Inhomogeneous seismic velocity structure and its relation with seismic activity in the central part of Tohoku, NE Japan

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We estimate seismic velocity structure of the crust in the central part of Tohoku, NE Japan, and discuss on its relation with seismic activity. We determined three- dimensional seismic velocity structure and relocated hypocenters simultaneously using the double-difference tomography method (Zhang and Thurber, 2003). Travel time data used are obtained from the Japanese universities joint seismic observation in the Tohoku Backbone range (1997-1998) and the aftershock observation for the 2003 M6.4 Northern Miyagi earthquake (Umino et al., 2004; Okada et al., 2004). We also used P- and S-wave data from networks of Tohoku University, JMA, Hi-net and JNES during the period from 1997 to 2008.

Obtained seismic tomography shows that higher Vs and lower Vp/Vs areas correspond with high seismicity area in the upper crust. One of these high Vs areas is consistent with the focal area of a moderate-sized earthquake (e.g. the 1996 M5.9 Onikobe earthquake). We also obtain low-Vp regions in the hanging-wall near the focal area of the 2003 northern Miyagi earthquake and Nagamachi-Rifu fault.

In the lower crust, we found some distinct low-Vs, low-Vp and high Vp/Vs areas. These low velocity zones are located just beneath the strain concentration zones along the backbone range and in the northern Miyagi region. Seismicity in the upper crust is higher just above these low velocity zones. These low-velocity zones in the lower crust might be caused by the upwelling flow of fluid originating from the mantle wedge. The present observation supports the hypothesis by Hasegawa et al. (2005) that anelastic deformation due to fluids forms the strain concentration zones and promotes the high seismic activities.