Relations between rupture zones of interplate earthquakes and the crustal structure off Miyagi.

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Magnitude 7.5 class interplate earthquakes have recurred in the region off Miyagi due to the subduction of the Pacific plate beneath the northeastern Japan island arc. This region is characterized by the existence of two rupture zones of large interplate earthquakes; a landward rupture zone (e.g. the 1978 earthquake) and a trench ward rupture zone (e.g. the 1981 earthquake). On August 16 2005, an interplate earthquakes with magnitude 7.2 occurred in the landward rupture zone. Although the epicenters of aftershocks were located at the southern side of the rupture zone of the 1978 earthquake, the epicenter of the main shock was close to that of the 1978 earthquake.

To reveal the relationships between the crustal structure and the distribution of interplate earthquakes, we conducted a seismic refraction/reflection experiment in the region off Miyagi with using 72 Ocean Bottom Seismometers (OBSs) in 2004. We used airgun-OBS data and applied the first arrival tomography and the traveltime mapping method, which is a kind of the migration method. We obtained P-wave velocity structure models and several reflector geometries.

In the north-south (NS) lines, that are parallel to the trench axis, the plate boundary is almost flat. On the other hand, the structure of the island arc crust significantly varies along NS-lines; the thickness of sediments, upper crust, lower crust fluctuate along the NS-lines. One of the notable features is that thick upper crust exists between the two rupture zones (landward and trenchward). The mantle wedge of the island arc is deep (more than 20km depth) and the resolution of the Moho geometry and the mantle wedge velocity were not so high. However, we can be fairly certain that the depth of the island arc Moho and/or the P-wave velocity of the top of the mantle wedge varies along the NS-liens; we estimate that the mantle wedge is relatively thin (or slow) around the epicenters of the 1978 earthquake and the 2005 earthquake.

These results indicate the possibility that the horizontal heterogeneity of the island arc crust, as well as the geometry of the plate boundary, affects the distribution of large interplate earthquakes, that is, the regional variation of plate coupling.