Frictional properties of the San Andreas Fault determined from dynamic modeling of afterslip

ABSTRACT

We investigate fault frictional properties from dynamic modeling of afterslip following the 2004 Mw, 6.0 Parkfield Earthquake on the San Andreas Fault. We use two co-seismic slip models constrained from seismological and geodetic data to compute co-seismic stress change on the fault and predict the time evolution of afterslip by assuming that fault friction is rate-dependent $\mu = \mu_* + (a - b)\ln\left(\frac{V}{V_*}\right)$. The model parameters include the pre-seismic Coulomb stress static friction μ_*, the rate dependency characterized by the quantity *a-b*, where *V* is the sliding velocity. The model parameters are determined from a non-linear inversion of the transient post-seismic geodetic signal measured at the continuous GPS stations. We consider the model with spatial varieties rate parameter *a-b*. All models provide a good first order fit to the geodetic time series. Static friction is estimated to about 0.4 on average and *a-b* falls in the $10^{-3}{\sim}10^{-2}$ range. The geodetic data require that, where positive, *a-b* decreases gradually with depth from about 7×10^{-3} at 0.5 km depth to a about 10^{-3} at the depth with co-seismic asperities. Our study provides a view of frictional properties at the kilometers scale over the 0-15 km depth illuminated by co-seismic stress change induced by the Parkfield earthquake. It is remarkable that our results are consistent with local frictional properties determined on rock samples recovered from the fault zones at 2.7 km depth thanks to the SAFOD experiment.