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長期海底地震観測による上越沖における地震活動と地震波速度構造
Seismicity and crustal structure in the tectonic zone off the Joetsu region as revealed by LT-OBSs

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At the eastern margin of the Japan Sea, large earthquakes have been occurred along a tectonic zone (e.g., 1964 Niigata earthquake, the 1983 Japan Sea earthquake, the 2004 Chuetsu earthquake and the 2007 Chuetsu-oki earthquake). Kato et al. (2008) suggested that reactivation of pre-existing faults within ancient rift systems by stress loading through a ductile creeping of the weak lower crust triggered the 2004 Chuetsu earthquake and the 2007 Chuetsu-oki earthquake. Because a source region of the 2007 Chuetsu-oki earthquake is distributed under the Japan Sea, aftershock observation using Ocean Bottom Seismometers were carried out (Shinohara et al., 2008). It is necessary to estimate precise aftershock distribution in order to understand the mechanism of earthquake generation. In addition, a seismic refraction survey was carried out to reveal crustal structure in the region (Nakahigashi et al., submitted). They indicated that most of aftershocks were occurred in the upper crust. Because the tectonic zone is thought to be spread in offshore region, it is difficult to understand a precise activity of the tectonic zone from only land-base observations. To compare the seismic activity with the crustal structure in the region is indispensable to understand the stress field in the tectonic zone and the tectonics in the eastern margin of the Japan Sea. In order to investigate a seismic activity in the tectonic zone, 10 Long-Term Ocean Bottom Seismometers (LT-OBS) were deployed from December, 2008, to October, 2009, in the off Joetsu region. First we estimated hypocenters of events using a location program for finding a maximum likelihood solution using a Bayesian approach (Hirata and Matsu ’ura, 1987). The velocity structure for the location was modeled from a previous refraction survey conducted in the same region. Foci of over one thousand and two hundreds earthquakes were estimated with high spatial resolution during the observation period. In general, seismic waves recorded by OBSs arrive later than those estimated from the average structure model due to unconsolidated sediments just below sea floor. Therefore we adjusted estimated P- and S-wave arrivals for each station. The hypocentral distribution revealed that most of events are occurred within the upper crust. It is consistent with a result of Shinohara et al. (2008). Our precise locations of the events are useful for crustal structure studies. For example, reliability of results from tomographic study is thought to increase by using our precise locations of the events as initial locations of the inversion. We can compare the seismic activity with heterogeneity in crust of the tectonic zone off the coast of Joetsu region.