Scaling relationship for intra-slab earthquakes (2)

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Intra-slab earthquakes excite remarkably larger quantities of high frequency seismic waves (higher than 1Hz) than do in-land and plate-boundary earthquakes of similar magunitudes. Qualitatively, this feature can be explained to a certain extent by the larger stress drop for intra-slab earthquakes. This means that the scaling relationship between the total area of asperities and the seismic moment for intra-slab earthquakes differs from that for earthquakes of other categories. Morikawa and Fujiwara (2001) pointed out that the scaling relationship for intra-slab earthquakes might possibly depend on the focal depth and/or by regions.

The December 2, 2001, Iwate-ken Nairiku-nanbu (IWT) earthquake (Mj=6.3, depth 130 km) had a hypocenter located in the lower plane of the double seismic zone in the Tohoku region and had a down-dip extension type focal mechanism. This situation is similar to the 1993 Kushiro-oki (KUS) earthquake (Mj=7.8, depth 101km). Here we examine regional variations in the scaling relationship by comparing source models for the IWT and KUS events.

We use a source model of the KUS event estimated by Morikawa and Sasatani (2001). Following their method of analysis, we constructed a source model of the IWT event using the empirical Green's function (EGF) method. We used as the EGFs the velocity records for a small event occurring near the IWT event hypocenter which were obtained by the Hi-net seismographic network operated by NIED. For the IWT main shock, however, we used strong motion accelerograms of KiK-net recorded in the same borehole as Hi-net seismographs, because some of the Hi-net records for IWT event were saturated. Instrument responses were corrected for for Hi-net records. We used the two horizontal components in this analysis, and all of them were band-pass filtered between 0.3 to 10 Hz. The source model was hypothesized as a configuration of several rectangular-shaped asperities on the fault plane. We estimated, by forward modeling, the area and stress drop of each asperity.

Comparing the two source models and assuming that a self-similar scaling low holds between the total area of asperities and the seismic moment, the total asperity area of the IWT event is somewhat larger than that of the KUS event. Correspondingly, the maximum stress drop of the IWT event is somewhat lower than that of the KUS event. Considering the uncertainties in the estimates of the fault area and stress drop for the small event, however, the differences cannot be regarded meaningful. We conclude that we do not need to consider regional differences in the scaling relationship for intra-slab earthquakes, at least for those occurring in the lower plane of the double seismic zone in the Tohoku and Hokkaido regions.