

Non-equilibrium thermodynamical interpretation for rate- and state-dependent friction law

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The rate- and state-dependent friction law is based on the experimental results of rock sliding friction. This law unifies two types of rock experiment results; the first one is the time dependence of static coefficient of friction (Dieterich, 1972) and the second one is slip velocity dependence of the dynamic coefficient of friction (Dieterich, 1978). This law is reproduced by using two equations called as constitutive law and evolution law.

Several versions of evolution law have been proposed in order to reproduce the experimental data better. However, none of them are completely satisfied.

We analyze this rate- and state-dependent friction law for the velocity-step and the healing tests from a thermodynamic point of view. Assuming a logarithmic deviation from steady-state, both results are reproduced. The proposed system of equations is a unification of the classical models (Dieterich, 1979; Ruina, 1983).

Keywords: friction, constitutive law, non-equilibrium thermodynamics, evolution law