A NEW APPROACH TO INTEGRATED TOP SEAL EVALUATION

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Effective top seals represent a component of the petroleum system that is rarely given adequate attention, yet these play a fundamental role in determining the validity of any potential hydrocarbon trap. Conventional top seal analysis typically involves cursory description of seal thickness, lithology and wireline log motifs. Less commonly sequence stratigraphic principals are applied in an attempt to predict facies variations from seismic signatures and any available well data. More sophisticated descriptions of seal capacity utilise mercury porosimetry to characterise the capillary entry properties of seal rocks and derive hydrocarbon column heights that seal is able to withhold. A major impediment to this approach is the limited number of samples used to quantitatively measure seal capacity. The seal to a hydrocarbon trap will fail at its weakest point and large volumes of hydrocarbon can be lost in a relatively short period of time from a small leak point. The likelihood of encountering this weakest point across a massive rock volume with a sampling strategy based on a handful of samples is remote and consequently top seal capacity is likely to be routinely overestimated.

In this study a new technique for rapid determination of rock composition from cuttings samples has been used to describe seal properties for the Skua Field, Timor Sea, Australia. This approach uses an automated scanning electron microscope called QEMScan to create detailed compositional and mineralogical descriptions of every individual fragment of each cuttings sample examined. A map of lateral and vertical variations in seal facies is then produced by interpolating data acquired from five wells across the field. A combination of simple contouring and more sophisticated geostatistical interpolation is used to provide a 3-dimensional description of seal composition tied to these control points.

Samples were chosen for detailed mercury injection capillary pressure (MICP) analysis using this compositional map as a guide. Minimum threshold pressures derived from these analyses are converted from a mercury-air to a hydrocarbon-water system in order to calculate likely column heights that could be retained. The variations in measured seal capacity are compared with changes in rock composition and associated electric log motif to investigate if a small number of MICP measurements can be up-scaled to produce a seal capacity map.

Future work is planned to extend this investigation into areas where there are currently no wells and to develop approaches to utilise seismic data and sedimentary modeling approaches to more effectively evaluate likely seal capacity pre-drill.