Waveform tomography for 3-D shear velocity structure in the lowermost mantle beneath the Northern Pacific

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We conduct waveform inversion (Kawai et al. 2014, GJI) to infer the 3-D SH-velocity structure in the lowermost mantle beneath the Northern Pacific, using ~20,000 transverse components of broadband body-wave seismograms for the first step. We use S, ScS and other phases that arrive between them. The 3-D SH-velocity models obtained by our inversion show three prominent features: (i) horizontal high-velocity anomalies up to about 3 per cent faster than the Preliminary Reference Earth Model (PREM) with a thickness of a few hundred km and a lower boundary which is at most about 150 km above the core-mantle boundary (CMB), (ii) low-velocity anomalies about 2.5 per cent slower than PREM beneath the high-velocity anomalies at the base of the lower mantle, (iii) a thin (about 200 km) low-velocity structure continuous from the base of the low-velocity zone to at least 400 km above the CMB. We interpret these features respectively as: (i) remnants of slab material where the Mg-perovskite to Mg-post-perovskite phase transition could have occurred within the slab, (ii,iii) large amounts of hot and less dense materials beneath the cold paleoslab remnants just above the CMB which ascend and form a passive plume upwelling at the edge of the slab remnants (Suzuki et al. 2016, EPS).

As a second step, we conduct waveform inversion using both the transverse and radial components to infer the more detailed isotropic shear velocity structure in the lowermost mantle beneath the Northern Pacific. We also infer the transversely isotropic (TI) shear-velocity structure for this region using two horizontal components. We conduct synthetic resolution check to examine the ability of our methods and dataset to resolve the TI shear-velocity structure.

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