A High-Definition Mineralogical Examination of Potential Gas Shales

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In 2008 shale gas production totalled over 5 Bcf/d and accounted for 8% of the total daily natural gas production in North America. While 70% of this was from the Mississippian Barnett shale of Texas, production in other fields has started to increase. Numerous thermally mature, organic rich shales have been identified and targeted as potential analogues to the Barnett. The evaluation of these shales has proven challenging as many conventional techniques such as well logging, petrophysics and core analysis are inconclusive in the very fine grained sediments that make up these reservoirs.

It has been recognized that mineralogy and texture can be a critical component in the resource potential of shales. Rocks with high silica (quartz) and low clay content typically have high Young's modulus and low Poisson's ratio making them more brittle and more prone to natural fractures and good candidates for fracture stimulation. Many shales exhibit covariance between silica and TOC (total organic carbon) suggesting a biogenic origin for the quartz. This biogenic quartz can also contain trace or rare earth elements typically found in organic materials. Aluminosilicates such as illite can have microporosity suitable for the adsorption of gas while other clay minerals can increase moisture content which reduces the adsorption capacity of shale.

In this study we utilize QEMSCAN, a high definition, automated mineralogical analysis tool, to evaluate the mineralogy and micro textures of potential gas shales. QEMSCAN allows a detailed evaluation far beyond the resolution of conventional thin section petrography and at a speed much faster than conventional SEM analysis.

We present a brief summary of data from a diverse selection of North American shales over a broad geological time frame: Cambrian Conasauga; Ordovician Utica; Devonian Muskwa and Duvernay; Mississippian Barnett and Floyd; Triassic Montney; and Cretaceous Colorado. The emphasis has been placed on correlating QEMSCAN with other analytical data including XRD, geochemistry, TOC and Rock-Eval.

We illustrate how QEMSCAN can rapidly identify different depositional facies within a shale section by classifying drill cuttings on the basis of mineralogy and texture. This combined with the bulk mineralogy from the analysis can rapidly identify optimal completion intervals, zones for horizontal development and intervals with a high propensity for fracturing.