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# Relation between mainshock rupture and aftershock sequence based on highly resolved hypocenters and focal mechanisms

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To understand a generation process of aftershock following a large earthquake, it is essentially important to elucidate whether an aftershock reflects re-rupture of mainshock fault plane or rupture of damage zone surrounding it. Liu et al. (2003) found that only a small portion of the aftershocks occurred on the rupture fault planes of the 1992 Landers Earthquake. However, since the location errors of the aftershock hypocenters in their study were up to 1 km, discussion based on more precisely determined hypocenters is essential.

A dense seismic observation network composed of 59 temporary stations was installed, immediately after the 2000 Tottori-Ken Seibu Earthquake (Mw 6.8). The high quality observation data gives us an excellent opportunity to clarity the above issue. To obtain highly resolved hypocenter locations, we used the Double Difference relocation method (Waldhauser and Ellsworth, 2000). Then, we used the differential travel time data determined from manually picked arrival times and cross-correlation analysis. We could determine the hypocenters of approximately 4,100 events that occurred during the period from October, 15 and November, 31, 2000. We also could obtain the focal mechanisms of 3,300 events, by using absolute amplitude data of P and SH waves, as well as P wave polarities.

Since surface faulting were not immerged above the aftershock region of the Tottri-Ken Seibu Earthquake (Ueta et al., 2002), we estimated subsurface structure of the mainshock fault planes on the basis of the relocated hypocenter and focal mechanisms distributions. Since we could see several 'earthquake clusters' that possess similar characteristic of focal mechanism, we divided the aftershock distribution (except the northern part of the aftershock region) into 5 earthquake clusters. We estimated the best-fit plane in earth earthquake cluster, by using principal component analysis (e.g. Shearer et al., 2003).

We could obtain 5 best-fit planes. Trends of the best-fit planes near the mainshock hypocenter and southern part of the aftershock region are consistent with those of mainshock focal mechanism obtained from P wave polarities and CMT analysis, respectively. On the other hand, in the northern part of the mainshock hypocenter, the best-fit planes suggesting conjugate fault were estimated. We found that most of the aftershocks in each earthquake cluster were distributed within zones of approximately 1.2 km width, rather than aligned on a single plane. We also evaluated the variety of focal mechanisms by using the Kagan angle (Kagan, 1991) from reference focal mechanisms that were estimated based on the best-fit planes. We found that the focal mechanisms of the aftershocks have wide range of the Kagan angle ($\leq 100^o$). These results suggest that many aftershocks represent rupture within fault damage zone around the mainshock rupture planes. The wide variations of focal mechanisms probably reflect the complicate structure in the fault damage zone.

Keywords: Aftershock, Hypocenter distribution, Focal mechanism, Mainshock fault