Subsurface structure below the southernmost area of South Japanese Alps estimated by seismic interferometry imaging

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In the Tokai area, seismological events, such as low frequency events and slow slip events as well as large earthquakes, are occurred caused by subduction of the Philippine Sea (PHS) plate. The eastern Tokai area is a transition zone from the collision zone of Izu arc to the subduction area. To understand the subsurface structure in this area and fill the gap between the previous seismic surveys, a seismic observation using a dense seismic linear array composed of 34 receivers was conducted in 2013.
In this study, we applied seismic interferometry imaging to the seismic records of the array observation. Seismic interferometry can retrieve the reflection response between two receivers as if one receiver is a virtual shot and the other is a receiver by calculating the cross-correlation of the transmission responses recorded at the two receivers. For a single receiver, the reflection response recorded at the receiver from a source at the same location is retrieved by calculating the autocorrelation of the transmission response recorded at the receiver. In this study, we used regional deep earthquakes occurred in the Pacific Oceanic slab as the seismic sources to image the PHS plate and crustal structures. We conducted autocorrelation analysis and created reflection profiles for both P- and S-waves. We projected the cross-correlation between two adjacent stations to their mid-point to improve the spatial density of the stations. After migration using the velocity structure obtained by the tomography analysis, we obtained the P- and S-wave reflection depth profiles.
In the S-wave depth profile, the shallower area above 25 km shows reflective, while the deeper area is less reflective. The boundary becomes shallower to the north-east of the profile. By comparing this profile with the result of other seismic surveys and with pre-existing plate models, we interpreted that the strong reflectors shown at the depth about 25 km in the southwest of this profile are the plate boundary. This interpretation is consistent with the result of Hirose et al. (2008) showing that the basaltic oceanic crust of the PHS plate shows low Vs and high Vp/Vs. In the eastern half of the profile lacks reflectors that correspond to the plate boundary. This may be attributed to a weak contrast of physical properties between the felsic island arc crust proposed by Kodaira et al. (2004) and the Japanese island arc crust, or complicated geological structure due to the collision of Izu arc.

Keywords: seismic array observation, seismic interferometry, reflection depth profile, plate boundary

