Shear-wave splitting around the Japanese Islands and its implications for lattice-preferred orientation of olivine

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A shear wave propagating through an anisotropic body splits into two shear waves with different velocities. A delay time between two waves is related to the strength of anisotropy along the path between source and receiver and a polarized direction of the first shear wave (fast direction) reflects the direction of anisotropy.

Many researchers have investigated shear-wave splitting in various subduction zones and found that anisotropy exists in the mantle wedge. The observed fast direction has been discussed in terms of mantle flow (Savage, 1999). Seismic anisotropy around the Japanese Islands has been studied mainly by shear-wave splitting measurements, and the understanding of mantle dynamics has been enhanced through obtained splitting parameters [e.g., Nakajima and Hasegawa, 2004; Long and van der Hilst, 2005; Anglin and Fouch, 2005].

Nakajima et al. [2006] investigated shear-wave splitting in the southwestern part of the Kurile arc and the northeastern Japan arc. For both arcs observed shear-wave splitting shows clear evidence for a striking rotation of fast direction across the arc, suggesting the different nature of anisotropy between the fore-arc and back-arc sides. Trench-parallel fast directions are observed in the fore-arc side, while fast directions observed in the back-arc side show approximately E-W or ESE-WNW in the NE Japan arc and N-S in the southwestern Kurile arc, which are characterized by the local dip direction of the subducted Pacific plate. In SW Japan, Hori et al. [2006] investigated shear-wave splitting and revealed that observed fast directions are almost E-W, suggesting the existence of anisotropy in E-W direction in the upper mantle.

This paper reviews recent observations of shear-wave splitting around the Japanese Islands and discusses a lattice-preferred orientation of olivine in terms of a plausible cause of anisotropy in the upper mantle.