



**GEOLOGICAL SURVEY OF CANADA  
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boreholes from Liard Plateau, Yukon (Mount Martin map  
area NTS 095-C/01)**

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## ***INTRODUCTION***

Cuttings and core samples have been analyzed using a Rock-Eval/TOC pyrolysis apparatus over the depth intervals noted for five wells listed below from Liard Plateau, Mount Martin map area. Typically up to a 100 mg of material was available for any depth hence duplicate or repeat analyses cannot be run if an instrument failure is suspected and thus the data are presented in an unedited form and must be used with caution. Every effort is made to obtain a representative sample from the vial of cuttings, but because of the small sample size, mixed lithology samples may not be completely representative and mixed lithology intervals may yield some scatter in the data.

<i>Well name and location</i>	<i>Depth Range</i>
KOTANEELEE E-37	11200-12760'
KOTANEELEE I-48	3177-3651m
KOTANEELEE L-38	2650-2990m
BEAVER G-01	410-14421m
NORTH BEAVER RIVER I-27	3179-12529'

Depth units used (feet or metres) are those in which the original well was drilled and logged, and in which the samples are currently labelled. In this open file, no attempt has been made to review the stratigraphy.

## ***EXPERIMENTAL***

Rock-Eval/TOC analysis provides fast and reliable characterization of the quantity and quality of sedimentary organic matter, as well as its thermal maturity. While most samples were analyzed on a Rock-Eval 6 Turbo (RE 6) instrument few pyrolysis experiments were conducted using Delsi Rock-Eval II (RE II) unit equipped with a Total Organic Carbon analysis module. The operating conditions and parameters for a RE II are provided in several GSC Open File reports. Although the measured parameters are nominally the same for the two instruments, the RE 6 operating conditions are slightly different as nitrogen is used as pyrolysis gas allowing for better temperature control. A typical RE 6 experiment is initiated with heating of a pulverized rock sample at 300°C for 3 min in nitrogen atmosphere, when naturally occurring hydrocarbons (free and adsorbed) are volatilized. The oven temperature is then steadily increased to 650°C at a rate of 25°C/min and decomposition of kerogen occurs. The amount of hydrocarbons volatilized at 300°C and evolved from kerogen during the ramped heating are quantitatively determined by a flame ionization detector, and recorded as the S1 and S2 peaks, respectively. The final stage involves oxidation and combustion of the residual organic matter at 850°C. The temperature measured at the maximum of the S2 peak is referred to as  $T_{peak}$  while  $T_{max}$  is calculated by subtracting about 40°C from  $T_{peak}$  (the exact correction is determined using a manufacturer standard). The amounts of CO and CO<sub>2</sub> are quantitatively determined by infrared detectors. Additional details on the RE6 instrument are available in Behar et al. (2001).

The percentage of carbon in CO<sub>2</sub> formed during oxidation and in the hydrocarbon peaks S1 and S2 is used to define the total organic carbon content (TOC), expressed as a weight percentage. The determination of the quality of organic matter is based upon the calculation of Hydrogen (HI) and Oxygen (OI) indices ( $HI=100 \times S2/TOC$ ,  $OI=100 \times S3/TOC$ ) which are related to the atomic H/C and O/C ratios (Espitalié et al., 1977). The OI versus HI cross plots ("pseudo van Krevelen diagrams") can be used as an organic matter type indicator at low and moderate maturities. The  $T_{max}$  is an indicator of relative thermal maturity. According to Espitalié et al. (1985) the oil window is defined by the following  $T_{max}$  ranges: 440°-448°C (Type I), 430°-455°C (Type II) and 430°-470°C (Type III). A cross plot of  $T_{max}$  versus HI is used to constrain estimations of organic matter type and its thermal maturity, while the Production Index ( $PI=S1/[S1+S2]$ ) is used to indicate staining of a sample or as an additional maturity parameter.

Rock-Eval results correlate to other techniques (Espitalié et al., 1985; Tissot and Welte, 1978). Source rock potential is sensitive to lithology, TOC and S2 values. It is common practice to rate carbonate rocks with lower TOC comparable with richer clastic rocks. Extractable HC yields from leaner carbonate rocks are comparable to richer clastic rocks (Tissot and Welte, 1978, p. 430; Gehman,

1962). The organic matter associated with carbonate rocks is often more hydrogen-rich and thermally labile than that in fine-grained clastic rocks. As a result, more TOC in carbonate rocks may be transformed into bitumen compared with average clastic source rocks of comparable maturity.

Rock-Eval/TOC parameters have reliable significance only above threshold TOC, S1 and S2 values. If TOC is less than or equal to 0.3% then all parameters have questionable significance and the experiment suggests no petroleum source potential. Oxygen Index (OI) has questionable significance if TOC is less than or equal to 0.5%. Both Tmax and Production Index ( $PI = S1/(S1+S2)$ ), have questionable significance if S1 and S2 values are less than or equal to about 0.2 mg HC/g rock. Results can be affected by rock mineral composition. The mineral matrix may either retain hydrocarbon compounds, generally lowering the S1 or S2 peaks, while increasing Tmax, or liberate inorganic CO<sub>2</sub> increasing S3 and OI. These effects are important if TOC, S1 and S2 are low, an effect not significant where sources have TOC values greater than 5%. OI values greater than 150 mg/g TOC suggest either low TOC or a mineral matrix CO<sub>2</sub> contribution during pyrolysis. Generally, a TOC content of at least 2% is needed for a source rock. Note that TOC and Hydrogen Index decrease with increasing thermal maturity due to hydrocarbon generation. Additional guidelines on the interpretation of Rock-Eval data may be found in Peters (1986), Snowdon (1995) and Sykes and Snowdon (2002).

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