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Reservoir architecture of estuarine tidal bar deposits in the McMurray Formation, Alberta, Canada

Huang Jixin¹

¹Research Institute of Petroleum Exploration & Development PetroChina Co. Ltd, Beijing, China.

A large fraction of THE Athabasca oil sand deposits are ancient fluvial and estuarine deposits, but few detailed three dimensional, tidal bar complex, architectural models have been build. In this study, estuarine, tidal bar complex deposits are found and modeled in the subsurface of Athabasca oil sand area, northeastern Alberta from the Lower Cretaceous McMurray Formation.

Sixty-one cores and four hundred and forty-eight wire line logs were used to constrain the architecture and faces distribution. Vertically, the fluvial deposits show high tidal influence at their seaward ends and pass upwards into tidal-dominated estuarine deposits characterized by coarse-grained tidal sand bar facies and tidal flats associations. Very thick tidal influenced litho-facies with thicknesses up to 22m exhibit semi-diurnal and semi-lunar cycles observed in mud couplets, tidal bundles and rhythmites. Laterally, stacked tidal bar deposit transition into marginal sandy to muddy tidal flat and marsh deposits. A single tidal bar is composed of upward-coarsening, cross-stratified sand, with mud drapes developed at the bases of foresets. The cross-stratified sands with mud drapes in the lower part of a single tidal bar mainly contain flaser laminations and ripples; the clean sands in the upper part mainly exhibit low-angle bedding and rare trough cross-bedding and planar cross-bedding.

The tidal bar and tidal flat complex in North Eastern Alberta suggests deposition in an offshore setting, with a transition of environments from proximal to distal estuarine mouth. The architecture is considered to reflect sediment evolution in this area related to the Lower Cretaceous sea-level rise in the Western Interior Seaway. This method could be used to distinguish and analyse ancient tidal bar and tidal flat complex in other similar sedimentary environments.

Keywords Reservoir architecture, Estuary, Tidal bar, Athabasca oil sand.

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