Source process of the 1964 Niigata earthquake estimated by using strong-motion records

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The 1964 Niigata earthquake (Mj7.5) is recently classified into the group of sequential events that occurred along the east rim of the Sea of Japan, such as the 1983 Japan Sea (Akita-Oki) earthquake (Mj7.7) and the 1993 Hokkaido Nansei-Oki earthquake (Mj7.8). The recurrence time of large events in this area is less understood because no other historical events have been recorded besides the 1964 event. However it is practical to construct the fault model of the scenario earthquake based on the 1964 event, when we perform the prediction of strong ground motions in the coastal area of Niigata Prefecture. Therefore the estimation of the detailed source process that can clarify the characteristics of strong motions during the 1964 event is important for the engineering purpose. Here we inferred the rupture process during the Niigata earthquake by inverting the strong-motion records observed with JMA's 50-type strong-motion seismographs and a SMAC-A type accelerograph.

As for the focal mechanism of the 1964 Niigata earthquake there have been two different interpretations, which are the high angle thrust fault of west hanging wall and the low angle thrust fault of east hanging wall. The recent studies concerning the re-estimation of the aftershock distribution support the high angle thrust mechanism for the main shock (Hamada, 1983; Kusano and Hamada, 1991). Hence we assume the initial fault model with strike angle of N200E and dip angle of 60 degrees. The depth of hypocenter is assumed to be 30 km and located at the mid-deepest point on the fault plane with the size of 100 km * 32 km. We estimated the spatio-temporal distribution of the moment-rate functions using the multi-time window linear waveform inversion (Hartzell and Heaton, 1983) and theoretical Green's functions obtained on the assumption of the 1-D layered medium. Five JMA stations we used the strong-motion records are Akita, Yamagata, Shirakawa, Takada and Wajima. In addition we used the records from Kawagishi town in Niigata city, which are observed with the SMAC-A type accelerograph and digitized by Kudo et al. (2000).

As a result we found relatively large slipping regions in the shallow area on the northern fault and deeper area on the southern fault viewing from the hypocenter, respectively. Total released moment is estimated as 2 to 6E20 Nm dependent on the weighting of the smoothing constraints. We will further investigate the effects of the variation of initial fault models, initial rupture velocity and other conditions during the inversion procedure.