

Depositional systems within New Zealand sedimentary basins

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The Cretaceous to Recent sedimentary succession in New Zealand corresponds to a 100 m.y. first-order transgressive-regressive 'megasequence', that reflects composite basin evolution, beginning with intra-continental rifting, and ending in passive margin quiescence or convergent margin orogenesis. The overall stratigraphic succession contains seven second-order depositional cycles, of 5 to 25 m.y. duration. These cycles are generally correlatable between regions as major, unconformity-bound transgressive or regressive packages, with characteristic subsidence profiles. The second-order cycles relate broadly to plate tectonic setting, although their development was generally markedly different on eastern and western sides of the proto-New Zealand sub-continent.

Second-order Cycles 1 and 2 in the west relate to intra-continental rifting associated with Gondwana break-up, and in the east reflect initial transgression onto a peneplaned basement landmass. Cycle 3 deposition initially corresponded everywhere to post-rift passive margin development, but from about 45 Ma was disrupted in the west by a tectono-sedimentary overprint linked to oblique spreading south of New Zealand. Cycle 4 represents carbonate-dominated deposition during maximum submergence of proto-New Zealand in the Oligocene, again complicated by incipient plate boundary-related tectonism in the west. Cycles 5 to 7 equate to progressive stages in the development of the Australia-Pacific plate boundary through New Zealand, expressed mainly by an increasing tempo of local and regional tectonic uplift and subsidence, and concomitant supply of clastic detritus to both subsiding depocentres and stable platform areas.

The schematic base level curve derived for the Cretaceous-Cenozoic record in New Zealand shows little resemblance to the long term first-order global sea-level curve of Haq et al. (1987), except for a broadly regressive trend in the Neogene. Some unconformities bounding second-order cycles show an apparent match with baselevel shifts on the global curve, but can be related, more convincingly, to local tectonic events. Accordingly we suspect that any eustatic influence on first- and second-order depositional cyclicity, at least, has either been comparatively minor, or is impossible to differentiate from the strong tectonic overprint.

From a petroleum exploration perspective, the distribution of potential source, reservoir, and seal rocks follows a similar pattern in many New Zealand basins. Source rocks of terrestrial origin occur within Cycles 1 to 3, in both syn-rift and transgressive coastal plain settings. Marine rocks with some source potential, most notably the Waipawa Formation black shale and its equivalents, are also found within these cycles. Potential reservoir rocks are present throughout the stratigraphic record. However, the most prominent reservoir fairways correspond to transgressive shoreline systems within Cycle 3, and to a variety of depositional facies belts within Cycles 5 to 7 in particular. Similarly, seal rocks are widespread, especially within Cycles 3 to 6.