

Description of the Horn River Group shales from one outcrop in the southern Peel Plateau, NWT

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Summary

Organic-rich Devonian shales of the Horn River Group have been well thoroughly examined in the Mackenzie Plain, where they have excellent hydrocarbon potential, however, their thermal maturity and hydrocarbon potential has not been adequately studied in the Peel Plain and Peel Plateau areas. Well-control is sparse in these regions, and needs to be complemented with outcrop studies. To infill a significant data gap in the areal coverage of the Peel Plateau area, two outcrops were described and sampled in the summer of 2016. This poster presents preliminary results of the field work.

Introduction

The Bluefish Member of the Hare Indian Formation and the Canol Formation, both of the Middle to Upper Devonian Horn River Group, are organic-rich shales in the Mackenzie Plain (NWT). These are good to excellent source rocks for hydrocarbons, and are thermally mature over large areas. The Canol Formation has sourced the oil pool at Norman Wells, which has been in production since the 1920s. In addition, the shales may be self-sourcing unconventional reservoirs with excellent economic potential. Both stratal units are present across the Mackenzie Plain, Peel Plain and Peel Plateau areas of the Northwest Territories. Their thermal maturity and hydrocarbon potential has, however, not been adequately studied in the latter regions. To better understand the thermal maturity and hydrocarbon potential of the Bluefish and Canol shales in the Peel Plateau area, a subsurface Rock–Eval/TOC sampling program was initiated by the Northwest Territories Geological Survey (NTGS) in 2015. In the summer of 2016, two outcrops were strategically selected for field examination/sampling based on their location and accessibility to fill areal gaps in the subsurface Bluefish and Canol source rock and thermal maturity dataset for the Peel Plateau. The outcrops are termed Arctic Red River East and Flyaway Creek, based on the nearest geographical feature. At both localities the top of the underlying Hume Formation and a near-complete section of the Horn River Group are exposed.

Method

In total, 70 m of section was measured at the Arctic Red River East locality, and 52 m at Flyaway Creek. The sections were photographed and described with a focus on lithostratigraphic divisions. Shales were described based on their friability, hardness, fresh and weathering colours, odour, and any other macroscopic features observed. Siliciclastic sandstones and carbonate pack- and grainstones were additionally described with the aid of a grain size comparator. Samples for geochemical and mineralogical analysis along with spectrometer data were collected at one metre intervals.

Results

At both localities, at the base of the outcrop nodular carbonate strata of the Hume Formation are exposed. Nodules are few cm to ~15 cm in diameter, and are separated by mudstone. The limestones are locally fossiliferous, especially toward the top of the formation, where the bedding is better developed. The Hume Formation is gradationally and conformably overlain by the siliciclastic Bluefish Member of the Hare Indian Formation. This contact has previously been interpreted to be unconformable, but at the Arctic Red River East location the two formations interfinger, indicating a conformable boundary. The Bluefish Member is a few metres thick, and comprises fissile black shale with few carbonate beds and concretions in its lower half. Tentaculids, characteristic of the Bluefish Formation, are abundant and visible on bedding planes and shale partings. The upper part of the Hare Indian Formation, informally termed the Bell Creek member, is composed of friable shale up to several tens of metres thick, but is typically heavily weathered and poorly exposed at both localities. The Canol Formation is several tens of metres thick and comprises fissile, dark grey siliciclastic shale locally interbedded with carbonate and sandstone beds. Interestingly, at the Arctic Red River East location carbonate interbeds are more common, whereas at the Flyaway Creek location graded siliciclastic beds are present but rare. The top of the Canol Formation is not exposed, but observations during helicopter fly-bys at both localities indicate that it is directly overlain by the Imperial Formation. Gamma-ray readings are typically high in the Bluefish Member (>200 API), lower for the Bell Creek member (100-200 API), and variable through the Canol Formation (150 - >300 API). Rock-Eval TOC and thin-section analysis will be completed in early 2017 to complement the field dataset.

Conclusions

This study has shown that exceptional outcrops provide valuable data to fill gaps in subsurface datasets. The lateral exposure in the outcrop has allowed us to ascertain that the contact between the Hume Formation and the Bluefish Member is, at least locally, conformable and gradational, in contrast to the previously described unconformity. The results of this study will enhance the knowledge of the thermal maturity and hydrocarbon potential of Devonian shales in the Peel Plateau area, and guide future investigations in the region.