

The role of transient deformation in triggering earthquakes

Fred F. Pollitz ⁽¹⁾

(1) U.S. Geological Survey, Menlo Park, California.

The processes of strain accumulation, release, and subsequent readjustment lead to a complicated pattern of stress evolution on a plate boundary with multiple fault strands. Even if the background stress loading of faults is reasonably well constrained from a secular strain accumulation model, the details of spatial and temporal pattern in stress concentration may be elusive. Static stress steps from earthquakes represent the largest perturbation of the system from secular strain accumulation. The paradigm that static changes in Coulomb failure stress control (in a statistical sense) the locations of future earthquakes has been successful for many "near-field" investigations, i.e., those in which seismicity patterns within one or two fault lengths are examined. Patterns of seismicity at greater distance suggest that viscoelastic relaxation of the ductile region beneath the seismogenic layer may also contribute to stress loading.

Examples are presented which document: (1) the transient surface velocity field at both near-field and far-field distances following three large earthquakes (the 1960 Chilean, 1964 Prince William Sound, and 1992 Landers earthquakes) and (2) the associated triggering of seismicity. The seismicity patterns which appear to require a major role for viscoelastic transient stresses include: (1) a time-transgressive southward migration of seismicity along western North America from ca. 1970 to 1994, (2) a strong acceleration in East Pacific Rise seismicity in the 1980's, and (3) the 1999 Hector Mine, California earthquake.

In general, such transient stress changes may compound static stress changes in the near-field and dominate the stress perturbation in the far-field.