

Basin-scale high-resolution sequence stratigraphy and internal architecture of the Spathian deposits of the Montney Formation in Western Canada (Lower Triassic).

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Summary

Thick Spathian deposits of the Lower Triassic Montney formation are preserved in Northeastern British Columbia, where they hold massive amounts of unconventional resources. A good understanding of the internal architecture of these marine deposits at basin-scale would provide a framework to: (1) better predict stratigraphic controls on the distribution of organic-rich deposits and on hydrocarbon migration pathways; and (2) investigate the impact of these geological heterogeneities on well performance at the regional scale.

In Northeastern British Columbia, the Spathian deposits mainly consist of offshore and offshore transition sediments forming a prograding wedge along depositional dip from the northeast to the southwest. This wedge is punctuated by flooding surfaces bounding parasequence sets. These internal units can be correlated regionally owing to their characteristic gamma ray log signature and to the very high density of well control. The regional correlation of these parasequence sets, based on over 1,400 wells, reveals well-defined clinof orm morphologies.

The facies analysis and the characteristic dimensions of these morphologies are consistent with “subaqueous shelf-prism clinof orms” that have been described on numerous present-day and ancient continental shelves (Patrino et al, 2015). Subaqueous shelf-prism clinof orms typically display a sigmoidal shape in the dip direction and along-shore-elongated depositional thick in plan-view. This geometry results from the interaction of clastic sediment input with shelf hydrodynamic processes such as storm generated waves, sediment gravity flows and offshore currents. Consequently, the topset, foreset and bottomset of these clinof orms are characterized by different depositional facies that can be predicted and mapped at basin-scale.

In the Spathian depositional system of western Canada, clinof orm bottomsets form the main source-rock intervals within the Montney Formation, due to anoxic conditions and lower sedimentation rates (less dilution). Clinof orm foresets result from higher energy processes and sedimentation rates, and form thick, mostly organic-lean siliciclastic intervals with better reservoir quality. Foreset deposits form the thickest part of the Spathian parasequence sets and are the main target of horizontal drilling and multistage fracturing. The shape of the depositional thick in map view clearly suggests that these deposits were influenced by major structural elements at basin-scale. Furthermore, the regional flooding surfaces bounding the parasequence sets, might form extensive permeability barriers that potentially control up-dip migration of hydrocarbons within the Montney petroleum system. Finally, the vertical and downdip lateral movements of the topset to foreset break in slope can be used in combination with facies analysis to construct a high-resolution sequence stratigraphic model of the Spathian deposits in Western Canada.

References

Patrino, S., Hampson, G. J., & Jackson, C. A. L. (2015). Quantitative characterisation of deltaic and subaqueous clinof orms. *Earth-Science Reviews*, 142, 79–119. <http://doi.org/10.1016/j.earscirev.2015.01.004>