



Variability of Secondary Pay in the Columbus Basin

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Most of the actively producing hydrocarbon reservoirs in the Columbus Basin are thick (100s ft), amalgamated sandstones deposited in a proximal delta front to shoreface continuum as part of the palaeo-Orinoco Delta. Various types of Secondary Pay, not developed by primary completions, are recognised. The concept of thinly bedded pay is well established but not all Secondary Pay types are thinly bedded. Thick successions of intensely bioturbated silty sandstones can also make viable reservoirs. This presentation illustrates how regional stratigraphic and depositional context can explain Secondary Pay types, allowing for appropriate field development planning.

Previous descriptions of thinly bedded pay in the Columbus Basin tend to come from the distal delta front. Low clay content sandstones with low-angle lamination to hummocky cross stratification are interbedded with non-net mudstones, which are typically fluid muds. Bioturbation intensity and diversity are low, reflecting high physio-chemical stress. Both laterally extensive sheets and confined chutes or channels are observed at outcrop. This Secondary Pay type is most common during delta advance (regression) and in areas down-dip from sediment entry points (delta distributaries). It reflects 'on-axis' but distal sedimentation associated with active delta lobes.

Thick, intensely bioturbated silty sandstones have a higher clay content and sedimentary structures are largely destroyed. Intense, relatively diverse bioturbation indicates lower physio-chemical stress. Laterally extensive sheets are observed at outcrop. This Secondary Pay type is most common during delta retreat (transgression) and in areas laterally offset from delta distributaries. It reflects 'off-axis' distal sedimentation associated with wave-reworked portions of the delta.

A third Secondary Pay type, comprising channelised thin beds associated with tidally-influenced delta plain sedimentation is observed at outcrop but has to date remained unrecognised in the subsurface. It represents a further potential habitat for the next phase of Columbus Basin hydrocarbon production.