Application of XRF to Cratecaous Organic-rich, Siliciclastic/carbonate Mudrocks, SW Manitoba

Hosseininejad, Somayeh*, Pedersen, Per K., Spencer, Ronald J., Department of Geoscience University of Calgary, Calgary, Alberta
hosseis@ucalgary.ca
Nicolas, Michelle P. B., Manitoba Geological Survey, Winnipeg, Manitoba

Summary

The upper Cretaceous sedimentary package on the eastern margin of the Cretaceous Interior Seaway in Manitoba is comprised of mixed siliciclastic and carbonate–rich sediments and hosts a large shallow gas accumulation. Non–calcareous, organic–lean mudrock of the Cenomanian Belle Fourche member of the Ashville Formation is overlain by the Turonian Favel Formation comprising the Keld and Assiniboine members. The succession is comprised of stacked parasequences of organic–rich, calcareous mudstone coarsening up to shallow water calcarenite beds. The overlying Morden member is also an organic–rich mudstone, but its non–calcareous character represents a likely significant change in oceanographic condition within the seaway and not a significant change in water depth. These different suits of mudrock facies have very different hydrocarbon source and reservoir properties as reflected in their geology, geochemistry and petrophysics.

This study utilizes different geochemical techniques (XRF, XRD and Mass Spectrometry) to determine whole rock geochemistry of these units to assist in understanding the distribution and lateral variation of sedimentary and thereby reservoir facies. Elemental trend analysis of normalized geochemical data shows that each of these different sedimentary assemblages is distinguishable by unique combination of major or trace element concentrations. However, inter–element relationships observed from one unit to another demonstrate a complex configuration as trace element boundaries do not always correspond with the sedimentary facies boundaries. These discrepancies have to be considered during chemostratigraphy work as it can influence reservoir modeling. Occasionally, different sedimentary facies have comparatively similar geochemical characteristic, while facies exhibiting relatively homogeneous appearance are chemically different. Thus, to identify and characterize all the various potential reservoir units, sedimentary facies observation need to be complemented by detail geochemical analysis. There are also trace elements that are associated with oil or gas within the strata and can be used to model the distribution of hydrocarbon in the system. A variety of elemental proportions can be utilized to identify different zones and possible sweet spots within the succession.

This approach constructs a framework for understanding the processes associated with mudrock deposition and considers mudrock microscale heterogeneities and its upscaling to the larger reservoir. It also helps to improve the resolution of routine stratigraphy and can contribute to our understanding from the sediment provenance, paleo-environment and basinal scale sedimentary events and finally link them to reservoir properties. The methods would be applicable to any tight gas and oil carbonate/siliciclastic shale reservoir.