The feature of planar hypocenter distribution at the Western Nagano Prefecture Region

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It has been considered implicitly that an earthquake occurs on pre-existing fault planes, which are relatively weaker than the surrounding region. A fault plane of large earthquakes is estimated from planar aftershock distributions. In other words, it is thought that there is a planar or a liner structure having a small strength where hypocenters are distributed planarly or linerly. In addition, we can know detailed spatial distribution of pre-existing fault planes by using many planar hypocentral distributions. However it has been difficult to know planar or liner hypocentral distributions of microearthquakes related to small earthquake of a M3 class for the reason that present observation networks do not have good detectability of microearthquakes and high accuracy of hypocenter locations.

In the aftershock area of the 1984 Western Nagano Prefecture Earthquake (Mj6.8) the dense seismic array with a sampling frequency of 10kHz has been operated since June 1995 (Iio et al, 1999). The dense seismic array has good detectability of microearhquakes, since earthquakes occur from 2km to 10km and ground noises are small. The network has high accuracy of microearhquake location because of dense seismic array.

We relocated many hypocenters from the data of the dense seismic array with the Joint Hypocenter Determination (JHD) method (Kissling et al, 1994) and estimated spatial distribution of fault planes of moderate and small earthquakes with planar hypocentral distribution. In addition, there are planar or liner hypocentral distribution even in the area which moderate and small earthquakes did not occur. In this study, we defined the fallowing two types of fault planes as the large-scale fault plane.

1. Aftershock fault plane: Planar aftershock distribution of moderate and small earthquake (Magnitude more than 3.0).
2. Pre-exiting fault plane: Planar microearthquake distribution without moderate and small earthquakes (Magnitude more than 3.0).

We found that the aftershock fault planes have various strikes and dips and almost all their strikes and dips are different from those of the 1984 Western Nagano Prefecture Earthquake fault. In addition, we found that the hypocenters within 100m from the estimated aftershock fault planes are less than 9% of all the hypocenters. The pre-exiting fault planes are located on an extension of aftershock fault plane and also far from it.

We found that aftershock fault planes are located at edges and inside of the low velocity zone, estimated from DD tomography (Takai et al, 2003). It is possible that occurrence of small or moderate earthquake are related to the low velocity zone, assuming that there are fluid in the low velocity zone.

The small earthquakes at edges of the low velocity zone are thought to be caused by stress concentration due to anelastic deformation in the low velocity zone. The small earthquakes inside low velocity zone are generated after many microearthquakes occurred inside low velocity zone. Their activity can be explained by the fluid and a strength reduction after many microearthquakes occurred. First pore fluid pressure increased because of increasing fluid inside low velocity zone. Secondly strengths of pre-exiting fault planes of microearthquake fall, and many microearthquakes occurred. Finally on the fault plane of small earthquake the strength of them falled, since many microearthquakes occurred. And small earthquakes are generated inside the low velocity zone.