

# **Laboratory Analytical Results for Sampling of Four Wells in the Northwest Territories**

Report for SR 2018-001

Submitted: November, 2019

## Introduction

The Central Mackenzie Valley (CMV) in the Northwest Territories (NWT) has been the target of oil and gas exploration since the early 1900s, with research focus shifting toward unconventional Devonian age reservoirs in the past few decades. To date, little attention has been paid to the overlying Cretaceous strata. This well sampling program has two main objectives: (1) to aid our collaborators at the University of Alberta with our mutual study of the Horn River Group in the CMV and to gather further input data for our own modelling efforts of these strata, and (2) to gather information on previously unstudied Cretaceous strata.

Objective 1: The NTGS Petroleum Geosciences Team is currently working in collaboration with Dr. Murray Gingras from the University of Alberta and his students on a project called “Assessing reservoir quality of Middle to Upper Devonian shales of the Central Mackenzie Valley using sedimentology, ichnologic and geochemical parameters”, which is part of a larger on-going project by our NTGS team called “Shale Basin Evolution in the NWT Mainland”. Their ongoing sampling and analytical work provides valuable information on the cored intervals of these wells. However, in order to supplement their dataset, and in addition gain knowledge for input into our future basin modelling efforts and complete the main NTGS project, the wells also need to be analysed outside the cored intervals. This sampling and analytical project is targeted at the non-cored intervals of four wells (Husky Little Bear N-09 and H-64, COPRC Loon Creek O-06, and MGM East Mackay I-78; see Fig. 1 for well locations and Appendix 1 for the list of samples) in order to fill this data gap.



Figure 1: Locations of wells sampled in this study.

Objective 2: Previously Cretaceous strata in the CMV have received limited attention as potential hydrocarbon reservoirs, despite the Slater River shales having been recognized as a potential source-rock, and the overlying Little Bear formation has gas shows (Rocheleau and Fiess, 2014). Baseline data is generally lacking, and this sampling program is designed to sample Cretaceous strata in the non-cored intervals of the abovementioned four wells.

## Testing/Analysis Procedures

Well cuttings are stored at the Core and Sample Repository, Geological Survey of Canada (GSC) in Calgary, Alberta. Sampled intervals were defined and approved by OROGO for SR 2018-001. Actual samples were chosen based on available cuttings sample material and quality. Samples of 20 g were collected from the unwashed cuttings, weighed, sieved, washed, and air dried. The dried sample was picked under a stereo microscope to remove any contaminants (drilling mud, cavings, wood chips, etc.). The picked sample was divided into portions for various analyses.

The following analyses were carried out:

- 1) Source Rock Pyrolysis and total organic carbon (TOC) content with a HAWK source-rock analyser at GSC-Calgary, AB on 160 samples (analytical data are in Appendices 2 and 3).
- 2) Whole-rock geochemistry by inductively coupled plasma-mass spectroscopy (ICP-MS) at Bureau Veritas Commodities Canada Ltd. in Vancouver, BC on 160 samples (analytical data are in Appendix 4).

## Data and Interpreted Results

Preliminary interpretation of the analytical results are listed below. Full results will be disseminated in an Open Report to be published in 2020.

### Source-rock analysis and TOC

- I-78: In the Cretaceous section, TOC content is generally low (1-2 %), with the exception of the lowermost part of the Little Bear Formation, where it is up to 9.57 %. Tmax values indicate that the rocks are immature (<430 °C). In the Devonian Imperial Formation TOC content is low (< 1 – 2.7 %), and Tmax values indicate a gradual increase from immature to oil window with increasing depth (<430 – 444 °C). The Devonian Canol Formation has TOC values between 2.1 and 6.5 %, and Tmax values that indicate maturity in the oil window (~440 °C).
- O-06: In both the Martin House and Imperial Formations TOC content is low, generally < 1 % to up to 1.4%, with the exception of the deepest sample in the Imperial Formation that has a TOC content of 3.3 %. Tmax values throughout the section are indicate immaturity, with a general increasing trend downward. Some samples indicate oil window maturity.
- H-64: The top of the Imperial Formation has low TOC content (< 1 %) and maturity ranging from immature near the top trending to oil window with increasing depth. The lowermost 60 m of the Imperial formation has relatively higher TOC content (1.1 – 3.3 %), and maturity in the oil window (~ 445 °C). The underlying Canol and Hare Indian formations,

and Bluefish Member, all show relatively elevated TOC content (2.6 – 7.6 %), and Tmax values indicate maturity in the oil window (~ 450 °C).

- N-09: Both the Cretaceous and Devonian samples show generally low TOC content (<1 – 2.5 %), with the exception of the Canol Formation (up to 4.2 %). Tmax indicates rock maturity increasing with depth from immature to oil window reached in the Imperial Formation and below.

### **Whole rock geochemistry**

The lithogeochemistry results are consistent with previously sampled rocks of the same formations at other (well and outcrop) locations. The results indicate that all samples comprise siliciclastic rocks, with the exception of the samples from the Hume Formation in the H-64 and N-09 wells. The origin of the rocks (terrestrial vs. biogenic/marine) and palaeoredox conditions during deposition will be determined upon further analysis and published in the forthcoming NTGS Open Report.

### **Appendices**

1. List of samples taken and analysed; includes sample ID, well ID, coordinates, depth, and geological formation (.xlsx file).
2. Source-rock analysis results and TOC data (.xlsx file).
3. HAWK analysis report and pyrograms for each sample (.zip file).
4. Whole rock major oxide and trace element geochemistry (.xlsx file).