

Mapping the crust structure under active volcanoes in Central Tohoku, Japan using P and PmP data

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Earthquakes in the Japan Islands mainly occur in the upper crust and in the subducting Pacific and Philippine Sea slabs, hence the seismic structure of the lower crust is generally less well determined, as compared with that of the upper crust and the uppermost mantle, because seismic rays do not crisscross well in the lower crust. Recent studies show that the use of Moho-reflected waves (e.g., PmP, SmS) can improve significantly the imaging of the lower crust structure (Zhao et al., 2005). Nakajima et al. (2002) showed that PmP waves can be clearly detected from crustal earthquakes in Northeast (NE) Japan. In this work we have studied the detailed 3-D velocity structure of the crust under the active arc volcanoes in the central part of NE Japan using the first P and PmP arrival time data. Following the criteria established by Nakajima et al. (2002), we identified and collected 394 PmP arrivals from Hi-net seismograms of 86 crustal earthquakes occurred from July 2002 to October 2006 among the 368 events we examined. The picking accuracy is 0.05-0.15 s. We also used 3356 first P-wave arrivals recorded by the Hi-net stations from 285 crustal events. To improve the PmP path coverage, some off-shore earthquakes are selected, which are accurately relocated with P, S and PmP data. These P and PmP data are inverted for the 3-D P-wave velocity structure of the crust by using the tomographic method of Zhao et al. (2005). Our detailed resolution analyses show that the addition of PmP data has greatly improved the resolution and reliability of the lower crust structure. The low-velocity (low-V) anomalies in the lower crust under the active volcanoes can be better imaged after the PmP data are used in the tomographic inversion. The low-V zones are clearly visible in the entire crust from the active volcanoes on the surface extending down to the Moho discontinuity. Deep, low-frequency, microearthquakes are clearly located around the low-V zones in the lower crust under the volcanoes. These results indicate that the crustal reflected waves (PmP, SmS) are very useful data for better imaging the structure heterogeneity of the crust, in particular, that of the lower crust.