

Static stress changes and spatio-temporal distribution of aftershocks in the 1999 Chi-Chi, Taiwan, Earthquake sequence

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Numerous aftershocks followed by the 1999 Chi-Chi, Taiwan, Earthquake (Mw7.6) provided us valuable data sets for studying aftershock occurrence and crustal structure in Taiwan. In this study, we focused on the role of static stress changes in triggering aftershocks. This mainshock occurred on September 20, 1999 (UT) with a 100-km-long surface rupture along the Chelungpu fault with fault slips of up to about 10 m. The area that aftershocks occurred was as broad as 150 km long and 100 km wide, which was almost half of the Taiwan Island and much larger than faulted area [e.g. Nagai et al., 2003]. The aftershocks were separated into 7 clustered activities concentrated in space, each of which also had different characteristics in temporal distribution. And their distribution had changed as compared with that of past seismicity. Aftershocks have various focal mechanisms, which indicate the complex crustal structure and the regional stress distribution originated by the relative motion between the Eurasian and the Philippine Sea plates. We calculated static stress change by the mainshock on objective fault planes, inferred from each clustered aftershock distribution and their focal mechanisms. We adopted the finite source dislocation model [Okada, 1992] to calculate the static stress change in an elastic half-space by the main shock. The results showed positive correlations between aftershock areas and positive stress changes in the Chi-Chi aftershock sequence approximately. However these correlations cannot explain temporal changes of aftershock occurrence. And static stress triggering is one of many factors to influence the occurrence of earthquakes, which include such as pore pressure, dynamic stress triggering by seismic waves passage, and tectonic loading. Indeed, Taiwan is located in the arc-continent collision zone between the Eurasian and the Philippine Sea plates with a convergent rate of about 7 - 8 cm/yr. We will discuss the relationship among the occurrence of the Chi-Chi aftershock sequence in space and time, the effect of static stress changes by the mainshock and the larger aftershocks, and other effects such as tectonic loading and crustal structure in Taiwan.