total organic carbon (TOC) in the Montney cores consists of migrated solid bitumen/pyrobitumen (migrabitumen) representing a former liquid oil phase which migrated into the larger paleo-intergranular pore spaces. The degree that paleo pore spaces are filled with solid bitumen is expressed as bitumen saturation index (BSI). The reservoir quality is influenced more strongly by BSI than by conventional determinants of porosity and permeability such as grain size, sorting, clay content and cementation. The concept of pore-occluding solid bitumen as an important negative control of reservoir quality elucidated here for Montney siltstones likely has applications to the technical and economic evaluation of other tight gas plays, particularly those in indirect basin-centred gas accumulations (Wood et al., 2015).

A semi-liquid fraction of hydrocarbon coexists with solid bitumen only in late oil generation to wet gas thermal maturity window. This important fraction of OM is regarded as the Fluid-like Hydrocarbon Residue (FHR), which is a thin film of semi-liquid hydrocarbon consisting of medium to heavy oil residue. Although small in mass, FHR is believed to provide surface lining of vast portions of the present-time pore spaces within the studied siltstone reservoir. This fraction is believed to play an important role in oil wettability of the reservoir (Sanei et al., 2015).

References

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