Comparison of the initial rupture processes between the M_w 6.2 mainshock and the M_w 4.1 largest foreshock of the central Tottori earthquake on October 21, 2016

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It is one of the essential questions in seismology whether or not the rupture termination of an earthquake is deterministic at the time of initiation (e.g., Iio, 2009). To investigate this issue, Noda and Ellsworth (2016, GRL) statistically characterized initial P waves using Japanese K-NET dataset. They concluded that the P-wave displacement began in a similar way at the onset and departed from the similarity earlier for smaller events in the magnitude range up to M_w 7. The departure time (T_{dp}) is approximately 30% of typical source duration, implying a connection between initial rupture process and the final earthquake size. To discuss this, we model slip histories during the initial stages of the M_w 6.2 central Tottori earthquake on October 21, 2016 in Japan and its largest foreshock of M_w 4.1 that occurred about two hours before the mainshock. Because these hypocenters are co-located and the focal mechanisms are identical according to the JMA catalog, we invert them using the same empirical Green's functions derived from other foreshocks. We use the Hi-net records surrounding the hypocenters and solve a linear system defined by the representation theorem for seismic sources using non-negative least squares method (Lawson and Hanson, 1974). Our result demonstrates that both ruptures initiate in a similar way until approximately 0.2 s after the nucleations. For the foreshock, the rapid growth completes at about 0.2 s which is consistent with T_{dp} and the duration of the “growth stage” (Uchide and Ide, 2010). On the other hand, for the mainshock, it continues to grow up rapidly even after 0.2 s. We consider that this variation in initiating process may have resulted in the difference of the final sizes.

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