Seismic velocity structure in the Western Nagano prefecture derived from accurate arrival times

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Microseismic activity is very active at the hypocentral region of the 1984 Western Nagano prefecture earthquake (M6.8) before the mainshock (Ooida et al.,1988), and the activity continues to the present. The present activity is not only distributed along the mainshock fault plane estimated from the simultaneous inversion of seismic waveform and geodetic data (Yoshida and Koketsu,1990), but also widely distributed in the eastern part of the hypocentral region.

In this study, for revealing the crustal structure, we estimate the seismic velocity structure by a travel time tomography using the accurate arrival times. Several studies had been conducted in this region by using a travel time tomography (Hirahara et al.,1992; Sekiguchi et al.,2004; Takai et al.,2005, fall meeting, the seismological society of Japan). Sekiguchi et al. informed the microseismic activity is not located in the low velocity zone, but Takai et al. informed that activity is located around low P velocity zone. This low P velocity zone coincides with the low resistivity zone derived by MT obsevation (Kasaya et al.,2002).

The dense seismic obsevation network is stalled in this region with recording system of the 10 kHz sampling frequency (Iio et al.,1999). The maximum number of station is 57. Noise levels range from 10-7 to 10-8 m/s, so S/N ratios are very good, because the stations are set on hard rocks. The clocks are corrected by GPS time signal every 2 hours, and the accuracy of timing is less than 1 ms. We read the arrival times of S waves using the transverse component to decrease the contaminations by converted waves. All arrival times are manually picked. The accuracy of P arrival times are about 1 ms.

We used 11,211 event that occurred from October 1995 to December 1999. The number of travel time data of P and S are 180,912 and 183,281, respectively. We used the Pseudo-bending method (Um and Thurber,1987), and LSQR method (Paige and Saunders,1982), for the ray tracing and matrix calculation, respectively. We simultaneously inverted origin times, hypocentral locations, and P and S velocity perturbations. We carried out the checkerboard resolution test by giving 10 percents perturbation to the initial velocity structure. We did not add noise. The obtained results show very good correlations between P and S perturbtions. This suggests that S velocity structure is well determined. The relationship between the velocity structure and seismicity, the low Vp/Vs zone tends to have high seismicity.