Evolution of real contact area between rough surfaces: toward the healing mechanism of fault strength

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Evolution of real contact area is important for healing of fault strength. The real contact area increases by creep of soft material, which leads to the frictional force recovery of a fault. Creeping of soft material causes vertical displacement and radial deformation. The former causes new contact, therefore real contact area increases. The latter causes evolution of real contact area by itself.

We constructed two models which describes the evolution of real contact area. The 1st model captures the vertical displacement but neglects radial deformation of soft material. The 1st model gives that the evolution of real contact area is power law function and the exponent is given by 1/n, where n is determined by plasticity of soft material.

On a contrary, the 2nd model focuses on radial deformation of soft material but ignores vertical displacement. This model also shows that evolution of real contact area is power of time. The exponent is 2/2n+1. For n is large enough, the exponent approaches 1/n which is the same as 1st model. The results of both models do not depend on a profile of the rough surface. Furthermore, both models show that Coulomb-Amonton's law holds for n is large enough.

Comparison our results to rate- and state- dependent friction law, b is given by b/myu_0=1/n. 1/n strictly increases with temperature and consistent with friction experiment data of Nakatani(2001).