

Facies characterization of the lower McMurray in the northern part of the Athabasca Oilsands, evidence for brackish-water and tidal influence.

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Summary

Outcrop studies at several locations along the Athabasca River north of Township 94 focus on examples of the lower McMurray Formation. Key outcrops include sections near Shell Landing, south and north of Daphne Island and at Pierre River, the northernmost location. All of these locations display an illuviated level of pedogenically altered clayey silt that demarcates the top of the lower McMurray.

Sedimentological observations and ichnological analysis indicates that southern locales are likely fluvial in their nature, but display evidence of tidal influence. The northernmost location displays tidal reversals and an ichnological assemblage characterized by *Cylindrichnus* and thereby should be regarded to be an estuary.

Introduction

The McMurray Formation is informally divided into lower, middle and upper units and those are generalized to represent fluvial, estuarine, and marine levels, respectively. Many workers recognize exceptions to this generalization, particularly in the middle and upper McMurray. Most workers have been content to consider the lower McMurray as dominantly fluvial in nature, but an excellent question is, to the north do we enter estuary strata associated with the lower McMurray? To test this question, we use a south to north transect of the lower McMurray in the northern part of the Athabasca Oilsands focusing only on outcrop data.

Theory and Dataset

Paleo-basinwards, for the McMurray Formation is northwards. As such, fluvial strata should translate into estuary units, if transgression reached as far south as the study area. If transgressive units are preserved, we expect to document the influence of tidal features, such as mud-beds and current reversals, and we predict the presence of a brackish-water trace fossil assemblage, which normally is present in areas where marine and fluvial waters mix.

Sections studied:

Shell Landing
57 12'41.64"N 111 36'26.62"W
~ 08-06-095-10 W4

Daphne Island North
57 17'57.46"N 111 39'43.29"W
~ 08-02-096-11 W4

Daphne Island South
57 15'29.12"N 111 38'33.77"W
~ 10-24-095-11 W4

Pierre River
57 26'32.03"N 111 38'26.74"W
~ 02-25-097-11 W4

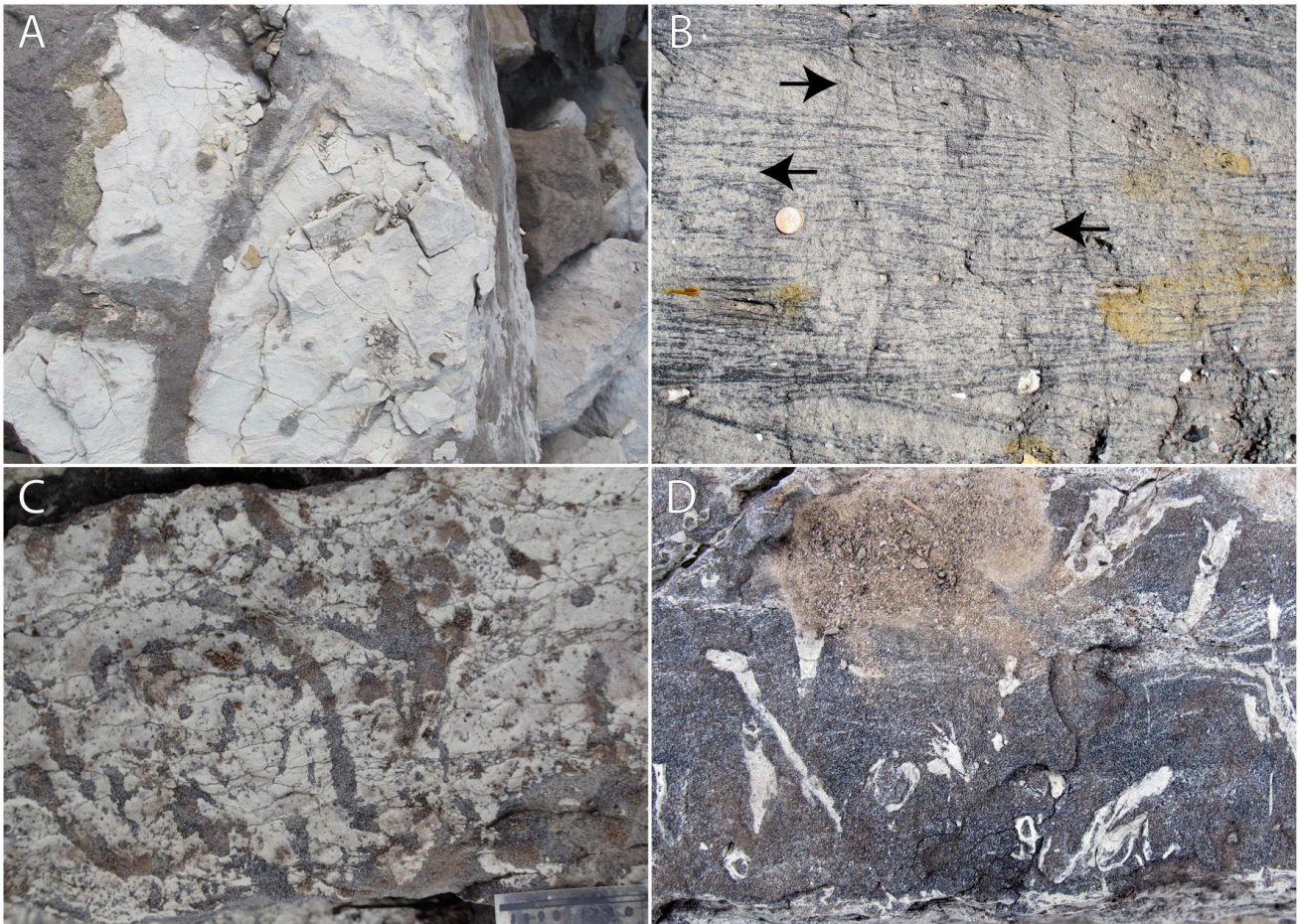


Figure 1: Examples of lower McMurray sedimentary fabrics. A. *Camborygma* (crayfish burrow?) from Shell Landing area. B. Reversals in ripples from Shell Landing. C. *Nactodemasis* (insect larvae burrows?) from Daphne Island North. D. *Cylindrichnus* (i.e. brackish water assemblage) from Pierre River.

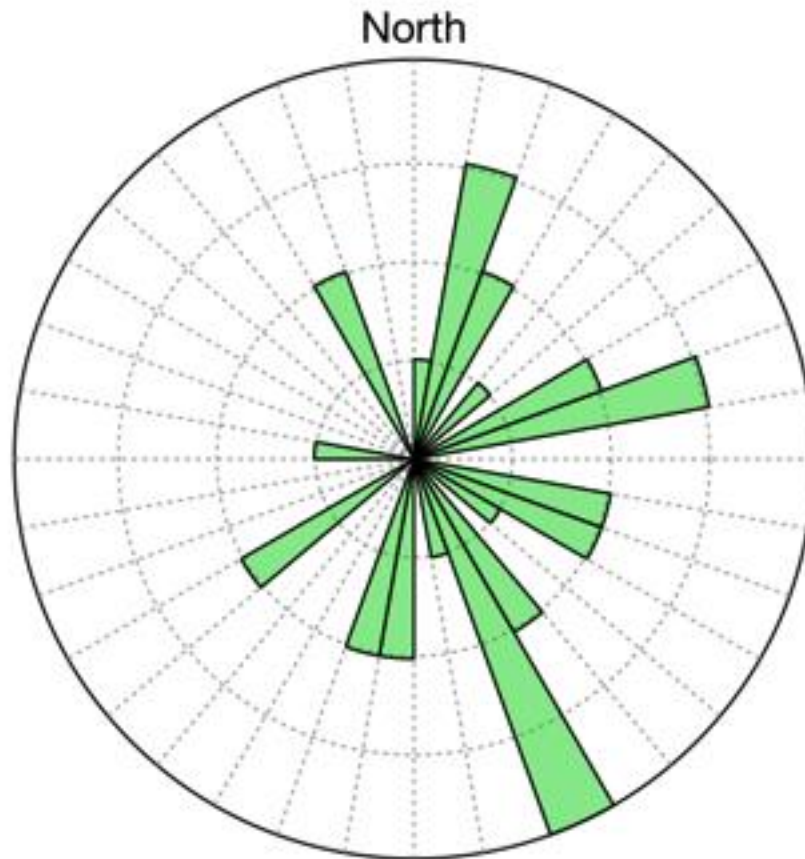


Figure 2: Foreset orientations of dunes and current ripples from the Shell Landing section.

Discussion

Even in the furthest south locations (Shell Landing and Daphne Island South, which are dominated by medium grain cross-bedded sandstones), rare sedimentary reversals are observed in the lower McMurray (Figs. 1B and 2). One trace fossil, *Camborygma* (possibly the domicile of a crayfish) is observed (Fig. 1A).

At Daphne Island North, two discernible facies associations are observed: (1) epsilon cross-stratified very coarse sandstone interpreted to represent fluvial point bar deposits; and (2) inclined heterolithic stratification (IHS), cross cut by the fluvial channel deposits. Within the IHS no tidal reversals are preserved. However, two types of trace-fossils are observed, *Nactodemasis* and *Siphonichnus* (Fig. 1C). The former is associated with insect larvae burrowing in the presence of fresh-water in unsaturated sediment, whereas the latter is normally recognized in brackish-water environments.

At Pierre River current reversals are observed and a pervasive if diminutive trace fossil assemblage dominated by *Cylindrichnus* is observed (Fig. 1D).

Conclusions

Rare tidal reversals and the presence of rare crayfish(?) burrows at the Daphne Island locale suggest that the strata are primarily fluvial with a tidal influence. However, the presence of better developed reversals at Daphne Island South and the *Siphonichnus* at Daphne Island north serve to show that marginal-marine influence increases northwards. This trend continues 10 km northwards to Pierre River, where laterally equivalent estuary deposits are preserved.