Optimizing the Mineralogy of a Petroleum Reservoir by Combining Mineral and Elemental Measurements

Mahdi Ammar*, Yohann Rocher, Emilie Colombel and Jerome Breviere
Schlumberger Geoservices
E-mail: mammar4@slb.com

Drill cuttings during drilling operations provide the first and most direct measurement of the minerals present in oil and gas reservoirs. The mineralogy of drill cuttings provides a reference for validating log measurements and for developing petrophysical applications. In surface logging, the mineralogy can be determined by analyzing cuttings crushed during drilling, coming directly from the drilled formation, transported by the drilling mud to the surface.

This paper presents two different techniques to determine mineralogy from cuttings: X-ray diffraction (XRD), a commonly used technique, and diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS), which has recently emerged as a rapid and efficient technique to perform simultaneous quantitative analysis of mineralogy and organic-matter from cuttings samples. These methods consist of robust techniques for performing a quantitative analysis of mineralogy from cuttings. In addition, these techniques require minimal sample preparation and analysis, making them suitable for performing real-time measurements at the wellsite.

In this paper, the authors present a procedure to examine the consistency between mineralogy and elemental composition (using eight major elements, including Si, Ca, Al, K, Na, Mg, Fe, and S). This method converts mineral data into elemental concentration and compares the reconstructed composition to the measured elemental composition with a quality-control associated score.

The new procedure introduces a mineralogy-plus algorithm, which extends the scope of the quality-control method by combining mineralogy and elemental composition. This procedure allows for reconstructing the mineralogy and optimizing the mineral quantification accuracy. Furthermore, this technique broadens mineral analysis by enabling detection of additional minerals previously not distinguishable by XRD or DRIFTS alone.

A study was conducted with an energy-dispersive X-ray fluorescence (ED-XRF) field instrument, and proved that the field-portable XRF technique is suitable for performing both quality-control and mineralogy-plus procedures in real time at the wellsite.

An accurate mineralogy determination is important in making real-time drilling decisions and in petrophysical analysis, especially in the unconventional onshore reservoirs. The method presented here consists of a robust and rapid procedure, which enables significant enhancement of the mineral quantification accuracy at the wellsite.