

Upper mantle structure beneath the Pacific Ocean revealed from seafloor and land broadband seismic observations

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Using broadband seismic data recorded on seafloor by more than 200 BBOBSs, as well as those on land, we measured phase speed dispersions of Love and Rayleigh wave up to 4th higher mode to determine the three-dimensional radially anisotropic shear wave speed structure in the upper mantle beneath the Pacific Ocean by surface wave tomography. Our model shows that the fastest anomalies at depths shallower than 100 km is located beneath southeastward of the Shatsky Rise and that strong radial anisotropy is located in the central Pacific at depths of 100 - 200 km and weak anisotropy is around the subduction zone. Isotropic shear wave speed structures show age dependence. Synthetic tests suggest that negative gradient of shear wave speed is not a reliable estimate for an absolute depth of discontinuity but may be useful for relative depths. Negative peaks of the gradient are located nearly the same depths except for regions beneath the Ontong Java Plateau, the Mid Pacific Mountains, and the Daito ridges. From age-averaged shear wave speed profiles and the half-space cooling model, we estimate a thermo-speed relationship of the Pacific plate. We construct deviation maps in the Pacific Ocean from a reference shear wave speed model by using that relationship. The deviation maps indicate that large negative residuals, which may be due to partial melt, anelasticity, and/or extra-heat from mantle plumes, are located along the ridge and beneath hotspots, and that large positive residuals beneath the northwestern Pacific Ocean.

Keywords: surface wave tomography, BBOBS, upper mantle