# Asperities of the 2007 Niigata-ken Chuetsu-oki earthquake inferred from the source imaging and the EGF method

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We first analyze P-wave records at local strong-motion stations to investigate the rupture process at the initial stage of the 2007 Chuetsu-oki, Niigata, Japan, earthquake (Mw6.6). P-wave portion of the near-source strong-motion records shows about two seconds of small but increasing amplitude arrival (so-called initial rupture phase) followed by the onset of the main energy release (main rupture phase). Second, we analyze S-wave records at the strong-motion stations to study the main rupture stage. In this study two issues are addressed: one is where the initial rupture process occurred, and the second is where the rupture process advanced at the main rupture stage (i.e., where the asperities are located). The first issue is addressed by locating the main rupture onset position with a master-event-like technique, and then the second issue is approached by mapping the P-wave energy onto plausible fault planes with a back-projection imaging technique and by modeling the S-wave records with the empirical Green function method. Eventually, the following were revealed. The rupture initiated and propagated on the NW-dipping plane which is a nodal plane of the focal mechanism solution. At 2.1 s after the rupture initiation the subsequent main rupture started at a position of about 4 km apart, southwestward and updipward from the hypocenter. The main rupture at this stage (the first asperity) occurred on the same plane as the initial rupture plane, and the rupture then transferred to the conjugated fault plane (SE-dipping plane). On this SE-dipping plane, two asperities are identified: one is located just near the first asperity (the second asperity); the other is off the coast of Kashiwazaki city (the third asperity). The mean rupture velocity is estimated to be 1.8 km/s during the initial rupture, while 2.8 km/s during the main rupture. Our results suggest that Kashiwazaki area suffered the strong effect of the forward rupture directivity during the first asperity break, and the large effect of the S-wave radiation pattern during break of the second and the third asperities.

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