

Stress field around the source area of the Miyagi-Oki earthquake by using ocean bottom seismographic data

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Interplate earthquakes ($M \sim 7.5$) have occurred along the subducting plate boundary of the Miyagi-Oki region, middle part of the Japan Trench area, repeatedly at about 40 years intervals. In 2005, the interplate earthquake ($M 7.2$) occurred in this region. By continuous deployment of ocean bottom seismometers performed around the source region of the earthquake, we could observe seismicity before and after the mainshock. Spatial distributions of coseismic and postseismic slips were estimated by Yaginuma (2006) and Miura et al. (2006), respectively. Inuma et al. (2007) reported reactivation of slow interplate slip following the largest aftershock.

We previously calculated hypocenters and focal mechanisms before and after the 2005 mainshock by using the 3D velocity structure determined by Yamamoto et al. (2008). The result showed that thrust type events tended to occur in the area of large coseismic slip corresponding to the asperity of the Miyagi-Oki earthquake. Meanwhile, aftershocks with focal mechanisms dissimilar to that of the mainshock tended to occur in the periphery of the large interplate slip area.

In this paper, we attempt to estimate stress field of the Miyagi-Oki region by performing stress inversion from the estimated focal mechanisms. First we suppose that stress field is uniform in the region, and we estimate orientations of principal stresses as well as stress ratio by using all of the focal mechanisms. The obtained stress field is in a reverse faulting regime having the compressional stress is in the down-dip direction of the plate subduction. This means the collision force between the land and oceanic plates is the primary factor controlling the stress state in this area. We investigated residuals between slip directions of the estimated focal mechanism and that expected from the obtained stress field for each of the earthquakes; we found that the non-thrust type events along the eastern rim of the 2005 mainshock source tend to have large residuals. Since most of these earthquakes occurred after the mainshock, it is probable that these non-thrust type earthquakes occur in response to the stress disturbance accompanied with the mainshock.

It is also notable that the residuals shows dependence on the depth measured from the plate boundary: the residuals are smaller for the events below the plate interface than those for the earthquakes located in the overriding plate. This suggests that the stress field in the subducting Pacific plate differs from that in the overriding North American plate. Actually, different stress orientations were estimated for the overriding and subducting plates by using the earthquakes within those two plates separately. The stress field in the Pacific plate is similar to the average one, while that in the North American plate has the minimum principle axis in the strike direction, strike slip faulting regime. The discontinuous change of the stress field across the plate boundary may be indicative of weak interplate coupling during the aftershock activity in the Miyagi-Oki region.