Geophysical Research Abstracts
Vol. 19, EGU2017-17294, 2017
EGU General Assembly 2017

Long-term crustal strength: Strain vs. strain-rate weakening

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In compressional systems, stress build-up in the continental crust is subject to horizontal forces. Upper differential stress thresholds in the Earth's crust are defined by the strength of brittle faults or ductile shear zones, depending of their rheological behavior. The longevity of such high strain rate zones is their mechanical weakness relative to surrounding, undeformed rocks. Whether weakening of brittle faults depends on accumulated strain (e.g., grain size reduction), strain rate (e.g., shear heating), or other effects is debated. I use a two-dimensional numerical code with a visco-elasto-plastic/brittle rheology to investigate the influence of strain and strain-rate weakening (often referred to as velocity weakening) on the long-term stress evolution of compressed continental crust. One of the main goals is to show whether average differential stresses remain similar during the formation of orogenic-scale fault zones of whether they occur in pulses.