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A Pilot Study on Three-dimensional S-wave Anisotropic Tomography

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Seismic anisotropy is a useful indicator for identifying the physical and chemical conditions of the Earth′s interior. To understand the dynamics of the subduction zone, we investigated P- and S-wave seismic anisotropy beneath the Japan islands through travel-time analyses.

Assuming weakly anisotropic media with horizontal symmetry axes, we resolved the three-dimensional P-wave anisotropic structure (with heterogeneity and azimuthal anisotropy described by the fast propagation direction and the strength of anisotropy) beneath the Japan islands. The obtained P-wave anisotropy in the crust is consistent with S-wave polarization anisotropy determined by splitting measurement for S phase, however, there is a discrepancy between P- and S-wave anisotropy in the deeper portion. This is because anisotropy in the uppermost layer has a significant effect on the S phases. This means it is difficult to construct three-dimensional S-wave anisotropic structure through S-wave splitting measurement.

However, to understand the subduction system, consideration of both characteristics of P- and S-anisotropy is required. In particular, mantle anisotropy is an essential factor. Accordingly, to resolve the three-dimensional S-wave anisotropic velocity structure of the Japan islands, we are working on tomographic study using S-wave travel-time under the same conditions as P-wave. In this study, we developed a three-dimensional S-wave anisotropic tomography method and applied it to S-wave travel-time data compiled by JMA to reveal a three-dimensional S-wave anisotropic velocity structure beneath the Chugoku and Shikoku district.

Keywords: P-wave anisotropy, S-wave anisotropy, travel-time tomograpy, azimutal anisotropy