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The 2011 off the Pacific coast of Tohoku earthquake recorded by offshore seismic/geodetic observation network

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A megathrust earthquake of M=9.0, the 2011 off the Pacific coast of Tohoku earthquake, occurred along the Japan Trench subduction zone to cause devastating damage to the Pacific coast of northeastern Japan. The rupture of the earthquake started at the central part of the subduction zone, where interplate earthquakes of M ˜ 7.5 have occurred along the subducting plate boundary repeatedly at about 40 years intervals, so-called Miyagi-Oki earthquakes. 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 the M9 earthquake as well as two large (M>7) earthquakes occurred within the source region of the M9 event, one in 2005 and another on two days prior to the mainshock. In this paper, we will review the seismicity and stress field after the 2005 earthquake, and 3D seismic velocity structure around its rupture area and also give a preliminary result of hypocenter location of the foreshocks, mainshock, and aftershocks of the 2011 M9 earthquake. The relocated hypocenter locations will be discussed in terms of relevance to the seismic velocity structure along the plate boundary.

The ocean-bottom pressure data have also been recorded in the rupture area to detect vertical movement of the seafloor. Our bottom pressure gauges (OBPs) detected secular vertical seafloor motion due to strong interplate coupling prior to the M9 earthquake. More than 10 OBPs were in place at the occurrence of the mainshock to provide co- and postseismic seafloor motion.

Keywords: the 2011 off Pacific coast of Tohoku earthquake, ocean bottom seismic observation