Fractures in Formation MicroImager (FMI) Log Versus Outcrop Data: Reservoir Character of a Thick-Bedded Deepwater Miocene Sandstone, New Zealand

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The aims of this study are to assess the potential for hybrid reservoirs that offer both clastic and fracture storage and flow paths and to test whether outcrop analogue studies can provide realistic models for the subsurface.

The Middle Miocene Tunanui Formation comprises a range of deep water facies, notably including metre-thick turbidite sandstone units with thin mudstone interbeds. Fractures were studied using an 8.1 m long scanline along a 1.78 m thick bed of fine, soft, calcareous sandstone. This bed is interpreted to be a flow-stripped turbidite. Data are compared with those from a similar facies of the same formation using FMI logs from exploration well Tuhara-1A, 23 km to the west.

The main fracture strike in outcrop is NNE and these fractures are scaleable. NNE fractures dipping WNW (Set A1) have a power trendline of $y = 0.4391x - 1.0927$ and those dipping ESE (Set A2) have a trendline of $y = 0.274x - 1.8063$. Similar orientations are identified in the subsurface in Tuhara-1A using FMI logs and most apertures (from scaled resistivity data) and fracture spacing data plot within the aperture-frequency zone obtained from outcrop data. This suggests:

(1) The outcrop data may be a good analogue for the subsurface for this formation; (2) There may be wider-aperture fractures in sets A1 & A2 missed by the vertical bore-hole; (3) This approach to predicting reservoir quality and character might be applicable for other deepwater sandstones in this basin, though power trendline formulae may differ in other formations.

The NNE-striking fractures are slightly oblique to the direction of principal horizontal shortening derived from first motion studies and to the main horizontal stress orientation as inferred from breakout directions observed on FMI logs. Cementation is variable but is insufficient to seal most fractures in either outcrop or the subsurface.