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Thermal pressurization を考慮した東北地方太平洋沖地震の 3 次元発生サイクルモデル
3D modeling of the cycle of a great Tohoku-oki earthquake considering thermal pressurization

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During the 2011 Tohoku-oki earthquake, large slips occurred in the region near the trench off Miyagi (e.g. Fujii et al. 2011). Hasegawa et al. (2011) showed that during the earthquake, the background deviatoric stress was completely released. This result suggests that the frictional strength decreased considerably. Recent studies on the fault rheology show that a considerable weakening can occur at a high slip velocity because of thermal pressurization or thermal weakening processes (Tanikawa and Shimamoto, 2009; Di Toro et al., 2011; Tsutsumi et al., 2011). Noda and Lapusta (2010) performed 3D simulations of earthquake sequences with evolving temperature and pore pressure resulting from shear heating, and they found that regions of more efficient thermal pressurization produce relatively large slips, resulting in large events with long interseismic periods. Mitsui et al. (2012) developed a 2D quasi-dynamic earthquake cycle model of the Tohoku-oki earthquake by considering thermal pressurization. The present study develops a 3D quasi-dynamic earthquake cycle model of the Tohoku-oki earthquake by considering thermal pressurization. We use a spectral solver for 1D diffusion problem developed by Noda and Lapusta (2010) to efficiently calculate the temperature and pore pressure evolution on a fault plane. We set several asperities in the regions off Miyagi, off Fukushima, and off Ibaraki, and set long asperities near the trench. We set the frictional properties of velocity weakening in the asperities; however, we set velocity strengthening outside of the asperities. Further, we set a low value for hydraulic diffusivity in the shallower part of the plate interface off Miyagi. The preliminary results show that M7.5 class earthquakes occur at the zone with relatively large hydraulic diffusivity. When rupture occurs around the low hydraulic diffusivity zone, significant thermal pressurization occurs and results in large and fast slips. This rupture propagates to the surrounding region and to the asperities of M7.5 earthquakes, because thermal pressurization occurs as a result of large slip even in the region of large hydraulic diffusivity.

キーワード: 2011 年東北地方太平洋沖地震, 3 次元地震発生サイクルモデル, thermal pressurization
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