Rock seismic anisotropy of Avacha peridotite xenoliths, Southern Kamchatka

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Shear-wave polarization anisotropy has been systematically investigated in the mantle wedge; it is common that fast directions in the fore-arc side are oriented subparallel to the trench, whereas fast directions in the back-arc side are oriented perpendicular to the trench (e.g., northeastern Japan: Nakajima and Hasegawa, 2004, Nakajima et al., 2006; Kamchatka: Peyton et al., 2001; Tonga: Smith et al., 2001). It is generally accepted that anisotropy in the back-arc side is likely to reflect olivine fabrics in the mantle wedge (e.g., Michibayashi et al., 2006). In contrast, several possible causes of anisotropy in the fore-arc side have been considered: deformation of water-rich olivine (i.e. B-type of Jung and Karato, 2001) in the mantle wedge, trench-parallel flow in the mantle wedge arising from along-strike variations in the dip of the slab, anisotropy in the crust and slab, and the occurrence of highly anisotropic foliated antigorite serpentine (e.g., Tasaka et al., 2008 and see their references). Yet, what we do not have any constraint is the mantle fabric beneath the volcanic front: i.e. rock seismic anisotropy in the low velocity zone. Here, we present that peridotite xenoliths from the uppermost mantle beneath the Avacha volcano, Kamchatka, preserve strong asymmetric fabrics with intermediate seismic anisotropy, and that the characters of the peridotite xenoliths are remarkably compatible with those derived from the uppermost mantle in the back-arc side of the mantle wedge reported previously. We calculated the seismic properties of the xenoliths from olivine and pyroxene CPOs and single crystal elastic constants. The small magnitude of measured S-wave splitting (delay time of 0.1-0.3 s in the area where the xenoliths were entrained) can be explained by the average seismic properties of mantle xenoliths for an approximately 13-38 km thick horizontal anisotropic layer. Consequently, it implies that although the low velocity zones are commonly attributed to the zones of partially melted mantle, the propagation of melt could not erase the existing CPO and related seismic anisotropy.