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Facies and Architecture of the Estuarine, Tidal-dominated Reservoirs in the McMurray Formation, Northeastern Alberta, Canada: An integrated case study using core and wireline data

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The Lower Cretaceous McMurray Formation is a key reservoir target in the subsurface of the Athabasca oil sand area, northeastern Alberta. A large fraction of these oil sands are ancient fluvial and estuarine deposits, and understanding their facies and architecture is critical for positioning development well to optimize production.

Using extensive core and wireline logs, this study, aims to address the facies and architecture of the estuarine tidal reservoirs in the area to develop a predictive reservoir depositional model for future reservoir description and resource progression purposes. Sixty one cores and wireline logs from four hundred forty eight wells were examined in detail. Facies analysis show that vertically, fluvial deposits that show tidal influence at their basinward directions pass upwards into tidal-dominated estuarine successions with predominantly of coarse-grained tidal sand bar and tidal flat deposits. These tidal-dominated successions can be up to 22m thick and show rather clear tidal signatures, including the occurrence of flaser/wavy/lenticular bedding, mud couplets, tidal bundles/rhythmites, and reactivation surfaces. Semi-diurnal and semi-lunar cycles are observed in these facies. Tidal bars consist of coarsening-upward successions with more heterolithic facies in the very lower part and cleaner cross-bedded (with continuous double mud drapes in their toes) and planar cross-stratified sands in the upper part. Laterally, stacked tidal bar deposits translate into sandy to muddy tidal flat and marsh deposits.

Overall the integrated analysis indicates that the tidal-dominated reservoirs in the study area are deposited in an offshore setting where there is transition from near to far segments of the estuary mouth. The vertical facies and architecture changes seen also ties to the evolution of sedimentation in this part of the Western Internal Seaway during the Lower Cretaceous.

Keywords Reservoir facies and architecture, Estuary, Tidal bar, Athabasca oil sands.