Portable XRF technology identifies the most fracable zones of shale reservoirs

Well site geochemistry with the Thermo Scientific Niton FXL saves time, reduces drilling costs and increases production

Introduction

Shale resource plays are the most actively explored and developed hydrocarbon plays in North America. These geologically common strata could be new resources for hydrocarbons in other continents as well. Innovative technologies such as horizontal drilling and fracking have had remarkable impact in the development of shale plays.

Well site geochemistry is another technology that has been applied in some formations in North America. It has provided a tremendous amount of valuable information that can be used for precise rock identification, mineralogy and mineral modeling, chemostratigraphy, reservoir characterization (permeability, porosity, fracture population, brittleness) and productivity. Portable X-ray fluorescence (PXRF) is a technology that can provide real-time, whole-rock geochemistry at the well site.

The use of PXRF data in shale plays has advanced significantly with a wide range of applications. While x-ray diffraction (XRD) analysis is a known technique for mineral identification, PXRF is an inexpensive and much faster method that can provide similar information (Figure 1).

Although rock identification is a very common task that geologists perform during mud logging, it can be challenging when small drill cuttings of fine-grained sedimentary rocks such as shales and siltstones are examined. PXRF assists in accurate rock identification and further sub-classification of these rocks by identifying their major and trace elements.

Whole rock geochemistry has been used historically in chemostratigraphy and its application in this field is quite developed. Oil and gas production companies are also very interested in the application of PXRF in evaluating productivity and reservoir characterization, including the brittleness and fracability of strata.

Application

Thermo Scientific™ portable XRF analyzers provide real-time, on-site and whole-rock geochemical analysis from magnesium (Mg) to uranium (U). The Thermo Scientific™ Niton™ Field X-ray Lab (FXL), equipped with z-CAL, a fit-for-purpose calibration and operation methodology for light elemental analysis, is ideal for the light element and trace metal analysis required for shale applications. These portable instruments can analyze any type of samples, from drill cuttings to oil and gas cores, outcrops, and piston cored sediments.
PXRF application in fracking

Hydraulic fracturing, or fracking, is a well-stimulation technique by which a high-pressure fluid (usually chemicals and sand suspended in water) is injected into a wellbore to create cracks in the rock formations in order to facilitate flow of liquids including oil and gas.

This method does not provide a quantitative value of brittleness (as a Young’s Modulus calculation would), but it does provide a rapid indication of relative brittleness and fracability within the formation.

Method

This case study was carried out on 221 samples collected from an oil and gas well site in Southeast Asia. The prepared samples were analyzed using the Niton XL3t-Ultra with 120 seconds total analysis time (30 seconds on each filter). The formation includes a thick sedimentary unit composed of shale, sandstone, siltstone, and rare limestone.

Results

As discussed above, brittleness and ductility of the rocks are represented by Si and Al, respectively. Therefore, the Si/Al ratio (shown as SiO₂/Al₂O₃ in Figure 3) can be used as a measure of relative brittleness (i.e. the higher the ratio, the higher the brittleness). In the studied well, the maximum relative brittleness is seen in the 600-750 foot interval, suggesting that this interval would show better response to fracking.

Figure 3. Chemical log showing SiO₂/Al₂O₃ as a fracability indicator.

Figure 2. Schematic diagram showing use of PXRF in identifying fracability of shale plays.

*Particularly if biogenic quartz is present.

**Potentially increase brittleness
Conclusion
Elemental analysis using Thermo Scientific Niton portable XRF analyzers can provide a wealth of data to assist with drilling, fracking, chemostratigraphy, mineral modeling, and precise rock identification. This case study shows that the Si/Al ratio can represent relative brittleness of strata and can help to find the most brittle intervals in vertical or lateral wells that will respond positively to fracking.

Well site geochemistry using portable XRF analyzers can help producers save time, reduce drilling costs, and increase production.

To discuss your particular applications and performance requirements, or to schedule an on-site demonstration, please contact your local Thermo Scientific portable XRF analyzer representative.