

The Upper Devonian - Lower Mississippian Bakken Formation of Subsurface Saskatchewan Revisited: Sedimentary Facies, Trace Fossils and Sea-Level Changes

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Being estimated to hold 25 billion barrels according to the USGS, the Upper Devonian - Lower Mississippian Bakken Formation represents one of the most important oil producer units in Saskatchewan. Three members have been previously defined in the Bakken Formation: a Lower and Upper organic-rich shaly members, and a calcareous sandy-silty Middle Member. Integration of ichnologic analysis with conventional sedimentologic data reflects a much more complex depositional history for the Bakken Formation than it has been suggested by previous studies, which advocated for open-marine conditions for the whole unit. According to the new ichnologic data obtained from the slabbing and detailed core analysis of sixty cores (1371 m) in Southeastern Saskatchewan, three distinct intervals involving several sea-level changes are recognized in the Bakken Formation: a basal open-marine interval, a middle brackish marginal-marine interval, and an upper open-marine interval. The basal open-marine unit which includes the Lower Member and the lower part of the Middle Member was deposited in a transgressive to highstand systems tract. After a sea-level drop followed by a sea-level rise, brackish marginal-marine deposits from the middle part of the Middle Member accumulated. Finally, as the transgression succeeded, fully marine conditions were reestablished in the entire area. This later phase is recorded by the upper open-marine interval from the upper part of the Middle Member and the Upper Member. Preliminary isopach maps of the open-marine sedimentary facies show a more extensive and homogeneous distribution. In contrast, the brackish marginal-marine deposits reflect a more restricted and heterogeneous distribution. A series of northwest-southeast trending facies belts with distal deposits reaching their maximum thickness in the southwest and more proximal deposits being increasingly thick toward the northeast of the open-marine facies from the lower interval suggest the presence of a shoreline northeast from the study area. Isopach maps of the brackish marginal-marine facies, however, reflect an irregular and embayed shoreline which resulted from a sea-level drop.