

Reservoir Geometry, Lateral Facies Continuity and Permeability Heterogeneities in Outcropping Shoreface Sandstones, Brunei Darussalam

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A wave-dominant, shallow marine succession includes an upper shoreface sandstone unit that can be traced laterally for more than 4.5 km through 12 outcrops. The fine to medium-grained sand is typically clean and parallel laminated with some swaley and trough cross-bedding and little bioturbation. The unit has a nearly constant thickness of 5 m over the entire distance, except where it decreases to 2.8 m approximately 300 m before pinching out. The decrease in thickness is accompanied by an increase in the amount of mud that occurs as thin beds, laminations and drapes, as well as interspersed mud resulting from increased bioturbation. There are other discrete zones laterally along the sandstone unit where the amount of mud and bioturbation is significantly greater than background values; these are presumably related to alongshore hydrodynamic variations at the time of deposition.

In situ permeability measurements are consistently in the 350 to 500 mD range in the weakly bioturbated, clean sandstone that dominates the unit, but drop to 150 to 200 mD in the relatively muddy and more intensely bioturbated zones and to <100 mD where the sandstone thins adjacent to the pinchout. Permeabilities may be even lower where vegetation covers the unit and the mud content is almost certainly higher, suggesting that upper shoreface sandstone reservoirs can be laterally heterogeneous or compartmentalized. The reduced volume and recovery factor caused by thinning and increased mud content could lead to significant overestimation of recoverable reserves in the last several hundred meters adjacent to a pinchout.