

Hydrocarbon-rich shales of the Middle Triassic in Canada: a comparative study of the Arctic's Murray Harbour Formation versus the Doig

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Abstract

The Middle Triassic strata of the Sverdrup Basin in the Canadian Arctic Archipelago are source rocks to many of the major conventional oil and gas reservoirs in the basin (Brooks et al., 1992). These strata also show strong geochemical and petrophysical resemblance to known unconventional hydrocarbon resources. We compare the Middle Triassic Murray Harbour Formation and marginal equivalents to the coeval Doig Formation of the Alberta Basin, to establish relationships between the units. Core samples of the Murray Harbour Formation taken from a well located in the west-central basin interior have been analysed using Rock-Eval, organic petrology, ICP-MS, scanning electron microscopy, profile permeametry, and helium pycnometry. Rock-Eval and organic petrology results reveal that samples have reached the oil generation window and show abundant distribution of free light oil and solid bitumen within the clay-rich matrix. This petrologic characteristic is similar to the self-sourced Doig Formation unconventional resource play. Total organic carbon (TOC) values for the organic-rich portion of this core are between 1.5 and 4.8 wt.%, and HI values range from 151 to 542 mg HC/g TOC. Porosity for the cored interval ranges from 1.7 to 5.3 %, and average permeability ranges from 0.0013 to 1.9100 mD. Samples show a positive correlation between total phosphorus and both porosity and free oil. This is likely related to the presence of phosphatic nodules within the rock providing intra-microcrystalline porosity for hydrocarbon accumulation. Samples also show a positive correlation between kerogen and porosity. This is suggestive of porosity occurring within the kerogen at the present level of thermal maturity. The Doig Formation shows a similar relationship between TOC and porosity (Chalmers and Bustin, 2012). Additionally, Chalmers and Bustin (2008) found that micropore surface area, such as that associated with residual organic matter, increases with increased thermal maturity. Much of the Murray Harbour Formation is situated in the deeper central part of the Sverdrup basin towards the east, where regionally, the unit is thermally overmature. Therefore, this area may prove to be more prospective as a shale gas reservoir in the Middle Triassic strata of the Sverdrup Basin.

References

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