Geophysical Research Abstracts
Vol. 12, EGU2010-1668, 2010
EGU General Assembly 2010

Postseismic variations in seismic moment and recurrence interval of small repeating events following the 2004 Parkfield earthquake

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Abstract
After the 29 September 2004, M 6.0 Parkfield, California earthquake, a large number of postseismic repeats of small earthquakes are observed. We analyze a subset of 34 M -0.4 $\sim$ 2.1 repeating earthquake sequences (RES) from 1987-2009 at Parkfield to examine the variation of recurrence properties in space and time. Many of the repeating events strongly accelerated following the Parkfield earthquake with greatly reduced recurrence interval (Tr) that increase systematically with time following Omori's law. The evolution of Tr directly reflects aseismic afterslip surrounding the rupture. In addition to this acceleration, we also find systematic changes in seismic moment (Mo), where many sequences experienced an immediate increase in Mo and subsequent decay as Tr approaches pre-2004 durations. The RES at shallower depth tend to have a larger range in both Tr and Mo, whereas deeper RES shows small variation. The shallowest RES, SAFOD target repeating sequences with the greatest magnitude (M1.8-2.1), however, reveal large variation in Tr but small variation in Mo. Earthquake simulations with rate- and state-dependent friction show that slip of velocity weakening asperities surrounded by a velocity strengthening fault is increasingly aseismic as the asperity patch size and loading rate decrease. These models predict that the degree of postseismic variation in Mo and Tr is a function of event size, consistent with the observation of decreasing Mo with increasing Tr for small RES. With a smaller percentage of aseismic slip during rupture, a small asperity appears to grow in Mo under high loading rate which is contrary to the view that Mo should decrease due to a reduced healing time.