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Finite element model investigation of fault shear stress accumulation due to elastic loading and viscous relaxation.

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Shear stresses on faults drive earthquake ruptures. Therefore their initial spatial distributions along faults become one of the first order controls on how large an earthquake grows, and their interseismic accumulation between earthquakes strongly influences the seismogenic potential of a fault. Here we investigate in a generic fault zone model using a finite element code, how the accumulation of shear stress along faults are influenced by the type of asperity (geometrical vs. stress), interseismic loading rate, and the viscoelastic properties of the fault zone and adjacent materials.

Shear stress accumulation along faults during the interseismic period is usually considered to be the result of slow elastic tectonic loading on frictionally locked fault interfaces. However, many rocks exhibit viscoelastic behavior over geological time scales. Thus if fault rocks and the surrounding host rock exhibit such time-dependent deformational behavior, interseismic loading of stresses along faults may not be simply described by time-independent linear elastic solutions. Time-dependent viscoelastic deformation relaxes stress over time and can alter the spatial pattern of stress heterogeneity along faults. Preliminary results of the modeling suggest that spatial diffusion of stress heterogeneities can occur due to viscoelastic effects especially when geometrical complexity is introduced at the fault surface. The interplay between relaxation time constants and tectonic loading rate will be further investigated to identify whether a particular rheology or tectonic setting is prone to stress relaxation effects due to viscous deformation.