

## The Mechanics of Deep Low Frequency Earthquake, Tremor and Slow Slip

# Satoshi Ide[1]; David Shelly[2]; Gregory Beroza[3]

[1] Dept. EPS, Univ. of Tokyo; [2] Department of Geophysics, Stanford University; [3] Stanford University

Non-volcanic tremor is a weak, extended duration seismic signal observed episodically in many subduction zones and on some major faults, often in conjunction with slow slip events. While most of the tremor waveform has a chaotic appearance, there are periods with relatively impulsive arrivals, which are termed low-frequency earthquakes (LFEs). We use Hi-Net data to study tremor and LFEs beneath Shikoku, Japan. Precise relocation places LFEs on the subduction interface, immediately down-dip of the locked portion of the plate boundary. Using a matched-filter technique with these LFEs as template events, we find that tremor can be explained as a swarm of LFEs. In order to determine the mechanism, we analyze stacked LFE waveforms and compare them with the waveforms of nearby earthquakes of known mechanism within the subducting Philippine Sea Plate. Both P-wave first-motion focal mechanism and the S-wave moment tensor analysis indicate that LFEs are shear slip on a low-angle thrust fault dipping to the northwest. We conclude that LFEs, and hence deep non-volcanic tremor, is generated directly by shear slip on the plate boundary, and represents a seismic signature of the accompanying slow slip events and recently discovered very low frequency earthquakes. This suggests that all these phenomena are different manifestations of the same process.