The Significance of Trace Fossils in Marginal Marine Deposits: The Construction of a Depositional Model For the Peace River Oil Sands

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ABSTRACT

In the subsurface of the Peace River region, billions of barrels of bitumen are present within Lower Cretaceous strata. Since the 1970's, bitumen-saturated sandstones of the Peace River Oil Sands have been considered to represent deposits of a marginal-marine depositional environment. Inherent with this setting is a stratigraphic and sedimentologic complexity that results from numerous factors, related in large part to the convergence of marine and non-marine depositional processes. Unraveling this complexity and deriving a depositional model for the Bluesky Formation, an important reservoir interval in the Peace River area, was largely accomplished through trace fossil analysis.

Trace fossils in marginal-marine deposits, and particularly estuarine successions, record numerous aspects of the original depositional setting. This is because trace-making organisms are strongly influenced by numerous physical and chemical factors that are variable across an estuary. These factors, or stresses, include lowered salinity, fluctuating salinity levels, high sedimentation rates, high current energy, turbidity, and low levels of oxygen in bottom and interstitial waters. Depositional subenvironments (e.g., bayhead delta, tidal channel, lagoon, tidal deltas, tidal inlet, barrier) within estuarine deposits of the Bluesky Formation were variably associated with each of these factors.

Low salinity and fluctuating salinity levels are interpreted to have contributed to patterns of low ichnofossil diversity and burrow dimunition proximal to the fluvial point source(s) in the upper and central parts of the depositional system. High sedimentation rates and current energy, evidenced ichnologically by sporadic, penetrative bioturbation were most significant in the vicinity of the tidal inlet in the lower estuary and in the bayhead delta of the upper estuary. High turbidity associated with the turbidity maximum in tidal channels of the central reaches of the estuary likely inhibited suspension feeding behaviors. Low levels of dissolved oxygen imparted an important stress on burrowing organisms in quiescent-water embayments, lagoons, and fine-grained tidal flats.