

New insights into the Three Forks Group, southwestern Manitoba: stratigraphic changes and new sedimentological model

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Summary

Over the last decade, there has been considerable amount of tight oil exploration and development focus in the Late Devonian-Early Mississippian Three Forks Group of the Williston Basin in southwestern Manitoba, namely the Torquay, Big Valley and Bakken formations. This group has demonstrated remarkable hydrocarbon development capacity, with excellent potential to find new discoveries. Prior to the drilling rush that has ensued, there was little core information to help properly evaluate the Torquay Formation. This formation was previously referred as the Lyleton Formation and the Three Forks Formation of the Qu'Appelle Group in southwestern Manitoba. Detailed evaluation of this formation has resulted in a revision to the stratigraphic nomenclature previously used in Manitoba, by extending eastern Saskatchewan's current nomenclature into Manitoba.

Understanding the stratigraphic framework has also lead to a better understanding of the depositional environment for the Three Forks Group, particularly the Torquay Formation. The depositional environment of the Torquay Formation had received little attention in the past. The first significant attempt was by Christopher (1961) who attributed the oxidation and brecciation of this component units to regional intraformational weathering processes and the development of soil horizons; this model was acceptable for its time, and while still valid today, can be extended into a farther reaching model. The sedimentary model proposed here for the Torquay has no modern analogue, but can best be described as a giant evaporitic platform. The challenge lies in the large scale needed for deposition of the aerially extensive evaporitic deposits, that are similar to sabhkas but much larger. The eastern edge of the basin, which comprises southwestern Manitoba and eastern Saskatchewan, best fits the evaporitic mudflat on a epeiric shelf model described in Warren (2006). Due to proximity to the basin edge, the depositional setting may have, at times, graded to continental evaporites. The arid climate at the end of the Devonian combined with tectonism and sea level fluctuations provided the right conditions for the deposition of evaporitic, oscillatory sedimentary cycles seen in this formation. The transgressive pulses that followed resulted in the deposition of the Big Valley and Bakken formations, and are recorded in the nearshore (Big Valley) and transitional-offshore to offshore (Bakken) sediments.

References

- Christopher, J. E. 1961: Transitional Devonian-Mississippian formations of southern Saskatchewan; Saskatchewan Mineral Resources, Report 66, 103 p.
- Warren, J. K. 2006: Evaporites: sediments, resources and hydrocarbons; Springer-Verlag Berlin Heidelberg, Germany, 1035 p.