

Temporal change of focal mechanism pattern in the Tohoku-oki region

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It is well known that after the occurrence of a megathrust earthquake, a pattern of focal mechanisms of subsequent events changes since stress field near the hypocenter is significantly changed. For example, in the case of the 2011 Tohoku-oki earthquake, the number of normal-fault earthquakes increased after the mainshock (e.g., Asano et al., 2011). Temporal change of the focal mechanism reflects the stress accumulation / release process in-between the megathrust earthquakes and the stress state recovery after the mainshock to pre-mainshock condition. However, there are still few studies discussing the temporal change of focal mechanism at high time resolution. In order to track the temporal change of stress field near the source area of the 2011 Tohoku-oki, we focused on the temporal change of the focal mechanisms in the 2011 Tohoku-oki region.

First, we classified the faulting type of earthquakes in the F-net catalog (National Research Institute for Earth Science and Disaster Prevention) as normal fault, thrust fault and strike-slip fault by following the method of Frohlich (1992). The time window for sampling was fixed to 10 days for after the mainshock and 50 days for before the mainshock. In order to stabilize the temporal change, we defined a sampling sequence so we can include a number of earthquakes more than 500 for after the mainshock and more than 100 for before the mainshock.

The results show that the ratio between the number of normal fault earthquakes to the total earthquakes increases step-wise after the mainshock and gradually decays with time. The gradual decay of the ratio has significant fluctuations and did not reach yet the level before the mainshock. The phenomenon of gradual recovery may reflect the flow of asthenosphere and after slip in deeper area of the hypocenter. It may also reflect changes of stress in the subducting and overriding plate. Moreover, focusing on before the mainshock, we observed the rapid decrease of the ratio. The same phenomenon was not observed from 1997 (start observation by F-net) to before the mainshock. This rapid decrease may relate to the preparation process of the 2011 Tohoku-oki occurrence.

Keywords: focal mechanism pattern, temporal change of focal mechanisms, 2011 Tohoku-oki earthquake