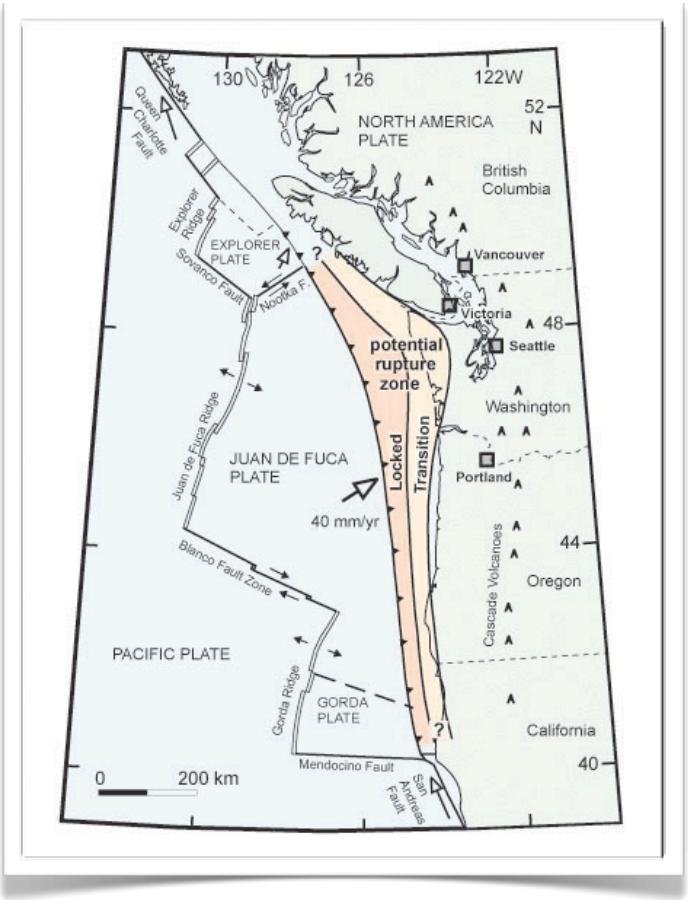
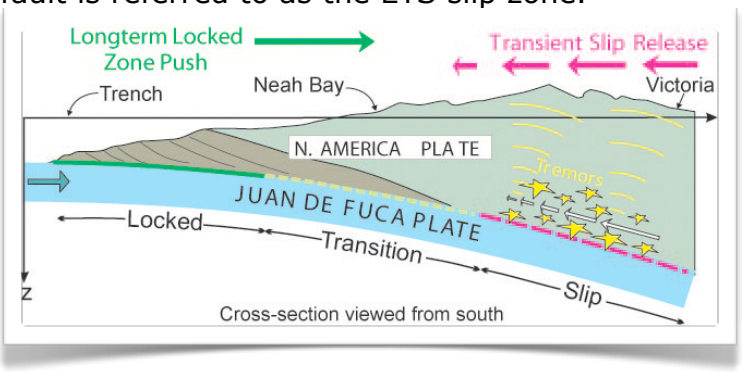
Episodic Tremor & Slip

Episodic Tremor and Slip (ETS) is the name given to a process that occurs deep below the Earth's surface, along faults that form the boundaries of tectonic plates. It involves repeated episodes of slow sliding, one plate over the other, of a few centimeters over a period of several weeks, accompanied by energetic seismic noise, called tremor.

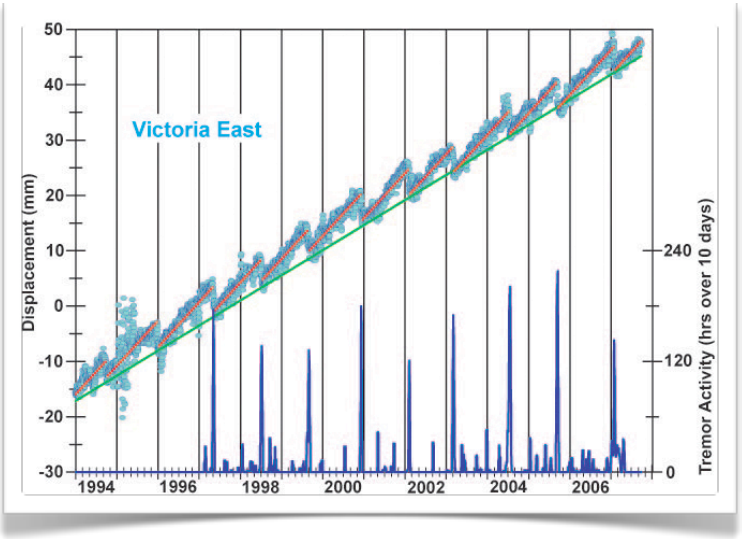


Map of the Cascadia Subduction Zone (CSZ) which extends along the west coast of North America from northern Vancouver Island to northern California. The big arrows show the direction of overall plate motion, the smaller arrows show relative motion across plate boundaries. The line with the triangular teeth marks where the oceanic Juan de Fuca Plate dips beneath the North America Plate.

Instead of slipping continuously at the long-term average rate of 4 cm/yr, the two plates are currently stuck together along the upper portion of the subduction fault - this is referred to as the locked zone. Over time, tectonic stress builds up across the locked zone. Every 500 years, on average, the stress becomes too great, and the locked zone ruptures with 10 to 20 meters of fault slip, causing a magnitude eight or nine earthquake. A decade of monitoring crustal deformation in southwestern British Columbia using precise, continuous Global Positioning System (GPS) instruments, has revealed a similar "stick-slip" behavior on a deeper portion of the subduction fault, but over a much shorter time scale, with very small, and slow slips. This deeper segment of the subduction fault is referred to as the ETS slip zone.



A Cross-section, looking north, of the Cascadia Subduction Zone showing the locked, transition, and slip zones on the interface between the Juan de Fuca and North America plates. Tremors locations are above the slip zone but probably extend into the transition zone.



This figure shows both the horizontal movement of a single GPS station (Victoria) in the saw-toothed line and corresponding tremor activity (the blue spikes along the bottom of the figure) for the same 13+ year time interval.