

## XRD Mineral Analysis

### X-Ray Diffraction (XRD)

Expert quantification of mineral composition in rock samples utilizing the Bruker D2 Phaser x-ray diffractometer (XRD) and TOPAS/EVA software is another unrivaled expertise of Premier Oilfield Laboratories. Using the phase identification capabilities of Bruker EVA software and the Rietveld mineral refinement capabilities of TOPAS, Premier provides a broad range of analytical and interpretative products for understanding reservoir mineralogy.

For instance, an assessment of brittleness index (BI) of the reservoir facies using high-quality mineral data is critical for defining geomechanical parameters. Bulk mineralogy and BI help assess the effectiveness of hydraulic fracturing, and are valid inputs for models focused on completion strategy and customized frac-stage designs.

### Two unique levels of XRD analysis are available:

**Premier QuickScan** analysis quantifies major sedimentary minerals, including total clay (with no clay speciation). *QuickScan* is suitable for large projects where timely decisions are of the essence in order to quantify major phases and evaluate semi-quantitative contributions from accessory and clay mineral phases. The *QuickScan* technique is particularly useful for screening a large set of samples to develop a smaller sample population for more detailed analysis.



Figure 1: Bruker D2 Phaser benchtop XRD.

**Premier QuantScan** analysis quantifies all mineral phases present, including clay species. This level of service is intended for projects where accuracy of analysis is paramount. Samples undergo a second round of pulverization in a McCrone micronizing mill and are side-loaded in special sample holders that reduce the preferred orientation of grains.

#### **Expandable Clay Analysis (QuantScan):**

In this analysis, the clay fraction is separated from the bulk rock using grain settling in a centrifuge. The clay fraction is then oriented on a special mount and dried in an oven. A baseline XRD scan of the clay separate is undertaken before the sample is glycolated overnight, then rescanned. The concentrations of expandable clays in the sample are quantified by comparing the shift between the baseline clay and glycolated clay XRD scans.

## Mineral Phases Quantified

- Total Clays
- Clay Species – Illite, Kaolinite, Chlorite and Smectite
- Quartz
- K-Spars (Orthoclase)
- Plagioclase
- Calcite
- Dolomite
- Pyrite
- Anhydrite
- Halite
- The washed cuttings samples are dried in an oven at 70°C for one hour.
- The dried cuttings samples are pulverized and homogenized using a centrifugal mill or mortar and pestle.
- The powder is analyzed for mineralogy by *QuickScan* or *QuantScan* techniques.

**Quality assurance and quality control:** A corundum standard is analyzed to ensure that the diffraction pattern is consistent over time.

## Standard Operating Procedures

### XRD analysis on slabbed core:

- Samples are cut/drilled from the butt-half of the core at the desired interval of analysis.
- The sample (core pieces or drilled powder) are then pulverized and homogenized using a centrifugal mill or a mortar and pestle.

### XRD analysis on drill cuttings:

- A powerful magnet is run over the drilled cuttings samples to remove metal contamination from metal drilling components.
- For a *QuickScan* analysis, cuttings are first washed in an ultrasonic bath with deionized water for 5 minutes in order to remove surface contaminants such as drilling mud. For *QuantScan*, a Dean-Stark extraction is used to clean all samples and extract oil or contaminants.

## Bruker D2 Phaser XRD Technical

### Specification:

Weight: 95 kg

Size: 24" X 24" X 28"

Detector: LYNXEYE; accuracy of 0.02 degrees two theta throughout the entire measuring range

X-Ray Tube: Co, x-rays generated at 30 kV / 10 mA

Single stage sample holder that fits 51.5 mm sample rings

Alignment: Not needed, factory aligned

Achievable Peak Width: < 0.05 degrees two theta

Instrument suitable for benchtop and mobile applications