Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG62-11 Room:103 Time:May 20 11:45-12:00

Anisotropic structures of oceanic slab and mantle wedge in a deep low-frequency tremor zone beneath the Kii peninsula

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Anisotropy is an important feature of elastic wave propagation in the Earth and can arise from a variety of ordered architectures such as fractures with preferential alignments or preferred crystal orientations. We studied regional variations in shear wave anisotropy around a deep low-frequency earthquake (LFE) zone beneath the Kii Peninsula, SW Japan, using waveforms of local earthquakes observed by a dense linear array along the LFE zone. The fast directions of polarization are subparallel to the strike of the margin for both crustal and intraslab earthquakes. The delay time of the split shear waves in intraslab earthquakes is larger than that in crustal earthquakes and shows a down-dip variation across the LFE zone. This indicates that anisotropy exists in the mantle wedge and in the lower crust and/or oceanic slab. We explain the observed delay time of 0.015˜0.045 s by suggesting that the mantle wedge consists of a deformed, 1˜15 km thick serpentine layer if the mantle wedge is completely serpentinized. In addition to high fluid pressures within the oceanic crust, the sheared serpentine layer may be a key factor driving LFEs in subduction zones.

Keywords: shear wave splitting, LFE, mantle wedge, serpentine, subduction zone, SW Japan