Integrated Advanced Surface Analysis and Petrophysics Formation Evaluation for Enhanced Reservoir Characterization

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Abstract

Objective/Scope:
The objective of this study is to achieve an accurate and reliable reservoir characterization by the calibration of spectroscopy logging data with drilled cutting samples and core data. The laboratory measurements done on selected crushed samples are used to calibrate the concentration of the elements measured by a new geochemical logging system and validate the petrophysical interpretation. The minimized uncertainty related to environmental corrections enhances reservoir characterization.

Methodology:
To improve the understanding of the reservoirs; the integrated rock and fluid analysis are essential for characterization and prediction. The geological complexity and the heterogeneous nature of the rock require detailed lithology determination and mineralogical composition quantification for an accurate estimation of the formation fluid saturation and reservoir assessment. A better understanding of the reservoir is necessary to improve the profitability and sustain the maximum production.

Production optimization was achieved by integrating geochemical data provided by the pulsed neutron down hole tool with X-Ray Fluorescence Elemental analysis (XRF) as first calibration step and derived minerals from pulsed neutron tools with direct mineralogical measurement from X-Ray Diffraction (XRD) tools as second step across the prospective interval.

Results:
The results from gamma rays emitted from the elemental composition of the rock fabric involved in the inelastic and capture interactions improved the lithological understanding. The geochemical logging tool clearly determined the dominant lithology and recognized the changes from sandstone to shales and carbonates. Also, the comparison of the geochemical logging tool-derived mineral model with XRD shows good agreement and the tool's ability to quantify minerals.

The improved lithology quantification was critical to determine fluid saturations (from open-hole resistivity measurements, intrinsic sigma and carbon counts from the geochemical logging tool as a qualitative indicators) and optimize reservoir completion and productivity.

Novelty:
The 3.25-inch tool diameter geochemical spectroscopy logging tool was introduced for the first time in Kuwait and it combined inelastic and capture gamma ray spectroscopy measurements together with XRF and XRD data to maximize well production.