Aftershock distribution of the 2005 off Miyagi Earthquake (M7.2) located by ocean bottom seismographic data

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We relocated the hypocenters of the mainshock and aftershocks of the 2005 off Miyagi Earthquake (M 7.2) by using the offshore seismic observation data. The observation was made by 30 pop-up type ocean bottom seismographs (OBSs) until the beginning of November. Ten OBSs had already been in operation at the occurrence of the mainshock, August 16, and we could relocate its hypocenter as well as the aftershocks.

We employed the double-difference hypocenter location method (Waldhauser and Ellsworth, 2000) for obtaining fine structure of the aftershock distribution. The relocated epicenter of mainshock is relocated at (38.18 N, 142.18 E) and the focal depth is estimated to be 33.5km. Distribution of relocated aftershocks is divided to several clusters. Especially, there are distinct clusters near the focal area of mainshock. In that area, there are two linear shaped clusters orthogonal to each other, one is WNW-ESE trending line and the other is NNE-SSW trending line. The hypocenter of the mainshock is located within the WNW-ESE trending cluster.

We also estimated the focal mechanisms of the aftershocks by using the polarities of the first P arrivals. Many aftershocks are determined to be of the thrust fault type, almost identical to the focal mechanism of the mainshock, but there are a number of earthquakes with reverse fault types with nodal planes of significantly higher than that of the mainshock mechanism. We noticed that earthquakes of the low angle reverse fault and the high angle reverse fault types distribute in the two linear clusters around the rupture area of the mainshock. Low angle reverse fault type events distribute in the WNW-ESE trending line of the aftershock cluster. Meanwhile, high angle reverse fault type events are found mostly in the NNE-SSW line. Focal depths of the aftershocks with high angle reverse fault type are little shallower than those of thrust type events forming a landward dipping plane, which corresponds to the plate interface. These results suggest that the earthquakes of the high angle reverse fault type are do not occurred along the plate boundary, the fault plane of the mainshock rupture, but occurred in the overriding plate. These intraplate seismicity might be activated due to the stress change caused by the mainshock rupture because the high angle reverse fault type events are dominant in the NNE-SSW line. The location of this cluster matches to the upward limit of the mainshock rupture and the compression stress can be increased in the overriding plate.