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Seismic anisotropy of the mantle wedge beneath the Sikoku region, Japan, from shear-wave splitting

Tadashi Terada[1*], Yoshihiro Hiramatsu[2]

[1]Natural Sci and Tec., Kanazawa Univ., [2]Natural System Kanazawa Univ.

A high-Vp/Vs region detected by seismic tomography suggests the existence of serpentinized peridotite in the mantle wedge beneath Shikoku region, Japan (Matsubara et al., 2008). Single-crystal of antigorite generates seismic anisotropy up to 72%. We can, thus, expect to detect the seismic anisotropy of serpentinized peridotite beneath Shikoku region using shear wave splitting. We perform the shear wave splitting analysis of Silver and Chan (1991) for waveforms of deep events (source depth of 30~80 km) recorded at Hi-net stations in Shikoku from 2004 to 2008. We obtain the orientation of a faster shear wave of NEE-SWW to E-W and the delay time of 0.02-0.15 s.

The lattice preferred orientation (LPO) of antigorite with the degree of 10% and the trench parallel b-axis and the trench normal a-axis inclined 10-20 degrees from the horizontal in a 20 km-thick layer can satisfy the observations. However, the crustal anisotropy also explains the observations (Kaneshima and Ando, 1989) and we find no difference of splitting parameters between the western Shikoku and the eastern Shikoku where no serpentinized peridotite is expected. We, therefore, consider that the shear wave splitting observed in this study is caused by the crustal anisotropy. This may show that there is no LPO in the mantle wedge beneath Shikoku region but the LPO with the vertical c-axis or an extremely thin layer of the LPO may also be a possible cause of no distinct shear wave splitting in the mantle wedge.

Keywords: seismic anisotropy, shear-wave splitting, high-Vp/Vs region, serpentine