A detailed 3D seismic velocity structure around the Atotsugawa fault system

Junichi Nakajima[1]; Aitaro Kato[2]; Takaya Iwasaki[3]; Shiro Ohmi[4]; Tomomi Okada[1]; Tetsuya Takeda[5]; Iidaka Takashi Japanese University Group of the Joint Seismic Observations at NKTZ[6]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.; [2] ERI, Univ. Tokyo; [3] ERI, Univ. of Tokyo; [4] DPRI, Kyoto Univ.; [5] NIED; [6] -

The Japanese University Group of the Joint Seismic Observations has conducted seismic observations around the Atotsugawa fault for the five years period started from 2004. Seismic observations installed 73 seismic stations in an area of 100km∗100km. We selected 1,272 earthquakes that occurred in the central part of Japan and arrival times from these earthquakes were picked at temporary stations as well as permanent stations. As a result, 211,503 P-wave and 135,262 S-wave arrivals were obtained. Here we describe 3D seismic velocity structure around the Atotsugawa fault and discuss its relation to seismic activity.

We applied double-difference tomography method (Zhang and Thurber, 2003, 2006) to a large number of arrival-time data obtained by the joint seismic observation. Earthquakes used in Nakajima and Hasegawa (2007) were additionally used and the total number of earthquakes used in this study is 3833. Arrival-time data derived from these earthquakes were 303,625 for P waves and 232,032 for S waves. The distance between earthquake pairs was limited to 10 km, which yields 1,790,531 (P wave) and 1,183,971 (S wave) differential travel-time data. Grid intervals were set at 10 km in the horizontal direction and 5-10 km in the vertical direction. The 3D velocity model by Nakajima and Hasegawa (2007) was used as an initial velocity model for the whole area and the velocities around the Atotsugawa fault were inverted.

Obtained results show that the velocity structure varies along the strike of the Atotsugawa fault. The volcanic regions in the eastern and western parts of the fault show an extreme low-velocity anomaly from the uppermost mantle to the surface. The depth limit of earthquakes in the both regions is locally shallower. A low-velocity zone exists below the seismogenic layer in the central part of the fault, where seismic activity is low down to a depth of 7 km. The low-velocity zone appears to be connected with that in the uppermost mantle. Since the depth limit of seismicity in this region is deeper compared to the both sides, we infer that the low-velocity anomaly is probably caused by the existence of fluids rather than by higher-temperature anomaly. In the across-fault cross sections, a low-velocity anomaly is imaged immediately below the Atotsugawa fault at depths of 15-25 km. These observations suggest the spatial relationship between seismicity and heterogeneous structure along the fault.