

# Stratigraphy and Sedimentology of the Tukweye Member of the Martin House Formation, Mackenzie Corridor, Northwest Territories

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## Introduction

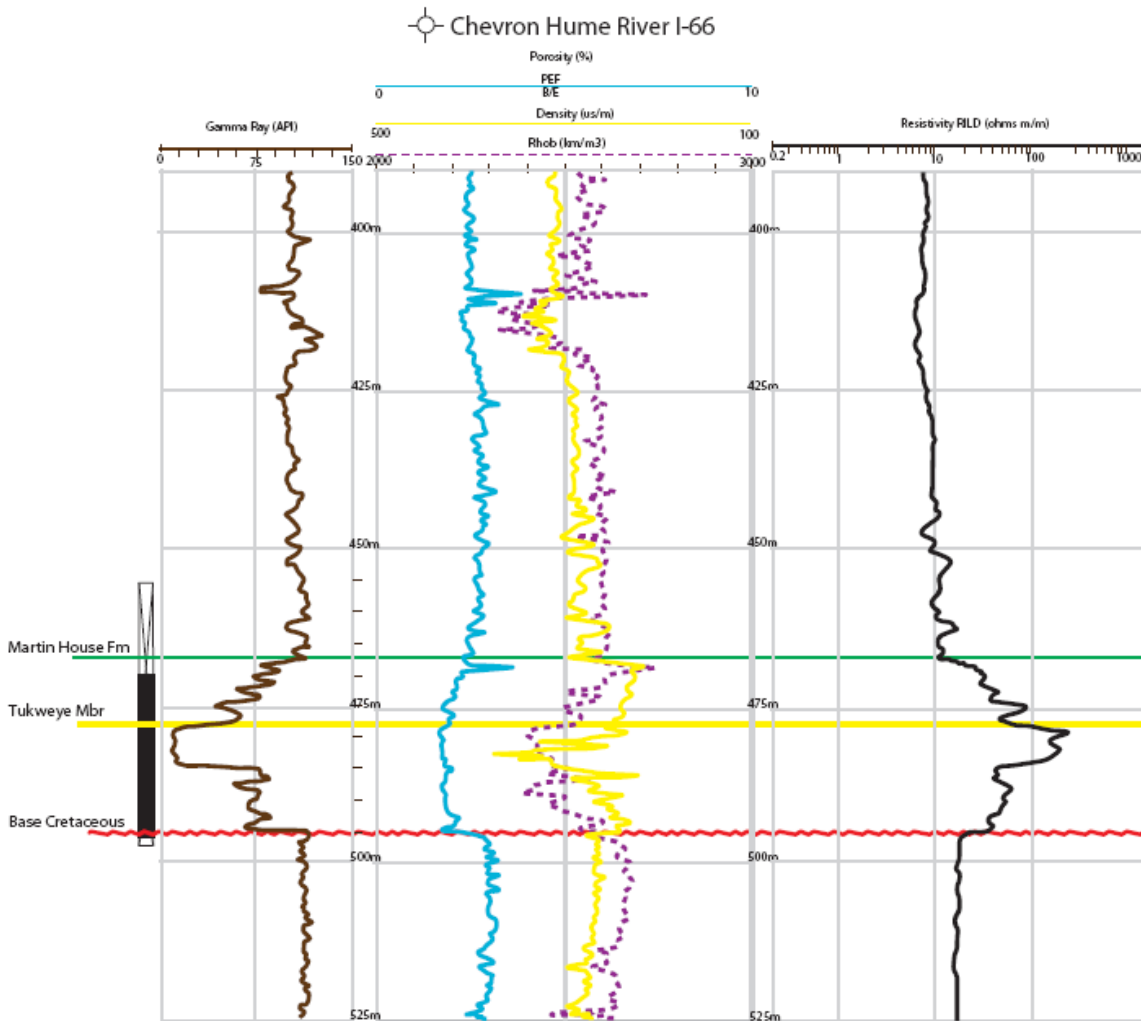
The Lower Cretaceous Martin House Formation in the Mackenzie Corridor represents a potential hydrocarbon exploration target in mainland arctic Canada. Reservoir quality of the sandstones may reflect changes observed in paleoenvironments. As part of a multidisciplinary study, eleven cores intersecting Lower Cretaceous strata (Figure 1) were analyzed for lithology, sedimentary structures, and ichnological characteristics. Thin sections from each core were analyzed using the Gazzi-Dickinson point-counting method. Palynology samples were evaluated by Geological Survey of Canada scientists (White, J. 2009; 2010).



Figure 1 Map of the study area showing eleven cores (yellow circles), six measured outcrop sections (pink triangles), Norman Wells town (yellow house), Tulita community (yellow house). The Keele Arch (green line) is a reactivated fault structure, interpreted as a topographic high during the deposition of the Martin House Formation. The Cap Fault (purple line) was reactivated several times prior to the Cretaceous to form the Mahoney Arch. The base map is modified from the Department of Natural Resources Canada (2010).

## Stratigraphy

A terrestrial facies, with coal and rooted floodplain deposits and/or fluvial channels, identified in cores and in wire-line logs defines the Tukweye member of the Martin House Formation (Hadlari, 2009). Transitioning laterally and vertically into the marine facies of the Martin House Formation, the Tukweye member is the oldest Cretaceous strata identified; it was dated Aptian to Lower Albian (White, 2010). The marine facies of the Martin House Formation are suggested as Lower Albian to Middle Albian (Thomson et al., 2008; White, 2010).



**Figure 2** Wireline logs from well Chevron Hume River I-66. This is the most complete set of cores in the study area. From left to right are shown the gamma ray, porosity logs and resistivity logs. The black box indicates the depths of the core boxes displayed. The red undulating line shows the unconformable contact between the Devonian Imperial River Formation shales with the overlying terrestrial sandstones and coals of the Tukweye Member. The yellow line shows the contact between the Tukweye Member and the overlying bioturbated marine sandstone of the Martin House Formation. The green line marks the conformable contact between the Martin House Formation and the Arctic Red Formation marine shale units.

## Results

Cores are grouped into three geographic regions: western Peel Plateau/Plains area, Mackenzie Plain area and Great Bear Basin area. From the western Peel Plateau and Plains area, the most westerly core from the Sainville D-08 well is characterized by a transgressive vertical succession from lower shoreface to offshore marine facies. Other westerly cores (I66, N58, N10) have terrestrial signatures with rooted sandstones, coals and incised channel deposits directly overlying Paleozoic strata; these are interpreted as Tukweye strata. Cores from well Chevron Hume River I-66 show the stratigraphy from the Devonian to the Tukweye Member to the marine Martin House Formation to the Arctic Red Formation (Figures 2 & 3 & 4). Martin House Formation bioturbated marine sandstones overlie the Tukweye strata and are conformably overlain by Arctic Red Formation siltstone and shale beds. Martin House Formation sandstones in the Peel Region and Mackenzie Plain dominantly comprise glauconitic monocrystalline quartz.

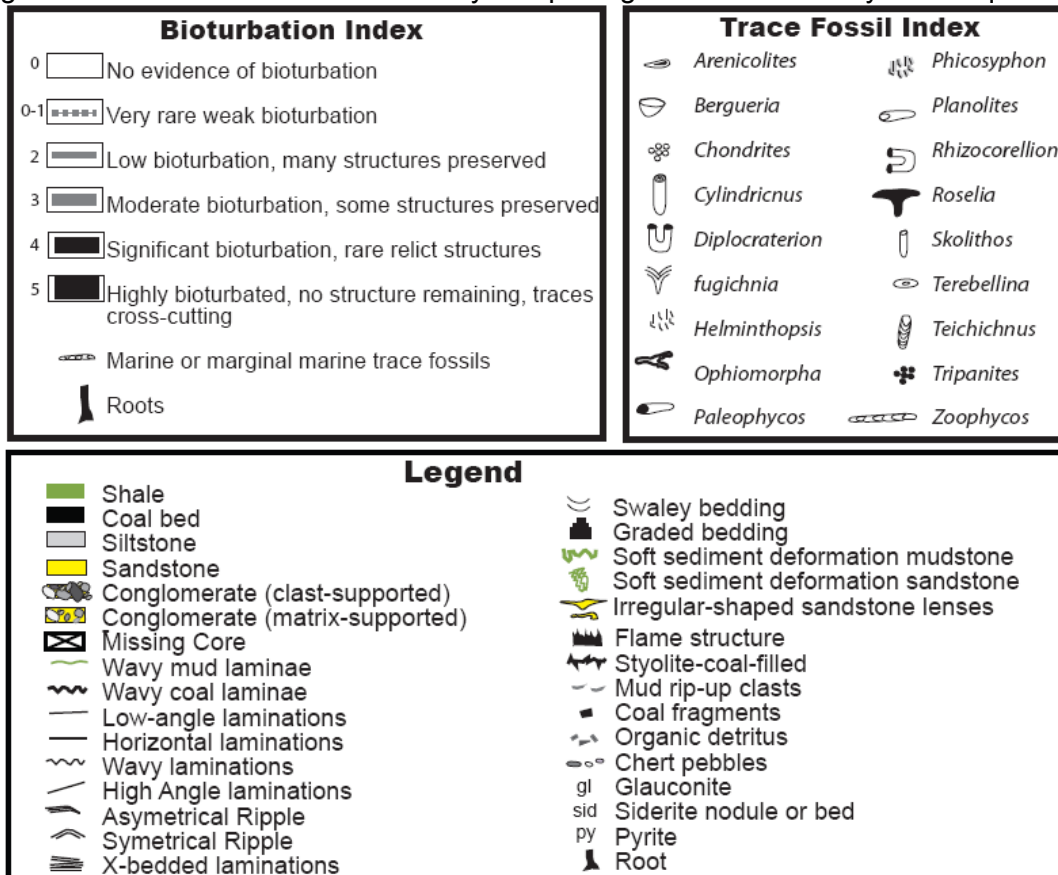


Figure 3a (above) Legend, bioturbation index and trace fossil index for Chevron Hume River I-66 lithologies. Bioturbation intensity is indicated to the right of each litholog with a thicker line for higher intensity bioturbation, or the absence of a line for none. The appropriate symbol is situated to the left of the bioturbation intensity line, with a root for bioturbation related to non-marine environments and the *Zoophycos* symbol for marine, or marginal marine bioturbation.

Figure 3b (below) Lithologs depicting Chevron Hume River I-66 cores 1, 2 and 3. The red line indicates the unconformable contact with the Devonian Imperial River shales. The yellow line indicates the flooding surface contact between the Tukweye Member and the overlying Martin House Formation marine facies. Note the numerous vertical traces overlying the conglomerate at the upper Tukweye Member contact. This is interpreted as a *Glossifungites* surface. Within the Tukweye Member all bioturbation is related to roots. There is a high amount of coaly detritus and a few thin coal beds. At other locations the Tukweye Member coal beds may be up to several meters thick.

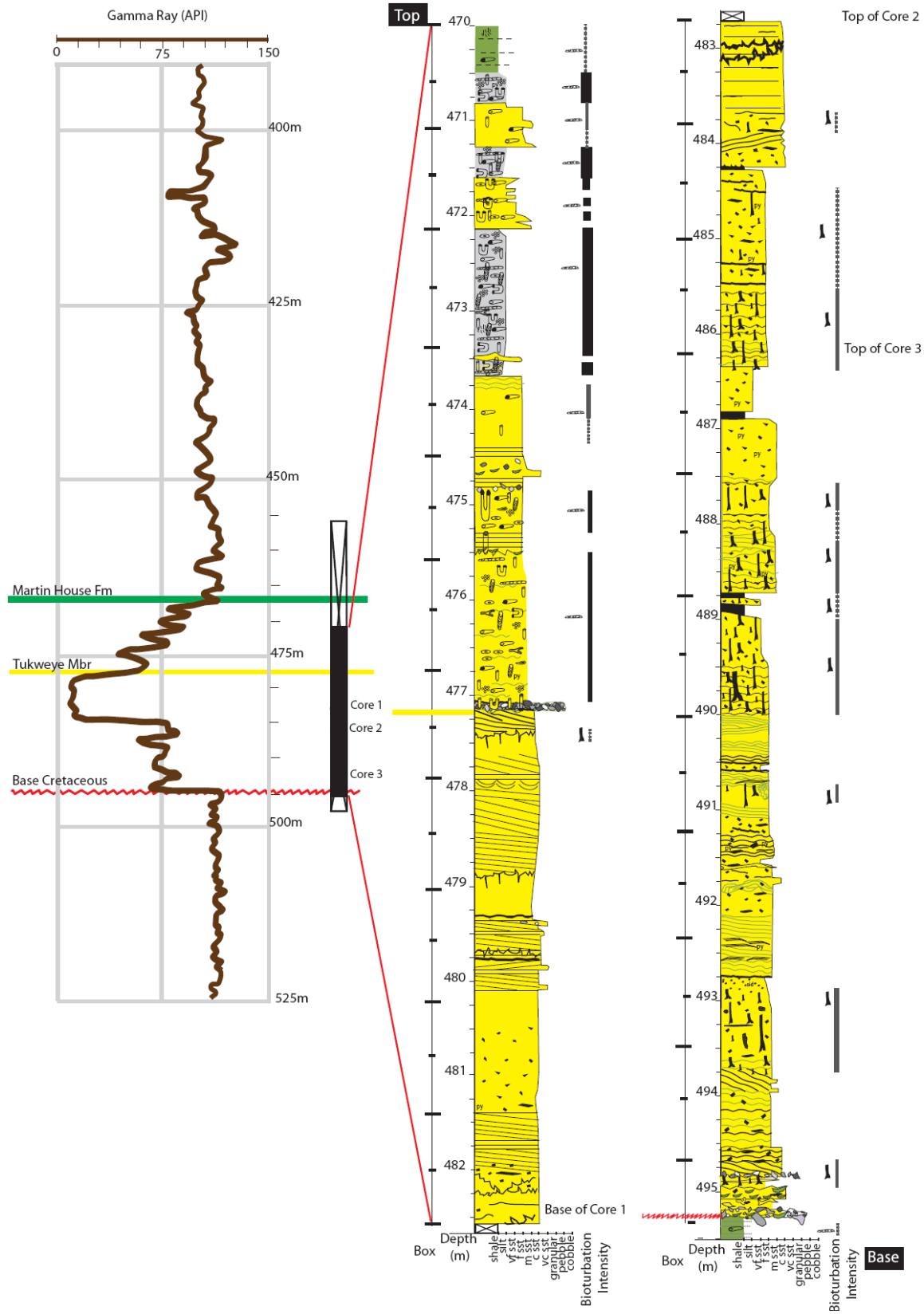
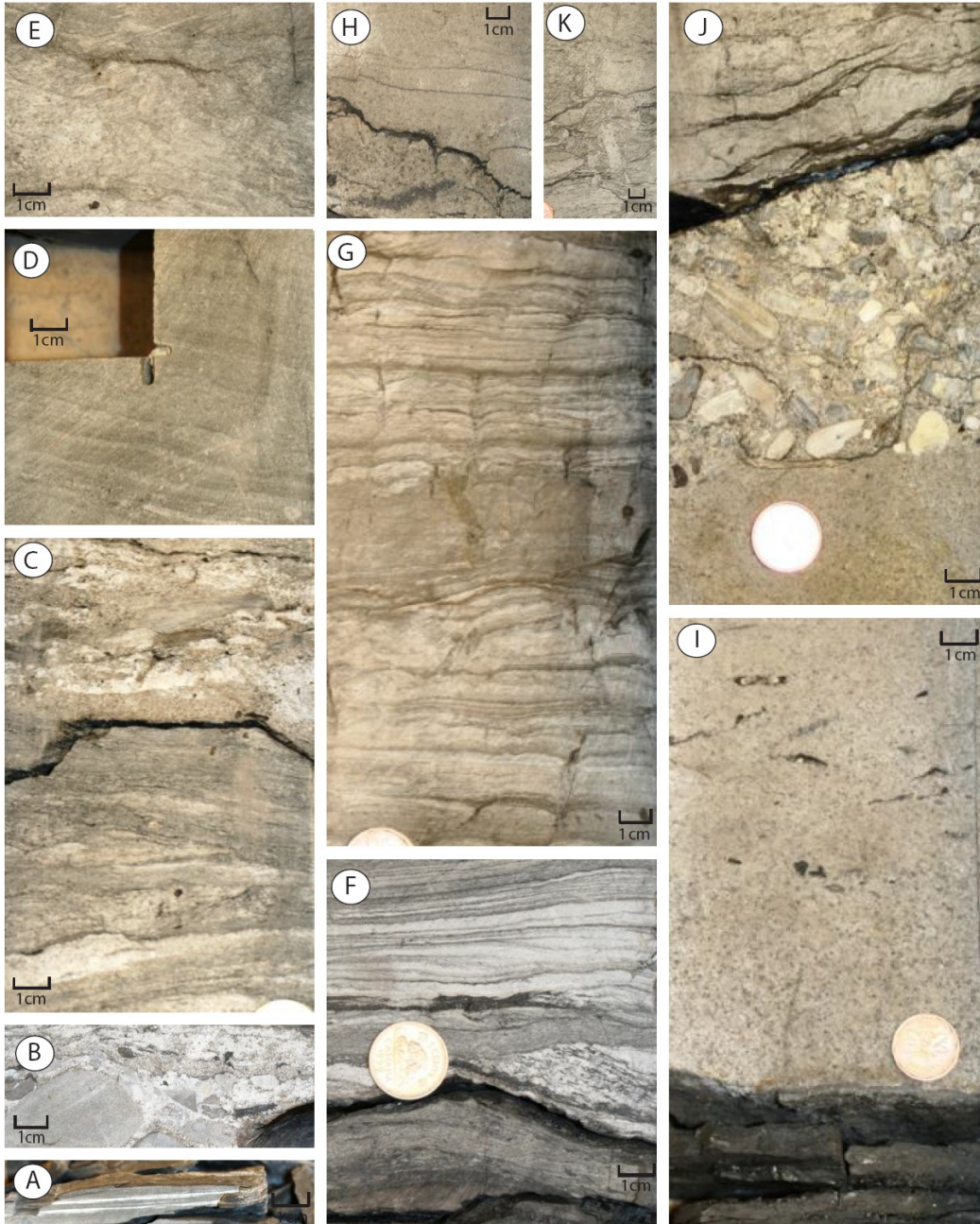


Figure 3b Litholog of Chevron Hume River I66 Well cores 1, 2 and 3.



**Figure 4** Photos of relevant facies within the 166 well. Photos are lettered with A as the deepest and K as the shallowest point. A) Devonian Imperial Shale Formation with fissile, dark shale becoming siltier with thin very fine grained sandstone lenses and very rare trace fossils near the Cretaceous contact. B) Conglomerate bed formed from chert pebbles and large mud rip-up clasts. C) Facies near the base of the Tukweye Member have mud rip-up clasts, rare scattered pebbles, high organic detritus, with a mottled texture or low-angle to planar bedding. D) High angle bedding with high organics and coaly detritus has roots bioturbating from above. E) Mottled sandstone with roots and high amounts of organic detritus. F) Coaly beds forming planar to low angle bedding; rare roots disturb the sediment from the overlying beds. G) Planar bedding disturbed by roots. H) Coal laminae form stylonite-like structures in the coarser grained sandstone beds. I) Thin coal beds interbedded with planar to high-angle coarse grained sandstone and coaly fragments are interpreted as a fluvial deposit. J) Upper contact of the high-angle coarse grained fluvial deposits of the Tukweye Member with the poorly sorted chert pebble conglomerate bed of the Martin House Formation. The sand-filled vertical traces extending downwards into the poorly sorted chert pebble conglomerate suggest a *Glossifungites* surface.

Central Mackenzie Plain cores, E30 and C21, are interpreted as fluvial facies associated with the Tukweye member. Petrography suggests a cherty monocrystalline quartz sandstone. Cores from Great Bear Basin (N30 H34, K76, M04 G22) contain facies of pro-deltaic, deltaic, tidal, fluvial, and low-energy marine depositional settings. Great Bear Basin sandstones are dominated by chert and polycrystalline rock fragments. A thin (8-70 cm) matrix-supported chert pebble conglomerate bed, interpreted as a transgressive lag, is present in some cores at the base of the Tukweye member and/or at the base of the Martin House Formation.

## Conclusions

The range of lithofacies and stratigraphic relationships mapped across the Mackenzie Corridor study area show complicated vertical and lateral variation within the Martin House Formation. The sub-Cretaceous unconformity may underlie the marine facies of the Martin House Formation, or the terrestrial facies of the Tukweye member. We conclude that several diachronous transgressive shorelines were present during the deposition of the Martin House Formation.

## Acknowledgements

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