

Miocene Submarine Volcanoes Within Taranaki Basin, New Zealand: Geophysical Imaging, Drilling Results, and Inferred Emplacement Processes.

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The Taranaki Basin to the west of New Zealand contains a substantial field of buried volcanoes (the Mohakatino Volcanics) that were emplaced into bathyal water depths during the middle and late Miocene. This volcanic episode was concurrent with subduction of the Pacific plate at an inferred trench to the east - an earlier manifestation of the present-day Hikurangi subduction zone which is paired with the Taupo Volcanic Zone of the central North Island and its continuation offshore to the north. The crust beneath the Taranaki Basin is a rifted continental margin. Prior to the inception of volcanism, the affected area contained a partially filled late Cretaceous and younger sedimentary basin with the sea bed onto which volcanics erupted at least 1,000m below sea level.

The Mohakatino Volcanics are imaged on an extensive composite grid of oil industry 2D seismic reflection data, and have been drilled by several exploration wells. Part of the area has been covered by a high resolution aeromagnetic survey. Tuffaceous sediments derived from the volcanoes are exposed within the Mohakatino Formation along the north Taranaki coast.

Seismic mapping reveals the volcanics as conical edifices with extensive aprons of volcanoclastic material blending laterally into the enclosing mainly fine-grained marine sediment. The core of each volcanic edifice is expressed as a zone of severely reduced seismic reflector coherence. Magnetic anomalies assist in mapping the position of the vent complexes. Each volcanic piercement is associated with a pronounced doming of strata beneath, and it is these domes that have attracted drilling for oil. Drilling has verified the structural interpretation, and oil was discovered within coarse volcanoclastic facies in one prospect. Petrological studies of well cuttings reveal hydrothermal alteration near the igneous intrusions within the core. There is insufficient data to fully understand the emplacement processes at and within the vent complexes.

Petrological studies of well material have shown that the Mohakatino Volcanics comprise mainly low to medium potash, calc-alkaline andesites, basaltic andesites, and subordinate basalts, representing partial melts of a volatile-rich mantle with no geochemical evidence for contamination with continental crust during magma ascent. The rocks

are typically porphyritic, and we have used hornblende geobarometry to estimate depth ranges of hornblende crystallisation which took place at mid-crustal levels. Radiometric and stratigraphic dating relationships suggest that there may be up to several million years between the hornblende crystallisation in mid-crustal chambers, and its subsequent extrusion to form subaqueous volcanic edifices. Mohakatino volcanism, which in general migrated from north to south through the middle and late Miocene, may thus be controlled by the timing of inception of back-arc extension, which is manifested as a system of normal faults that offset some of the Mohakatino volcanic edifices.