

Local earthquake reflection tomography of Southwest Japan using P and PmP data

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A detailed tomographic image of the crust under a north-south belt region of Southwest Japan is determined by using the first arriving P-waves and the reflected P-waves from the Moho discontinuity (PmP). One of the Quaternary volcanoes (Daisen) is located in the region and the largest inland fault in Japan, the Median Tectonic Line, runs through the region. The 6 October 2000, magnitude (M) 7.3, western Tottori earthquake occurred in the northern part of the study area, right beside the Daisen volcano [1], and the 27 July 1955, M 6.4, southern Tokushima earthquake occurred in the southern part of the study area. The Philippine Sea plate is subducting under SW Japan from the Nankai Trough. Therefore a detailed study of the crust structure under this region is important for understanding the seismotectonics and arc volcanism.

In this 200-km long and 60-km width region, crustal reflected waves from the Moho discontinuity (PmP) have been identified clearly by comparing the observed waveforms with synthetic seismograms computed using the technique of Wang (1999) [2]. In total, we picked up 1331 P, 478 PmP arrivals from 60 events that occurred in a period from September 2002 to September 2006 with focal depths of 6-22 km and M 2.0-4.0. The data are recorded by 29 stations which belong to the Hi-net, JMA and Japan university seismic networks. We applied the updated tomographic method [3] to the P and PmP arrival times to determine a 3-D P-wave velocity structure of the crust. Six layers of grid mesh are set up at depths of 1, 5, 10, 18, 28 and 40 km. The spacing between grid nodes is about 25 km in the horizontal directions, which represents the lateral resolution scale of the obtained tomographic images.

Our results revealed significant low-velocity anomalies beneath the Median Tectonic Line and the Daisen volcano, which suggest that Daisen is potentially an active volcano. In the lower crust, we detected low-velocity anomalies overlying the subducting Philippine Sea plate, which may indicate the existence of fluids released by the slab dehydration. The southern Tokushima earthquake occurred between low and high velocity zones. The western Tottori earthquake and other nearby strong earthquakes occurred around the Daisen volcano, which may be related to the upwelling magma.

The distribution of P and PmP rays along the profile and detailed resolution analyses indicate that the PmP reflected waves can improve significantly the resolution of the crust tomographic images, especially that of the lower crust, as was also found for the Landers earthquake area in Southern California [3].

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