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New Zealand subduction margins: variations in structural, sedimentary, and geomorphic responses to tectonic and climatic controls.

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The obliquely-convergent Pacific-Australian plate boundary in the New Zealand region is characterised by two opposite-facing subduction margins, linked by a transpressive continental collision zone in central South Island. In the south, along the Puysegur Trench, oceanic crust of the Australian plate is subducting north eastward beneath the Puysegur and Fiordland margins. In the north, along the Hikurangi margin, the Pacific plate is subducting westward beneath North Island, the shallow depth (c. 3000 m) of the trench (Hikurangi Trough) and the low dip ($<5^{\circ}$) of the inter-plate thrust reflecting the elevated thickness (12-15 km) of the subducting oceanic crust (Hikurangi Plateau). The Fiordland and Hikurangi subduction margins represent natural laboratories for increasing understanding of tectonic – sedimentation interactions above subduction zones. The margins have been evolving for about 16-8 Myrs and 25 Myrs respectively, but their present geomorphology has largely developed during the last few million years. Lateral variations in the principal tectonic and oceanic drivers along the length of New Zealand result in several important variations in climate, and in margin structure, sedimentation, erosion, and geomorphology.

The sedimentation and erosion history of both subduction margins are strongly influenced by glacio-eustatic cycles, but in different ways. Southern latitude and westerly aspect result in Fiordland being characterised by cyclical deforestation of metamorphic basement rocks, and glacier advances that excavate fiords and directly supply sediment to off-shelf submarine outwash fans, channel systems and turbidite basins. Quaternary basins on the Hikurangi margin record migrating shorelines and sedimentation depocentres, numerous unconformities, and soft-rock terrestrial sources and sig-

nificant volcanic ash, whilst canyon activity and width of shelf varies spatially and temporally. High-resolution sedimentary studies of both margins are essential for developing the stratigraphic framework necessary for active tectonics analysis, whilst tectonic processes have important feed back into depositional and erosional systems.

Lateral changes in the obliquity of convergence between the Pacific and Australian plates contribute to variations in the degree to which crustal strain is partitioned between dextral strike-slip faults that accommodate much of the margin parallel component of the convergence vector, and a largely contractional forearc with margin-normal shortening accommodated by thrust faulting, folding, and uplift. The highly-oblique Fiordland margin is steep, largely devoid of a continental shelf, and is dominated by the dextral Alpine Fault and a young ($<$5 Ma), moderately tapered (8-9°), narrow (25 km) thrust wedge beneath the Fiordland Basin. By comparison, the structure and geomorphology of the Hikurangi margin is highly variable. The central section reaches 150 km in width and includes an inboard, strike-slip and reverse faulted, polyphase-deformed, Mesozoic and Tertiary sedimentary sequence, and a wide (70-80 km), very low-taper ($<$3°) frontal accretionary wedge. The frontal wedge has developed in response to thick ($\sim$4 km) trench fill sediments, efficient ($>$75%) accretionary processes, and smooth subducting plate. Subduction erosion of the upper plate occurs along the northern section, in response to high relief on the subducting plate, seamount-impact avalanche systems, and thin ($\sim$1.0-1.5 km) trench-fill sediment. Major canyon systems and thick ($>$4 km) trench-fill turbidites characterise the southern section, where the southward-narrowing frontal thrust wedge merges into the strike-slip faults of northern South Island (Marlborough Fault System), above part of the subduction zone that now may be permanently inactive.