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A model for flash heating in sheared fault gouge JEAN CARLSON, University of Illinois Urbana Champaign, AHMED ELBANNA, University of California Santa Barbara — We develop a model for sheared gouge layers that accounts for the local increase in temperature at the grain contacts during sliding. We use the shear transformation zone (STZ) theory, a statistical thermodynamic theory, to describe irreversible macroscopic plastic deformations due to local rearrangements of the gouge particles. We track the temperature evolution at the grain contacts using a one dimensional heat diffusion equation. Our model predicts a logarithmic rate dependence of the steady state shear stress in the quasi-static regime. In the dense flow regime the frictional strength decreases rapidly with increasing slip rate due to thermal softening at the granular interfaces. The transient response following a step in strain rate includes a direct effect and a following evolution effect, both of which depend on the magnitude and direction of the velocity step. In addition to frictional heat, the energy budget includes an additional energy sink representing the fraction of external work consumed in increasing local disorder. The model links low-speed and high-speed frictional response of gouge layers, and provides an essential ingredient for multiscale modeling of earthquake ruptures with enhanced coseismic weakening.

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