Solid Earth Physics Seminar, Harvard University

Wednesday 15 February 2017, 1:45 pm
4thFloor Faculty Lounge, Hoffman Lab, 20 Oxford Street

Complex Spatiotemporal Evolution of Seismicity and Source Parameters of the 2008 M_w 4.9 Mogul Earthquake Swarm in Reno, Nevada

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Abstract:

After approximately 2 months of swarm-like earthquakes in the Mogul neighborhood of west Reno, NV, seismicity rates and event magnitudes increased over several days culminating in an M_w 4.9 (M_L 5.1) dextral strike-slip earthquake on 26 April 2008. Although very shallow, the M_w 4.9 main shock had a different sense of slip than locally mapped dip-slip surface faults. We relocate 7549 earthquakes, calculate 1082 focal mechanisms, and statistically cluster the relocated earthquake catalog to understand the character and interaction of active structures throughout the Mogul, NV earthquake sequence. Rapid temporary instrument deployment provides high-resolution coverage of microseismicity, enabling a detailed analysis of swarm behavior and faulting geometry.

Double-difference waveform-based relocations reveal an internally clustered sequence in which foreshocks evolved on multiple structures surrounding the eventual main shock rupture. The relocated seismicity defines a fault-fracture mesh and detailed fault structure from approximately 2–6 km depth on the previously unknown Mogul fault that may be an evolving incipient strike-slip fault zone. The seismicity volume expands before the main shock, consistent with pore pressure diffusion, and the aftershock volume is much larger than is typical for an M_w 4.9 earthquake. We group events into clusters using space-time-magnitude nearest-neighbor distances between events and develop a cluster criterion through randomization of the relocated catalog. Identified clusters are largely main shock-aftershock sequences, without evidence for migration, occurring within the diffuse background seismicity. Finally, we estimate well-constrained, independent P- and S-wave corner frequencies for 148 earthquakes ($2.2 \geq M_L \leq 5.1$) using EGF-derived spectral ratios. Resulting stress drops vary over two orders of magnitude and enable investigation of stress drop variation within a well-recorded sequence.