Sedimentology and Stratigraphy from the Mixed Siliciclastic-Carbonate, Upper Devonian Imperial Formation, Northwest Territories

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Abstract

A 361 m thick succession of the Upper Devonian Imperial Formation in the Mackenzie Corridor, Northwest Territories, Canada (Fig. 1), comprises 40 upward-coarsening cycles, 3-15 m thick. The formation is a potential conventional reservoir and unconventional gas target in the subsurface within 10 km of the studied outcrop.

Shoreline trajectory analysis provides insight into the depositional evolution of ancient basin margins. The upward-coarsening cycles, or parasequences, are arranged into a series of multiple parasequence sets; variations in gross parasequence thickness, sandstone:siltstone ratio, and facies are utilized to deduce shoreline trajectories. The majority of parasequences are capped with hummocky cross-stratified sandstone and the consistency in their character suggests that aggradation was dominant. It is hoped that shoreline trajectory interpretations from the outcrop exposure can be used to predict stratal packaging in the prospective reservoir region (Fig. 2).

Despite the overall aggradational nature of the depositional system, the lower 17-18 parasequences comprise 4 subtly progradational parasequence sets, inferred to be characterized by rising shoreline trajectories. Each parasequence set shows an upwards increase in gross parasequence thickness, grain-size, and proportion of proximal, sandy facies. The upper 18-19 parasequences form retrogradational parasequence sets, with successive parasequences characterized by a gradual decrease in gross thickness and proportion of sandy lithofacies. These cycles are interpreted to record an overall, back-stepping of shorelines through the depositional evolution.

In general fossil debris beds occur in the uppermost portions of parasequences. The top of the 18th parasequence is characterized by unique facies attributes, including trough cross-stratification and in-situ fossils (i.e., horn and tabulate corals). In-situ coral growth is interpreted to result from sediment starvation attributed to either: (1) onset of transgression; or (2) autogenically controlled sediment flux (e.g., delta lobe switching). The tops of other parasequences consist of hummocky cross-stratified sandstone beds, suggesting that parasequence 18 preserves the most proximal sandstone beds in the entire stratigraphic package; it marks the transition from progradational to retrogradational shoreline trajectory.

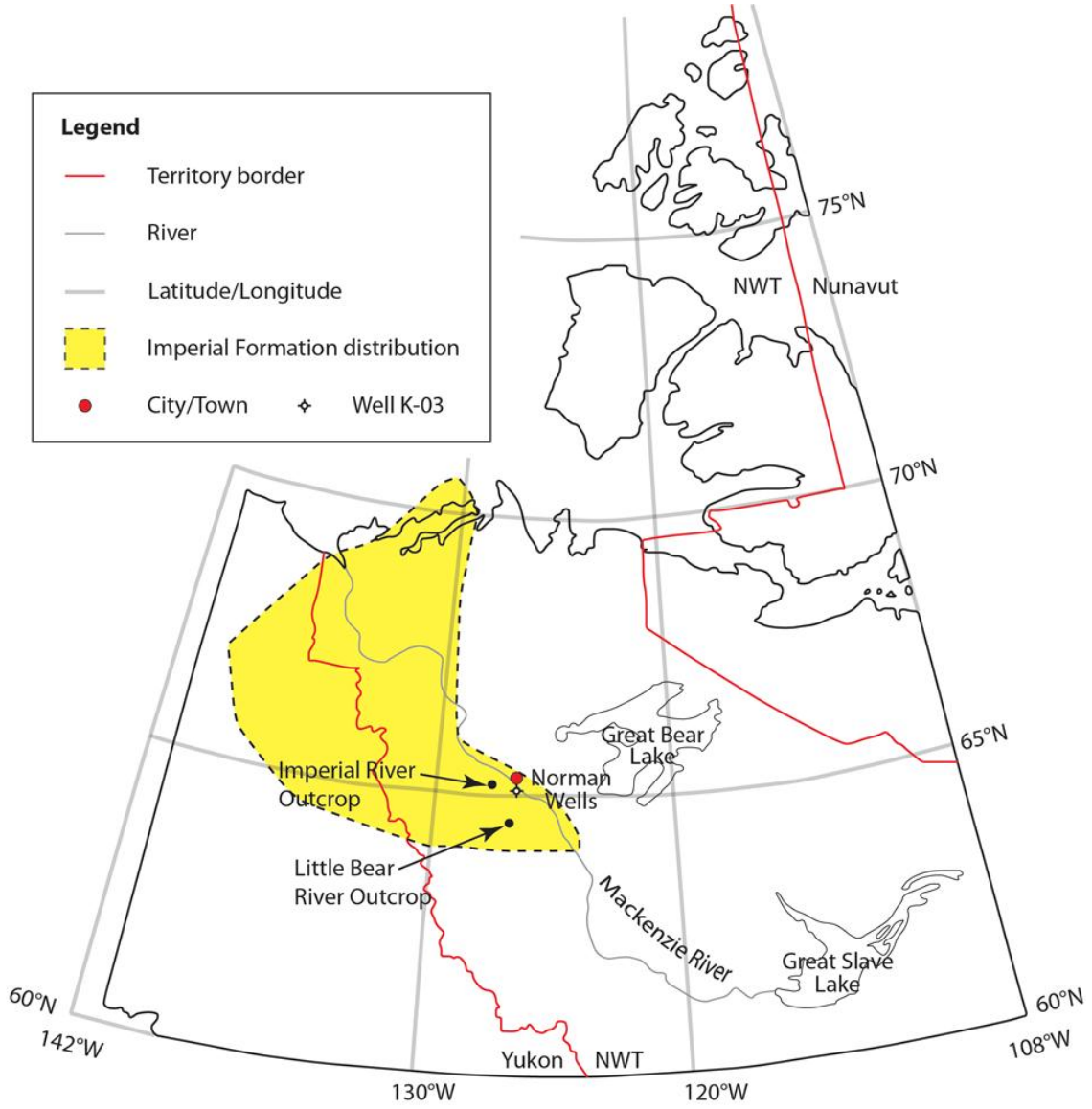

Figure 1: Study area map showing the distribution of the Imperial Formation across the Northwest Territories and Yukon. Modified from Hadlari et al. (2009).

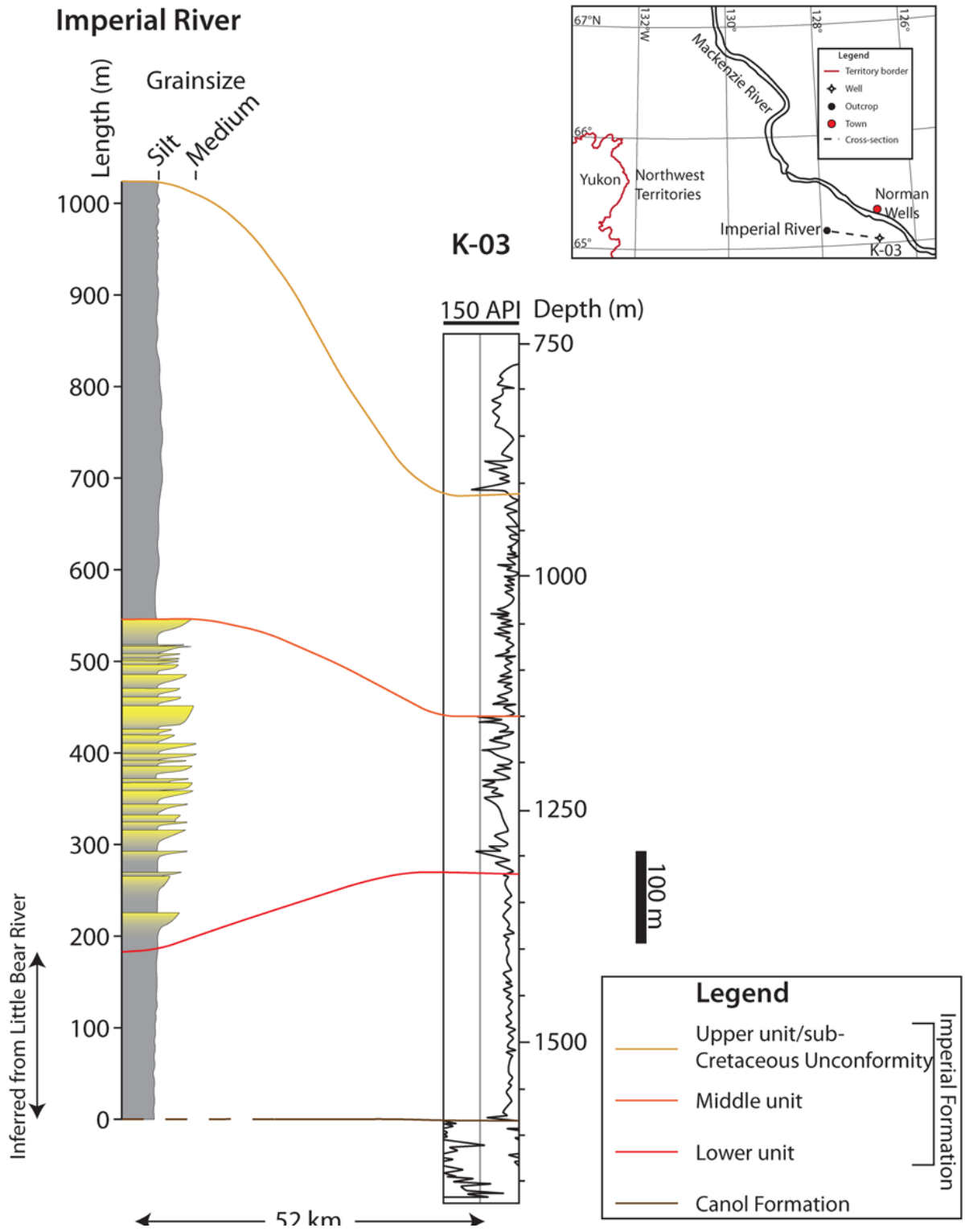

Figure 2: Regional correlation between the Imperial River outcrop and well K-03-65-10-126-45 (K-03). The dashed line at the base of the outcrop is due to uncertainty of the contact with the underlying unit.

References

Hadlari, T., Tylosky, S. A., Lemieux, Y., Zantvoort, W. G., and Catuneanu, O., 2009, Slope and submarine fan turbidite facies of the Upper Devonian Imperial Formation, Northern Mackenzie Mountains, NWT: Bulletin of Canadian Petroleum Geology, **57 (2)**, 192-208.