Generation mechanism of shallow inland earthquakes in NE Japan and the 2008 Iwate-Miyagi Nairiku earthquake

Tomomi Okada[1]; Norihito Umino[1]; Akira Hasegawa[1]; Matsuzawa Toru Group for the aftershock observations of the Iwate-Miyagi Nairiku Earthquake in 2008
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[1] RCPEV, Graduate School of Sci., Tohoku Univ.; [2] -

The 2008 Iwate-Miyagi Nairiku Earthquake (M 7.2) occurred on June 14, 2008 in the Tohoku Backbone range strain concentration zone, NE Japan. Seismic activity is high in this concentrated deformation zone. In this presentation, we discuss on the generation mechanism of the 2008 Iwate-Miyagi Nairiku earthquake (Okada et al., 2009) and other recent shallow inland earthquakes in NE Japan based on the seismic tomography.

Beneath the focal area of the 2008 Iwate-Miyagi Nairiku earthquake, we found the distinct low-velocity regions continuously distributed from the mantle wedge to the lower crust. This low-velocity zone in the lower crust extends upward to the upper crust, branching into three portions, each of which reach active volcano at the surface. Just below the focal area of the present earthquake lies this low-velocity zone in the lower crust. This low-velocity zone would correspond to a region of partial melting.

Beneath the focal areas of the 2003 northern Miyagi earthquake and the 1998 Iwate Nairiku Hokubu earthquake (Nii et al., 2009), distinct seismic low velocity areas are also distributed. Such low velocity regions can be seen beneath the other seismic active / strain concentration zones in NE Japan. These observations suggest that fluid, released from partial melting zone, promotes the crustal deformation and occurrence of the earthquakes.

Based on the distribution of aftershocks of the 2008 Iwate-Miyagi Nairiku earthquake, the fault plane of the main shock is inferred to dip to the west. Lower-seismic-velocity hanging wall can be imaged in the central and the northern part of the focal area. Similar low-velocity hanging wall was imaged also for the 2003 Northern Miyagi earthquake (Okada et al., 2007). We infer from this low velocity hanging wall that the earthquake occurred along the pre-existing normal fault, which is formed in Miocene when Japan Sea was opened, as compressional inversion earthquake. Distinct low-velocity zones in the upper crust can be found also beneath active volcanoes. Shallow seismicity tends to avoid these low velocity zones and occur outside of them. Such weak regions in the upper crust would also promote the local crustal deformation and stress concentration in the surrounding areas.