Radial, transverse and vertical receiver function analyses -Dipping seismic discontinuities beneath the Kii Peninsula-

Kazuo Ogawa[1]; # Kazuro Hirahara[1]; Takuo Shibutani[2]

[1] Geophysics, Sciences, Kyoto Univ.; [2] DPRI, Kyoto Univ.

http://www-seis.kugi.kyoto-u.ac.jp/~hirahara/

Three kinds of receiver function analyses are examined for elucidating the dipping seismic velocity discontinuities in the crust and upper mantle beneath linear seismic array stations with the spacing of 5 km in the Kii Peninsula, southwest Japan. First one is the radial receiver function (RF) analysis, in which the radial component of the P-wave coda portion from a teleseismic event is deconvolved with the vertical one. This analysis enhances the phases converted from P to S-wave (Ps) at seismic discontinuities beneath the seismic station. The second one is the transverse RF analysis and the transverse component is deconvolved with the vertical one, which enhanced Ps phases at dipping seismic velocity discontinuity interfaces. These two are rather traditional, but the last one is new. That is the vertical RF analysis and the vertical component is deconvolved with the source time function of the event. For obtaining the approximate source time function, we stack all the vertical waveforms observed at the whole seismic array stations. The vertical RF enhances the reflected P waves (Ppdp) at the surface and the seismic velocity discontinuities (d) beneath the station.

In deconvolution, we use extended-time multi-taper method (Shibutani et al.,2008). And we apply Gaussian low-pass filter of alfa=5.0 for radial and transverse RFs and of 3.0 for vertical RFs.

Assuming phases in RFs are Ps and Ppdp ones, we transform time-domain RFs to depth-domain ones based on a reference 1-D velocity model of JMA2001. Then, we stack the RF amplitudes projected onto cells with 1x1 km along the south array. Radial and transverse RF images show the dipping seismic discontinuities of the continental Moho at depths of 20-40 km, and of the oceanic Moho at depths of 30-90 km, accompanied by polarity reversals in transverse RFs according to back-azimuths. Vertical RF image additionally shows the discontinuity between the upper and the lower crust at depths of10-20 km.

To investigate the effect of 3-D dipping interfaces when transforming to depth RFs assuming a 1-D reference model, we construct the 3-D heterogeneous model with the 3-D dipping Philippine Sea slab and produce synthetic waveforms including Ps and Ppdp phases at the Moho, the slab top, the oceanic Moho and the slab bottom using GBM method (Hirahara,2006) which is modified from Sekiguchi (1992). Then, referring to the synthetic time-domain RFs, we recognize each phase in observed RFs examining arrival times and polarities according to back-azimuths. Next, we produce RF images from synthetic waveforms in the same way as in the observed ones. We compare the assigned dipping discontinuities with the imaged ones to confirm the 3-D dipping effects.

Though this study is preliminary, through RF analyses with synthetic waveforms, we show that three-kinds of receiver function analyses have potentials for determining P and S wave velocity structures together with the 3-D dipping velocity discontinuities in combined with local travel time tomography.