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Collision and subduction structure of the Tanzawa and Izu blocks and its relation to seismic activity

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In recent years, collision and subduction structure in the Izu Collision Zone has been revealed by intensive seismic experiments of Special Project for Earthquake Disaster Mitigation in Urban Areas. Wedge-like structure of the Tanzawa block and its delamination from the subducted Philippine Sea plate were found in the eastern part (Sato et al., 2005; Arai et al., 2009), and clear collision boundaries located at the both sides of the Misaka and Tanzawa blocks in the western part (Sato et al., 2006; Arai et al., 2009). However, crustal structure in and around the Izu block and its relation to seismicity, especially in the lower crustal level, are not well understood.
In order to reveal the crustal heterogeneity dominated by the collision/subduction process, we carried out tomographic analysis combining active and passive source data. From travel time data of 35 active sources and 1105 earthquakes, hypocenters and velocity structure were simultaneously determined based on the double-difference method (Zhang and Thurber, 2003). The root mean square of travel time residuals was reduced from 0.26 s to 0.11 s after 9 iterations. Checkerboard resolution test showed good recovery in seismically active areas. Using the best velocity model, 5973 earthquakes were relocated. Then, spacial variation of b value was determined based on maximum likelihood method (Utsu, 1964; Aki, 1965) from the relocated hypocenter distribution and the magnitude of JMA catalog.
Velocity structure obtained shows strong crustal heterogeneity including low velocity zone of trough-fill sediments and high velocity zone of the Tanzawa block. Relocated hypocenter distribution indicates about 10 km thick seismicity zone dipping northward in the depth of 10-30 km between the Tanzawa Mountains and the Hakone volcano. This seismic activity is considered to be intraslab earthquakes which occur within the Izu-Bonin middle/lower crust with Vp of 6.5-7.0 km/s. In addition, this area shows relatively low Vp/Vs of 1.7-1.8 and low b value of 0.6-0.7. These results imply that the seismicity is not caused by dehydration embrittlement, but by mechanical factors.

Keywords: Izu Collision Zone, Tanzawa Mountains, Izu Peninsula, Seismic wave velocity structure, Seismicity, b value