Crustal erosion and accretion processes leading to forearc uplift of Raukumara Basin, Hikurangi-Kermadec subduction zone, northeastern New Zealand

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New seismic reflection and refraction data from northern New Zealand allow us to determine crustal thickness, map a forearc basin containing 12 km of sediment, and image the subduction thrust at 30-40 km depth. The Moho lies at 18 km beneath the basin centre, and at 35 km at the southern margin. Raukumara Basin is uplifted along its eastern and southern margins but is only weakly deformed, suggesting uplift by crustal underplating. We infer from the spatial correlation between maximum uplift and the intersection of the Moho with the subduction thrust that lower crustal accretion processes are modulated by crustal thickness: crustal material is accreted from a subduction channel when the density instability becomes large enough. The trench-slope has many small extensional faults and lacks coherent internal reflections, suggesting collapse of indurated rock, rather than accretion of >1 km of sediment from the down-going plate to the trench-slope; this was previously interpreted as evidence for subduction erosion. We propose cyclical mechanics that involves net accretion: lower crustal accretion from a subduction channel causes uplift of the forearc ridge; the trench-slope becomes steeper; the slope collapses; collapsed material and sediment from the subducted plate is transported towards the lower crust down a subduction channel; more lower crustal material is accreted. We suggest that this process led to net crustal accretion but left no evidence for accretion at the subduction front or on the trench-slope.