Features of seismic wave velocity structure and seismicity in the Izu Collision zone

Ryuta Arai[1]; Takaya Iwasaki[2]; Hiroshi Sato[1]; Susumu Abe[3]; Naoshi Hirata[1]

[1] ERI, Univ. Tokyo; [2] ERI, Univ. of Tokyo; [3] JGI, Inc.

http://www.eri.u-tokyo.ac.jp/ryuta/

Since the middle Miocene, the Izu-Bonin arc has been colliding with the Honshu arc in central Japan associated with subduction of the Philippine Sea plate. This process is responsible for forming a complex crustal structure called the Izu Collision Zone. To obtain direct evidences of the deep structure dominated by collision and subduction, an intensive seismic experiment using explosive and vibroseis sources was conducted in the eastern part of the Izu Collision Zone in 2003 (Sato et al., 2005). CMP reflection and refraction/wide-angle reflection data were acquired on a 130-km-long seismic line crossing the collision boundary named Tonoki-Aikawa Tectonic Line (TATL) and the Tanzawa block, the fragment of the former Izu-Bonin arc. The structure from refraction tomography and forward ray tracing modeling showed remarkable lateral velocity variation across TATL and some clear reflectors in the deep crust. A north dipping reflector beneath the Kanto Mountain was interpreted to be the deeper extension of the TATL. From the geometry of reflectors, we interpret the Tanzawa block is delaminated from the subducting slab due to the collision to form a wedge-like body thrusting between the upper and lower crust of Honshu. The velocity model also indicates that the Tanzawa block corresponds to the upper crust and the upper part of the middle crust of the Izu-Bonin arc, offscrapped from the subducted PHS plate (Arai et al., submitted).

In order to improve the velocity image, especially the lateral velocity variation in the deeper part, and investigate the relationships between the crustal activity and complicated crustal structure, we carried out tomographic analysis combining active and passive source data. From travel time data of 559 sources, 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 0.18 s to 0.09 s after 11 iterations. Checkerboard resolution test showed good recovery in the upper 15-20 km crust. Hypocenter distribution and velocity structure obtained showed some interesting features associated with the crustal heterogeneity;

1) Seismic activity concentrates around the collision boundary.

2) Seismogenic zone in the Honshu crust is characterized by low Vp/Vs zone, and its lower limit deepens toward the collision boundary.

3) Aseismic region corresponding to the Tanzawa block is characterized by high Vp/Vs. Vp and Vp/Vs are well consistent with those of tonalite determined by laboratory experiment (Kitamura et al., 2003).

4) Prominent seismic activity is seen in the deep part of the Izu-Bonin crust (15-25 km depth) beneath the Tanzawa Mountain.