

## Foreshock activities before the 2011 Tohoku-Oki Earthquake

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The 2011 Tohoku-Oki Earthquake (Mw 9.0) was preceded by a series of evident foreshock activity for about a month. Kato et al. (2012) identified more than 1,000 earthquakes by applying a waveform correlation method to land-based seismic records and discussed the spatio-temporal development of the foreshock activity. They interpreted the foreshock migration in terms of the propagation of aseismic slip in the vicinity of the mainshock hypocenter to suggest relatively fast slip immediately after the largest foreshock (Mw 7.3), occurred two days before the mainshock promoted the rupture of M9 mainshock. Since their hypocenters were determined by only the land seismic data, they can be much improved by including the arrival time readings recorded by ocean bottom seismographs (OBSs) deployed around the foreshock activity area. Suzuki et al. (2012) relocated the hypocenters of foreshocks with a magnitude 2.0 or larger using the OBS data and showed the foreshock activity initiated at the trenchward end of the foreshock activity zone, ~ 30 km away from the M 7.3 foreshock epicenter. This demonstrates that the OBS data significantly improve the resolution of epicenter distribution especially in the dip direction of the seismogenic zone. In this study, we relocated the hypocenters of the foreshocks identified by Kato et al. (2012) by using the OBS arrival time data. We picked the arrival times by manual and 1385 hypocenters, out of 1416 events on the list of Kato et al. (2012), were relocated.

Keywords: Foreshock events, Hypocenter relocation, Ocean Bottom Seismograph (OBS), Tohoku-Oki Earthquake