

## Advances in the evaluation of SE Asian Miocene shaly sand reservoirs

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South East Asian middle Miocene silici-clastic reservoirs are prolific oil and gas producers, but they also present many challenges to log interpretation. The frequently "hot sand" formations typically have a moderate to high silt content, locally developed clay laminations and often fairly fresh or brackish formation waters. The result is what have been referred to as "low resistivity and low contrast" pay zones. These show little variation in the resistivity response between, for example, water filled muddy sands or conversely, thinly interbedded oil bearing sands.

Log analysts have traditionally attempted to solve this low resistivity, low contrast problem by developing increasingly complex variants of the Archie and Dual Water models, as well as by forward modelling techniques. Interpretations are sought by using sophisticated mathematical techniques, with some geological

constraints to counter the risk of non unique solutions.

However, the last 3 years have seen the systematic introduction across S.E. Asia of new generations of logging tools which allow more direct measurement of the petrophysical parameters. This paper will look at two case studies from this region.

In the first, from the Malay Basin, nuclear magnetic resonance is used to distinguish oil bearing "hot" sands (Gamma Ray >120 API) with very similar porosities and clay content, but radically different permeabilities. Electrical images explain how the difference in the depositional setting has resulted in clays being laminated in the more permeable reservoir, but dispersed (a consequence of bioturbation) in the less permeable member.

In the second example, we shall demonstrate how high resolution logging allows quantitative analysis of gas sands developed at the decimetric scale. This analysis is possible because the newer tool sensors benefit from miniaturization technology, and the ability to do real time environmental corrections and speed corrections to compensate for borehole conditions. When integrated with electrical image data the presence (or absence) of gas charge in sands interbedded at the centimetric scale can also be evaluated. Drill Stem Tests confirmed this analysis and a new reservoir was discovered across a previously "thought to be non productive" level in a Bangladeshi gas field.

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