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Aftershock seismicities of three great earthquakes and their implications for lithospheric deformation

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Assessment of influence of great earthquakes on reginal seismicity is high priority for seismic hazard mitigation. However, the properties of aftershock seismicity have not been fully understood. Since 2004, there were three great earthquakes with magnitudes greater than 8.8, which are the 26 December 2004 M9.1 Sumatra-Andaman earthquake, the 27 February 2010 M8.8 Maule earthquake, and the 11 March 2011 M9.0 Tohoku-Oki earthquake. In this study, we investigate the seismicities and focal mechanism solutions of earthquakes in the three regions that belong to active convergent plate boundaries. The seismicities and focal mechanism solutions of the earthquakes before and after the great earthquakes during 2000-2012 are investigated by time period, focal depth, and faulting type. It is observed that the numbers of events increase abruptly right after the great earthquakes, and decrease gradually with time. Thrustal earthquakes occur dominantly in the regions. It is observed that a large number of strike-slip events occur in the Sumatra-Andaman region after the great earthquake. On the other hand, thrustal earthquakes are still most dominant in the Maule region after the great earthquake. Also, we find large numbers of shallow-focus normal-faulting events in the Tohoku-Oki region after the great earthquake. It is intriguing to note that all three regions present shallow-focus normal-faulting earthquakes that are clustered around the slab boundaries with large slips. Thrustal earthquakes are found to be clustered around the slip edges. The observation suggests that the ambient stress field changes by the slip amount. The occurrence of normal-faulting earthquakes in large slip regions can be explained as a result of lithospheric elastic rebounds of plates after the great earthquakes.

Keywords: aftershock, seismicity, focal mechanism, b value, lithospheric deformation