Investigating Lithosphere Strength With Thin-Shell Tectonic Modeling

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The behavior of many major faults on Earth can only be explained if they are assumed to be much weaker than expected from Byerlee's Law alone. However, there is no agreement over what is a realistic range of friction parameters for faults, or its possible dependency on fault network geometry. Both can be studied with numerical forward modeling, but this requires knowledge of the detailed 3-D geometry of the faults. The latter is now available for most of California, thanks to the SCEC Community Fault Model (southern California) and to the USGS program "3-D Geologic Maps and Visualization" (San Francisco Bay and surrounding region). We model the behavior of the California fault network with the finite-element code SHELLS. We use as input a coarse global grid, with local high-resolution representation of actual faults based on the existing 3-D fault maps. By comparing the simulation results with data on fault-slip rates, we can determine how the faults in this network interact, the role of small faults, and we can quantify the typical fault strength in a continental transform plate boundary setting.