Spatiotemporal variations of the aftershock distributions after the occurrence of the 2004 mid-Niigata prefecture earthquake

Aitaro Kato[1]; Shin'ichi Sakai[2]; Naoshi Hirata[1]; Satoru Nagai[1]; Eiji Kurashimo[1]; Takashi Iidaka[3]; Toshihiro Igarashi[1]; Yoshiko Yamanaka[3]; Satoko Murotani[4]; Tomonori Kawamura[5]; Takaya Iwasaki[6]; Toshihiko Kanazawa[7]

[1] ERI, Univ. Tokyo; [2] Earthquake Research Institute, Univ. of Tokyo; [3] ERI, Univ. of Tokyo; [4] ERI,Univ. of Tokyo; [5] ERI; [6] ERI, Tokyo Univ.; [7] ERI, Tokyo Univ

A shallow Mw 6.6 inland earthquake occurred in northwestern Japan (Niigata prefecture) on October 23, 2004, and caused serious seismic damages including landslides in the surrounding areas. It is remarkable that the number of large aftershocks is significantly greater than other large inland earthquakes (JMA) that have recently occurred in Japan, and the sequence of aftershocks with magnitudes greater than 4 continued for approximately 2 weeks after the occurrence of the mainshock. The aftershock distributions have changed with the elapsed time after the occurrence of mainshock by inducing the large aftershocks, and finally showed the highly complex patterns composed of many earthquake clusters. The interaction between the earthquake clusters through the stress transfer has potential to develop such complex aftershock distributions. Since the accurate aftershock distributions are significant to understand the earthquake interaction through the stress transfer and the crustal heterogeneity, it is critically of importance to determine the accurate hypocenter locations with dense seismic network.

We deployed 56 temporary seismic stations during approximately one month after the occurrence of the 2004 mid-Niigata prefecture earthquake. The number of 1059 aftershocks has been relocated using the manually picked arrival data obtained at the temporary and the surrounding permanent seismic stations. Since the crustal velocity structure laterally changes around the source region (Takeda et al, 2005, A. Kato et al., 2005), the hypocenter locations are determined assuming two different 1D velocity structures of the northwestern and southeastern sides of the source region. The boundary between these velocity structures roughly coincides with that of the Muikamachi fault and its northeastward extension. Further, the station corrections are determined using the average of the residual at each station, and adopted to the hypocenter calculations.

Based on the spatiotemporal variations of the relocated aftershocks, at least, the fault planes for ten large events are identified. It is further observed that the aftershock area extended to both northeastward and southwestward directions. The eastward dipping fault planes are dominant on the northeast edge, which is also supported by the geological studies. The triggered seismicity at the northeast edge was more significant than the southwest one. This difference could be interpreted by the discrepancy of the accumulated shear stress level at the mainshock rupture.