

Japan Geoscience Union Meeting 2011

(May 22-27 2011 at Makuhari, Chiba, Japan)

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MIS036-P188

Room:Convention Hall

Time:May 27 14:15-16:15

Relocation and fault planes of the 2011 off the Pacific Coast of Tohoku and 1933 Sanriku earthquakes

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We relocated foreshocks, mainshock, and aftershocks of the 2011 off the Pacific coast of Tohoku earthquake (Mw 9.1) using the modified joint hypocenter determination (MJHD) method in order to obtain their accurate hypocenters and to identify fault planes of larger earthquakes. We used P-wave arrival times at stations worldwide reported by the U. S. Geological Survey (USGS). We confirmed by relocated hypocenters that the mainshock and aftershocks had occurred along the plate boundary between the North American and Pacific plates. We also confirmed that the Mw 7.5 foreshock, which occurred two days before the mainshock, and the largest aftershock (Mw 7.9), which occurred a half hour after the mainshock, are thrust earthquakes along the plate boundary. The second largest aftershock (Mw 7.6), which is a normal-faulting earthquake, occurred at outer rise of the Japan Trench and was well relocated with its aftershocks. We found that its fault plane is dipping westward with N-S strike. This implies that the western side of the fault plane had subsided and it leads to the westward plate subduction.

The 1933 Sanriku earthquake (M 8.4) and its aftershocks, of which epicentral area is located NE of the epicentral area of the 2011 event, were also relocated by the MJHD method. The relocated hypocenters indicate that the fault plane of the 1933 Sanriku earthquake dips westward with an angle of $\sim 30^\circ$.

Keywords: off the Pacific Coast of Tohoku earthquake, 1933 Sanriku earthquake, relocation, fault plane, joint hypocenter determination