

## Resolving Subtle Episodes of Tremor and Slip

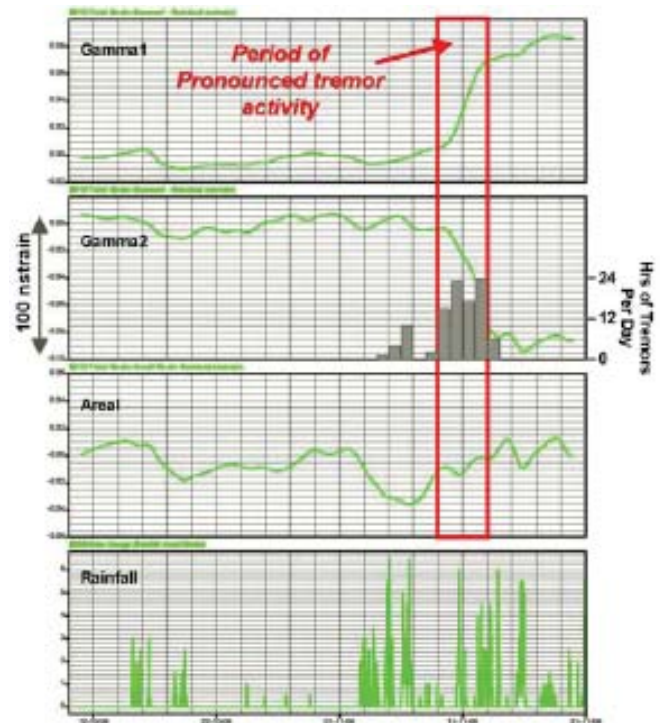
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**Figure 1.** Area of tremor occurrence on Vancouver Island from November 9 to 12, 2006. The shaded region in central Vancouver Island indicates the primary area of tremor activity for this four-day period. The location of the B012 strainmeter is indicated by the red circle. Blue squares mark the location of nearby continuous GPS stations, none of which showed significant displacements coincident with tremor activity.

Examination of the past 12 years of seismic and continuous GPS data for northwestern Washington and southern Vancouver Island has shown that this part of the Cascadia subduction zone is marked by clearly recognizable, repeated episodes of deep plate slip and seismic tremors, called Episodic Tremor and Slip (ETS). For this part of the Cascadia margin, these prolonged ETS episodes last anywhere from a week to a month and, over the past 12 years, have occurred fairly regularly with a recurrence interval of  $14.5 \pm 1.2$  months. Shorter, more sporadic episodes of seismic tremor have been observed at other times throughout northern Cascadia, but corresponding crustal displacements have not been well resolved with GPS, leaving unanswered the question of whether the identical phenomenon is taking place for these more random tremor events. Data from PBO borehole strainmeters (BSM) recently installed under the EarthScope Project may provide the answer. A recent four-day episode of seismic tremor in central Vancouver Island resulted in ill-defined surface displacements at the closest continuous GPS stations. However, strain data from the BSM (B012) at Ucluelet, located on the west coast of central Vancouver Island, are consistent with an

episode of slip on the deeper subducting plate interface to the northeast of this site, the region where the tremors were observed. Simple elastic dislocation models with 2 to 3 cm of slip constrained to the subducting plate interface can replicate the observed strain signal as well as the limited surface displacements. These results suggest that BSM data may prove critical in identifying more subtle slip events and that sporadic, shorter episodes of tremor can be associated with slip on smaller asperities. Establishing the locations, size distribution, and recurrence patterns for the slip asperities is critical for understanding the processes involved in ETS and the relationship of ETS to regional earthquakes.



**Figure 2.** Strain components at B012 (Ucluelet, Vancouver Island) for the period of October 10 to November 21, 2006. Linear trends and atmospheric pressure signals have been removed. Shear strain components show a significant signal associated with a period of intense tremor activity in central Vancouver Island. Areal strain variations show a smaller change and appear to be strongly influenced by rainfall.