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The Comparison of QEMSCAN and XRD Analysis in the Mineralogical Characterisation of Unconventional Reservoirs: The Benefits of an Integrated Approach

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As oil and gas exploration becomes increasingly focused on unconventional plays such as tight gas, oil and gas shale, and oil sands, the requirement for improved knowledge of the physical characteristics of the reservoir becomes ever more important. Understanding the composition and texture of the rock matrix is critical as the mineral components intrinsically control fundamental petrophysical parameters such as grain density and directly or indirectly influence many of the wireline responses e.g. density, resistivity, spontaneous potential, gamma ray, sonic etc. Therefore, accurate and reproducible determination and quantification of the mineral assemblage is of growing importance in petrophysical, wireline and engineering interpretations.

Despite advances in instrumentation and associated quantification techniques, mineral analysis methods are prone to a range of uncertainties. For instance, data derived from traditional mineralogical analytical methods may be subject to potentially large errors; optical analysis can be controlled by grain size and the experience of the petrographer whilst X-ray diffraction (XRD) can be influenced by the presence of phases with variable or poor crystallinity and may be sensitive to differences in sample preparation. This may be compounded in non-cored and / or lateral wells where cuttings may be the only samples available for analysis. Even methods well-suited to cuttings analysis are typically based on the analysis of a 2D section through a sample and so may be influenced by sample variance e.g. lamination, patchy cements etc.

As part of an analytical round-robin testing programme, a suite of 20 unidentified test samples were submitted for mineralogical analysis by XRD and QEMSCAN. The results were referenced to baseline geochemical data from X-ray fluorescence analysis. Repeat analysis of samples, re-prepared as simulated cuttings, by QEMSCAN was undertaken to test analytical reproducibility and the influence of sample variance on the modal mineralogical results. The results of this study are presented, compared and discussed with particular reference to the relative merits of each technique.

A well considered integrated approach to mineralogical analysis is therefore vital for the accurate characterisation of unconventional, mineralogically complex or problematic reservoirs, especially through non-cored or horizontal wells where only cuttings are available.