Understanding Porosity and Permeability Relationships to Mineralogy and Organic Matter in Unconventional Gas Reservoirs Utilizing New Technologies

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Unconventional gas has become an increasingly important resource. Unlike conventional reservoirs, shale gas reservoirs serve as the reservoir rock, source rock and seal. The natural gas produced from “gas shales” is derived from gas trapped within the natural fractures, open pore spaces, and/or adsorbed onto the kerogen.

New applications have been developed to enhance our understanding of the non-conventional reservoirs, including shale gas, in particular relationships between mineralogy, pore fabric and organic matter. Although it is well known that pore fabric is directly related to permeability anisotropy, our research suggests that micro-porosity networks within shale gas reservoirs are often poorly understood, and it is not always clear what the porosity relationship is to the kerogen. An enhanced knowledge of the host rock lithology from these same resulting datasets would also be beneficial to enhanced recovery programs such as 'fracing'.

Integrating two of our new applications, QEMSCAN™ and Magpore™, with measured TOC (Total Organic Carbon), kerogen organofacies, and optical maturity, will help to answer these questions by quantitatively analysing cuttings and/or core samples taken through the reservoir interval. Data from a variety of shale gas reservoirs of differing organofacies, maturity and richness will be presented.

QEMSCAN™, an automated mineralogical scanning technique with a combined SEM and EDS system will map bulk mineralogy, lithotypes and organic matter within each sample. The recorded quantitative mineralogical data is used in conjunction with conventional petrological analysis, EM analysis and magnetic susceptibility measurements (Magpore™) to increase understanding of the rock and organic fabric and its relationship to porosity, permeability, and permeability anisotropy. Standard TOC measurements will be compared to those quantified by QEMSCAN™.

Results from these niche techniques related to organofacies type, maturity and TOC will provide unique information on the geometry, form and type of the pore network of Unconventional Gas Reservoirs, as well as providing a quantitative analysis of the mineralogy and lithology of the host reservoir rock and its relation to the kerogen present. The data generated will have considerable relevance to predicting the fluid flow properties and storage capacity of the host reservoir rock and also benefit exploration efforts.