

Shallow, non-episodic tremor in the forearc of the Cascadia subduction zone

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Sequences of non-volcanic seismic tremor have been identified at depth along the Nankai and Cascadia subduction zones¹⁻³. Although the causes of non-volcanic tremor are not well understood, they have been attributed to vibrations created by the migration of fluids released from the subducting oceanic slab. In Cascadia near southern Vancouver Island, analysis of transient surface deformation shows that slow slip occurs every 13-16 months on the inter-plate boundary landward of where it is locked. Non-volcanic tremors occur simultaneously in the same region, and migrate >150 km along strike from south to north in a similar way to the slow slip. These episodic tremors are broadly distributed between 5 km and 45 km depth, locating them in both the subducting Juan de Fuca plate and the overriding North American plate. We show that many of these episodic tremors correlate with the subduction megathrust. We also demonstrate the existence of a new class of non-volcanic tremor that occurs between the episodes of slow slip. These non-episodic tremors do not migrate along strike, and are shallower than the episodic tremor sequences, being found mostly at 5-10 km depth within the North American plate. Non-episodic tremor sequences may be related to undetected slip on a smaller region of the inter-plate boundary. Consequently slow slip need not be episodic at intervals of 13-16 months, but may in fact be a continuous process with spatially variable magnitude. Alternatively, non-episodic tremors could arise from readjustment of the crust, as expressed by local earthquakes, following the preceding episodic slow slip event.