Utilising New Technologies to Better Understand Porosity and Permeability Relationships to Mineralogy and Organic Matter in Shale Gas Reservoirs

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Shale gas has become an increasingly important resource in the North American market, and 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.

We have developed new applications to enhance our understanding of shale gas reservoirs, particularly regarding relationships between mineralogy, pore fabric and organic matter. Pore fabric is directly related to permeability anisotropy, but our research suggests micro-porosity networks within shale gas reservoirs lack a clear understanding of the relationship between porosity and organic matter. Further, improved understanding of the host rock lithology would also be beneficial to enhanced recovery programs such as 'fracing'.

Integrating our two new applications, QEMSCANTM and MagporeTM with measured TOC (Total Organic Carbon), kerogen organofacies, and optical maturity, will help to answer these questions by quantitatively analysing ditch cuttings and/or core samples taken through the reservoir interval. Data from a variety of shale gas reservoirs (such as the Barnett Shale, Haynesville East Texas Shale, Fayetteville Shale, and Arkoma Basin Woodford Shale) of differing organofacies, maturity and richness will be presented.

QEMSCANTM, 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 (MagporeTM) 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 QEMSCANTM.

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 Shale 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.