The Development of Inclined Heterolithic Stratification in a Tidally Influenced, Fluvially Dominated River, Fraser River, British Columbia

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Abstract

Predicting the lateral and vertical extent of mud beds in Middle McMurray Fm inclined heterolithic stratification (IHS) is necessary to ensure the economic viability of hydrocarbon extraction from these deposits. However, in core it is not possible to determine the continuity of mud beds and muddy successions because of limited data. This is not the case in modern settings. To assess the continuity of mud beds and mud-dominated units, a mid-channel bar (detached point bar) in the mesotidal reach of the Fraser River, British Columbia was studied. The distribution of mud and sand beds across the bar, and the sedimentological and ichnological character of these deposits were determined. The overall point bar succession exhibits a fining-upward profile with an increase in mud-bed thickness from the shallow subtidal to the upper intertidal zone. Conversely, sand bed thickness decreases from the base of the channel upward. A fining-downstream trend is observed around the bar, due to an increase in mud-bed thickness in the downstream direction. In addition, mud beds in the shallow subtidal zone are much more laterally continuous on the downstream end of the bar, with some beds being correlateable distances greater than 1 km.

A low diversity assemblage of diminutive infauna-generated burrows characterizes the ichnology of the system. Where present, bioturbated horizons tend be rhythmic in nature, reflecting annual cyclicity in environmental stresses. Burrowing is limited to the muddy horizons, or extends down from muddy horizons into underlying sand beds. Burrow initiation in sand beds was not observed.

Sand is mainly transported in the late spring and early summer, when river discharge increases by nearly an order of magnitude due to the flood stage freshet induced by melting snow pack in the British Columbia interior. Throughout the remainder of the year, relatively low flow conditions ensue, enabling the accumulation of fine-grained (muddy) sediments, and the establishment of stable brackish-water conditions. The latter is favourable for infaunal colonization.

The depositional model presented herein may prove to be a useful tool for hydrocarbon exploitation by providing an analog model for predicting lithological heterogeneities (i.e. lateral and vertical extent of mud beds). In particular, the IHS developed in the tide-influenced reach of the Fraser River may prove beneficial in predicting along- and across-strike changes in mud distribution of Middle McMurray Fm point bars.