Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS39-04 会場:国際会議室 時間:5 月 25 日 09:45-10:00

2011 年東北地方太平洋沖地震： 震源断層の地震学的イメージ
Seismic image of coseismic fault extending from the hypocenter to the trench axis by the 2011 Tohoku-oki earthquake

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The large tsunami followed the 2011 Tohoku-oki Earthquake is believed to be caused by a fault rupture extending from around 20 km deep at the plate boundary to a shallow part of the subduction zone at the Japan Trench, on the basis of seismic wave, tsunami and geodetic data. Those observations may indicate a need to revise a conceptual model of a subduction seismogenic zone which proposed a shallow part of subduction zone is aseismic slip zone. In order to examine a coseismic fault between the hypocenter and the trench axis, we processed seismic and bathymetry data acquired during a rapid response geophysical cruise soon after the earthquake, from 14th to 30th March in 2011, by using JAMSTEC R/V Kaire. From the seismic image, the plate interface can be traced down to around 20 km deep where the fault rupture was initiated. The angle of the plate interface seems to become low from the up-dip of the hypocenter at around 15 km deep. This variation of subduction angle is consistent with a seismic velocity image previously obtained by wide-angle OBS data. The seismic image of the up-dip end is characterized by a reflective zone slightly above the oceanic crust and a wedge-shaped structure which called a frontal prism. A weak reflector slightly above oceanic crust at the base of the frontal prism can be traced to the trench axis. In addition, comparing the seismic image of the trench-filled sediment obtained before and after the earthquake shows a seismological evidence of a co-seismic fault rupture extending along the plate boundary to the seafloor at the trench; i.e., the seismic image of the trench-filled sediment after the earthquake shows a compressional structure with several reverse faults branching from the master fault which reaches the trench axis. This result shows that a shallow part of a plate interface can be a seismic slip zone and that slip to the trench along the plate boundary is a cause of a large tsunami.
Keywords: Tohoku-oki eqrthquake, seismic image, fault, trench axis