Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS29-04 会場:105 時間:5 月 21 日 14:30-14:45

Thermal pressurization によって増加するすべり量と破壊伝播速度の抑制: ダイラタンシーの効果
Suppression of slip and rupture velocity increased by thermal pressurization: Effect of Dilatancy

浦田 優美[1*], 久家 慶子[1], 加瀬 祐子[2]
URATA, Yumi[1*], KUGE, Keiko[1], KASE, Yuko[2]

[1] 京都大学大学院理学研究科, [2] 産総研　活断層・地震研究センター
[1]Dept. Geophysics, Kyoto Univ., [2]AFERC, AIST

We investigate effect of dilatancy on dynamic ruptures with thermal pressurization (TP), taking into account a power law relationship between permeability and porosity, based on 3-D numerical simulations of spontaneous rupture propagation obeying a slip-weakening Coulomb failure criterion.

Effects of dilatancy on rupture propagation with TP were often investigated in 2-D numerical simulations, or with attention only to behaviors at a single point on a fault plane. Moreover, in the previous simulations, it has never been considered that permeability can change with porosity. Because the hydraulic diffusivity, which controls TP, is proportional to permeability, the changes in permeability along with porosity would affect TP and dynamic ruptures.

To consider changes in porosity and permeability in dynamic ruptures with TP, we solve the thermal and hydraulic diffusion equations with a porosity term by the finite-difference method. Our numerical algorithm for dynamic ruptures is based on the method by Kase and Kuge (2001). Pore pressure from the diffusion equations is included in effective normal stress, while slip velocity and shear stress give the heat source in the diffusion equations. In our model, the frictional heating and the processes of dilatancy occur within the shear zone. We consider both reversible and irreversible changes in the porosity (Segall and Rice, 2006), assuming that the irreversible change is proportional to the slip velocity. Permeability changes with the porosity, according to the power law by David et al. (1994). We put a square fault with the length of 4 km in the infinite medium. The fault is subjected to uniform external stresses.

We reveal that the slip amount decreases with increasing dilatancy coefficient or exponent of the power low, and the rupture velocity is predominantly suppressed by the coefficient. This is observed whether applied stresses are high or low. The deficit of the final slip concerned with the coefficient could be smaller as the fault size is larger.