Examining Changes in Earthquake Triggering Behavior Across the Ocean-Continent transition, Gulf of California

Award: 05-48785 (March 2003)

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The transition from a transform to a spreading plate boundary between southern California and the Gulf of California corresponds to a distinct transition in earthquake clustering behavior that has implications for seismic hazard and fault-zone rheology. Despite occurring in continental crust, the seismicity in the Salton Trough resembles oceanic transform faults in that it is dominated by earthquake swarms that last from a few hours to a few days rather than the mainshock-aftershock sequences that dominate the rest of California. We studied a series of earthquake swarms on transform faults in the Salton Trough, the Gulf of California, and the EPR to determine if a common physical mechanism was likely responsible in all t hree settings. The 2005 Obsidian Buttes swarm of more than a thousand earthquakes provided the best opportunity to date to assess the mechanisms driving seismic swarms. The recorded seismicity can only explain 20% of the geodetically observed deformation, implying that shallow, aseismic fault slip was the primary process driving this swarm. Additionally, the seismicity in the initial part of the swarm migrates along the strike of the fault at ~1 km/hr and the spatial extent is an order of magnitude larger than would be expected based on the total seismic moment-release (low overall stress drop). We compared these properties for a suite of earthquake swarms from the Salton Trough, Gulf of California, and EPR transform faults and find that a migration velocity of ~0.1-1 km/hr and a low overall stress drop are characteristic of all three regions. The migration velocity matches the geodetically observed rupture velocity of creep events, indicating that aseismic slip is the drivin g process responsible for the unusual earthquake clustering behavior in all three regions.

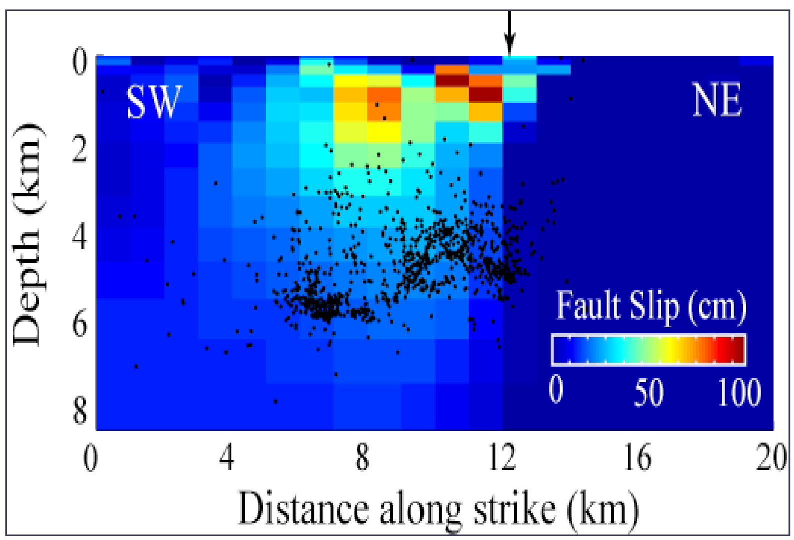

Figure: From Lohman and McGuire, 2007. Slip model derived from inverison of InSAR data spanning the 2005 Obsidian Buttes swarm. The InSAR data requires fault slip equivalent to a Mw 5.7 earthquake, however the sum of all of the microseismicity during the swarm (black dots) isMw5.2 indicating that the vast majority of fault motion occurred as shallow aseismic fault creep.

Lohman, R. and J. J. McGuire, Earthquake swarms driven by aseismic creep in the Salton Trough, J. Geophys. Res. 112, B04405, doi:10.1029/2006JB004596, 2007.

Roland E. and J. J. McGuire, Earthquake swarms from the East Pacific Rise to the Salton Trough, in preperation for Bull. Seism. Soc. Am., 2008.