Lithospheric structure and tectonics of Tokyo metropolitan area

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1.Introduction

Beneath the Tokyo metropolitan area, the Philippine Sea plate (PHS) subducts into a narrow mantle wedge formed by the subduction of Pacific plate (PAC) beneath Northern Honshu. Subducting PHS slab hits the PAC and internal deformation of the PHS slab is estimated as possible mechanisms producing intra-slab earthquakes (Wu et al., 2007: GRL). Due to shallow location of the PHS slab, intra-slab earthquakes can generate intense damage in the metropolitan area. The information on the shallow geometry of the PHS has been increased by the seismic profiling using controlled sources (Sato et al., 2005: Science). On the seismic reflection profile along the eastern part of the Kanto mountains, the upper surface of the PHS slab was imaged down to 25 km in depth. On the other hand, along the Odawara-Kofu profile, the lower crust of PHS slab is imaged as reflective layers in width of 10-km beneath 30 to 40 km in depth beneath the Misaka mountains, suggesting the increasing the depth of the upper surface of PHS slab to the westward. It is not clear whether that the depth change of PHS slab is continuous or discontinuous. If the slab has large-scale faults or deficit, PHS slab beneath the Kanto basin can move independently against the major part of PHS and also the flow of mantle below and upper slab generate complicated motion of the slab. Thus to reveal the slab structure beneath NW of the Izu collisopn zone is significant for understanding the seismotectonics beneath Kanto area.

2. Dense seismic array observation along the Hanno-Fuefuki line

To obtain the image of PHS slab, dense seismic array observation was carried out along a 60-km-long seismic line between Hanno and Fuefuki. In both places the seismic reflections from the PHS slab were observed by the former seismic profiling. Earthquakes were observed from 15 October, 2008 and 6 February, 2009 by 75 locations deployed in 500 to 750m interval. Forty seismic stations have a vertical-component velocity sensor with a natural period of 1 Hz and thirty-five stations have a MEMS sensor. High quality data were obtained for the analysis using receiver function and seismic interferometry to obtain the image of PHS slab.

3. Seismic reflection profiling using explosive sources along the Hanno-Fuefuki seismic line in 2009

To obtain the detailed image of the upper surface of PHS slab, seismic profiling using explosive sources will be carried out in fall, 2009 under the Special Project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area. Together with the result of seismic images by earthquakes, a low-fold seismic reflection profiling reveals the detailed structure of PHS slab beneath the Izu collision zone.

4. Shortening deformation and strain partitioning in and around the Izu collisison zone

The 2008 Iwate-Miyagi nairiku earthquake emphasized the importance of the risk of blind active faults covered by volcanic products. In the Izu collision zone, an arc crustal block of Izu-Bonin arc is now colliding against Honshu arc. The eastern boundary of the Izu block is the Kannawa-Kouzu-Matsuda fault system. However, northwestern boundary is not recognized as active fault due to thick cover of volcanic products of Mt. Fuji. Judging from gravity anomaly pattern, it is highly probable that the Kannawa fault extend to SSW direction to the Sagmi bay.

5. Summary

By newly developing network of seismic stations (MeSO net), the detailed structure of PHS-slab beneath Kanto is getting clear. Dense seismic array observation and low-fold reflection profiling by explosive sources, the detailed PHS-slab structure will be revealed. For the crustal active fault system around the Izu collision zone, the strain portioning of fault-systems is poorly understood. To evaluate the potential of seismic risk around the area, research on possible blind thrusts in the northwestern part of the Izu collision zone is needed.