Fault geometry of the 2007 Chuetsu-oki Earthquake inferred from aftershock distribution by a dense marine and land seismic network

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The 2007 Chuetsu-Oki earthquake occurred on July 16, 2007. To obtain a detailed seismic activity is important for understanding of mechanism of the earthquake generation. Although online seismic networks have been operated in the land area close to the source region, the spacing of the stations is not sufficient to obtain precise aftershock distributions in the source region. Therefore, a dense network of temporary land seismic stations were deployed in and around the source region. Because the source region lies mainly under the offshore region, it is difficult to estimate geometry of the faults from the land seismic network data only. Thirty-two Ocean Bottom Seismometers (OBSs) were deployed from July 25 to August 28 in and around the source region of the mainshock to obtain detailed aftershock distribution of the 2007 Chuetsu-oki earthquake. In addition, a seismic survey using airguns and OBSs was carried out during the OBS observation to obtain a seismic velocity structure below the observation area for a precise hypocenter determination.

The aftershocks with high spatial resolution during the observation period using OBSs, temporally installed land seismic stations, and telemetered seismic land stations were located using the double-difference method. Most of aftershocks occurred in a region in depths range of 6 - 15 km, which corresponds to the 6-km/s layer. From the depth distribution of the hypocenters, the aftershocks occurred along a plane dipping to the southeast in the whole aftershock region. The dip angle of the plane by the aftershocks is approximately 40 degrees. Because JMA reports that the fault plane dipping to the southeast of the focal mechanism by polarities of the first arrivals has a dip of 37 degrees, the dip angle of the plane formed by the aftershock is consistent with that of the fault plane of the mainshock mechanism solution. A size of the aftershock area on the plane dipping to the southeast becomes 28 km x 13 km in consideration of this dip angle. This size of the aftershock region is comparable to the magnitude of the mainshock. The fault plane of the mainshock is considered to be represented as a single plane with a dip to the southeast as a whole. There seems to be a few planes in northern part of the aftershock region. Especially, some planes have dips to the northwest. Because the planes dipping to the northwest are small, it is estimated that the small areas of the planes dipping the northwest does not have a large contribution to radiation of a seismic energy during the main rupture.