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Heterogeneity of crustal strength at the Nojima Fault, Japan, derived from clustered seismic activities

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Repeated water injection experiment was carried out at the Nojima fault, Japan, in 1997 and 2000. We performed temporary seismic observations in 1997 and 2000 to record injection-induced and natural earthquakes. We carried out a seismic observation also in 2001 to record natural earthquakes. We observed clustered seismic activities among both the injection-induced and natural earthquakes (Figure 1). We measured the slight changes in their hypocenter locations adopting the cross-spectrum technique. We derived the cluster dimensions of at least 20-150 m from the cross-spectrum analysis. The locations of the earthquake clusters are concentrated in two regions with dimensions of about 2 km. We proposed the following model on heterogeneity of crustal strength around the Nojima fault, on the basis of the observed clustered seismic activity: A low-strength region with the dimension of about 2 km is composed of the several small regions with the dimensions of at least 20-150 m. The low strength may be achieved by extremely high crack density in comparison with the surroundings.

Keywords: Nojima fault; induced earthquake; earthquake cluster; crustal strength; heterogeneity.

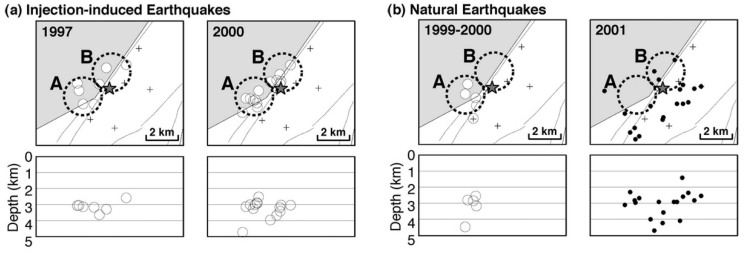

Figure 1. Locations of the earthquake clusters. Open circles denote the relocated hypocenters of the largest earthquake in each cluster. The earthquake clusters concentrate in the regions A and B, denoted by dotted circle. Star denotes the location of injection hole. No earthquake clusters are detected in 2001, and the hypocenter of each earthquake is plotted by the solid circles, for reference.