

Tsunami earthquakes and their source process are one of open questions in earthquake seismology because the tsunami earthquakes are rare events comparing to ordinary earthquakes with the same magnitude. In order to understand a generating mechanism of tsunami earthquakes, we search any small events showing similar properties with tsunami earthquakes happened before and after main shock. We focus on three tsunami earthquakes and their foreshock & aftershock activities, such as Nicaragua(1992/09/02, Mw7.7), Java Island(2006/07/17) and Mentawai Islands(2010/10/25, Mw7.8).

We investigate foreshock and aftershock activities from earthquake catalogs with a period of twenty years, published by ISC and USGS. Evaluating the spatiotemporal patterns of their activities in three regions, we have found that four foreshocks near the epicenter of the main shock from August 10 to August 13 in the region of the 1992 Nicaragua earthquake. Moreover, we also observed the migration of their activities heading from the northeast to the southwest. We evaluate the regional and spatiotemporal seismicity in small regions with dividing epicenter area ($5^\circ * 5^\circ$) into twenty-five segments and each segment is actually $1^\circ * 1^\circ$. Based on cumulative frequency distributions, we have found out that two seismic quiescence segments existed in Nicaragua, and both of them are near the main shock area.

We also investigate amplitude ratio of surface to body waves from their fore- and aftershocks exceeding magnitude 5, with comparing to that from the main shock. Here, after applying a band pass filter (0.01 to 0.1 Hz) to each event, the maximum-amplitude ratio of the surface wave to the SV wave is calculated. We have found that especially three earthquakes (Foreshock 8/11(Mb 5.1) and Aftershock 9/5(Mb 5.3), 9/6(Mb 5.3)) that occurred in the same region of the Nicaragua earthquake showed similar features with the amplitude ratio from the main shock. This suggests that a slightly

smaller earthquake with similar characteristics as a tsunami earthquake occurred just before and immediately after the occurrence of the tsunami earthquake.