Award Number: U.S. Geological Survey# 1434-HQ-97-GR-3016

Seismogenic Faults in Southern California

Leonardo Seeber and John G. Armbuster

Lamont-Doherty Earth Observatoru.

Palisades, NY 10964

telephone: 914-365-8385

fax: 914-365-8150

Email: nano@ldeo.columbia.edu

Abstract

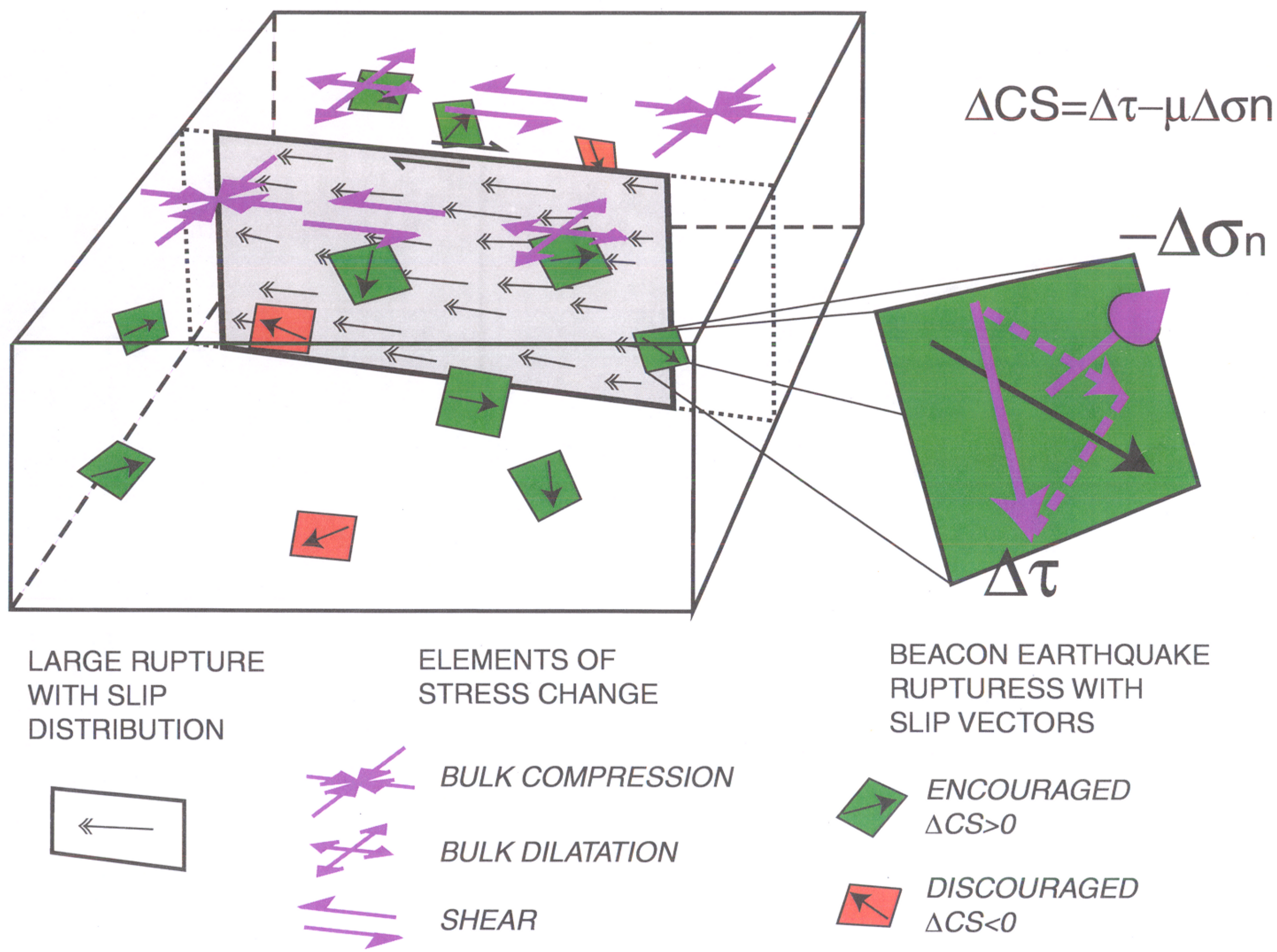
Earthquake as Beacons of Stress Change

Large earthquake ruptures cause regional static stress changes that depends on their slip distribution; small earthquake respond to these and other changes and can serves as sensitive stress beacons. We use a dense field of seismicity resolved as slip on many faults to constrain complexities of the stress change and its cause. We derived for the first time a credible slip distribution along a major rupture from the surrounding seismicity over the following few years. Our approach combines with increasing accessing to high-quality data promises new opportunities in monitoring stress changes in the crust from both natural or engineering causes.

A fault rupture is symptomatic of two stress changes: one that brought that fault to failure followed by another one caused by the rupture. Thus, faults interact and the timing of a fault rupture is generally affected by previous neighboring rupture[1]. Earthquake display faults at failure and offer information on stress in both their causative and responsive role[2]. This work explores the potential of high-resolution data on many small earthquakes to characterize a changes in stress (Figure 1). First, we follow previous investigations and use a new technique to gauge the responses of the seismicity

to a given stress change from a large rupture. We then turn the problems about and determine the slip distribution on the main rupture that best fits the response of the seismicity. This slip distribution matches previous direct determination remarkably well. This result opens a suite of new opportunities to monitor mechanical conditions in the uppercrust and to investigate process leading to failure on faults.

The mechanical state of a fault can be characterized by Coulomb stress[3] CS=___n-p),a scalar parameter, where__shear stress on the fault_, *n=normal stress,*=coefficient of friction, and p-pore pressure. As a result of a shear dislocation on a “causative” fault, a “beacon” fault will generally experience a change in_,n,and p. Changes in pore pressure_p are probably coupled with fluid flow and affect time dependent properties of the fault; they are neglected in this time-independent analysis of the beacon response. Thus we calculate_CS=______n assuming an elastic medium5 (Figure1). _CS>0 is expected to “encourage” the beacon fault toward failure; _CS<0 is expected to “discourage” it from failing. This expectation can be tested for earthquakes that are resolved as shear failures with specific location, strike , dip, and rake5. In general. *CS is* significant within a rupture-length of any rupture6. Both deformation and stress changes, however, are dominated by the largest rupture7. We consider the simple and by now classical interaction experiment where _CS stems from a large rupture and affects a multitude of beacon earthquake which are assumed to be too small to mutually interact[2].



Seeber and Armbruster FIGURE 1