Episodic Tremor and Slip

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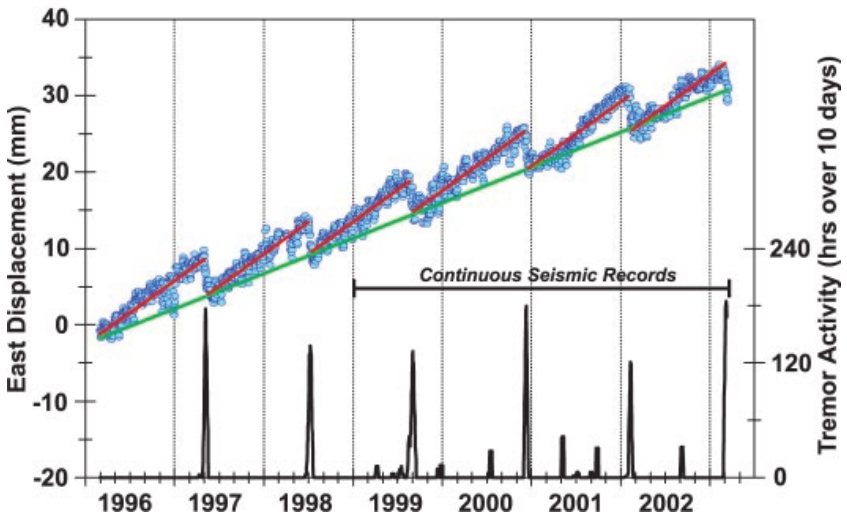
ASU Earthscope seminar 2010

What is ETS?

- Episodic
  - Repeats in a predictable manner, 10-20 months for the Juan de Fuca subduction zone
  - Lasts days to weeks
- Tremor
  - Tremor unrelated to earthquakes
  - Low frequency, 1-10 Hz
  - Looks like noise, multiple stations must be used to observe it
- Slip
  - Tremors are associated with the subduction zone suddenly reversing movement

Actual Data

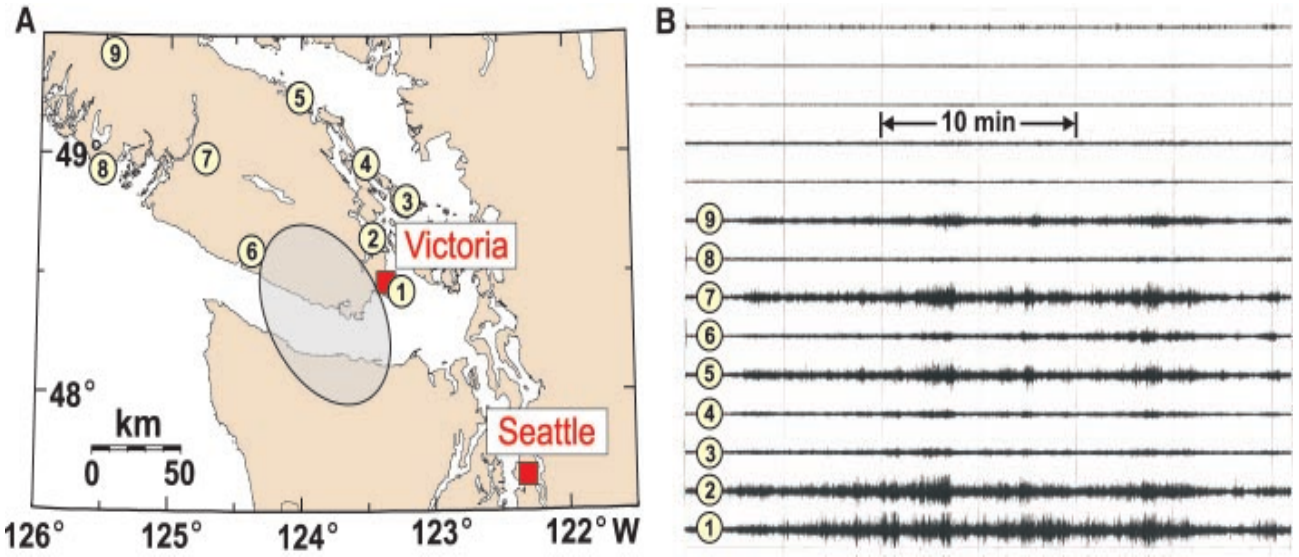


Rogers and Dragert, 2003

- Stair step pattern shows sudden reversals in overall eastward movement movement
- Green lines are average convergence rate
- Red lines are mode convergence rate

Individual Tremors

- Tremors can only be detected by comparing envelopes of seismic signals



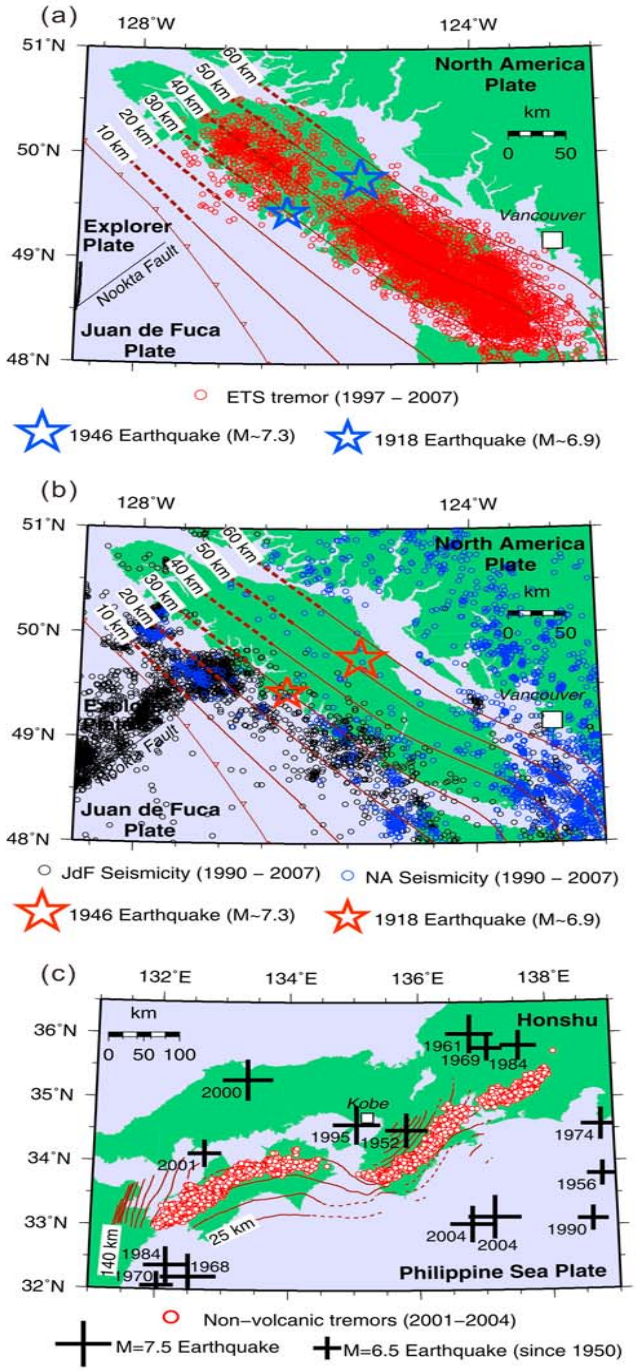
Rogers and Dragert, 2003

Videos of Models

Click me
Then click me
Video from Stephen Holland's web site:
http://members.shaw.ca/science1/

Cause?

- ETS is considered an intermediary between brittle deformation (earthquakes) and ductile deformation
- Source is unclear
  - Tremor is hard to detect, harder to pinpoint source
  - Candidates include the trust surface, within the continental crust, and within the slab

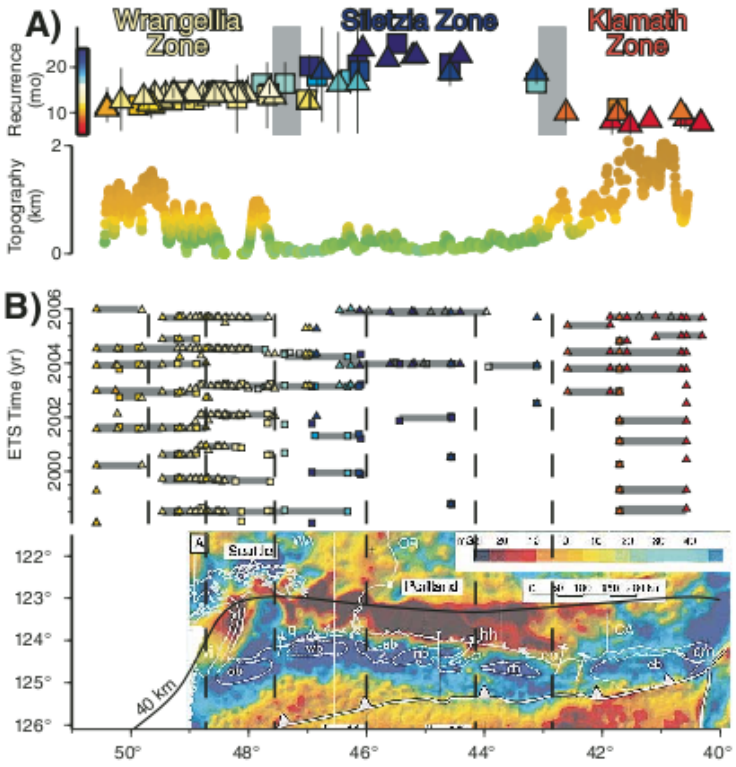


Relationship to Earthquakes

- Earthquakes and ETS do not occur in the same region
- Unclear if earthquakes prevent ETS, or if ETS prevents earthquakes
  - Models for both options have been proposed

Kao et al, 2009

Variation in ETS



- Characteristics of ETS seem to be related to the overriding plate
- Especially recurrence interval
- There appears to be a preference in how the tremor migrates

Brudzinski and Allen, 2007

The Papers

- 2 main, 2 supplementary
- Read the science paper first, it gives the best intro

Segmentation in episodic tremor and slip all along Cascadia

- Brudzinski and Allen
- Show variation is ETS across Cascadia
- Proposes causes for variation

Tremor patches in Cascadia revealed by seismic array analysis

- Ghosh et al.
- New detection/data processing method
- Set up their own array in the path of ETS
- Used new “beamforming” technique to filter ETS from noise
- Shows ETS is patchy

Northern Cascadia episodic tremor and slip: A decade of tremor observations from 1997 to 2007

- Kao et al.
- Long review/data reprocessing paper
- Only paper that goes into data processing in detail
- Looks at more controversial issues
  - ETS and earthquakes
  - depth/location of ETS

Episodic Tremor and Slip on the Cascadia Subduction Zone: The Chatter of Silent Slip

- Rogers and Dragert
- Introductory paper
- Everything in this paper seems to have been more or less accepted