

Resolving power of receiver functions produced from Hi-net stations to reveal upper mantle discontinuities

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We have so far applied receiver function (RF) analyses of seismic waveforms observed at F-net, J-array and IRIS broadband stations to investigate the upper mantle velocity discontinuities beneath the Japan Islands. In our analyses, we have used a much larger number of data and stations than those in previous studies. These broadband stations, however, have an enough density of broadband stations for obtaining a clear 3-D image of upper mantle discontinuities. On the other hand, we have another seismic network, Hi-net, operated by NIED (National Research Institute for Earth Science and Disaster Prevention). In spite of short-period stations, this network has much higher station spacing than other broadband networks. In this study, in order to get finer receiver function images of upper mantle discontinuities than those with only use of broadband data, we examine the resolving power of short period seismic waveform data of Hi-net to reveal the upper mantle discontinuities.

We have so far examined 2,308 short-period seismograms observed at 432 Hi-net stations. We used 72 teleseismic events with the magnitudes greater than 5.5, which occur during a period from Oct 2000 to Jun 2002. 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 0.06, 0.1, 0.3 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 P- and S-wave 3-D tomographic velocity models. Then, SVD filtering is applied to the depth domain RFs. We keep largest 6 eigenimages to construct filtered RFs. Finally, we construct 2-D stacked RF image projected on cross-sections along several profiles to see the detailed velocity discontinuity structure.

In case of long period component, both the 410 km and 660 km discontinuity are confirmed partly beneath the Japan Islands, although they cannot be seen in case of relatively short period component less than 3 seconds in this study. The subducting PAC, however, cannot be traced since there were only small number of stations in Kanto region, central Japan in the analyzed period. RF image, produced by more than 10 seconds component, shows the 520 km discontinuity beneath the Kanto region. We can say that there is a possibility that the data provided by Hi-net show the high resolution RF image, because the number of the station has increased in Tokai and Kanto region since Apr 2003. The power of short-period waveform data to reveal upper mantle discontinuities will be increased with the augmented RFs constructed from new station data after April 2003.

We are grateful to NIED 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.