Three-dimensional seismic velocity structure around the focal area of the 26 May 2003 Miyagi-oki intraslab earthquake (M7.1)

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Recent studies have enhanced our understanding of the occurrence of interplate earthquake through the asperity model. On the other hand, little is understood on the occurrence of intraslab earthquakes, though several conceptual models (e.g. dehydration embrittlement) have been proposed (Meade and Jeanloz, 1991; Kirby, 1995; Seno and Yamanaka, 1996).

On May 26, 2003, an intraslab earthquake (M7.1) occurred off Miyagi Prefecture, northeastern Honshu, Japan. Aftershocks extend both into the crust and into the mantle of the slab (Okada and Hasegawa, 2003). Many earthquakes occurred near the hypocenter of the main shock before the 2003 event. This high background upper-plane seismicity within the mantle may correspond to the area with large amount of hydrated minerals (Okada and Hasegawa, 2003; Sakoda et al., 2004).

Mishra and Zhao[2004] have already performed P-wave velocity inversion using arrival-time data from about 2100 earthquakes and showed that the low velocity anomaly exists around the main shock area, even if the inversion was done without the arrival-time data from aftershocks. This result suggests that the low velocity anomaly exists around the source area before the occurrence of the main shock, Which seems to be related to the high background seismicity there.

However, they used an initial velocity model comprising the Pacific plate with higher velocity than the surrounding mantle wedge. In this study, we adopted a 1-D initial velocity structure without the high velocity Pacific slab. We have done inversion using arrival-time data from 7278 earthquakes routinely determined by Tohoku University (from October 1, 1997 to May 18, 2003). In this process, we adopted a grid spacing of 0.2 degrees in the horizontal direction and 10-30km in the depth direction. Obtained velocity images dearly show the high velocity zone corresponding to the subducting slab and the low velocity anomaly around the source region of the main shock. Our results are consistent with the results of Mishra and Zhao[2004], suggesting the low-velocity anomaly around the source area of the 2003 Miyagi-oki earthquake is not an artifact but really exists there.