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Upper mantle structure of the Pacific and Philippine Sea plates revealed by seafloor seismic array observations

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Seismic tomography studies have revealed the structure and dynamics of Earth's interior since the 1980s. However, the spatial resolution of the oceanic region is not good enough caused by sparse distribution of the seismic stations. The observations with broadband ocean-bottom seismographs (BBOBSs) since the 2000s enabled us to obtain seismic tomography models with higher spatial resolution.
Our Japanese BBOBS group deployed more than 100 BBOBSs in the Pacific Ocean and obtained a high-resolution (300-500 km) three-dimensional shear wave velocity structure in the upper mantle beneath northwestern and south Pacific Ocean by using surface wave tomography technique.

In the northwestern Pacific Ocean, where the Pacific plate subducts beneath the Philippine Sea plate, we found that the shear wave structure in the Philippine sea plate is well correlated with the seafloor age in the upper 120 km, three separate slow anomalies in the mantle wedge at depth shallower than 100 km beneath the Izu-Bonin-Mariana arc, which have a close relationship with the three groups of frontal and rear arc volcanoes having distinct Sr, Nd, and Pb isotope ratios, and that the Philippine Sea plate, which is a single plate, shows very large lateral variations in azimuthal and radial anisotropies compared with the Pacific plate.
In the South Pacific Ocean, where midplate hotspots are concentrated, we found that the localized slow anomalies are found near hotspots in the upper mantle, estimated thickness of the lithosphere is about 90 km in average and is thinned by $\sim$20 km in the vicinity of hotspots, which may represent thermal erosion due to mantle plumes.