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脆性塑性遷移を考慮に入れた地震サイクルモデル
Earthquake sequense simulations accounting for brittle-plastic transition

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In understanding sequences of earthquakes from the point of view of mechanics and structural geology on the fault rocks, brittle-plastic transition of rocks is of great importance as evidenced by field observations of repeated overprinting of pseudotachylyte (frictional melting) and mylonitic (ductile) deformations [e.g., Lin et al., 2005]. Near the down-dip limit of the earthquake ruptures which produce such fault rocks, mylonitic deformation which takes place dominantly during interseismic periods probably affects the stress accumulation process in the shallower brittle zone where earthquakes nucleate. Earthquake generation process is often discussed in terms of the rate-dependency of the frictional resistance of a fault [e.g., Tse and Rice, 1986]. On the other hand, the brittle-plastic transitions are typically expressed as a strength profile across the crust [e.g., Goetz and Evans, 1979]. Given the rate-strengthening characteristics of ductile plastic deformation, these two pictures are closely related to each other [e.g., Sholtz, 1988]. Quantitative discussion by actually solving or simulating sequences of earthquakes on a fault accounting for brittle-plastic transition is required to connect mechanics and structural geology on the fault-rocks.

Recent development of an empirical constitutive equation of a shear zone accounting for brittle-plastic transition (friction-to-flow law) [Shimamoto, 2004, JpGU meeting, Noda and Shimamoto, 2012] enables us simulating sequences of earthquakes consistently with the Brace-Goetz strength profile. The fault model [e.g., Kawamoto and Shimamoto, 1997] which is conceptually constructed based on experimental studies is realized in numerical simulations in which both long-term tectonic loading and coseismic inertial effects are fully accounted for [e.g., Lapusta et al., 2000]. By referring the investigation of the texture of experimental specimens [e.g., Hiraga and Shimamoto, 1987], we can discuss expected fault rock structures after simulations of earthquake sequences. We will also discuss the similarities and differences between the earthquake sequences produced by the logarithmic rate- and state-dependent friction law and the rate- and state-dependent friction-to-flow law.

キーワード: 地震サイクル, 脆性塑性遷移
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