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Seismic radial anisotropy of the lithosphere and asthenosphere beneath the Shikoku Basin from records by OBSs

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In order to constrain the one-dimensional radially anisotropic structure of the oceanic upper-most mantle, we analyze surface waves in a broadband frequency range, 0.01-0.15 Hz (7-200 sec), using in-situ observed data. Data are those of broadband ocean bottom seismometers (OBSs) operated in the Shikoku Basin, the past (15-30 Ma) back-arc spreading region in the western-most part of the Pacific Ocean. For the first step of analyses, we measure average phase velocities of Love and Rayleigh waves in the Shikoku Basin area using two methods: seismic interferometry at frequencies higher than 0.035 Hz (30 sec), and conventional array analysis of earthquake waveforms at lower frequencies. Obtained phase velocities are consistent between two methods at an intermediate frequency band around 0.035 Hz. We then search for the optimal 1-D radially anisotropic structure that fits observed and theoretical waveforms by simulated annealing.

As a result, there are two types of structures, RAS1 and RAS2, that can similarly explain the observation. For both types of structures, SH-wave is faster (VSH > VSV), the intensity of radial anisotropy (VSH?VSV)/Vmean is 5-10 % at a depth range of 50-80 km, and smaller than 5 % at depth shallower than 30 km. This result is not affected by scaling laws that constrain parameters, such as the intensity of P-wave radial anisotropy. The depth of the largest anisotropy is deeper than the top of low velocity zone for RAS1, and is same as the top of low velocity zone for RAS2. RAS1 implies that the intensity of radial anisotropy is decreased at shallower depth by some mechanism such as canceling with opposite anisotropy VSV > VSH made at the spreading center. RAS2 implies that radial anisotropy is strongest at the top of low velocity zone due to strain accumulation or the melt-layering structure in the asthenosphere.