Moho and Philippine Sea plate structure in the central Japan from receiver function analysis

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In the central Japan, the Itoigawa-Shizuoka tectonic line (ISTL), that forms the western margin of the Fossa Magna, runs through this area from the north to the south and intersects the Median tectonic line (MTL) at the Suwa city. In the south region, the Philippine Sea (PHS) plate is subducting from the Suruga trough and the Sagami trough to the northwest with a collision of the Izu Peninsula. In order to understand the tectonics of this area, we investigate the Moho and Philippine Sea plate structure on the basis of the teleseismic receiver function analysis.

In this study, we use teleseismic P waves recorded by the J-array, the Hi-net and a temporal local seismic network, which was conducted around the northern and central part of the ISTL [Yoshimoto et al. (2002)]. We use 257 stations from these seismic networks and 166 earthquakes that range in epicentral distance from 30-90 degree and in magnitude 6.0 to 7.0. Teleseismic waveforms with duration of 30s from 5s before the P wave arrival based on the IASP91 velocity model are used to construct receiver functions. The receiver functions are calculated using a stabilized deconvolution technique known as the water level method (water level =0.001) in the frequency domain. To remove the high-frequency noise, a Gaussian low-pass filter of a=3 is applied. After the visual inspection to remove the unstable receiver functions, on which large ripple preceding to the P arrival are found, we obtain 4179 receiver functions through a series of screening processes. Assuming a single Ps conversion, we transform time domain receiver functions into space domain on the basis of the migration technique using the reference velocity model.

Regional variation of the Moho depth and the upper boundary of the subducting PHS plate are obtained from the receiver function analysis. A good spatial correlation between the conversion location of Ps phase and the hypocentral distribution in the subducting slab is observed at depths shallower than 40 km, except for the northwest part of Yamanashi prefecture, where seismic activity is very low and clear Ps phase is not detected. In the Tokai region, the upper plane of the subduction slab down to the depth of 70km is detected beneath the northwest of the Gifu prefecture to the center of the Nagano prefecture. The conversion phases from the Moho are observed beneath the inland area at the depth of about 30-40 km. These phases are clear in the middle and northern part of the area studied. The depth of this discontinuity increases from the north to the south and from the west to the east. Vertical profiles based on the receiver functions from array stations suggest that the Moho changes its depth discontinuously in the vicinity of the ISTL and MTL. To verify this characteristic, the back-azimuth dependence of the receiver functions at the stations adjacent to these tectonic lines is investigated. At stations near the ISTL, the conversion depth of the Moho phase increases about 5 km in the east of the ISTL. This result indicates a sudden increase of the Moho depth right beneath the ISTL. The conversion depth of the Moho phase observed at stations near the MTL decreases in the northwest. This result and the previous array analysis indicate the shallow Moho in the region between the ISTL and MTL compared to the outer region.