

Aftershock distributions of three large off-Miyagi Prefecture earthquakes in 2005 revealed by sP phase

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Three large earthquakes occurred off Miyagi prefecture, Japan in 2005. November 15, 2005 earthquake (M7.1) is one of them and occurred in the far-off Miyagi prefecture, near the Japan trench. A small tsunami was generated by this event and observed at coastal stations of NE Japan. Focal mechanisms of the main shock and large aftershocks are low-angle normal fault type. The other two events are August 16, 2005 Miyagi-Oki earthquake (M7.2) and August 24, 2005 (M6.3) far-off Miyagi prefecture earthquakes. Both events took place about 80km and 180km away from the east coast of Honshu respectively and their mechanisms are low-angle reverse fault type. Many aftershocks took place after the occurrence of these earthquakes and located by the seismic network of JMA and other networks. Since all the events occurred outside of the network, their hypocenters, especially focal depths, are not constrained well.

A distinct later phase is often observed in vertical component seismograms between direct P and S wave arrivals for the earthquakes whose epicentral distances are greater than 250km. This phase was identified as sP phase and arrival time difference between this phase and the first P wave is very sensitive to focal depths of events (Umino et al., 1995). We checked 3 components of seismograms of the aftershocks of these earthquakes. Distinct sP phase was identified for those aftershocks and we used them for the hypocenter relocation procedure. Waveform data for the relocation procedure were taken from the Hi-net, JMA network and the Japanese University network.

Aftershocks of November 2005 earthquake were analyzed for the period from 15 November to 31 December 2005. The arrival time differences between P and sP phases of the aftershocks increase from ~7.5 seconds to ~9.5 seconds with decreasing the longitudes of the hypocenters. Therefore, focal depths of aftershocks increase from about 12km to 18km from east to west. Distribution of aftershocks dips at an extremely low angle of less than 15 degree toward the west-northwest direction, the plate convergence direction of the subducting Pacific plate in this region. Although our results may contain some epicentral errors due to poor station coverage, the aftershock distribution agrees with the source area of the small tsunami after the main shock. Therefore 15 November 2005 (M7.1) event is thought to have occurred west-northwest dipping normal fault in the Pacific plate beneath the trench-outer rise.

Aftershocks of 24 August 2005 (M6.3) far off Miyagi prefecture earthquake and 16 August 2005 Miyagi-Oki earthquake (M7.2) were analysed for four months period data. Relocated aftershocks of the M 6.3 earthquake range from 10km to 17km in focal depths and has low dip angle towards the subducting direction of the Pacific plate there. Relocated aftershock focal depths of the M7.2 Miyagi-Oki event increase from about 25km to 55km. Further, aftershocks of both events are distributed along the boundary between the subducting Pacific plate and the overlying plate.