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Slab break off -or loss of mantle instability - beneath Western North Island, New Zealand ?

T.A. Stern (1), W.R. Stratford (1,2), M.L. Salmon (1,3)

(1) Victoria University of Wellington, School of Earth Sciences, Wellington, New Zealand (tim.stern@vuw.ac.nz), (2) Dept of Geography and Geology, University of Copenhagen, Copenhagen, Denmark, (3) RSES, Australian National University, Canberra, Australia

At many active continental margins of the world there exist geophysical data that could be interpreted either in terms of a slab break off, or the loss of thickened mantle lithosphere from the overriding plate. Here we examine central Western North Island of New Zealand, where a particular good geological and geophysical data base permits a test between these alternatives.
Deep earthquakes ($\sim$600 km) occur beneath the western North Island of New Zealand, at the southern end of the Tonga-Kermadec Trench system (Pacific plate subducting westward beneath the Australian plate). A widely held view is that these earthquakes represent a detached piece of Pacific-slab that broke off about 4 Ma. The earthquakes and other phenomena linked to this event could, nevertheless, be explained by the thickening then detachment of Australian mantle lithosphere. For example, hi –K volcanism of a Pliocene-Recent age is located in Western North Island, directly above the deep earthquakes. Such volcanism has been noted to be associated with slab break off, but could also be related to delamination of mantle lid. Evidence more consistent with the loss of mantle instability from the overriding Australian plate comes from studies of crust and mantle structure. A geophysical transect across the southern boundary of the proposed detachment zone, and directly above the deep earthquakes, reveals a major step in both the Moho and the mantle lid of the Australian plate. A 7 -10 km step in the Moho is seen from receiver functions, which is consistent with the dominant 1 mgal/km gravity gradient across the step. Upper mantle studies on Pn, Sn , Qp and teleseismic P-wave delays all point to change in the thickness of the mantle lid from 100-200 km in south-west North Island to 10-20 km, at most, in central and northwestern North Island. The steps in both the Moho and mantle lid step are coincident, suggesting that part of the lower crust was removed with the mantle lid. Intense lower crustal seismicity clusters around the Moho step, indicating it's a recent phenomenon, yet there is no evidence of surface faulting above the step. Geological data show a sudden and regional rock uplift event starting at $\sim$ 5 Ma. Rock uplift extends $\sim$ 150 km west and east of the deep earthquakes and , once corrected for exhumation, the 'tectonic uplift" is $\sim$ 1200 m. If a slab break-off was the cause of the sudden, regional uplift we would predict the uplift to have been focused to the east, towards the trench. We argue, based on data available to date, that the most straightforward manner to explain the above geophysical/ geological phenomena of western North Island is in terms of the loss of a mantle instability, rather than a slab break off.