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High-resolution aftershock distribution of the 1999 Chi-Chi, Taiwan earthquake

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The 1999 Chi-Chi, Taiwan, earthquake (ML7.3) occurred on September 20, 1999 (UT) in central Taiwan. An obvious surface rupture was observed along the previous recognized north-south trending Chelungpu Fault over 100 km and bending to northeast approaching its northern end. Taiwan is located in the site of ongoing arc-continent collision zone between the Eurasian Plate and the Philippine Sea Plate, which is characterized by a well-developed fold-and-thrust belt. The characteristics of the 1999 Chi-Chi, Taiwan, Earthquake are very similar to those of subduction zone earthquakes [e.g. Kikuchi et al., 2000]. The Central Weather Bureau Seismic Network (CWBSN) recorded over 20,000 aftershocks for six months. The aftershocks covered an area of 150 km long and 100 km wide, which is almost a half of the Taiwan Island and much larger than faulted area. In this study, we clarify the high-resolution spatial distribution of aftershocks recorded by a temporary aftershock network [Hirata et al., 2000].

The temporary aftershock observations of the 1999 Chi-Chi earthquake were conducted for two months from 15 days after the main shock. Over 8,000 aftershocks were recorded by the observation. For our purpose, we applied the joint hypocenter method [Kissling et al., 1994] and the double-difference earthquake location method [Waldhauser and Ellsworth, 2000] to the aftershock data.

We selected about 7,000 aftershocks located with arrival times recorded at more than 5 stations. We could relocate 5,648 aftershocks for the observation term by the two methods. The relocated aftershocks were clearly separated into many clusters and consisted of several planes. Three east-dipping plane distributions were clarified at shallow depth, especially in the northern part of the rupture zone of the main shock. The dipping angle agreed with those of their focal mechanisms, that of the main shock fault, and those of recognized major faults. A west-dipping plane distribution was also clarified at depths from 20 to 35 km around the hypocenter of the mainshock. It suggested that a conjugate-fault system could explain the distribution in the east of the hypocenter of the mainshock. Below the surface trace of rupture, aftershocks occurred only at a depth of 10 km. It was deeper than the rupture area by the mainshock. About 30 km east of the main shock fault zone, a highly active seismicity occurred at a depth of 10 km.

We suggest that the aftershocks of the 1999 Chi-Chi earthquake occurred on many complex small planes including the main fault rupture zone of the mainshock and also other small faults, which are not ruptured among the mainshock. These faults are interpreted as a part of the fold-and-thrust belt in the Taiwan Island. A detailed study of the spatial and temporal distribution of the aftershocks will clarify generation mechanism of the large earthquake, triggered earthquakes, and inhomogeneity of the crust in the collision zone.