

3-D Shear Wave Speed Structure Beneath the Philippine Sea Plate

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The Philippine sea is a marginal basin in large part opened through the two episodes of back-arc spreading. The evolution history of the Philippine Sea plate should be reflected in the upper mantle structure. However, the spatial resolution achieved by previous studies is not good enough to discuss seismological structures in terms of the plate tectonic history. Recently, several stations in oceanic islands have been installed and long-term broadband seismic observations on the seafloor have been conducted as a part of the Ocean Hemisphere Project (OHP). These seismic observations, in addition to existing data, enable us to reveal the seismic structure of the Philippine Sea plate with an unprecedented resolution.

We measured phase velocities of the fundamental and first three higher modes of Rayleigh waves for the source-station pairs within a latitudinal range from -20S to 45N and a longitudinal range from 110E to 165E, using a fully non-linear waveform inversion method by Yoshizawa and Kennett (2002). The measured multi-mode phase velocities are inverted to a 3-D shear wave speed structure using the three-stage inversion technique by Yoshizawa and Kennett (2004), which allows us to incorporate the effects of finite frequency as well as ray path deviation from the great-circle. The inverted model has a good resolution in the upper 250km of the mantle, showing a persistent feature of subduction of the Pacific plate against the Philippine Sea plate along the Izu-Bonin-Mariana trenches. The thickness of the Philippine Sea plate is in general significantly thinner than the Pacific plate and the shear wave speed in the asthenosphere is very slow. The southern, older part of the Philippine Sea plate is much thicker than the rest. The slowest shear wave speed of the Philippine Sea plate can be found along its spreading axis at the Mariana trough.