Transgressive Sandstone Sedimentology of the Albian Martin House Formation, Peel Region, Northwest Territories*

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Abstract

In the Peel Region of NWT, the 10-50 meter thick Martin House Formation records Albian transgression of the Western Interior Seaway. Martin House Formation comprises up to three sandstone units separated by intervals of offshore mudstone. The 5-10 m thick basal sandstone records a transgressive facies succession from upper to lower shoreface sandstones overlain by offshore mudstone. A proposed depositional model for the lower sandstone consists of wave-dominated barrier bar deposits in the west and restricted, tide-influenced deposits in the east. Upper Martin House Formation sandstone units record shoreface progradation from east to west. The uppermost sandstone is overlain by an up to 1 km thickness of Arctic Red Formation offshore mudstone. Within the Martin House Formation reservoir properties are more favourable in eastern, marginal marine sandstones (>15% porosity; >50 mD permeability).

Introduction

This work is an output of the project entitled "Regional Geoscience Studies and Petroleum Potential, Peel Plateau and Plain". A partnership of Northwest Territories Geoscience Office, Yukon Geological Survey, and the Geological Survey of Canada (e.g. Pyle et al. 2006), one of the project objectives is to better understand the sedimentology and stratigraphy of the Cretaceous succession within the Peel Plateau and Plain (Peel Region; e.g. Hadlari, 2006). To this end, we expand on a preliminary report of Martin House Formation sedimentology (Hadlari and Zantvoort, 2007).

Martin House Formation of Peel Region is a marine sandstone at the base of the Cretaceous succession. It is 10-50 m thick and unconformably overlies mudstones, siltstones, and sandstones of the Late Devonian Imperial Formation. Correlative units elsewhere in western Canada are the Chinkeh Formation in the Liard Basin and the Bluesky Formation in Alberta and British Columbia.

Sedimentology

At the Mackenzie Mountain front west of Norman Wells (Figure 1 and Figure 2), Martin House Formation comprises up to three distinct sandstone units separated by offshore mudstone. The basal sandstone unit is up to 15 m thick, regionally widespread, and locally overlies the sub-Cretaceous unconformity. The lower part of the basal sandstone consists of cross-stratified, bioturbated sandstone containing traces *Diplocraterion*, *Skolithos*, and *Thalassinoides* that compose the *Skolithos* ichnofacies. These upper shoreface deposits are succeeded by lower shoreface sandstone containing hummocky cross-stratification that gradationally pass upward into offshore mudstone.

In western sections of the basal sandstone (Figure 3), the upper shoreface facies are composed almost entirely of intensely bioturbated sandstone that we interpret as being deposited in a wave-dominated setting, possibly a barrier bar. In the east, such as at Imperial River, traces are similar but the lower part of the basal sandstone contains intervals of interlaminated sandstone and mudstone. In addition, trough cross-stratified channel sandstones up to 1.5 m thick incise the strongly bioturbated sandstone and mudstone. The increasing proportion of mudstone to east and the occurrence of channel sandstone is considered to record a more restricted, possibly estuarine, setting.

In the subsurface east of Norman Wells the basal sandstone of the Martin House Formation has yielded good porosity (> 15%) and permeability (>100 mD) values. From outcrop samples, porosity and permeability values are relatively low in western sections, such as Arctic Red River, due to the presence of intergranular cement. From Imperial River, strongly bioturbated sandstone has 22% porosity and 58 mD permeability, and non-bioturbated channel sandstone has 16% porosity and 96 mD permeability.

Upper sandstones of Martin House Formation record shoreface progradation. They are composed of upward-coarsening successions of offshore mudstone, lower and middle shoreface hummocky cross-stratified sandstone and upper shoreface swaley cross-stratified sandstone. Upper sandstone units shale-out to the west, indicating a basinward facies transition that can also be seen in well logs.

Conclusions

During deposition of Martin House Formation, there was a landward facies transition eastward from Flyaway Creek to Imperial River. The basal sandstone records a transgressive facies succession, with wave-dominated deposits in the west and tide-influenced marginal marine, possibly estuarine, deposits in the east. The marginal marine deposits have the best reservoir properties of Martin House Formation sandstones that have been analysed. In the upper part of the Martin House Formation, sandstones record shoreface progradation from east to west within an overall transgressive succession that culminated in thick offshore mudstone deposits of the Arctic Red Formation.

Acknowledgements

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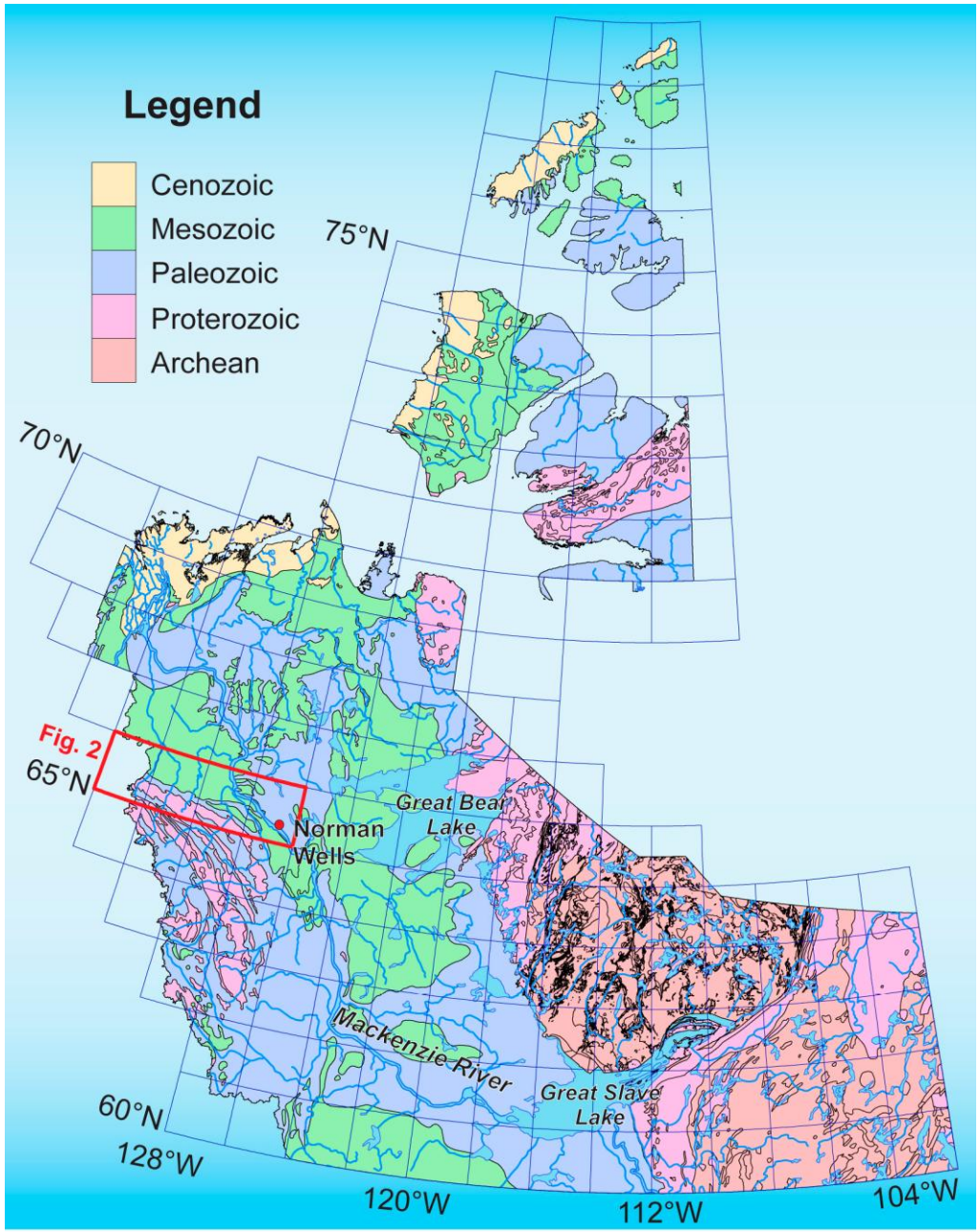

Figure 1. Geology of the NWT showing location of Peel project study area.

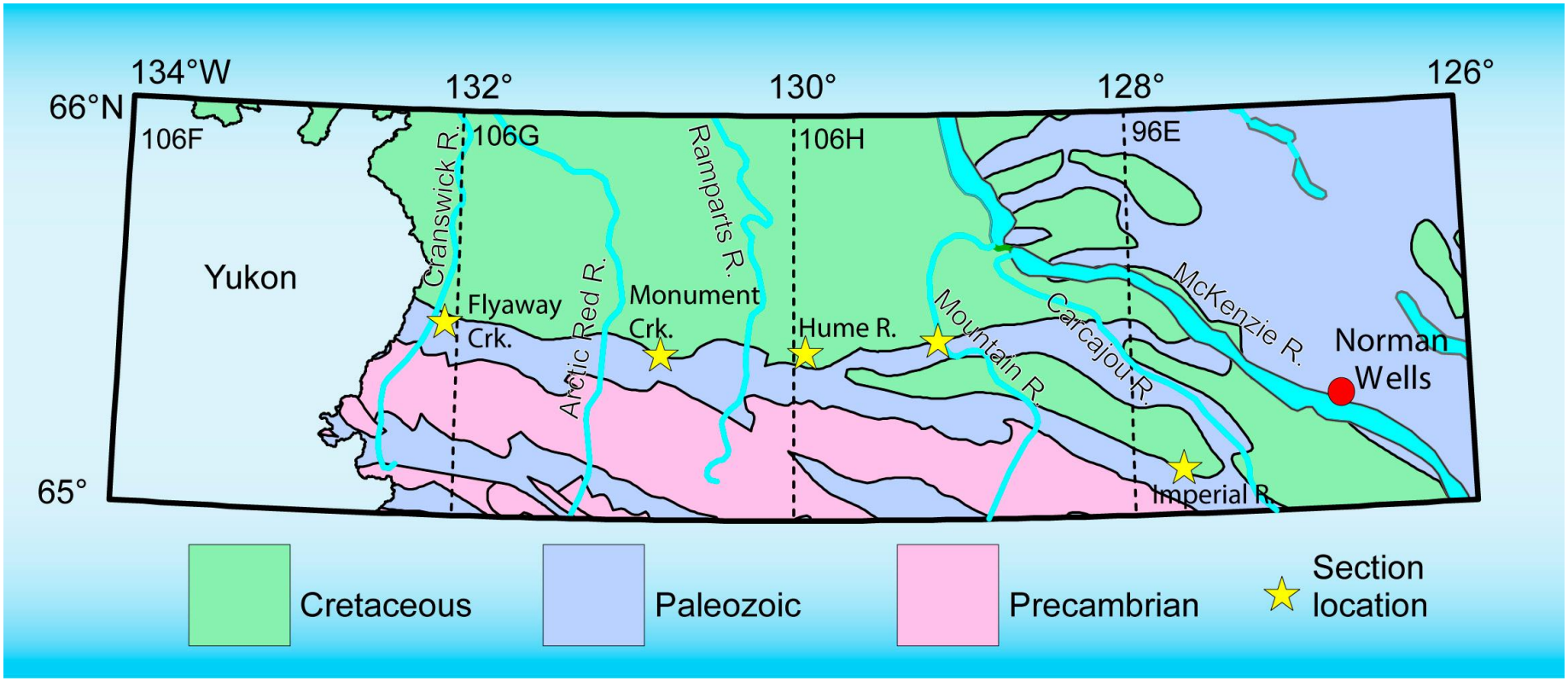

Figure 2. Study area showing location of measured sections.

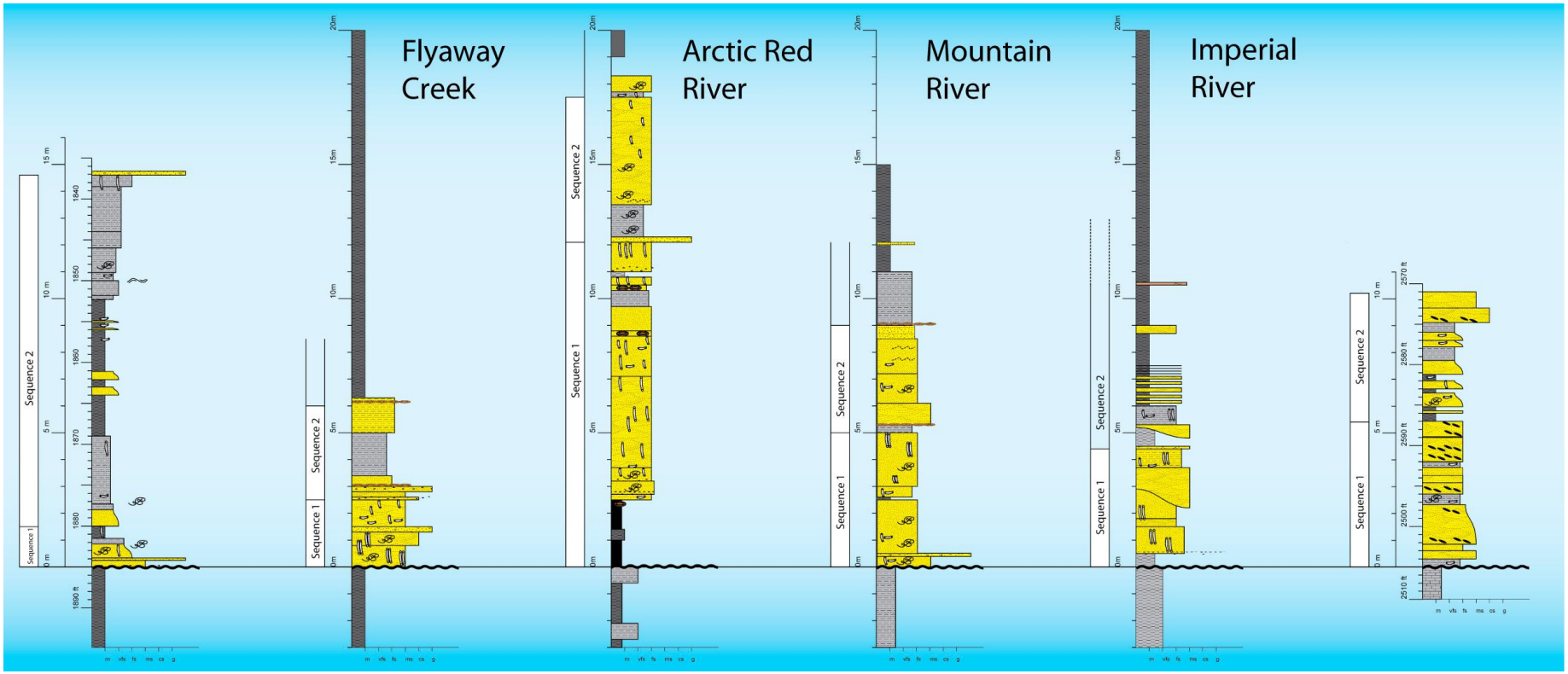

Figure 3. Summary of measured sections.