A New Insight into the Depositional Architecture of the Middle Member of the Bakken Formation, Williston Basin

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Abstract

The Bakken Formation spans the late Devonian to Mississippian periods, and constitutes a complete petroleum system in the subsurface of the Williston Basin in the USA and Canada. The Formation is composed of four members: a basal sand-rich Pronghorn member, lower black shale member, a dolomitic silty sandstone middle member and an upper black shale member. This study describes facies and sequence stratigraphic analysis of the middle member of the Bakken Formation, by examining 56 drill cores complemented with micropetrography and well log analysis. The Middle Bakken is composed of six facies, including laterally extensive (>100 km) stromatolitic interval, focal facies here, deposited in a storm- and tidally-influenced shelf system. The stromatolitic facies occur in the upper section of the Middle Bakken. Sequence stratigraphic analysis revealed three units with large-scale shallowing upward to deepening upward patterns. The lower unit is composed of shallowing upward (subtidal-intertidal) facies. The middle unit comprises scour-based, massive, crossbedded sandstone with ooids (an intertidal shoal facies). The upper unit is composed of fining-upward microbial carbonates, boundstones and storm-influenced wackestone facies interpreted as deposited subtidal zone. The upper unit has a sharp upper contact with the Upper Bakken shales, indicating an abrupt deepening of water depths. Five systems tracts constitute the entire Bakken Formation—LST-TST, HST, second LST, and second TST, denoting a repeated regressive-transgressive cycle. The Middle Bakken is represented by the HST, second LST, and second TST, and were interpreted as being formed when supply matched accommodation on a low-gradient inclined shelf. This model can be integrated with seismic and geomechanical investigations toward the prediction of hydrocarbon-productive zones, and in optimization of reservoir production within the Williston Basin.