

A new look at episodic slip through precise tremor locations in southwest Japan: "fast" sub-events and tidal triggering

David R. Shelly (UC-Berkeley), Gregory C. Beroza (Stanford University), and Satoshi Ide (University of Tokyo)

Transient slow slip events are increasingly being recognized as important components of strain release on faults and may substantially impact the earthquake cycle. Surface-based geodetic instruments provide estimates of the overall slip distribution in larger transients but are unable to capture the detailed evolution of such slip, either in time or space. Accompanying some of these slip transients is a relatively weak, extended duration seismic signal, known as non-volcanic tremor, which has recently been shown to be generated by a sequence of shear failures occurring as part of the slip event. By precisely locating the tremor, we can track some features of slip evolution with unprecedented resolution. Here, we analyze two weeklong episodes of tremor and slow slip in western Shikoku, Japan. We find that these slip transients do not evolve in a smooth and steady fashion but contain numerous sub-events of smaller size and shorter duration. In addition to along-strike migration rates of ~ 10 km/day observed previously, much faster migration also occurs, usually in the slab dip direction, at rates of 25-150 km/hour over distances of up to 20 km. We observe such migration episodes in both the up-dip and down-dip directions. These episodes may be most common on certain portions of the plate boundary that generate strong tremor in intermittent bursts. The surrounding regions of the fault may slip more continuously, driving these stronger patches to repeated failures. Tremor activity has a strong tidal periodicity, possibly reflecting the modulation of slow slip velocity by tidal stresses. This suggests that the expected high confining pressures may be mitigated by high pore fluid pressures in the tremor source region, making the very small tidal stress perturbations relatively more important.