Geophysical Research Abstracts
Vol. 14, EGU2012-13398, 2012
EGU General Assembly 2012

Stress in Continental Lithosphere: Constraints from numerical models of earthquake cycle with laboratory-derived rheologic laws

Y. Fialko and C. Takeuchi

Scripps Insitution of Oceanography, University of California San Diego, La Jolla, California, USA (yfialko@ucsd.edu)

We present numerical models of earthquake cycles on a strike-slip fault that incorporate laboratory-derived power-law rheologies with Arrhenius temperature dependence, viscous dissipation, conductive heat transfer, and far-field loading due to relative plate motion. We use these models to explore the evolution of stress, strain, and thermal regime on "geologic" time scales ($\sim 10^6 - 10^7$ years), as well as on time scales of the order of the earthquake recurrence ($\sim 10^2 - 10^3$ years). Strain localization in the viscoelastic medium results from thermomechanical coupling and power law dependence of strain rate on stress. For conditions corresponding to the San Andreas Fault (SAF) in California, the predicted width of the shear zone in the lower crust is $\sim$3-5 km; this shear zone accommodates more than 50% of the far-field plate motion. Coupled thermomechanical models predict a single-layer lithosphere in case of "dry" composition of the lower crust and upper mantle, and a "jelly sandwich" lithosphere in case of "wet" composition. Deviatoric stress in the lithosphere in our models is relatively insensitive to the water content, the far-field loading rate, and the fault strength, and is of the order of 10^2 MPa. Furthermore, stress in the lithosphere is found to inversely correlate with the velocity of relative plate motion.