Three-dimensional heterogeneous structure within the subducting Pacific slab inferred from Double-Difference Tomography

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A configuration of the upper boundary of the subducting Pacific slab has been estimated by previous studies (Hasegawa et al. [1994], Zhao et al. [1997]), while the heterogeneous structure within the slab has not been well studied. Recent seismological studies have shown three-dimensional heterogeneous structure in the subducting Pacific slab.

Mishra and Zhao [2004] estimated the P-wave velocity structure around the focal area of the Miyagi-oki intraslab earthquake (M7.1) that occurred on May 26, 2003, and revealed the existence of a low-Vp zone around the hypocenter. Okada and Hasegawa [2003], and Sakoda et al. [2004] found the intensive seismicity in the area between the upper and lower planes of the double seismic zone near the focal area before the occurrence of the M7.1 event. In addition, they suggested that there exist hydrous minerals around the focal area, and its dehydration caused the intensive background seismicity. Zhang et al. [2004] investigated the intraslab velocity structure beneath Iwate prefecture by Double-Difference Tomography (Zhang and Thurber [2003]), and showed the existence of high Vp/Vs area in the upper plane of the double seismic zone and low Vp/Vs zone in the lower plane of DSZ. Shelly et al. [2006] studied three-dimensional velocity structure beneath Ibaraki prefecture and obtained similar results to Zhang et al. [2004]. Kita et al. [2006] investigated the seismicity within the upper plane of DSZ and found the 'upper-plane seismic belt', which runs parallel to the depth contours of the Pacific slab at depth of 70-90 km.

In this study, we estimate fine structure within the Pacific slab by Double-Difference Tomography. We divided the study area into 4 areas. In each area, we used about 9,000-15,000 events and 55-76 stations. Horizontal grid separation is 10-25 km and vertical separation is 6.5 km. The obtained results are as follows: (1) a remarkable low-Vs zone exists in the uppermost part of the subducting slab, which probably corresponds to the oceanic crust, (2) low-Vs zone extends down to 80 km depth, (3) at depths deeper than 80 km, a low-Vs and high-Vp/Vs zone is distributed in the mantle wedge, immediately above the slab crust, which may suggest the serpentinization there.