Imaged and predicted mantle structure of the subducted Izanagi-Pacific ridge under East Asia

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The intersection between a subduction zone and a spreading mid-oceanic ridge leads to a distinct gap or ‘slab window’ within a subducting slab. Seismic tomographic imaging of such gaps offers potential first-order constraints for convergent margin plate reconstructions, as contrasting plate tectonic models often show first-order differences in the reconstructed location and configuration of ridge-trench intersections.

Along East Asia it has been proposed that the Izanagi-Pacific ridge subducted either: (1) sub-parallel (at low angle) to the entire Eurasian margin from 55 to 60 Ma, (2) at a high angle across South China and Japan in Cretaceous times, or (3) offshore along an intra-oceanic subduction zone and never subducted under Eurasia. We mapped a 4000 km-long, laterally-continuous and NE-SW trending slow tomographic ‘slab gap’ at ~750 km to 1200 km depth within the well-imaged East Asian mantle under present northern Sakhalin to central China. We used mantle flow models (Flament et al., 2017) to show that this mapped slab gap is the tomographic signature of the subducted Izanagi-Pacific ridge. The geometry of the slab gap and the subduction time inferred from slab unfolding both support subduction of the Izanagi ridge at low-angle between 60 and 55 Ma. Conversion of S-wave peturbations to temperatures using standard equations indicates the slab gap is 100˚C to 300˚C hotter than the surrounding Izanagi and Pacific slab lithosphere, which is in the range of the mantle flow model temperature field predictions.

Our study shows that slab gaps from ancient ridge subduction events can be identified in seismic tomography models, and can persist within the mantle for at least 40 Ma. The mapping of this slab gap in tomography models could be used as a template to reconstruct other convergent margin.

Keywords: ridge subduction, seismic tomography, geodynamics

