Source process of the October 21, 2016, Tottori-chubu earthquake

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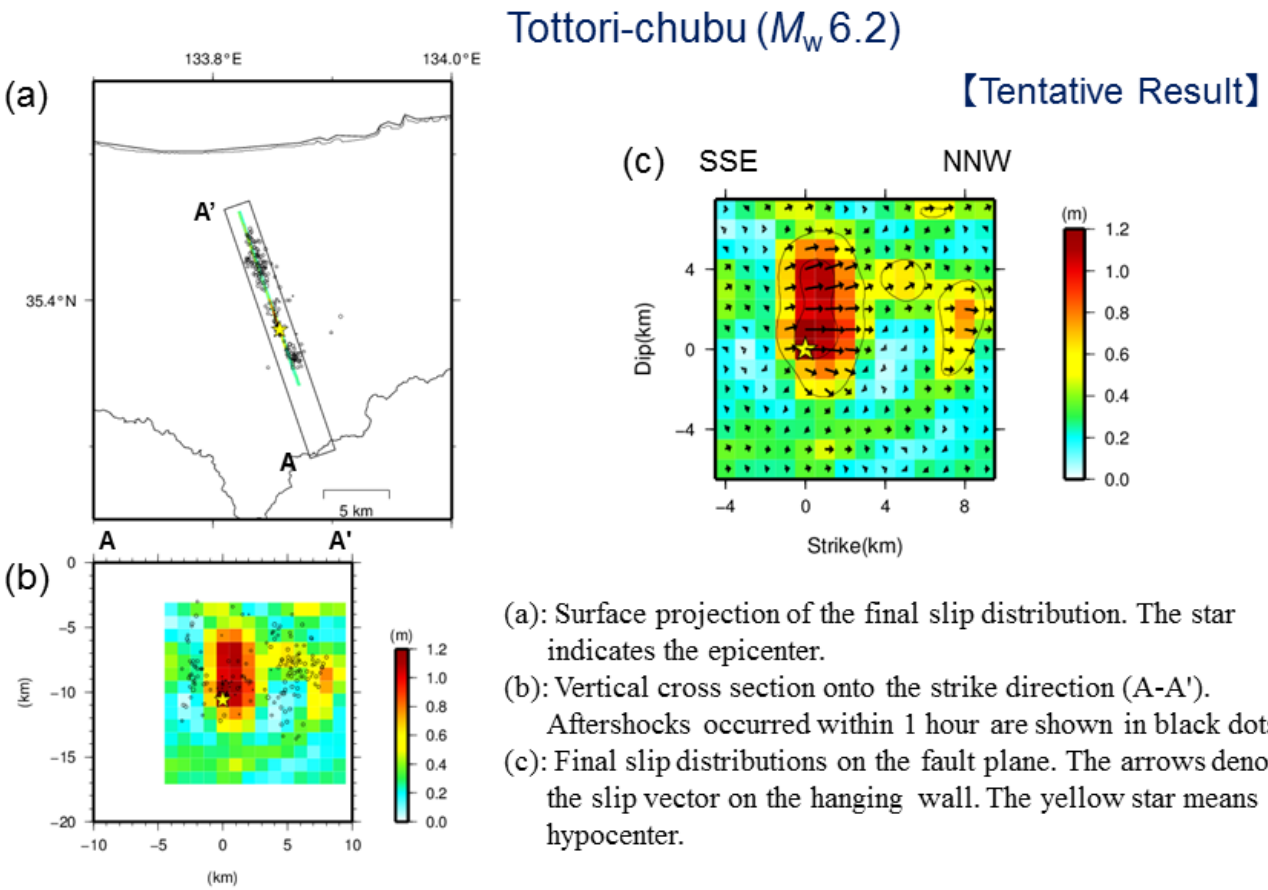
<INTRODUCTION>
An M 6.6 earthquake occurred at 14:07 on October 21, 2016 in central Tottori Prefecture. During this earthquake, high acceleration records were observed within the source region. For example, JMA intensity 6- was recorded at TTR005 (K-NET, Kurayoshi), and the PGA at this station was about 1380 gal in EW component and 1490 gal in the synthetic of three components. The effect of surface geology is regarded as one of the reasons for these strong motions in general. However, two distinct wave packets are recognized in the observed waveforms in the near source region, and long period pulse like shape is dominant in the former packet, on the other hand, short period component is significant in latter packet. These observations suggest that the effects of the source process are not negligible for the strong motions. So a waveform inversion analysis was applied for this earthquake to consider the effect of the source process.
<OUTLINE of ANALYSIS>
We used the waveforms from 16 KiK-net borehole stations (by NIED) to reduce the effects of the surface geology. In Addition, two K-NET stations, TTR005 which is located immediately above the source region, and OKY015 which is located in the south of the source, were incorporated in the inversion analysis. The acceleration waveforms were filtered between 0.03 and 0.8 Hz, and were integrated to velocity waveforms for the inversion analyses.
The source processes were inverted by the multi time window analysis (Yoshida et al., 1996, Hikima, 2012). The Green’s functions were calculated using 1-D velocity models, which were tuned by the waveform inversion method (Hikima and Koketsu, 2005), using the records of the Mw 4.1 event occurred on October 21. The fault planes of the initial models were configured by referring to the F-net mechanism solutions and the JMA hypocenter parameters. The final model was determined by considering the degree of fitness between the observed and synthetic waveforms. The size of subfaults for the inversion analyses were set in 2 km for preliminary trials, and in 1 km for the final result.
<RESULT>
The fault parameters were set tentatively as follows: the strike and the dip are 341 and 89 degree, and the length and the width are about 14 and 14 km, respectively. The depth of hypocenter is 10.6 km.
Left-lateral slip component is dominant, and the estimated moment magnitude (Mw) is about 6.2. A large slip area (asperity) was estimated around the hypocenter and its shallow part, in which the maximum slip was nearly 1.2 m. The rupture propagated toward the northern portion mainly, additionally a small asperity was estimated near the northern edge of the fault plane.
<DISCUSSION>
According to the inversion result, two asperities are obtained near the hypocenter and at the northern edge of the fault. So, it is considered plausible that these asperities are corresponding to the two wave packets observed in the waveforms. Furthermore, the larger asperity is existing between the hypocenter and the TTR005, so, the directivity effect from the asperity seems to be one of the reasons that caused the long period pulse waveform at the station. On the other hand, the short period component of the latter wave packet is the effect from the northern asperity, those slip velocity was comparatively large. Thus, it seems that the spatiotemporal source process obtained by the waveform inversion can explain the dominant characteristics of the observed waveforms.
We also calculated the stress change from the final slip distribution by using Okada's program. The stress

drop is at most 20 MPa, so, this value is comparable level with the past crustal earthquakes. This result indicates that the strong motion excitation of this earthquake was almost average level of other crustal earthquakes.

Keywords: Source process, Strong motion, Tottori-Chubu earthquake, Crustal earthquake



(a): Surface projection of the final slip distribution. The star indicates the epicenter.
(b): Vertical cross section onto the strike direction (A-A'). Aftershocks occurred within 1 hour are shown in black dots.
(c): Final slip distributions on the fault plane. The arrows denote the slip vector on the hanging wall. The yellow star means hypocenter.

