The detailed hypocenter and stress distribution around the Itoigawa-Shizuoka Tectonic Line

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The Itoigawa-Shizuoka Tectonic Line (ISTL) in central Japan is a 150 km long fault system, consisting of north-trending east-dipping reverse, northwest-trending left-lateral strike-slip, and north-trending west-dipping reverse faults. To estimate the detailed hypocenter and stress distribution is important for understanding the fault structures and complex tectonics around the ISTL. We relocated the hypocenter locations, using the differential arrival time obtained by both manual picking and waveform cross-correlation analysis. We estimated the spatial distribution of stress field by applying the stress inversion to the focal mechanisms.

The hypoDD algorithm was applied to the double-difference data using the initial hypocenters which were estimated by using the three-dimensional structure around the ISTL (Takeda et al., 2006). We used the 8,800 earthquakes which occurred in the period between 1 January 2002 and 31 May 2007. The differential arrival times for the manually picked P- and S-wave were 180 million pairs. We also used the differential arrival times obtained by the waveform cross-correlation analysis. The correlation measurements were conducted by using a velocity waveform of 0.75 s time window applied a 3-20 Hz band-pass filter, including the manually picked P- or S-wave arrival times. We obtained a data set of accurate differential arrival times that contained 111 million pairs.

We determined the focal mechanisms using absolute P and SH amplitudes and P-wave polarity. According to the method in Ide et al. (2003), we determined the spectral levels by fitting the omega2-model (Boatwright, 1987). We determined the focal mechanisms for the events which have the P-wave polarity data greater than or equal to 10. We could precisely determine the focal mechanisms of 710 events around the ISTL.

The lower limit of hypocenter depth distribution around the ISTL is getting deeper from the northern to the southern part. The seismogenic zone is thinning around the Suwa Lake in the central part of The ISTL. A cluster of earthquakes is located at 15km depth under the Kamiya Fault in the northern part of the ISTL, which have strike slip or intermediate type focal mechanisms with the P axes of EW direction. In the northern and southern part of the ISTL, we can observe the earthquake distribution at the deep part of the ISTL. The focal mechanism of these earthquakes is strike-slip or reverse fault.

We estimated the spatial distribution of stress field along the ISTL, using the multiple inversion method (Yamaji, 2000; Otsubo and Yamaji, 2006). We identified the different stress solutions from the inversion results, using the k-means clustering algorithm (Otsubo et al., 2006). We could find 5 different stress solutions around the ISTL. We verified the stress solution acting on each focal mechanism, by comparing the maximum shear stress direction calculated from each stress solution and the observed slip direction on the nodal plane of focal mechanisms. We estimated the spatial changes of stress field from the focal mechanisms of which observed slip directions are consistent with only one stress solution. As a result, it is found that the spatial stress distribution estimated by this method is consistent with the slip direction on the each fault segment of the ISTL.