Mineralogical Characterization of the Upper Devonian Duvernay Formation of Alberta, Western Canada Sedimentary Basin

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Summary

The Frasnian (Upper Devonian) Duvernay Formation is a significant target for unconventional exploration initiatives in Alberta, particularly for liquids. We focus on the origin of variability in the Duvernay that is significant to the producibility of hydrocarbons, which in other reservoirs may reflect variations in primary composition, diagenetic alteration, thermal maturity, sediment source, primary production, clay content and hydrodynamic conditions. Shale composition exerts control over porosity and pore size distribution and the potential of the pore system to store and deliver gas.

We report here on preliminary results from high resolution geochemical datasets in long continuous cores from our first two wells, one in the East Shale Basin and one in the West Shale Basin,. ICP and ICP-MS techniques were used to analyze major, minor and trace elements. Organic matter was analyzed using LECO-TOC and Rock-Eval.

TOC contents are near 1% at the base of the Middle Duvernay, generally show variation with a slight increase upward to 3 to 4% near the top of the Duvernay, and then abruptly decrease at the top of the formation. TOC decreases in carbonate-rich intervals. In the lower Duvernay, Al_2O_3/SiO_2 ratios decrease systematically parallel to a slight increase in TOC upward. Al_2O_3/SiO_2 ratios increase again in the upper Duvernay while TOC remains relatively similar in the two units.

Overall, SiO_2 varies strongly and inversely with CaO content, TOC appears unrelated to the K_2O/Al_2O_3 ratio, a very weak covariation in SiO_2 and Zr is observed, and SiO_2 does not covary with either K_2O or Al_2O_3. This is interpreted to indicate that both detrital and biogenic sources are contributing to the silica content.

The mineralogy of mustones is assessed using mathematical and statistical methods. A combination of the XRD identification of minerals present and a normative calculation based on whole rock composition provides a quantitative estimate of mineralogy. Variation in reservoir qualty can be understood by asessing mineralogy estimates and measured porosity and permeability in a stratigraphic context. Pore size distribution and the potential of those pores to

store gas is affected by shale composition. Patterns in clay, silica and TOC content will be assessed geographically to determine where these three parameters are optimized.

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