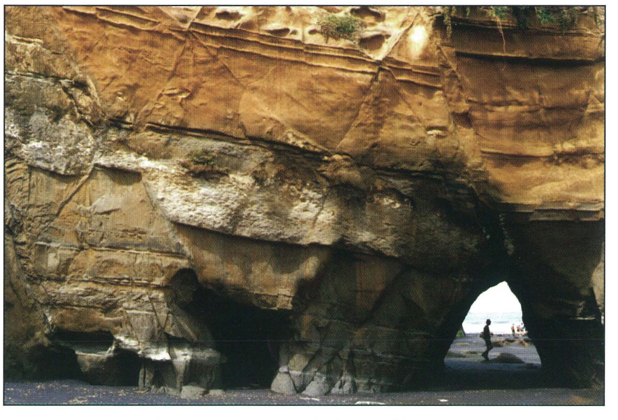
Reservoir Studies Of Outcropping Deep Water Miocene Sequences, North Taranaki, New Zealand

Outcrop studies are an important tool to understanding deep water reservoir successions, due in part to the inherent problems in studying modern deep water depositional systems. Deep water deposits are important reservoir types worldwide. Key outcrop areas in several parts of the world are increasingly being used to understand subsurface reservoir characteristics of these sediments. The Mt Messenger and Urenui Formation outcrops in north Taranaki show a wide range of deep water facies types from basin floor to slope, and illustrate a variety of sedimentary stacking patterns and scales of sedimentary cyclicity. The outcrop section, when combined with nearby subsurface data sets, together with data from the nearby producing reservoir intervals in equivalent Mt Messenger strata in the Kaimiro and Ngatoro Fields, is becoming internationally renowned as a key area to study deep water sedimentation.



Mt Messsenger Formation - North Taranaki

GNS scientists have been studying the section for the past decade and have published widely on a range of sedimentary and reservoir characteristics. The outcropping Late Miocene rocks are approximately 2 km thick, and are spectacularly exposed in coastal exposures up to 240 m high. They comprise a regressive sandstone succession spanning basin floor fan deposits toward the base, to slope filled channels in the uppermost portions of the section. Thick-bedded basin floor fan sandstone sheets and thin-bedded sandstone and siltstone reservoir facies are particularly well represented in the 50 km long coastal section.

Sediments that make up the Mt Messenger and Urenui successions were sourced from the rapidly rising tectonic hinterland of central New Zealand associated with the development of an active convergent margin between the Australian and Pacific Plates during the Late Miocene. Much of the sediment was derived from South Island basement terranes. In addition, sediment supply to the deep water was influenced by fluctuating eustatic sea-level during the Late Miocene, events that are well documented on a global scale.

The coastal section represents a series of stacked 4th-order sequences, each deposited over a 100-300,000 year duration within 3rd-order lowstand cycle. In the stratigraphically lower portions of the outcrop, these cycles comprise an upward fining transition from thick-bedded massive and faintly bedded sandstone, to thinly bedded sandstone and siltstone, to capping (often slump-folded) mudstones. Thick-bedded sandstones are commonly amalgamated and are relatively continuous laterally, displaying in general, low-angle scoured surfaces at the base of sandstone beds. These are interpreted as basin floor fan successions, deposited in lower to mid bathyal water depths, based on foraminiferal data. Stratigraphically higher 4th-order sequences show heterolithic bed types and pronounced channelisation, and are interpreted as base-of-slope deposits. Middle portions of the outcrop display a change to alternating sandstone and siltstone beds with pronounced sedimentary structures, channelisation, and abundant scour geometries. These are interpreted as slope fan turbidites, deposited in middle to upper bathyal water depths. Sequences in the upper part of the outcrop within the Urenui Formation are mudstone dominated, and are marked by spectacular conglomerate and sandstone-filled channels tens of metres thick. They are interpreted as slope muds and clastic-filled slope channels, respectively, deposited in upper bathyal water depths.

No single 4th-order sequence is exposed in its entirety. Erosion in the inland hill country of north Taranaki has removed the up-slope and shelfal equivalents of the individual cycles that are preserved along the coast. However, along the outcrop extent, a two-dimensional cross section of successively younger, stacked 4th-order cycles is preserved. In this way, a full range of lithofacies and geometries that characterise deep water 4th-order sequences from basin floor to slope is preserved, and from this a composite model has been developed that illustrates the internal architecture of 4th-order sequences. Future work will include improved understanding of sedimentary heterogeneities using outcrop and subsurface datasets, and applying RMS modelling software to constrain 3D geological models of reservoir development.

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