3-D S-velocity structure in the lowermost mantle beneath the Northern Pacific

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We previously (Suzuki+, 2016) reported the results of waveform inversion to infer the three-dimensional (3-D) S-velocity structure in the lowermost 400 km of the mantle (the D" region) beneath the Northern Pacific region. Our dataset consists of about 20,000 transverse component broadband body-wave seismograms observed at North American stations (mainly USArray) for 131 intermediate and deep earthquakes which occurred beneath the western Pacific subduction region. Synthetic resolution tests indicate that our methods and dataset can resolve the velocity structure in the target region with a horizontal scale of about 150 km and a vertical scale of about 50 km. The 3-D S-velocity model obtained in that study shows 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 150 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 Kula or Pacific slab remnants just above the CMB which ascend and form a passive plume upwelling at the edge of the slab remnants.
Since our initial work we subsequently conducted waveform inversion using both the transverse- and radial-component horizontal waveform data to infer the isotropic shear velocity structure in the lowermost mantle beneath the Northern Pacific in more detail. We also compute partial derivatives with respect to the 5 independent elastic constants (A, C, F, L, N) of a transversely isotropy (TI) medium, and conduct a synthetic resolution test to examine the ability of our methods and dataset to resolve the anisotropic structure in this region using two-component waveform data.

Keywords: waveform inversion, lowermost mantle, S-velocity structure

