Velocity structure of the Philippine Sea plate beneath the Boso Peninsula revealed by seismic tomography

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The analysis of the seismic tomography of the Boso Peninsula focuses on the velocity structure of the Philippine Sea plate (PSP) beneath the area. Thirty temporal seismic stations were constructed along the line across the Boso Peninsula from the year 2003. Double Difference Tomography method (tomoDD) was applied to those travel time data together with JMA pick data to obtain P- and S-wave velocity structure and identify the previous definition of the upper surface of the Philippine Sea plate (UPSP).

Data and Method

Observation

- Stations: We use 183 stations including 30 temporal and 96 network routine (NIED, JMA, ERI) stations and 57 explosion receiver points in and around the Boso Peninsula.
- Events: We use 406 regional sources and 12 explosive sources.
- Travel-Time data: We obtain data from temporal and routine stations in and around the Boso Peninsula and add JMA unified catalogue data from February 2004 to January 2006.

Method

Double-Difference Tomography method (Zhang and Thurber, 2003) are applied.

- Grid nodes are as follows.

X grid (E30S +); 20km spacing
Y grid (N30E +); 10km spacing
Z grid; 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80 and 100km

- Initial velocity model: We use horizontally averaged 1-D velocity structure model derived from the BOSO 2002 Wide-Angle Analysis for shallow depth and the previous velocity model in the Kanto region (Matsubara et al., 2005).
- Number of absolute travel-time data is 55880 for 418 events
- Number of differential travel-time data is 133623 (P wave) and 91188 (S wave).
- RMS reduces after five sets of iterations from 0.58 s to 0.34 s.

Results

Velocity structure of the uppermost crust

- The P-wave structure of the uppermost crust along the line located in the central part of the Boso Peninsula (Y5) consists with the BOSO 2002 Wide-Angle Analysis. A high velocity is found in the southern potion and northern potion, while a low velocity zone is found in the middle portion correlated with a basin.

Velocity structure of the Philippine Sea plate

- The subducted Philippine Sea slab core is clearly imaged in all cross sections as high-velocity and its associated overlying oceanic crust is imaged as low-velocity.
- The PSP velocity structure is simple in the westward however its structure is complicated in the eastward.
- The upper surface of the subducted PSP (UPSP) derived from deep seismic reflection profiling (Sato et al., 2005) corresponds to our results along the westward line Y2, Y3, Y4 and eastward Y6. However, along the Y5 line across the central part of the Boso Peninsula, it is not exactly clear. The velocity profile shows that the PSP oceanic crust seems to be much deeper than the previous UPSP. The slab dips at ˜30 degree up to 20 km depth in the southern portion of the Y5 and dips at ˜20 degree toward the north from 20- to 35-km accompanied with a low velocity zone, while the previous UPSP is the same up to 20 km depth but is flat toward the north. Comparing with other profiles we surmise that this low velocity zone is probably the oceanic crust of the PSP. The top of the PSP is ˜10 km deeper than the previous one in the central part of the Boso Peninsula.