P and S wave receiver function imaging of crustal structure beneath the Kii Peninsula

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In conventional receiver function (RF) analyses, we have usually analyzed P wave coda portions from teleseismic events and used P-to-S converted (Ps) waves that are generated at the discontinuities of seismic velocity beneath the observation stations (e.g., Tonegawa et al., 2005). On the other hand, there have been few RF analyses which use S-to-P converted (Sp) waves. Here, we distinguish two RF receiver analyses and call the RF analyses of Ps and Sp waves P-wave and S-wave RF ones, respectively. P-wave RF analyses have so far revealed remarkable structures of velocity discontinuities such as Moho. In addition to P-wave RFs, however, inclusion of S-wave RFs would double the data, leading us to obtain the more detailed structures. The analyses of Sp converted waves are inferior to the ones of Ps converted waves in the survey of deep structure, but they have the advantages that Sp waves are not affected by multiple reflected or scattered waves from the shallow discontinuities because Sp converted waves arrive before S waves. Therefore S-wave RFs are enough worth utilizing in the structural survey. In this study, we examined the potential of S-wave RF analyses, and in addition tried to obtain the more detailed structure by joint analyses of both P and S-wave RFs.

We investigated the crustal and the uppermost mantle structure beneath the Kii Peninsula in this study. We used the waveforms observed at a F-net broadband station from teleseismic events with the magnitudes lager than 6.0 and the distance greater than 30 degree. P-wave RF was calculated by deconvolving the radial component with the vertical one, but S-wave RF was calculated by deconvolving the vertical component with the radial one. Then we applied 1 Hz low-pass Gaussian filter to exclude high frequency noises, and also SVD filter to enhance the coherent phases in RFs for each station. Moreover we transformed the time domain RFs into the depth domain ones, and made RF image by projecting RFs onto the cross section and stacking them.

In the P-wave RF image beneath a station of Nogami in the Kii Peninsula, we could recognize clear Ps phases at the Conrad, the Moho, and the oceanic Moho of the Philippine Sea plate. On the other hand, in S-wave RFs, we found the phases that are regard as Sp ones converted at the Conrad and the Moho. It was, however, difficult to find the Sp phases converted at the oceanic Moho of the Philippine Sea plate, because of fewer S-wave RF data including Sp phases at the depth of the oceanic Moho of the Philippine Sea plate. This is why there are no Sp rays converted at deep discontinuities such as the oceanic Moho of the Philippine Sea plate from the events with the epicentral distances less than 50 degrees. Moreover, since S-wave portions was worse in quality than P-wave one, we could get less sharp phases in S-wave RFs than in P-wave ones. However Sp converted waves have larger ray parameter than Ps ones and the distances of the Sp conversion points from the station are larger and different from those of Ps ones. Therefore, we could investigate the wide range structure by S-wave RF analyses in addition to P-wave ones. This study suggests that joint P and S-wave RF analyses enable us to investigate effectively the relatively shallow structure in the crust and the uppermost mantle beneath the observation stations.