Undulation of the upper mantle discontinuities beneath the Japan Islands - With depth-migration based on 3-D velocity models -

Takashi Tonegawa[1]; Kazuro Hirahara[2]; Takuo Shibutani[3]

[1] Grad. Sch. Env. Studies, Nagoya Univ.; [2] Environmental Studies, Nagoya Univ.; [3] RCEP, DPRI, Kyoto Univ.

We applied receiver function (RF) analyses to P wave coda potions of 389 teleseismic events observed at 138 high density broadband stations including F-net, J-array, IRIS and Korean stations in order to present high-resolution RF imaging and to investigate the 410 km and 660 km seismic velocity discontinuities and the descending Pacific plate (PAC) in the upper mantle beneath both the Japan Islands and the Korean Peninsula.

RFs are constructed through frequency domain division of radial components by vertical ones with a water level of 0.01. The low-pass Gaussian filters of 0.1, 0.3, 1.0 Hz are also applied to examine the frequency dependence of the visibility of the discontinuities. Assuming the phases in RFs are produced by Ps converted ones at depths, we transform the time domain RFs to the depth domain ones using recent regional P- and S-wave 3-D tomographic velocity models.

Beneath the Japan Islands, the dipping positive RF amplitudes corresponding to the PAC can be traced to a depth of 200 km clearly, and further down to a depth of 600 km slightly. Comparing the distribution of the earthquakes with positive RF amplitudes corresponding to the PAC, the small dipping part of the PAC can be detected remarkably, in contrast, the large dipping one of the PAC cannot be traced clearly. The 660 km discontinuity is confirmed clearly and uniformly beneath the whole Japan Islands. Similarly, 410 km discontinuity is detected clearly beneath the Japan Islands. However, beneath the Korean Peninsula, the 410 km one is not detected clearly. We consider that the reasons are both the differences of the station spacing and the regional differences of the thickness of the 410 km discontinuity. Also, the 410 and 660 km discontinuities are undulated due to the subducting cold PAC slab. That is, in our results, the 410 km discontinuity seems to be locally elevated by 30 km, from 420 km to 390 km, where the PAC penetrates, and the 660 km discontinuity is broadly and gradually downwarped westwards by 50 km, from 680 km to 730 km, which is consistent with the stagnated PAC on the 660 km discontinuity.

Since the 3-D velocity model we use cannot have realized high-resolution in the deep Earth, the 660 km discontinuity is elevated where the PAC stagnates despite the negative Clapeyron slope. However, comparing the undulation of the 410 km discontinuity referring to the 3-D velocity model with the one referring to iasp91, the large difference of the undulation cannot be seen except for the absolute value. This would indicate that the effect of the lateral variation, such as mantle wedge, cold subducting slab, beneath the Japan Islands is relatively small.

We are grateful to the J-array, F-net, IRIS and KIGAM for providing the data, and we are especially thankful to Prof. D. Zhao in Ehime University, Prof. K. Koketsu in Univ. of Tokyo, Dr. Nakamura in Japan Meteorological Agency for giving us 3-D P- and S-wave velocity models, respectively.