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Prospecting the Southwest Pacific mantle for fossil slabs by using regional tectonic reconstructions, surface geology and seismic tomography

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The Late Cretaceous to Cenozoic evolution of the Southwest Pacific region is complex, and many reconstructions show a large degree of discrepancy. In particular, models for the Northland region in New Zealand show southwest-dipping subduction, northeast-dipping subduction or northwest-dipping subduction in the Cenozoic. A new tectonic model is proposed that incorporates the regional geology from Northland, New Caledonia and the d'Entrecasteaux region into the large-scale Australia-Pacific-Lord Howe Rise tectonic framework. In the new model, the Northland and New Caledonia regions are interpreted to bear the hallmarks of a ~2500 km long former northeast-dipping subduction zone with an east dipping Three Kings subduction segment in between, along which the South Loyalty Basin was subducted. The d'Entrecasteaux zone to the north of New Caledonia is interpreted as a dextral transform fault that accommodated west-directed slab rollback by tearing of the slab from the surface lithosphere. Eocene-Early Miocene volcanic activity along the Loyalty-Three Kings-Northland plateau seamount chain is interpreted as arc volcanism and timing of this volcanism puts constraints on the timing of subduction activity. Post-subduction and syn- to post-obduction Late Oligocene to Early Miocene volcanism in New Caledonia, Northland and the Norfolk Basin is interpreted as slab-detachment induced volcanism, and therefore constrains the timing of slab detachment. Such geological and geochronological data thus constrain the longevity of subduction and the timing of slab detachment, both of which started in the north and propagated southward. The geological and geochronological data have been incorporated into regional tectonic reconstructions and coupled to different "absolute" global reference frames to be able to predict the geographical location and depth of the detached South Loyalty

slab. Gobal S-wave, Bulk-Sounds and P-wave tomography models have been used to see if the predictions fit with the regional tomography. It is found that the S-wave and P-wave models show a good agreement between predicted and observed slab signature in terms of geographical location, size, geometry and depth. The new tectonic model thus solves the existing controversy of subduction polarity in the Northland-New Caledonia region, explains the timing and spatial distribution of arc volcanism and syn- to post-obduction volcanism, fits within the Southwest Pacific tectonic framework, and is in accord with mantle tomography.