Relationship between fault geometries of inland earthquakes occurred in Japan and their largest aftershocks

Shigeki Aoki[1]; Nobuo HAMADA[2]

[1] MRI, JMA; [2] JMA

1. Introduction

The relocated aftershock distribution of the 2004 Mid Niigata Prefecture Earthquake (M6.8) (Aoki et al., 2005) shows that there are double fault planes with a distance 5 km in parallel dipping and the upper and lower of the planes represent the faults of the main shock and the largest aftershock (M6.5), respectively. Aoki (2006) investigated recent seismicity and the coseismic crustal deformation of the 1945 Mikawa Earthquake (M6.8), and discovered not only the low-angle reverse fault related to the main shock but also the right-lateral strike slip fault in the northern part of the aftershock area the largest aftershock (M6.4) occurred. In this study we research the relationship between faults geometry of 27 inland earthquakes of M6.5 or greater occurred in Japan and their largest aftershocks by the JMA hypocenter catalogue during the period from 1923 to 2005.

2. Main shock occurred after 1970

Our purpose is to distinguish between fault of main shock and fault of the largest aftershock. Because the earthquakes occurred after 1970 have enough precision to chase the change of the activity, 11 main shocks after 1970 were investigated by the aftershocks occurred during three months from the occurrence of the main shock.

For example, in the 1984 Western Nagano Prefecture Earthquake (the main shock of M6.8 and the largest of M6.2), there was an activity formed by the secondary aftershocks accompanied by the largest aftershock in the western edge of the E-W fault of the main shock, and the strike of the activity was conjugate to the fault of the main shock.

We can summarize that 7 out of 11 main shocks, in particular all of 5 main shocks accompanied M5.5 or greater aftershocks, had the largest aftershocks which occurred off the faults of the main shocks. Also, the faults of the largest aftershocks were parallel or conjugate to the faults of the main shocks.

3. Main shock occurred before 1970

We cannot often distinguish the distribution difference between the aftershocks and the secondary aftershocks before 1970. However, in the aftershock areas of at least 11 among 16 main shocks, there are small concentrated seismic activities which seem to be part of aftershocks in recent seismicity. In this section, these main shocks are studied by recent seismicity and the aftershocks occurred right after the occurrence of the main shock.

For example, the 1927 North Tango Earthquake (M7.3, M6.4) produced the Gomura fault as main rupture and the Yamada fault as sub rupture, which were perpendicular to each other. At present, there are noticeable seismic activities on these faults. The largest aftershock occurred in the southern part of the aftershock area where the Yamada fault is located. The aftershocks were activated in the southern part of the area after the occurrence of the largest aftershock. With the foregoing in mind, we speculate that the largest aftershock occurred on the Yamada fault.

We can summarize that 4 among 5 main shocks with M6.0 or greater aftershocks seemed to have the largest aftershocks which occurred off the faults of the main shocks.

4. Relationship between larger aftershock activity and the largest aftershock

Utsu(1999) regarded D, which denotes the magnitude difference between the main shock and the largest aftershock, as the degree of aftershock activity. In this study, 8 among 9 main shocks of D 1.0 or smaller accompanied five or greater number of aftershocks of M5.0 or greater. There were three main shocks of D over 1.0 with five or greater aftershocks of M5.0 or greater. These suggest that Utsu's indicator D is reasonable for the degree of the larger aftershock activity. Because the largest aftershock of greater magnitude than predicted occurs on the different fault from the main shock's, aftershock activity turns out to be superposition of aftershocks of the main shock and secondary aftershocks of the other subsequent large aftershocks. As a result, the degree of the activity can be high.