

Understanding the Montney Formation through Core and Non-Destructive XRF Analyses combined with High Resolution Imagery

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Properties of the Montney Formation are quite complex; however, by applying a combination of information obtained from multiple analytical techniques many of these complexities can be unraveled. Here, we employ data obtained from core observation, laboratory analyses, portable XRay Fluorescence (XRF) measurements and high resolution imagery to better understand three cores through the Montney Formation.

Portable XRF instruments allow a large amount of data to be obtained rapidly, with minimal sample preparation or drilling impact, and at low cost. Rock powders, cuttings, slabs or core faces can be analysed directly using this non-destructive technique. In this study calibrated XRF analyses provide highly precise and accurate data on the bulk chemistry of the cores. Proprietary normative mineral algorithms are applied in order to convert the elemental chemical data to mineralogy. Mineral abundances determined from the XRF analyses correlate well with those obtained by X-Ray Diffraction, thin section point counting and SEM analyses. SEM elemental mapping provides detail into how different minerals are present within the Formation and how they effect rock properties. Mineralogy in the Montney Formation is variable and the most abundant minerals are calcite, dolomite, quartz, feldspar and illite. Minor amounts of phosphates, anhydrite, barite, pyrite, and TOC are also present.

Mineralogy and trace element data from XRF analyses are used to determine reservoir properties through a set of semi-empirical equations. Porosity and mechanical properties, including Poisson's ratio and Young's modulus, are determined using XRF Solution's proprietary Specific Mineral Interaction algorithms in which phenomenological coefficients are determined through multivariate analyses of XRF data, wireline log and lab data. Formation specific algorithms developed from vertical wells can be applied to cuttings analysed from horizontal production wells, where conventional log analyses are impractical or too expensive. The information obtained is particularly valuable for geosteering purposes if conducted on site in real time or for post well completion planning. Data obtained using portable X-Ray Fluorescence instruments provide a cost-effective means for optimization of both completions and production from horizontal wells.

High resolution core imagery provides a detailed view of the micron-scale rock fabric within the Montney Formation. These images can provide more detail of the fabrics present (such as grain size, sorting and shape) than are seen in visual inspection of the core. Used in conjunction with XRF data it provides a very high resolution perspective on the reservoir properties and mineralogy of a core.

Application of these techniques to the three Montney Formation cores allow us to subdivide them into several chemical stratigraphic units that are not readily seen in core or through wireline log analyses. The chemical stratigraphic units are based on correlation of both major and trace element composition among the cores. Mineralogy variations across and within these units point to variation in the deposition of sediments and toward a better understanding of changes in depositional processes involving detrital framework grains, clay minerals and carbonates. Changes in environmental conditions, particularly oxidation and reduction, can also be placed in context. Finally, variation in reservoir properties, including porosity and mechanical properties, are also seen to follow the chemical stratigraphic architecture, mineralogy and appear to be a result of variation in the depositional processes and environment.