Geophysical Research Abstracts
Vol. 13, EGU2011-13110-3, 2011
EGU General Assembly 2011

Damage Structure, Permeability and Seismic Properties of Fault Zones in the Seismic Cycle in Nature and the Laboratory

Thomas Mitchell

Ruhr-University Bochum, Institute for Geology, Mineralogy, and Geophysics, Experimental Geophysics Laboratory, Bochum, Germany (tom.m.mitchell@btinternet.com)

Elucidation of the internal structure of fault zones by understanding the spatial distribution, structure, geometric and textural characterization of damage around faults at various scales in nature can help to predict fault growth processes, subsequent mechanics, bulk hydraulic and seismological properties of a fault zone. Detailed field studies of fault zones over a range of scales, combined with constrained laboratory studies can provide a powerful means for quantitative measurements and understanding of such properties. The episodic recurrence of seismic events suggests that fault zone mechanical and transport properties can vary cyclically, leading to variations of structure and hydraulic properties over different timescales during the seismic cycle. Therefore deformation experiments at a range of strain rates and conditions are important in order to understand differences between interseismic and coseismic fault zone evolution.

Damage surrounding faults has been attributed to fault growth processes, damage due to the juxtaposition of geometric irregularities, and earthquake rupture. In this contribution, we present a summary of quantitative and qualitative data on the scaling, symmetry and spatial variations in damage distribution and textural characteristics of a variety of crustal-scale strike slip fault zones, along with a range of experimentally produced examples of such damage and subsequent variations in hydraulic and seismic structure. In general, the primary controls on fault zone architecture are the depth of faulting, the protolith, the fault displacement and the interaction with other faults and/or pre-existing structures. Variations in such controls can result in a wide variety of fault structures and associated proerties; damage surrounding fault cores of various sizes and complexity is represented by deformation on a range of scales from microfracturing of the rock matrix to macroscopic fracture networks. Faults studied are hosted with a range of lithologies and include the San Andreas Fault (USA), Arima Takatsuki Fault (Japan,) Caleta Coloso Fault (Chile), Gole Larghe fault (Italy) and the Carboneras Fault (SE Spain).