Crustal structure in and around the western part of Atotsugawa fault derived from a dense seismic array observation

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The Atotsugawa fault is located at the northern boundary of the Niigata-Kobe Tectonic Zone (NKTZ). It has been found that the eastern part of the Atotsugawa fault shows the creep movement, and low seismicity. On the other hand, the relative fault movement at the western part has not been observed, and the seismicity is more active than the eastern part. It is, thus, suggested that the fault might be stuck at the western part. It is significantly important to investigate what kinds of crustal heterogeneities around the fault cause the difference of the fault movements properties, and seismic activity between the eastern and western parts along the Atotsugawa fault.

In order to understand the crustal structure in and around the Atotsugawa fault, we conducted a temporary seismic array observation across the western part of the Atotsugawa fault from August to October in 2004. The 47 seismic stations were deployed subparallel to the linear line (the station interval is 0.5 ~ 1 km, the total length is about 30 km) perpendicular to the fault strike, and 8 stations were installed around the linear array. Each seismic station consists of a 1 Hz, 3-component seismometer and a long term low power digital recorder. The seismograms were recorded by sampling rate of 200 Hz at 47 stations, and 100 Hz at 8 ones. Three shots at the northern, the center, and southern edges of the linear array were fired to get the resolution of the velocity at the shallow layer.

We selected 223 earthquakes in and around the fault from the JMA catalog during the seismic array observation. Both P- and S-wave arrival times observed at 55 temporary stations and the surrounding 61 permanent stations were picked manually. Then, the double-difference tomography (Zhang and Thurber, 2003) has been applied to the arrival time data. The initial 1-D velocity model and hypocenters for the tomography were determined by the joint hypocenter determination (JHD) technique (Kissling et al., 1994).

Two low velocity zones at the surface are found around the surface trace of the Atotsugawa- and Ushikubi- fault, which might be derived from the low velocity structures within the fault zones. The high velocity body is imaged beneath the surface trace of the Atotsugawa fault at the depths from 3 to 6 km. Further, the low velocity zone is observed beneath the high velocity bodies. The seismic activities seem to be high at this low velocity zone. The thickness of the shallow layer gradually increases from the surface trace of the Ushikubi fault to the southern parts of the studied area, which coincides with the increase of the number of the active fault traces.