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Mechanisms of regional scale uplift in the Hikurangi Margin implied by fluvial and marine terrace data

N. Litchfield, K. Berryman, S. Ellis and A. Nicol
GNS Science, New Zealand (n.litchfield@gns.cri.nz / Fax: +64 570-4600)

The Hikurangi Margin is being actively uplifted in response to oblique collision between the Pacific and Australian plates. We have calculated post-glacial ($<$18 cal. ka) fluvial incision rates for 10 major rivers of the southern and eastern North Island, and compared these with independent measures of late Quaternary (rock) uplift rates from pairs of fluvial terraces (55 and 18 ka) and 125 ka marine terraces. Although post-glacial incision rates overestimate rock uplift rates, there is a crude correlation between the two, and the spatial map patterns are similar. Thus, we infer that the combination of both data sets can be used to examine variations in Late Quaternary tectonic uplift rate along the Hikurangi Margin.

Using these data sets we identify some broad uplift rate patterns: (1) generally lower rates in the south (1-2 mm/yr), (2) a broad NE-striking uplift zone centred upon the central and northern axial ranges ($\leq$3mm/yr), and (3) locally very high uplift rates (4-5 mm/yr) in the central Mohaka and upper Mata River catchments. These correspond with changes in the morphology of the uplifted forearc; in the south the forearc is wide ($\sim$250 km) and topographic relief is generally low, while to the north it is narrow ($\sim$100 km) and the margin is relatively steep. The large wavelength of these patterns and lack of correspondence with onshore upper plate reverse faults suggest that the uplift is largely the result of deep-seated subduction processes.

2D numerical (finite element) modelling has been used to examine the uplift rates and patterns as a consequence of a range of subduction processes including: (1) subduction of the relatively buoyant Hikurangi Plateau, (2) tectonic erosion resulting from sediment starvation on the incoming plate, and (3) subduction of seamounts. Each of these processes, along with sediment underplating, have previously been interpreted to be occurring along the Hikurangi Margin. Subduction of the Hikurangi Plateau pro-

vides the most probable mechanism for relatively low rates of uplift ($<$1 mm yr^{-1}) across much of the margin. Sediment underplating is the probable mechanism for the broad anticlinal uplift of the central and northern axial ranges. This is possibly aided by changes in sediment supply to the trench and subduction of seamounts. Localised uplift zones could also be the result of subduction of seamounts or smaller wavelength variations in underplated sediment. The tectonic erosion models also have two other important implications for Hikurangi Margin tectonics; a localised increase in frictional coupling on the interface in the north, opposite to that observed from seismicity, and that normal faults in the Raukumara Peninsula area (northern axial ranges) may be bending moment faults resulting from high rates of uplift on the Peninsula.

This study provides a nice example of how surface processes (fluvial and marine) can be used to place constraints on deep seated tectonics. The study also complements ongoing investigation of Hikurangi Margin subduction earthquakes.