Spatio-temporal occurrence patterns among the foreshocks preceding the 2007 Noto Hanto earthquake

Issei Doi[1]*, Hironori Kawakata[1]

[1]College of Science and Engineering, Ritsumeikan University

Foreshocks are a key for understanding the preparation and generation processes of the mainshock. In rock failure experiments, it is well known that acoustic emissions occur prior to the major failure (e.g. Scholz, 1968; Lockner et al., 1992). Recently, analyses of seismograms recorded by a dense seismic observation network have revealed new insights of foreshocks through studying uncataloged smaller foreshocks. Clustered foreshocks adjacent to the mainshock hypocenter with identical seismograms were found for the 1999 Izmit inter-plate earthquake in Turkey (Bouchon et al., 2011) and the 2008 Iwate-Miyagi Inland crustal earthquake in Japan (Doi and Kawakata, 2012). In this study, we try to make it clear how common the clustered foreshock occurrence and to grasp whether other foreshocks occur in total mainshock rupture volume. Focusing on the 2007 Noto Hanto Earthquake with JMA (Japan Metrological Agency) magnitude (Mj) of 6.8, we estimated the spatio-temporal clustered seismicities of the foreshocks in the source region.

By analyzing continuous seismograms that recorded activity in the 25 days before the earthquake, we detected 36 small seismic events around the mainshock hypocenter that classified as members of mainly three clusters. Two clusters included more than ten events and occurred some distance from the mainshock fault, indicating that the clusters did not relate to the mainshock event. The cluster located along the mainshock fault was only the third one. Especially, this cluster was mapped in the same general vicinity as the rupture initiation point of the mainshock and consisted of four foreshocks in succession with identical seismograms. This cluster began twelve minutes before the mainshock and then ceased for period of quiescence for the last eight minutes. The occurrence pattern of this clustered foreshock sequence is similar to that observed in association with the 2008 Iwate-Miyagi Inland earthquake.