Seismic structure beneath the Philippine Sea from seafloor and land observation: implication for evolution of island arc

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We obtained three-dimensional shear wave speed structure of the upper mantle in and around the Philippine Sea region from seismograms recoded by dense land-based and long-term broadband ocean bottom seismographic stations. We employed a technique of surface wave tomography, in which multimode phase speed are measured and inverted for a 3-D shear wave speed structure by incorporating the effects of finite frequency and ray bending. The new ocean bottom data provided us with high spatial resolution (˜300km) in the Philippine Sea region. In the upper 120 km, the shear wave speed structure is well correlated with the seafloor age of the provinces. At depth greater than 160 km, fast anomalies of the subducted slabs of the Pacific plate is clearly defined. Along Izu-Bonin(Ogasawara)-Mariana arc, we have detected three slow anomalies at depth shallower than 100 km in the mantle wedge. The locations of these anomalies are well correlated with the along-arc variations of the isotopic variations, suggesting that the mantle flow in the mantle wedge along the Izu-Bonin-Mariana arc can be separated into three segments with a chemical difference. We also found the slow speed anomalies along the Kyushu-Palau ridge at depths greater than 120 km, which may be a sinking mafic/ultramafic residue of the partial melting formed in the arc crust evolution of the paleo-island arc at the Kyushu-Palau ridge until 30Ma.