Distant earthquakes can trigger deep slow fault slip

May 11 2011

(PhysOrg.com) -- Researchers examining the San Andreas Fault in central California have found evidence that distant earthquakes can trigger episodes of accelerated (but still very slow) slip motion, deep on the fault.

While a sudden slip on a fault generates earthquakes capable of strong shaking, a fault can also slip slowly. Sometimes, these slow movements on a fault, known as creep events, are accompanied by a weak ground vibration known as a tectonic tremor, which can be detected on sensitive seismometers.

Using data from these seismometers, researchers from the U.S. Geological Survey, along with Zhigang Peng, assistant professor in the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology, and graduate student Chastity Aiken, examined the locations and timing of tremor activity following large distant earthquakes. In some cases, they found evidence that triggered slip and its associated tremor migrated along the length of the fault, and persisted long after the passage of seismic waves from the distant earthquake. The scientists hypothesize that distant earthquakes can act as a trigger for ongoing episodic creep events, sometimes altering their timing.

The researchers also noted that creep events in other locations can sometimes trigger earthquakes. While they caution that their study was focused on triggered tremor rather than triggered earthquakes, they suggest that prolonged triggered creep episodes could be relevant for

both phenomena. In particular, triggered creep episodes could provide a physical explanation for the time delay commonly observed between passing seismic waves and distantly generated earthquakes.

Published online this week in the journal, "*Nature Geoscience*," the study, "Triggered creep as a possible mechanism for delayed dynamic triggering of tremor and earthquakes," is the latest of ongoing research on the effects of large earthquakes on distant faults. While distantly triggered small earthquakes are relatively common, another recent study found no evidence for distantly triggered large earthquakes, at least during the first few days after a large event. The current study provides a possible mechanism to explain a range of time delays between a large distant event and triggered earthquakes.

More information: Triggered creep as a possible mechanism for delayed dynamic triggering of tremor and earthquakes, *Nature Geoscience* (2011) doi:10.1038/ngeo1141

Abstract
The passage of radiating seismic waves generates transient stresses in the Earth's crust that can trigger slip on faults far away from the original earthquake source. The triggered fault slip is detectable in the form of earthquakes1, 2, 3 and seismic tremor4, 5, 6, 7. However, the significance of these triggered events remains controversial8, 9, in part because they often occur with some delay, long after the triggering stress has passed. Here we scrutinize the location and timing of tremor on the San Andreas fault between 2001 and 2010 in relation to distant earthquakes. We observe tremor on the San Andreas fault that is initiated by passing seismic waves, yet migrates along the fault at a much slower velocity than the radiating seismic waves. We suggest that the migrating tremor records triggered slow slip of the San Andreas fault as a propagating creep event. We find that the triggered tremor and fault creep can be initiated by distant earthquakes as small as magnitude 5.4

and can persist for several days after the seismic waves have passed. Our observations of prolonged tremor activity provide a clear example of the delayed dynamic triggering of seismic events. Fault creep has been shown to trigger earthquakes10, 11, 12, and we therefore suggest that the dynamic triggering of prolonged fault creep could provide a mechanism for the delayed triggering of earthquakes.

Provided by Georgia Institute of Technology