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One-dimensional shear velocity structure beneath Okinawa trough inferred from surface wave phase velocity

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Structures beneath back-arc basins or marginal seas are as important as those just beneath island arcs to understand the whole systems of subduction zones. However number of studies on structure beneath back-arc basins is limited because of few seismic stations in back arc basin.

This study focuses on the structures beneath Okinawa trough. Philippine sea plate is subducting along the Ryukyu trench and the Ryukyu arc is an island arc of this subduction zone. Okinawa trough is located in backarc region of Ryukyu arc and is considered to be a region of backarc spreading. Crustal structure along the Okinawa trough has been investigated by the Japan Coast Guard (e.g. Horiuchi et al., 2011) and the Moho depth has been obtained. For the upper mantle structure, Nakamura et al. (2003) inferred three dimensional P and S-wave structure by body wave tomography and several studies inferred three dimensional S-wave tomography as a surrounding part of continent by surface wave tomography (e.g., Huang and Zhao, 2006). However, the mantle dynamics beneath the Okinawa trough has not been well imaged.

As the first step of investigation of the mantle dynamics beneath the Ryukyu arc and Okinawa trough, we inferred one-dimensional shear-wave velocity structure of crust and uppermost mantle beneath the Okinawa trough. We also inferred that beneath East China Sea continental shelf.

We measured phase velocities of Rayleigh and Love waves by two-station method and obtained dispersion curves. We used stations of F-net of National Research Institute for Earth Science and Disaster Prevention (NIED), China Digital Seismograph Network (CDSN), and Global Seismograph Network (GSN).

We then inferred one-dimensional shear-wave average structure along the path by genetic algorithm. We assumed radial anisotropy in uppermost mantle (Moho to 220 km) and isotropy in other layers.

Shear wave velocities just below the Moho beneath the Okinawa trough is significantly lower than that beneath the continental shelf. It may suggest partial melting due to upwelling beneath the Okinawa trough. However, the velocities around 220 km is higher than that beneath the continental shelf, suggesting that origin of the upwelling is not deep. The upwelling could be a passive flow like that beneath mid-ocean ridge. SV velocities beneath western part of the Okinawa trough is lower than SH velocities, while SV and SH velocities beneath eastern part are similar to each other. This radial anisotropy may be caused by the shape of the cracks of partial melt or preferred orientations of mantle minerals.

Keywords: Okinawa trough, backarc spreading, seismic structure, surface wave