Geophysical Research Abstracts
Vol. 13, EGU2011-2001-1, 2011
EGU General Assembly 2011

Continuous offshore seismological and geodetic monitoring in a M 7.5-class megathrust earthquake rupture zone, northeastern Japan forearc

Ryota Hino and the Miyagi-Oki Earthquake Research Team
Dept. of Geophys., Tohoku University, Sendai, Japan (hino@aob.gp.tohoku.ac.jp)

Interplate earthquakes of 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. Since 2002, we have maintained a seismic and geodetic observation network in the source area of the earthquakes by repeating deployment and retrieval of ocean bottom off-line recording instruments. The network of ocean bottom seismometers (OBSs) successfully observed detailed spatio-temporal variation of microseismicity before and after the occurrence of an interplate earthquake of M 7.2 in 2005. The OBS data showed increase of microseismicity around the rupture area of the 2005 earthquake 7 days before its occurrence. The hypocenters of the M7.2 earthquake and most of its aftershocks formed a landward dipping plane at depth of about 40 km, defining the exact location of the plate boundary ruptured by the major interplate earthquake. Since the crustal thickness of the northeastern Japan forearc is about 20 km, the estimated focal depth of the 2005 earthquake indicates that the seismogenic zone extends down to the plate interface beneath the forearc mantle. We attempted to image 3D seismic velocity structure around the rupture zone using the OBS data and found that less hydrated state of the forearc mantle, characterized by high seismic velocity and low Poisson's ratio anomalies, is account for the strong interplate coupling and large coseismic slip at the asperities of the megathrust earthquakes. Detailed inspection on the aftershock activity of the 2005 earthquake revealed the existence of the seismicity off the plate interface. This intraplate seismicity is interpreted to be induced by the stress change due to the coseismic slip of the M 7.2 earthquake. Since the location of the off-plane aftershock activity is strongly dependent on the spatial distribution of the coseismic slip, the observed aftershock distribution put strong constraint on the location of the asperities ruptured by the 2005 earthquake. Although the aftershock activity and the postseismic slip ceased within two years after the occurrence of the 2005 earthquake, a slow slip event was detected in late 2008 by the continuous ocean bottom pressure (OBP) monitoring. Although the amount of vertical movement of the seafloor is in an order of cm, it was clearly discriminated from pressure disturbance due to physical oceanographic phenomena. The source location of the slow slip event was estimated near the axial area of the Japan Trench, up-dip side of the rupture area of the 2005 earthquake. The 2005 earthquake did not rupture entire source region of the precedent 7.4 earthquake occurred in 1978 and several fault patches are considered to remain unbroken after the 2005 earthquake. Since accelerations of interplate slip, as the slip event observed in 2008, can potentially load the unbroken portions of the seismogenic zone, the offshore observation needs to be continued to monitor spatio-temporal distribution of aseimic slip along the plate boundary.