

Precise aftershock distribution of the 2011 off the Pacific coast of Tohoku earthquake revealed by ocean bottom seismogr

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The 2011 off the Pacific coast of Tohoku earthquake occurred at the plate boundary between the Pacific plate and the landward plate on March 11, 2011, and has a magnitude of 9. Many aftershocks occurred following the mainshock. To obtain a precise aftershock distribution is important for understanding of mechanism of the earthquake generation. In order to study the aftershock activity of this event, we carried out extensive sea floor aftershock observation using more than 100 ocean bottom seismometers just after the mainshock. Deployment and recovery of the OBS were repeated four times, and we use the data from more than 70 OBSs just after the mainshock to the middle of June, 2011. We selected 1908 events whose epicenter is located below the OBS network from the JMA earthquake catalog, and P and S-wave arrival times were picked from the OBS data. Hypocenters were estimated by a maximum-likelihood estimation technique and one dimensional velocity structures was modeled using the results of previous refraction study in the study region. Thickness of sedimentary layers changes at each OBS site was evaluated and the estimated travel times by the location program was corrected. A precise aftershock distribution for approximately three months in the whole source area, with an emphasis on depths of events, using the OBS data was obtained. The OBS networks located 1005 earthquakes with a high spatial resolution. The epicenter distribution is not uniform. In the epicenter distribution, the aftershocks may be divided into a number of clusters from a geometrical view point. The aftershocks form a plane dipping landward in the whole area. Comparing our results to velocity structures by marine seismic surveys, there is no aftershock along the plate boundary in the region off Miyagi, where a large slip during the mainshock is estimated. A plate coupling in this region may change due to occurrence of the mainshock. Activity of aftershocks within the landward plate above the source region is high and many aftershocks within the landward plate have normal fault type or strike-slip type mechanism. On the other hand, many events with reverse fault (thrust) type mechanism occur along the plate boundary. Within the subducting oceanic plate, most of earthquakes has normal fault type or strike-slip type mechanism. The stress field in and around the sources region of the 2011 mainshock changes as a results of the mainshock.