



## **Anatomy of a Transgressive Sandstone: Sequence Stratigraphy of the Martin House and Lower Arctic Red Formations (Albian), Peel Plateau and Plain, NWT**

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### **Summary**

Martin House and lower Arctic Red formations are sub-divided into 6 depositional sequences. Fluvial and floodplain facies of sequence 1 were deposited in a paleovalley recording a pre-existing basin geometry with drainage directed northward. Offshore marine deposits of sequence 2 were deposited in the far western part of the study area indicating that a new geometry had been established with the basin deepening westward and probably northward. From west to east sequence 3 records offshore, barrier bar, lagoon, and tidal flat deposition during relative sea level fall. The Keele Arch probably had an exposed shoreline. The base of sequence 4 is a regional ravinement surface overlain by a transgressive-regressive succession. At the base of sequence 4 the transition to offshore facies marks the base of the Arctic Red Formation in most areas. In eastern areas proximal to the Keele Arch the highstand systems tract of sequence 4 is represented by an offshore to prograding shoreface succession. Sequences 5 and 6 are generally progradational and shale westward.

### **Introduction**

This work presents a sequence stratigraphic analysis of the Albian Martin House and lower Arctic Red formations based on drill core, well logs, and measured sections from outcrop. Fieldwork was undertaken west of Norman Wells (Fig. 1) as part of an NGTO-YGS-GSC project entitled: “Regional Geoscience Studies and Petroleum Potential, Peel Plateau and Plain, Northwest Territories and Yukon” (Peel Project). The material covered here will be included in a project compilation published by NTGO.

Cretaceous rocks in Peel Plateau and Plain regions have previously been sub-divided into Martin House, Arctic Red, and Trevor formations (Mountjoy and Chamney, 1969; Yorath and Cook, 1981). The work of Dixon (1999) is the most comprehensive reference for the Cretaceous of the northern Mackenzie Valley. Based on new biostratigraphic analysis, Thomson et al. (2008) sub-divided the Cretaceous succession into Albian-aged Martin House and Arctic Red formations, and Cenomanian-Turonian-aged Slater River and Trevor formations. Preliminary Peel Project results regarding sedimentology of the Martin House Formation have been reported by Hadlari and Zantvoort (2007).

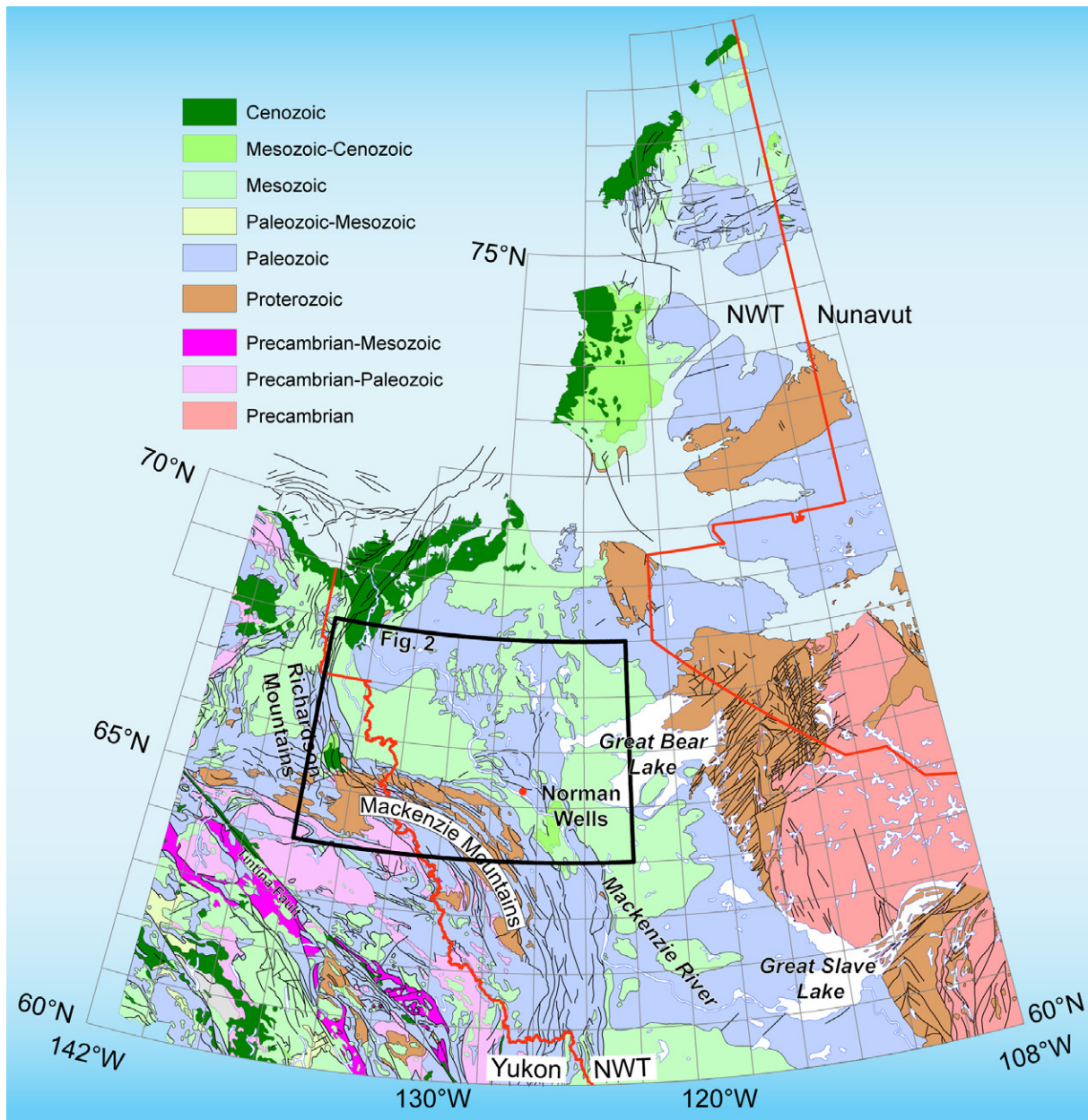


Figure 1: Location map showing Yukon – NWT geology and outline of study area. The Peel Plateau and Plain region is north of the Mackenzie Mountains and west of Norman Wells.

## Stratigraphy

An informal non-marine unit of Martin House Formation, sometimes referred to as Gilmore Lake member, will herein be referred to as Tukweye member. Distribution of Tukweye member is restricted to an approximately north-trending corridor.

The “Basal Sandstone” is an informal lithostratigraphic sub-unit of Martin House Formation comprising a sandstone-dominated interval overlying the sub-Cretaceous unconformity. Locally it composes the entire Martin House Formation, but generally there are other sandstone intervals separated from the Basal Sandstone by mudstone. It is generally less than 10 m thick, but there are two areas west of the Keele Arch

where it exceeds 10 m in thickness, a pattern which is suggestive of a barrier bar and lagoonal or estuarine system. Martin House Formation was not deposited on the Keele Arch, which was a paleohigh.

A lithostratigraphic section is useful for illustrating the distribution of the Basal Sandstone as a potential reservoir. A sequence stratigraphic correlation better illustrates the depositional history; Martin House and lower Arctic Red formations are sub-divided into 6 depositional sequences (Fig. 2).

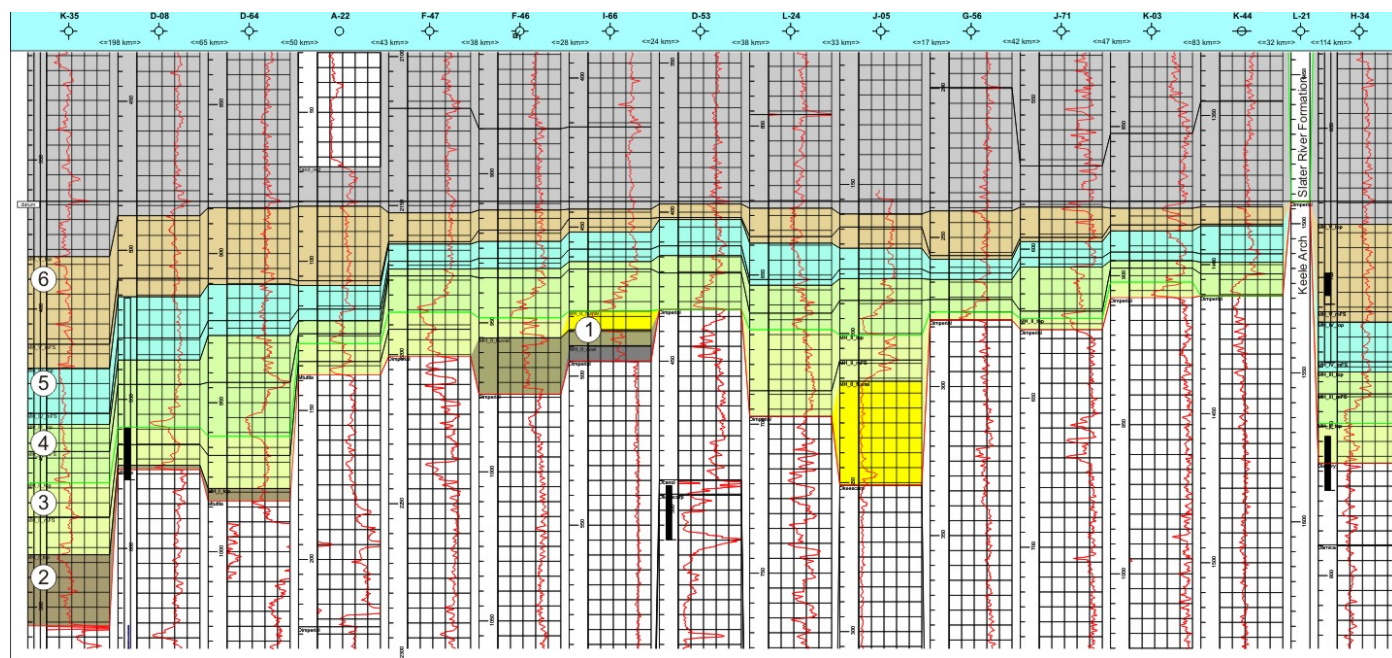


Figure 2: Location map showing Yukon – NWT geology and outline of study area. The Peel Plateau and Plain region is north of the Mackenzie Mountains and west of Norman Wells.

Sequence 1 correlates with non-marine deposits of the Tukweye member. It is restricted to a north-trending corridor representing a paleovalley. This trend preserves the drainage pattern at the very start of base level rise.

Sequence 2 consists of offshore deposits only present in the far western part of the study area. This distribution marks the onset of the new geometry of a westward-deepening basin that continued through the Albian.

Sequence 3 is present across most of the study area. In character it is transgressive-regressive in basinward areas and regressive in eastern areas proximal to the Keele Arch. In most locations it represents the base of the Martin House Formation and a large portion of the Basal Sandstone.

Sequence 4 has a regionally extensive ravinement surface at its base and can be consistently picked on well logs. In all areas the base is an upward-fining transgressive succession from lower shoreface to offshore. It may represent the top of the Basal Sandstone, and the base of offshore mudstone is generally the base of the Arctic Red Formation. In areas proximal to the Keele Arch the top of sequence 4 is a prograding shoreface succession.

Sequence 5 is a shale-dominant upward-coarsening succession that increases in thickness westward. In areas proximal to the Keele Arch there is shoreface sandstone at the top that shales out basinward (westward).

Sequence 6 is based on well logs picks, thickens westward, and is interpreted to be a progradational succession similar to sequence 5.

### Examples

Sequence 1 at well I-66 is a succession of floodplain and fluvial deposits. Root traces and coal laminae are common within the interstratified sandstone and mudstone of the floodplain facies. The ravinement surface at the base of sequence 4 is represented by a pebble lag. The lower portion of sequence 4 is an upward-fining succession of bioturbated storm deposits; a diverse suite of traces is present.

At well D-08 a very thin interval of Sequence 2 is preserved, it is transgressive from a basal lag to offshore mudstone. A *Glossifungites* surface comprising *Thalassinoides* and *Diplocraterion* marks the base of sequence 3. Bioturbated sandstone passes upward to offshore mudstone; this transgressive succession is not recorded in more proximal areas. The upper part of sequence 3 is upward-coarsening, as distal storm deposits of cross-laminated sandstone increase in abundance. The base of sequence 4 is complex. Near the top of sequence 3 a *Glossifungites* surface penetrates underlying strata and is overlain by a pebble conglomerate interpreted as a transgressive lag. The *Glossifungites* surface is picked as the base of sequence 4. The lower part of sequence 4 consists of bioturbated sandstone and the gamma ray log indicates that the succession is upward-fining.

### Conclusions

Martin House and lower Arctic Red formations are sub-divided into 6 depositional sequences. Terrestrial deposits of sequence 1 record the pre-existing basin geometry with drainage directed northward. By sequence 2 a new geometry had been established with the basin deepening westward and probably northward. From west to east sequence 3 records offshore, barrier bar, lagoon, and tidal flat deposition during relative sea level fall. The Keele Arch probably had an exposed shoreline. The base of sequence 4 is a regional ravinement surface overlain by a transgressive-regressive succession. Sequences 5 and 6 are generally progradational and shale westward.

### Acknowledgements

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