Tidally-Influenced Point Bars: Morphological Signatures and their Application to the McMurray Formation

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ABSTRACT

Medial components of the McMurray Formation are composed largely of inclined heterolithic stratification (IHS). These are normally interpreted to represent tidally influenced point bars associated with large-scale (deep) channels. Recent research suggests that many of these IHS successions may represent stacked and discrete genetic units that accumulated within relatively shallow channels. These successions maintain relatively uniform dip directions and dip angles across apparent discontinuities, suggesting that point bar attachment is in part geomorphologically controlled. Moreover, bed profiles in outcrop do not reveal typical sigmoidal profiles that are commonly attributed to fluvial point-bar deposits.

Studies of modern point bars using aerial photographs underscore the morphological differences between tidal point bars and their fluvial counterparts. These include sinuosity, width-to-depth ratios, and point-bar wavelength and amplitude. In spite of these apparent contrasts, subsurface models rarely recognize that fluvial and tidal point bars exhibit different 3-dimensional architectures.

This study considers three modern, marginal marine examples: Tillamook Bay, Willipa Bay, and Shepody Bay. All three locations demonstrate the following: (1) tidally-influenced point bars maintain lower sinuosities than their (immediately adjacent) low-gradient, fluvial counterparts; (2) tidally influenced point bars exhibit more uniform point-bar dip directions; (3) point bar length—measured as a chord across the point bar—in tidally influenced systems is greater than with the adjacent fluvial systems; and, (4) channel depth in tidal channels, is relatively shallow, only slightly deeper than the attached fluvial. Furthermore, we observe no evidence of channel abandonment within the realm of the tidal system although these are immediately apparent within the fluvial. All of the systems studied herein, suffer only minor fluvial input throughout most of the year with high-energy flash discharges in the winter or spring. The scales of the adjoining tidal channels are, however, remarkably similar to analogous accumulations observed in the McMurray Formation.

The reported data can be applied to ancient McMurray IHS successions: (1) preservation of stacked and apparently conformable IHS successions can result from more uniform dip directions observed in tidal-channel deposits; (2) in general, the thickness of individual channel units is relatively thin (< 8-9m); and, (3) significant fluvial input are not needed to explain long, laterally continuous

genetic channel units—ie. the fluvial attachment to the McMurray ‘estuary’ may have been minor.