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The strength of faults in the upper and lower crust in California, USA.

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The strength of major strike-slip faults like the San Andreas has been controversial for decades. We use a global finite-element code with a variable-resolution grid and global plate-driving forces to determine whether the effective friction on the San Andreas fault is high (0.6 - 1), intermediate (0.3 – 0.5) or low ($\leq$ 0.2), whether a single value of effective friction can be used for all mapped active faults within California, and whether weakening of the ductile lower crust associated with faulting is important. We compare our model results with existing data on fault slip-rates, GPS velocities, stress field, and earthquakes depth distribution. The comparison indicates that all faults are weak (effective friction coefficient $\leq$ 0.2), and that additional weakening of the major faults in the network is important (i.e. brittle strength is variable among faults). The effective friction coefficient for the strongest faults in the region is in the range 0.2 - 0.05. The San Andreas fault is a very weak fault among weak faults, with effective friction < 0.05 for most of its length. All viable solutions also indicate that weakening of the lower crust below major faults in the system is necessary, i.e. major faults must exist as localized, narrow shear zones in the lower crust as well, while minor faults could be limited to the upper, brittle crust.