geoconvention
Calgary • Canada • May 15-19 2017

Geochemical, Structural, and Mineralogical Controls of the Duvernay Shale Thermal Maturity

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The thermal maturity of the Duvernay has been recently addressed with a focus on the Rock-Eval pyrolysis peak. The approach is a multidimensional look at the raw data complemented by calculated transformation ratio. The results have been integrated with the mapping of basement features and revealed a structural control of the thermal maturity oblique to the basin configuration at the time of the Duvernay sedimentation, i.e., oblique to the Rimbey Leduc Reef Trend. The main basement features are based on aeromagnetics, and abnormal basement gasses (N_2, He, H_2) sampled in wells and reported to the Alberta Energy Regulator.

The organic matter and the overall Duvernay mineralogical composition has been evaluated using and comparing four different XRF instruments with a variety of anodes and from three different laboratories. Many samples were analyzed using various instruments to verify repeatability and better understand the differences between the instruments. Two organic facies types can be distinguished: a pyritic facies and a non-pyritic facies. Outstanding TOC prediction is obtained after separation of these two organic facies. Additionally, iron and sulfur have proven to be very good to extremely good at predicting brittleness with the XRF data being compared to the mechanical rebound hardness measured on the same sample location (best estimate).

Additionally, extensive data sets of shades of gray (256 tints) have been compared to Duvernay XRF elemental data. Here again, a distinction between pyritic and non-pyritic facies provides increased accuracy. The pyritic facies prediction favors the use of sulfur rather than iron and vanadium is more accurate for the non-pyritic organic type.