Rivers, Estuaries and Bays: Fragmented Stratigraphy of the Athabasca Oil Sands, Northeast Alberta

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Detailed sedimentological and stratigraphic analysis of over 80 outcrops, ~ 300 cores, and over 5000 well logs allows for a better understanding of the Athabasca oil sands deposit, hosted primarily by the McMurray Formation in northeastern Alberta. Much of this work has relied on facies mapping on a regional scale, facilitated through facies analysis of outcrops, cores and well logs, as well as comparisons with modern analogues.

Typically in the past the McMurray succession has been interpreted as a lower 'Fluvial,' middle 'Estuarine,' and upper 'Coastal Plain' facies associations. Results from the regional facies analysis for the Athabasca deposit show that much of the preserved stratigraphy is fragmented; that no clear distinctions can be made between the middle 'Estuarine' and upper 'Coastal Plain' facies associations; and that no single model applies to the total succession that is preserved. Major disconformities separate different system tracts and they should not be considered to be parts of a single entity, or single systems tract. At least five different systems tracts can be mapped for the Athabasca oil sands deposit, and within each systems tract are preserved portions of fluvial, estuarine and bay-fill successions.

In terms of modern analogues, the interpretation of the lowermost part of the McMurray as fluvial remains, being interpreted as a low-stand braided fluvial systems tract. Overlying transgressive successions show stacked interdigitation of fluvial-estuarine and bay-fill successions that change in three-dimensions. Comparisons with modern analogues of the Maritimes of Eastern Canada show that some of what has been identified as "inclined heterolithic stratification" and previously interpreted as estuarine channel and point-bar successions may be re-inpterpreted as crevasse/washover channel and bay-fill successions. These types of deposits have more regional bay fill mudstones at the base of the stacked sequences and facies models differ significantly from the fluvio-estuarine channel and point bar deposits that lack the more regional basal mudstone deposits.

In areas of reduced accomodation space, for example in Athabasca Central and Athabasca South, not all the paleoenvironments are preserved. Recognition of the proper paleoenvironmental setting is critical for prediction of reservoir heterogeneity, including lateral and vertical segregation of gas, bitumen and water reservoirs. Such regional mapping within different time-transgressive systems tracts allows for the efficient development of the vast bitumen resources of the Athabasca oil sands.