The Large Tidally-Influenced Point Bars of the McMurray Fm.: From Sedimentology To Reservoir Modeling Alberta, Canada

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Outcrops and subsurface investigations emphasize that around Fort McMurray the main bitumen reservoirs of the McMurray Formation are large point bar deposits. Sedimentological studies performed on these reservoir objects have shown that tidal currents occurred in the meandering paleoriver system. These tidal inputs increased reservoir heterogeneities primarily because of successive mud decantation periods and the many reactivation or erosion surfaces.

Five main reservoir heterogeneities have been described on Steepbank River outcrops: mud accumulation during channel abandonment; mud drapes along accretion surfaces that are downward interfingered into cleaner sands; floodplain deposits on top of the point bar; reactivation surfaces typically associated with mud-clast deposits; and mud-clast breccias accumulated at the base of the channel. At the same time, five main facies have been emphasized on these studied tide-influenced point bars: mud-clast breccias, cross-stratified sands, slightly heterolithic rippled sands, highly heterolithic burrowed sands, and thick mudstones. For each of these facies, petrophysical properties have been established, enabling their application as rock-types for the Steepbank River outcrop modeling. This deterministic method of modeling, improved by light detection and ranging (LiDAR) data, used truncated Gaussian simulations constrained by the proportion cube, sedimentological logs corresponding to hard data, and adequate variograms. The resulting facies and heterogeneity distributions conform closely to the outcrop reality, lending support for the modeling method.

This deterministic sedimentological model is at the root of steam-assisted gravity drainage (SAGD) simulation tests performed for a water-steam injector horizontal well underlain by a fluidized-bitumen horizontal producer well. Results of the simulation boxes filled by this sedimentological modeling more closely match outcrop analogues, than results obtained by the more commonly used purely stochastic models, This is because of the occurrence of large-scale inclined heterolithic stratification, which is generally overlooked in stochastic models; or alternatively is replaced by horizontal heterogeneities, which would be highly detrimental for bitumen production from SAGD horizontal wells. Thus in purely stochastic modeling, bitumen recovery prospects tend to be underestimated or permeability heterogeneity is overestimated.