

Sand body character of the modern Baram Delta: implications for petroleum reservoir models in Northwest Borneo

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The modern Baram Delta has long been interpreted as a wave-dominated delta and extensively used as a modern analogue for the prolific shallow marine sandstone reservoirs in Northwest Borneo, but no detailed sedimentological studies have been completed. Recently, a companion study concluded that it is actually a fluvial and tidal influenced delta, although the sand bodies are influenced by wave energy to a lesser extent.

The deltaic sands include a transverse mouth bar, channel marginal bars and shoreline sands. Mud dominated facies with subordinate organic matter are widely distributed within the very shallow sub-tidal zone all over the delta.

The transverse mouth bar is 3.5 km long, < 2 km wide and 3–5 m thick. On the seaward side, it is parallel laminated and small-scale cross-bedded, moderate to well-sorted fine sand with little interbedded mud and

organic matter. Conversely, the landward side has poorly sorted interbedded fine sand and mud with abundant organic matter, trough cross-beds and is highly bioturbated. The sand has moderate reservoir potential because large parts of the sand body have a moderately high mud content.

The channel marginal bars are situated on both sides of the river mouth with the geometry of 2–3.5 km long, 1 km–< 2 km wide and 2–3 m thick. They are oriented at a high angle to the shoreline sand, and sub-parallel to the river mouth channel. Sand facies on the seaward side tend to be cleaner, better sorted and less burrowed compared to the sheltered parts, which are influenced by fluvial and tidal processes. High angle trough cross-beds and low angle cross-beds with organic matter, mud layers and laminae reduce the reservoir potential to moderate to low.

The shoreline sands are a laterally extensive facies, but the intertidal zone is less than 20 m wide with only 1–2 m thick. Clean shoreface sands are moderate to well-sorted fine sand, but only extend seaward for a few tens of meters. Organic matter, especially plant remnants, is moderately abundant in layers within the parallel and low angle cross-beds. Reservoir potential is moderate to high in the narrow sand bodies.

In general, the depositional setting is unable to generate good quality, wide and laterally extensive reservoir sands. The seaward sides of the sand bodies tends to have better reservoir potential than the sheltered areas due to wave reworking. Most parts of the delta are without wave influence and abundant fine-grained sediment and organic matter derived from river create permeability barriers and reduces the reservoir potential.

Most of the wave-dominated, producing reservoir sandstones in Northwest Borneo vary significantly from the Baram Delta sands in that they are kilometres wide and are parallel laminated, low angle cross-bedded and hummocky cross-stratified, fine to medium grained, moderately to well-sorted and partly bioturbated by vertical and horizontal burrows. Therefore, the modern Baram Delta is an inappropriate modern analogue for the reservoir sands of Northwest Borneo.