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Anisotropic feature inferred from receiver function and S-wave splitting analysis around the high strain rate zone

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In the high strain rate zone (HSRZ), E-W compressive stress field is observed, and large earthquakes with M>6 are frequently occurred. In this study, we try to reveal depth-dependent anisotropic feature in this region by using teleseismic receiver functions (RFs) and S-wave splitting information. As a target, we select NIED Hi-net stations N.TGWH and N.TSTH, which are located very close to the HSRZ. For RF analysis, we choose M>5.5 teleseismic events from October 2000 to September 2012. Low-pass filters with fc = 1 and 2 Hz are applied to estimate RFs. In the radial RFs, we find clear positive phase arrivals at 4 s in delay time for both stations. Since this time delay corresponds to 35 km-depth velocity discontinuity existence, these phases may be the converted phases generated at the Moho discontinuity. Seeing the back-azimuth paste-ups of the transverse RFs, we can find polarity changes of later phases at 4 s in delay time at the N.TSTH station. This polarity change occurs for direction of N0E (north), N180E (south), and N270E (west). Although we have no data in N90E (east) direction, this feature implies that anisotropic rocks may exist above the Moho. In order to check this feature, we consider 6-layered subsurface model and compare synthetic RFs with the observation. The first three layers are for thick sediments and upper crust including a dipping velocity interface. The fourth, fifth and sixth layer corresponds to the mid crust, lower crust and uppermost mantle, respectively. The best model infers that the mid- and lower-crust beneath the N.TSTH station should have strong anisotropy whose fast axis directs to the N-S, though the fast axis in the uppermost mantle seems to show E-W direction. At the N.TWAH station, we should consider that thick low-velocity mid crust whose fast axis directs to the N-S in order to explain clear negative phases arriving just before the Moho phase. To check anisotropic feature of these stations, we also apply S-wave splitting analysis to the local events. In order to avoid contaminations of scattered phases, we select seismic waveforms with incident angle less than 35 degrees. We select good S/N records and apply 2-8 Hz butter-worth type band-pass filter to the waveforms. Then, we estimate the leading S wave polarization direction (LSPD) and delay time of each event. We can select crustal earthquakes (< 30 km in depth) and the intermediate-depth earthquakes (80˜120 km) which occur along the subducting Pacific slab. For deeper events, LSPD shows NW-SE. On the other hand, only for shallow events, LSPD indicates NNW-SSE. This result is consistent with the feature of RFs. We can conclude that the crustal anisotropic feature beneath these stations corresponds to the lineament on the ground surface, not to the E-W compressive stress field. The LSPD in the uppermost mantle may reflect to the lattice-preferred orientation of anisotropic minerals beneath the stations.

Keywords: High strain rate zone, Receiver function, Anisotropy, NIED Hi-net