Detailed seismic velocity structures in the focal areas of recent large inland and intraslab earthquakes in Japan by DD tomography

Tomomi Okada[1]; Tadashi Yaginuma[1]; Junichi Suganomata[2]; Yusuke Tsuji[1]; Akira Hasegawa[1]; Haijiang Zhang[3]; Clifford H. Thurber[3]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.; [2] RCPEV,Graduate School of Sci.,Tohoku Univ.; [3] Univ. of Wisconsin

Detailed seismic velocity structure in and around the focal area may provide clues to understanding the generation process of earthquakes. We performed seismic tomography to obtain the seismic velocity structure in and around the focal areas of several inland earthquakes in Japan. We applied the double-difference (DD) tomography method (Zhang and Thurber, 2003, 2005), which has the advantage of obtaining the high-resolution seismic velocity structure in and around the focal area. The travel time data are from dense temporary seismic networks deployed for aftershock observation.

We find that the fault zones have specific characteristics in the seismic velocity structure. For the thrust fault earthquakes (the 2004 Mid Niigata M6.8 and the 2003 northern Miyagi M6.4), aftershocks are distributed along a dipping plane across which the estimated seismic velocities change abruptly. Both P-wave and S-wave velocities in the hanging wall are lower than those in the footwall. One possible interpretation is that these two earthquakes occurred on faults that formed as normal faults (in the Miocene) and are reactivated as reverse faults under the current compressional stress regime. For the strike-slip type earthquakes (the 1995 southern Hyogo M7.3 and the 2000 western Tottori M7.3), low velocity zones of a few kilometers width are present along the mainshock fault plane or along the aftershock alignment. This suggests that the fault planes of these earthquakes are located in or on the edge of low velocity zones. In the earthquakes we have studied includes (the 2001 Geiyo intraslab earthquake and the 1997 northwestern Kagoshima earthquake), these low-velocity zones seem to be distributed in and/or around the hypocenter of the mainshock. Large coseismic slip areas tend to concentrate in the relatively high velocity areas along the fault plane, consistent with studies in other areas. These observations suggest a direct correspondence between high-velocity bodies and asperities.