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From Core to Cuttings: XRF-Guided Geosteering in the Viking

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ABSTRACT

Accurate well placement in the Viking Formation of Central Alberta is challenging due to a thin target window, variable lithology, and ambiguous gamma-ray (GR) responses between bounding units, including the overlying Westgate Shale and underlying Joli Fou Shale. These factors introduce significant uncertainty in stratigraphic positioning and increase the risk of operational inefficiencies such as sidetracks, screenouts, and target-zone exits.

To address these challenges, X-ray fluorescence (XRF) geochemical data was first collected from core to establish a detailed reservoir framework, with emphasis on identifying stratigraphic continuity and unique elemental signatures within internally defined lithological units. Rapid, non-destructive analysis (~60 seconds per sample) provided high-resolution elemental data, which was calibrated into formation-specific mineralogical and reservoir property models. Outputs included quantitative mineralogy (framework grains, clays, and carbonates), as well as derived reservoir properties such as porosity, permeability, and geomechanical indicators.

Using this calibrated dataset, five distinct stratigraphic units within the Viking interval were defined based on diagnostic geochemical signatures, including the Westgate Shale, Upper Bioturbated Sand, Main Sand, Transitional Unit, and Joli Fou Shale. Key elemental indicators (e.g., Zr, Cu) and mineralogical trends enabled reliable differentiation between units, even where conventional logs exhibited overlap or ambiguity. A color-coded TVD profile was developed to provide intuitive stratigraphic positioning along the wellbore.

Following model development, an offset horizontal well was analyzed to validate the stratigraphic framework and assess its reliability away from core control. Results demonstrated strong consistency between predicted and observed stratigraphy, confirming the robustness of the XRF-based correlations.

The workflow was subsequently deployed during real-time geosteering, where XRF-derived stratigraphic constraints provided critical decision support in situations where conventional logs were ambiguous or misleading. In one case, unanticipated structural variation resulted in divergence from the predicted stratigraphic model; XRF data enabled rapid recognition of the deviation and correction to maintain target-zone placement. In a second case, azimuthal gamma-ray responses suggested upward stratigraphic movement into a higher gamma unit. XRF signatures indicated the wellbore was within the lower transitional interval, providing additional information that no steering adjustments were necessary.

XRF-derived geochemistry provides a robust, high-resolution complement to conventional log-based correlation and supports more accurate geosteering in thin reservoirs such as the Viking Formation.