

The Besa River Formation in Liard Basin, British Columbia

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Summary

The Liard Basin occurs within the Western Canada Sedimentary Basin and is defined by thick sections of Middle to Late Mississippian and Cretaceous clastic strata. It occupies a unique position, falling between the northerly to northeasterly trending structures of the Mackenzie and Franklin mountains and the northwesterly striking Rocky Mountains. Its eastern margin is well defined by the Bovie structure whereas the northern and western boundaries roughly correspond to the edges of thick Carboniferous and Cretaceous strata, respectively. The southern limit is approximately delineated by thinning of Cretaceous and Carboniferous clastic sections to regional thicknesses.

The Middle Devonian to Middle Mississippian Besa River Fm. is a predominantly shale succession that was deposited in Liard Basin and now outcrops along the eastern slopes of the Rocky Mountains in northeast British Columbia. It contains the deep-water basinal equivalents to carbonate and shale developed to the east in the subsurface of the Western Canada Sedimentary Basin. In the outcrop belt of westernmost Liard Basin, the Besa River Fm is about 300 m thick whereas the correlative carbonate and shale are over 2000 m thick near the Bovie structure. In central Liard Basin, the upper Besa River Fm contains a gas-saturated, silica- and organic-rich section equivalent to the Exshaw Fm and an underlying unit informally referred to as the Patry member. The Exshaw and Patry succession has recently been the focus of shale-gas exploration, with the initial development well producing over 6.5 BCF (184 x 10⁶m³) of natural gas since 2011.

Re-Os systematics of shale in upper part of the organic-rich zone, together with U-Pb dating of an associated thin tuff define an age at the Devonian-Mississippian boundary and corroborates correlation with the Exshaw Fm. The underlying organic-rich Patry sequence is developed in central and western Liard Basin and is considerably thicker along its eastern limit at the Kotcho shelf edge, where it defines a north to north-easterly trending section that is over 200 m thick. The proposed depositional model for this succession incorporates a regional transgression near the end of Late Devonian Kotcho deposition that is accompanied by anoxic bottom waters. Maximum flooding occurred during deposition of the lower Exshaw. Although an early model suggested a Bovie-parallel fault created the accommodation space for the thicker section of Exshaw and underlying Patry lithologies (Ferri et al., 2016), seismic data indicates that this sequence likely represents a westward thinning clinoform.

References

Ferri, F., McMechan, M., and Creaser, R., 2015. The Besa River Formation in Liard Basin, British Columbia. In: Oiland Gas Geoscience Reports 2015, British Columbia Ministry of Natural Gas Development, pp. 1-27.