Joint inversion of body-wave and surface-wave data for the fine 3-D structure of Japan subduction zone

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We determined high-resolution P and S wave velocity tomography of the Japan subduction zone down to a depth of 700 km by conducting joint inversions of a large number of high-quality arrival-time data of local earthquakes and teleseismic events which are newly collected for this study. We also determined 2-D phase-velocity images of fundamental-mode Rayleigh waves at periods of 20 to 150 s beneath Japan and the surrounding oceanic regions using amplitude and phase data of teleseismic Rayleigh waves. A detailed 3-D S-wave tomography of the study region is obtained by jointly inverting S-wave arrival times of local and teleseismic events and the Rayleigh-wave phase-velocity data. Our inversion results reveal the subducting Pacific and Philippine Sea slabs clearly as dipping high-velocity zones from a 1-D starting velocity model. Prominent low-velocity (low-V) anomalies are revealed in the mantle wedge above the slabs and in the mantle below the Pacific slab. The distinct velocity contrasts between the subducting slabs and the surrounding mantle reflect significant lateral variations in temperature as well as water content and/or the degree of partial melting. The low-V anomalies in the mantle wedge are attributed to slab dehydration and corner flows in the mantle wedge. A sheet-like low-V zone is revealed under the Pacific slab beneath NE Japan, which may reflect hot upwelling from the deeper mantle and subduction of a plume-fed asthenosphere as well. Our present results indicate that joint inversions of different seismic data are very effective and important for obtaining robust tomographic images of the crust and mantle.

Reference
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