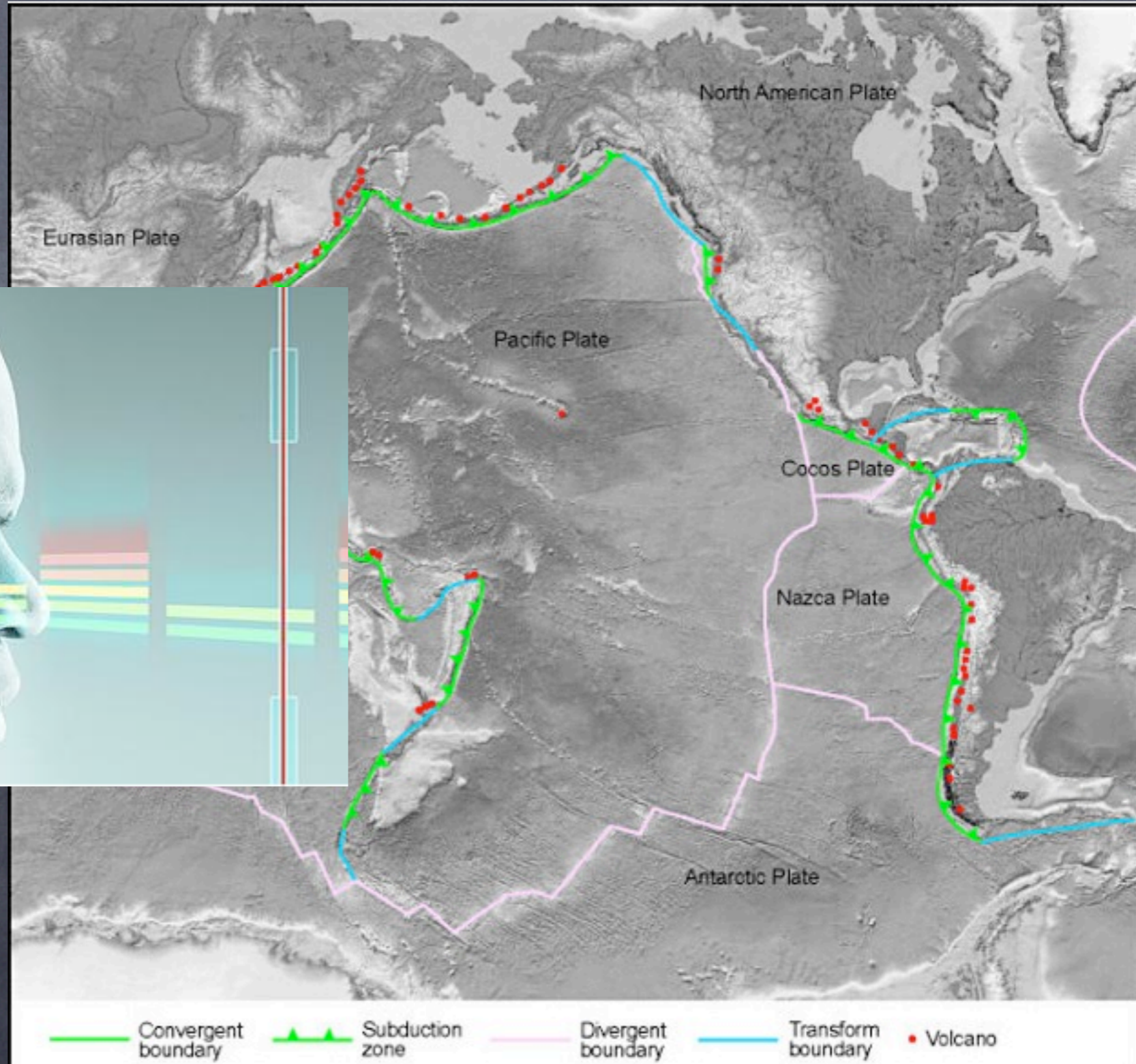


Do subduction earthquakes foreshadow their arrival?



John Vidale
U. Washington

Talk outline



Talk outline

- Subduction geometry



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- Subduction geometry
- Correlations
- Not much use



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- Possible run-aways
 - Aseismic slip
 - Fluid



Talk outline

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- Correlations
 - Not much use
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 - Aseismic slip
 - Fluid
- Possible symptoms
 - Accelerating moment releases
 - Acc. correlation with tides
 - Changing b-value
 - Acc. corr. w/ focal mech.



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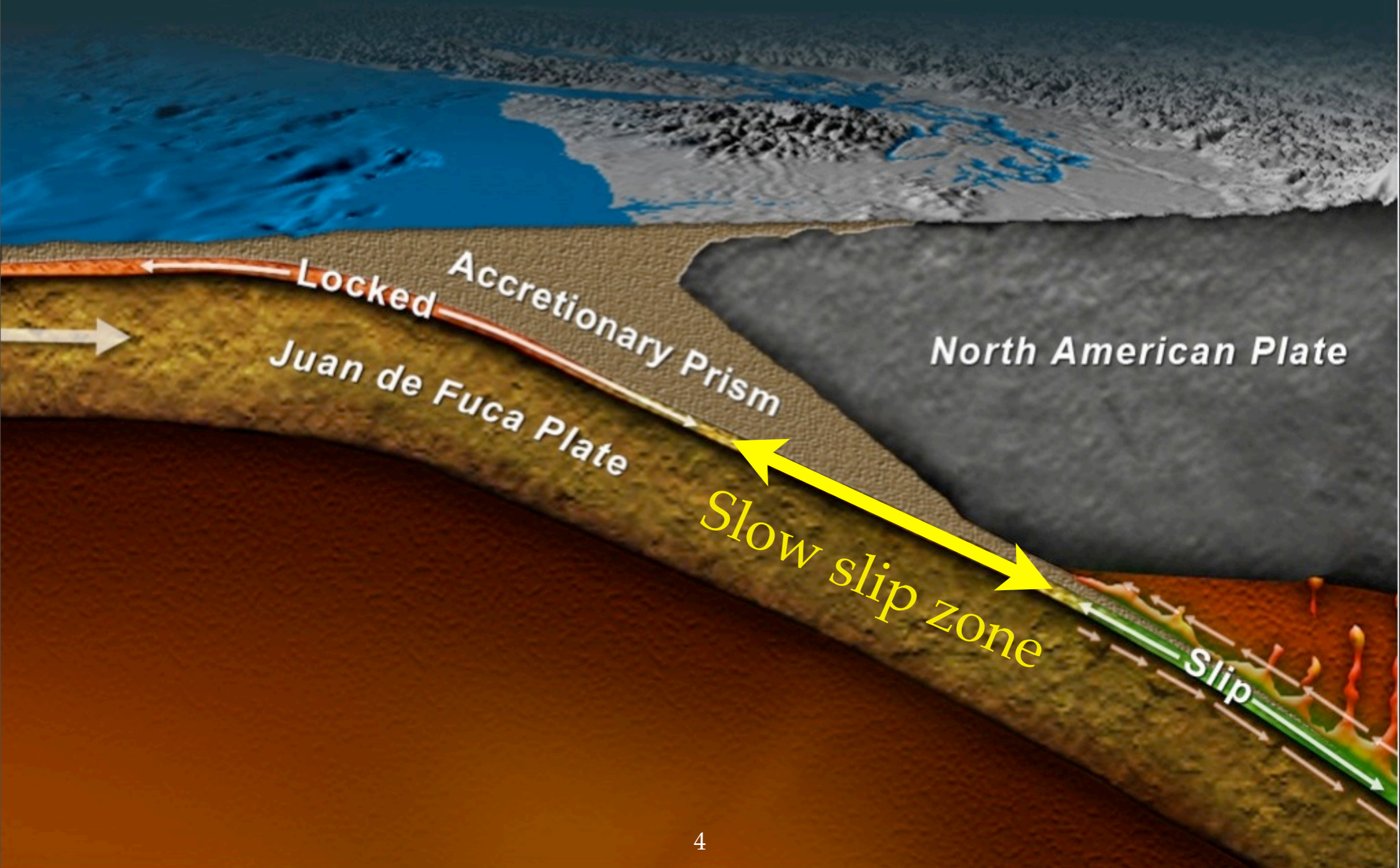
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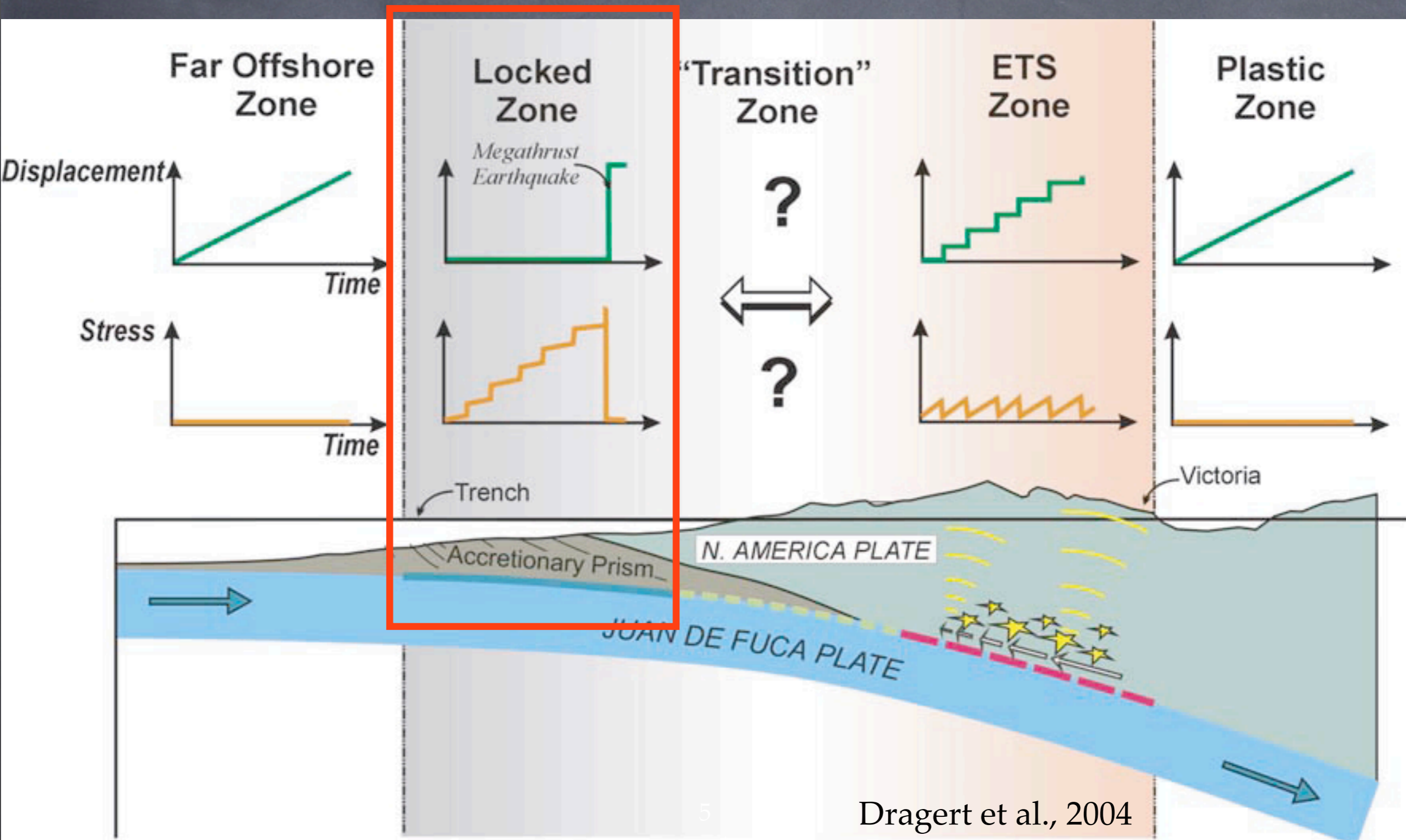
Change in fluid pressure or distribution

More exotic processes in nucleation zone

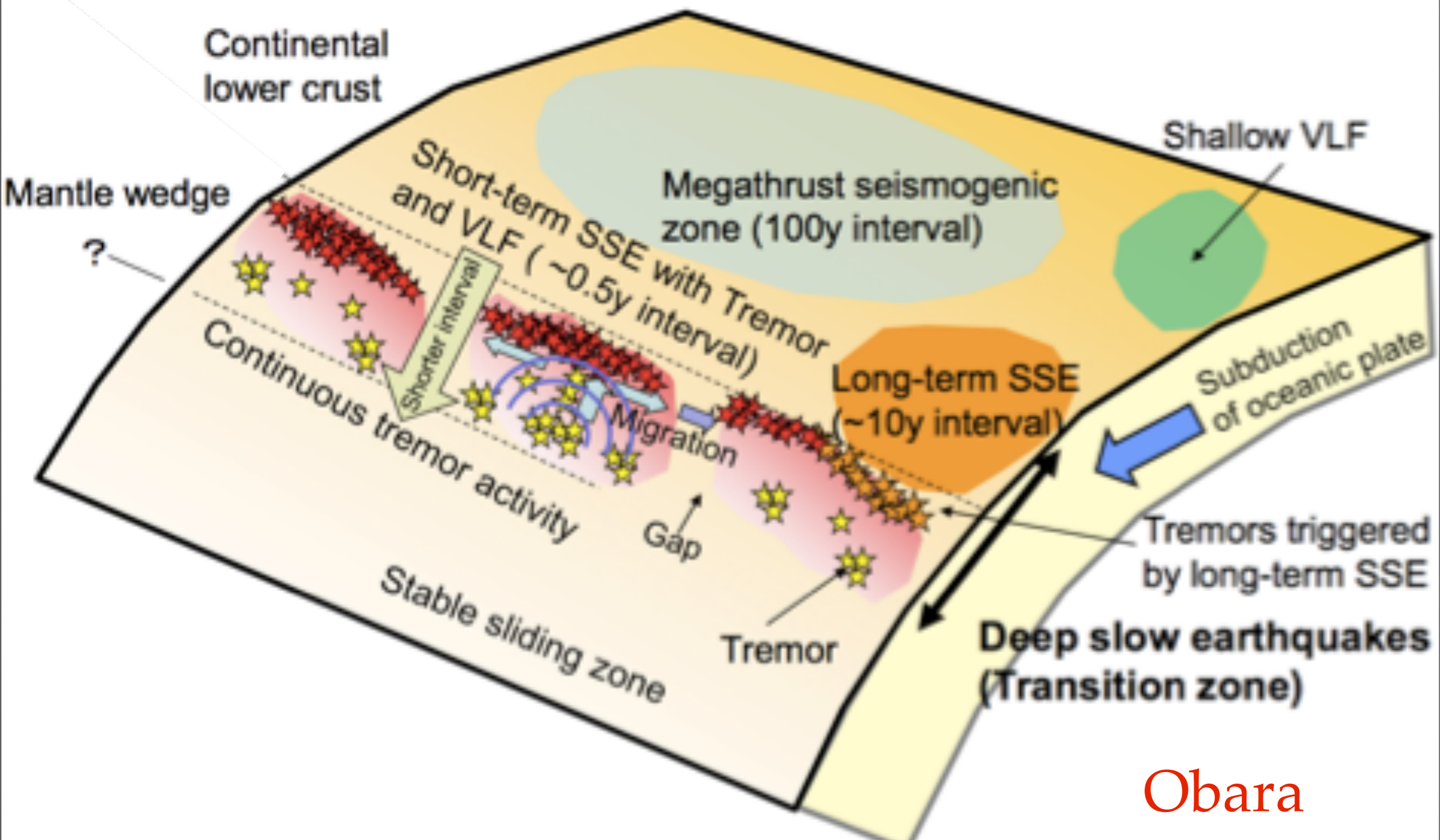
Subduction cross-section



The locked plate interface

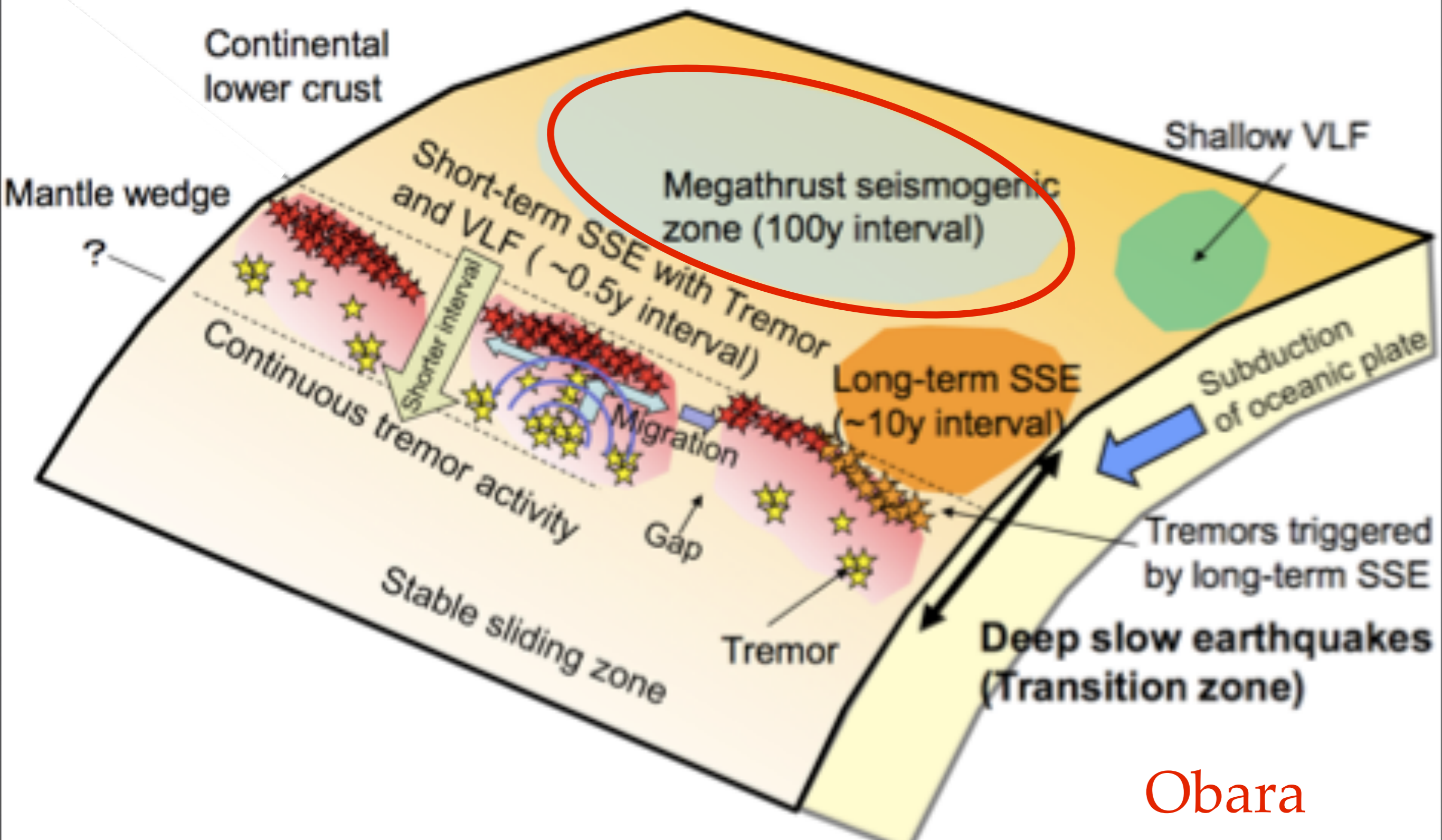


Many facets of ETS in Japan



Obara

Many facets of ETS in Japan



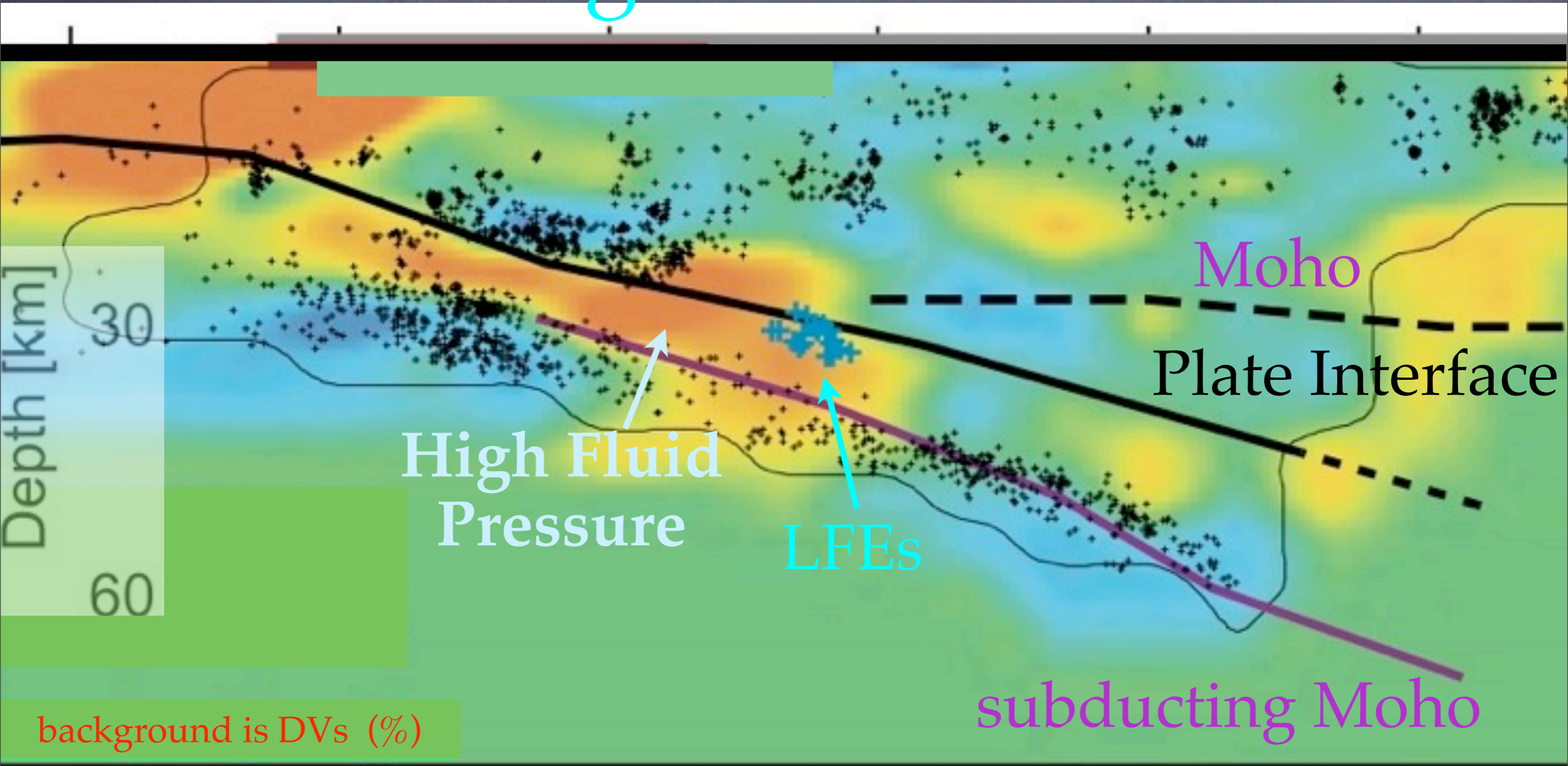
Obara

Central Japan subduction structure

Locked

ETS region

Stable Slip



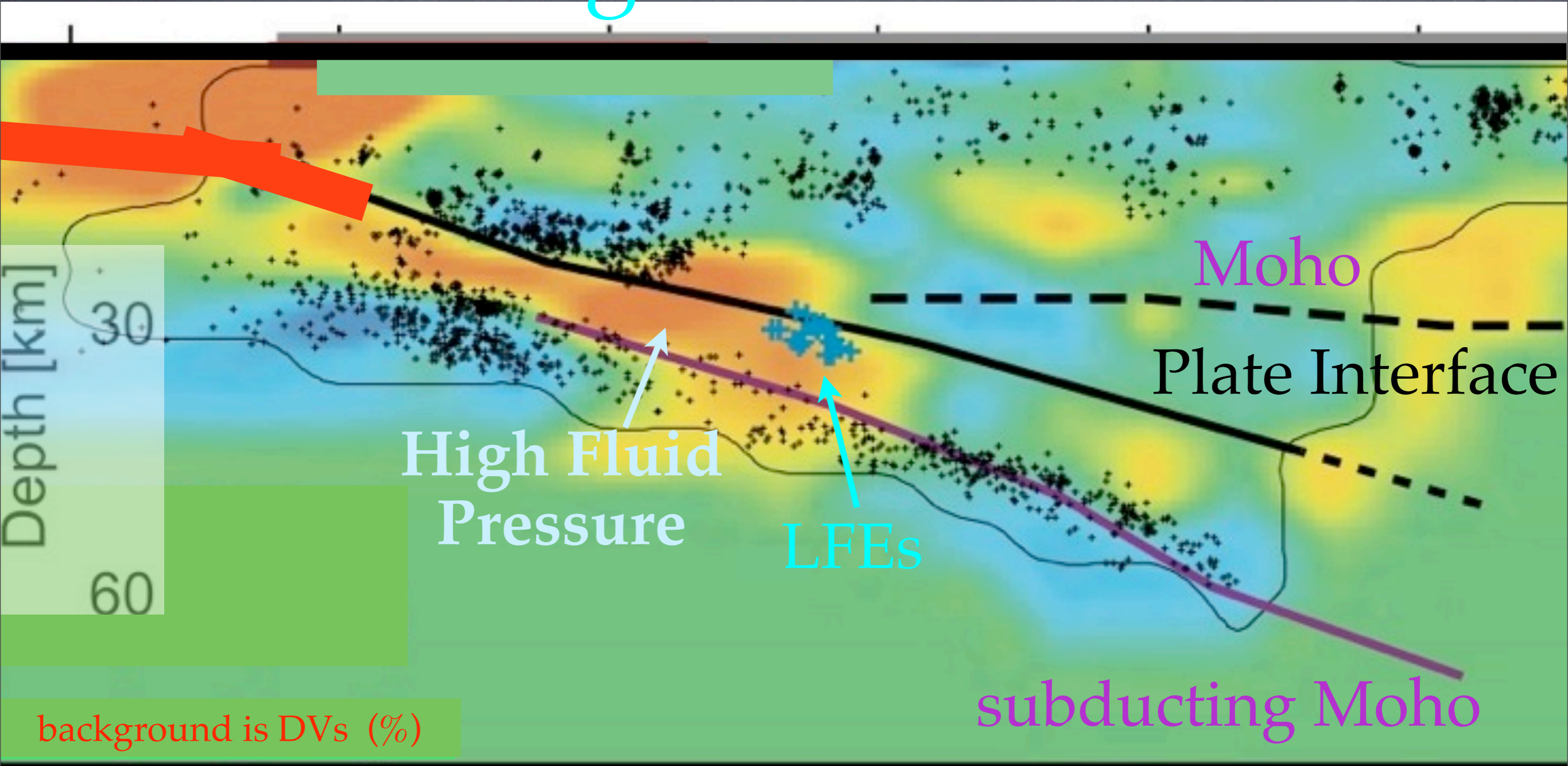
Hirose et al., 2008, Shelly et al., 2006, Audet, 2009, Abers et al., 2009

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ETS in space
and time

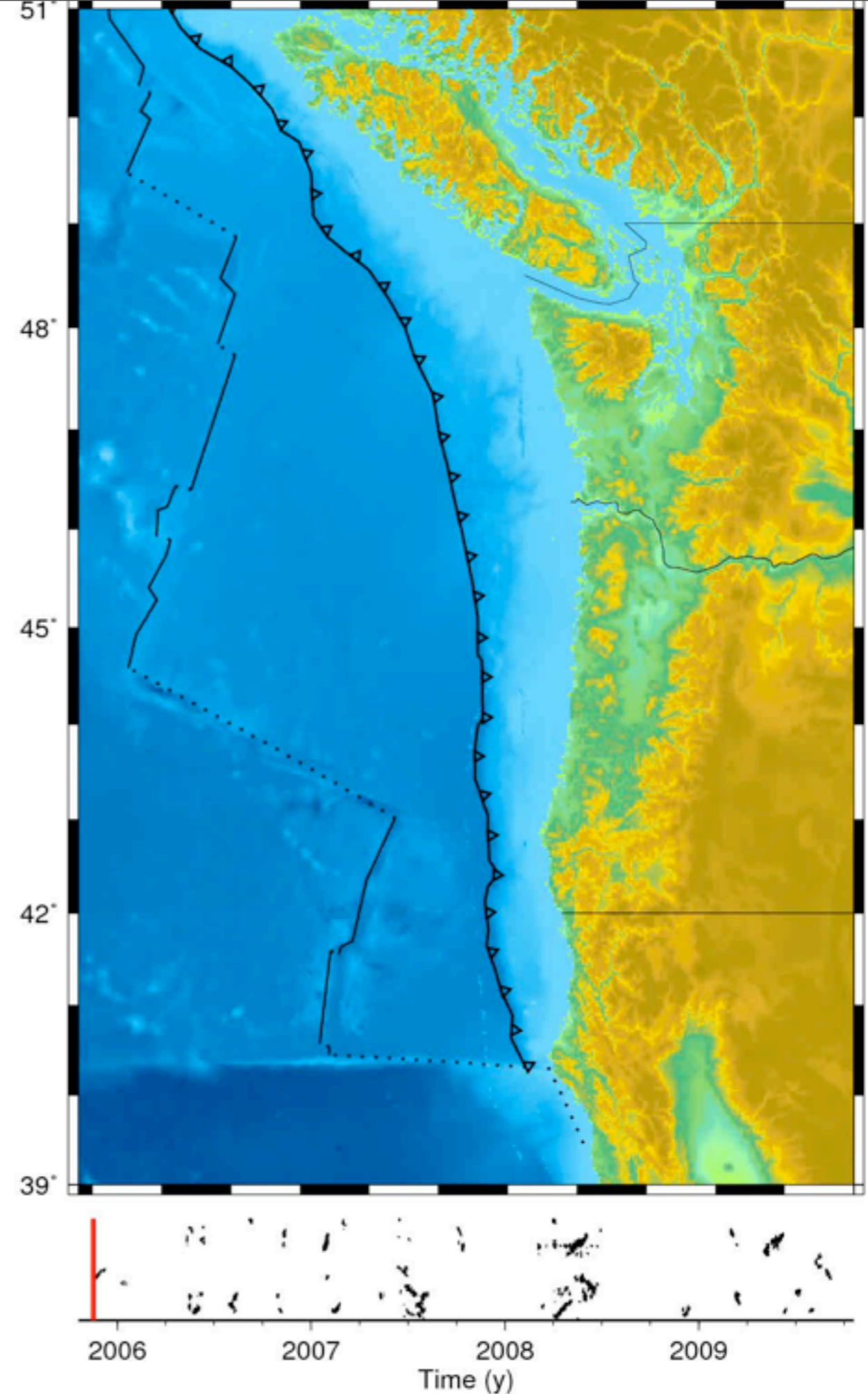
Suggestion of
non-local
fluctuations

Courtesy Mike Brudzinski

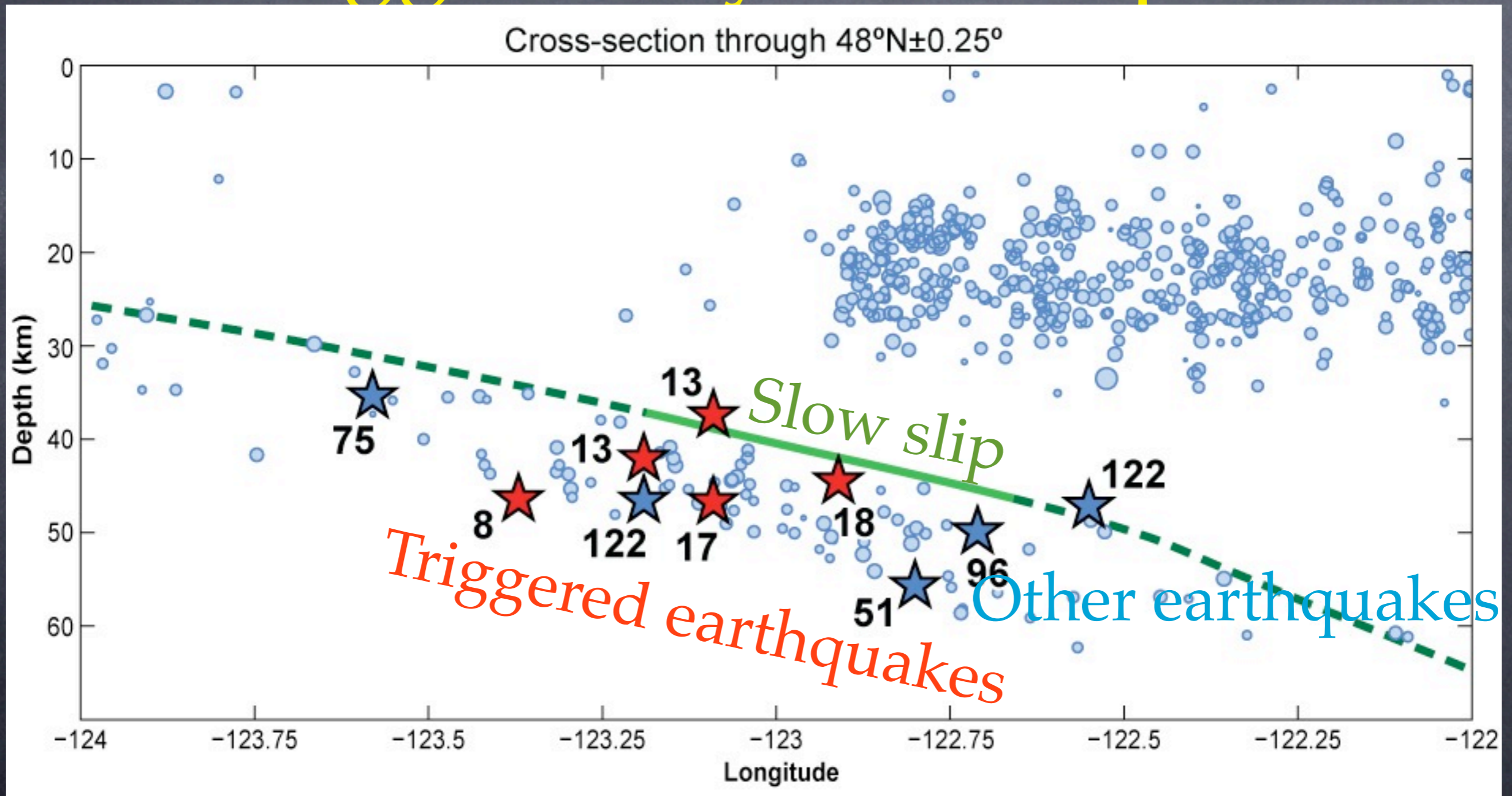
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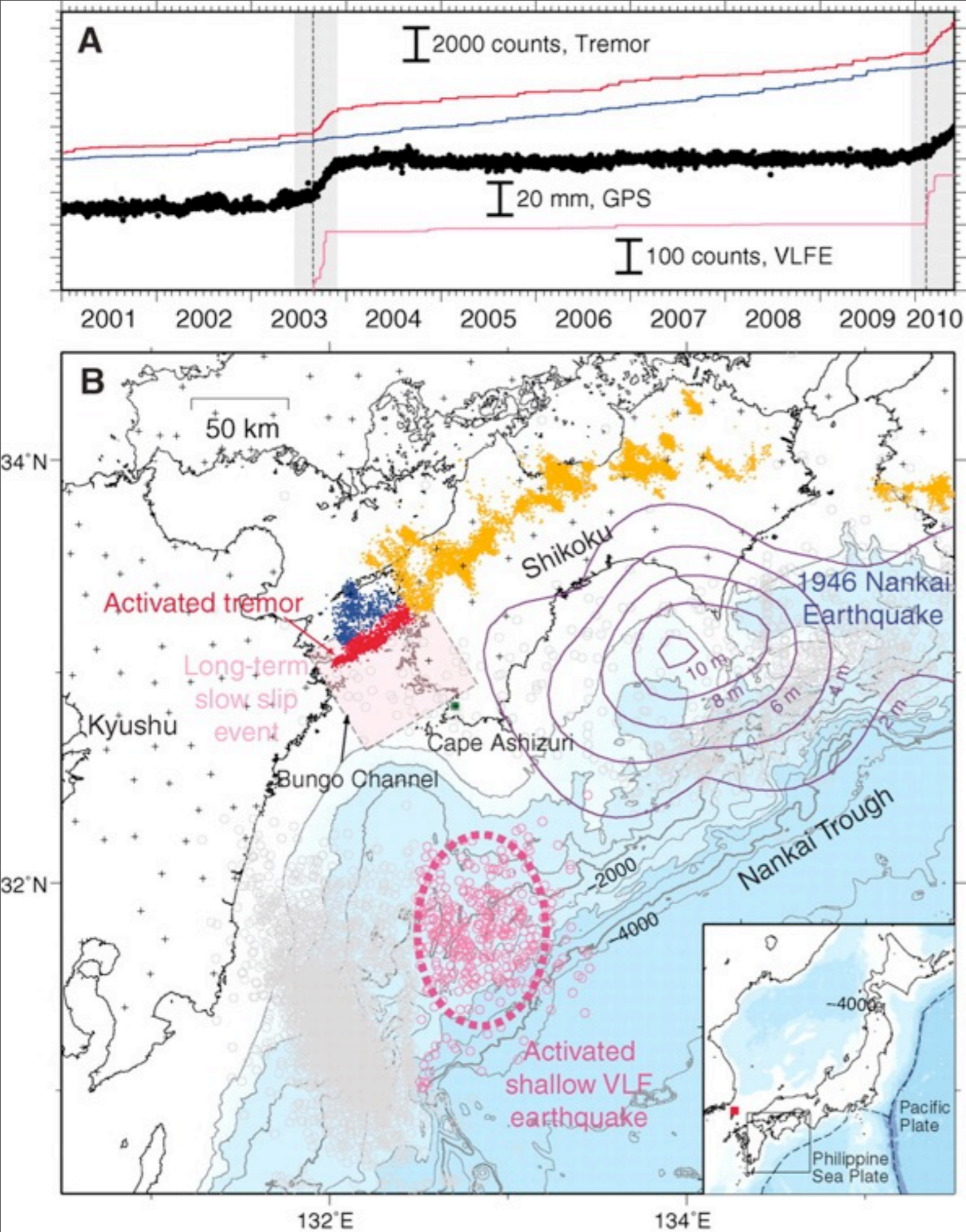
Courtesy Mike Brudzinski



Tiny earthquakes triggered by slow slip



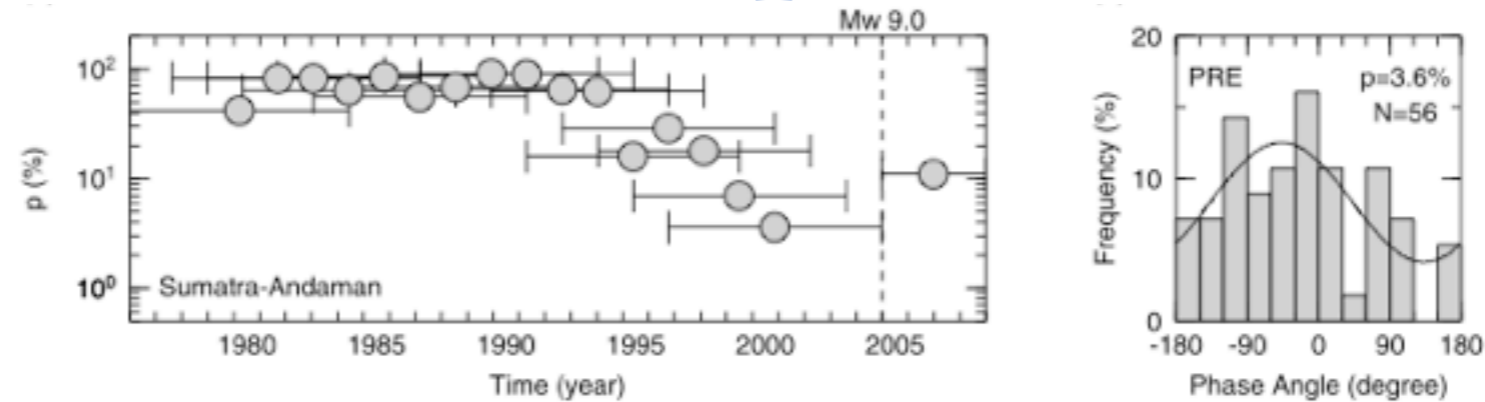
Vidale et al., 2011



Slow slip event on side of an asperity

Fig. 1 (A) Time series of the cumulative number of shallow VLFs (pink line) to the south, off Cape Ashizuri [pink circles in (B)], cumulative number of tremor sources in the downdip (blue line) and updip (red line) regions in the Bungo channel [blue and red dots in (B)], and (black dots) detrended GPS displacement record (east component) at Ohtsuki [green square in (B)] with respect to Kamitsushima [red square in (B) inset].

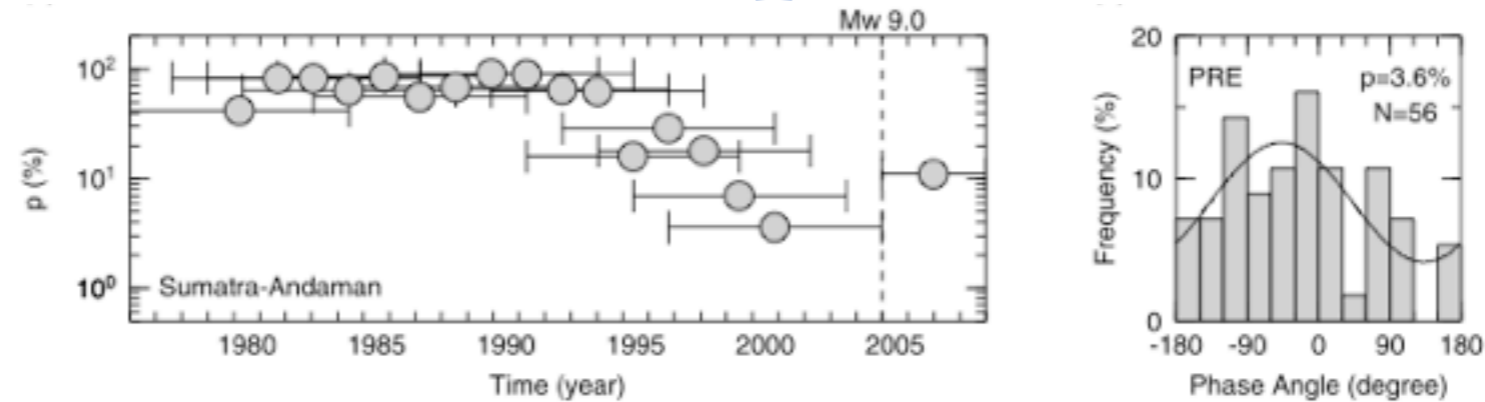
Sumatra as an example of four proposed more definitive precursors



S. Tanaka,
GRL, 2010

Figure 2. (a) Temporal variation of p -value in the area of the Sumatra-Andaman earthquake. A time window of 3000 days, which is represented by horizontal bar, is shifted by 500 days. (b) Frequency distribution of tidal phase angles in the 3000 days prior to the Sumatra-Andaman earthquake. Solid curve represents a sinusoidal function fitted to the distribution.

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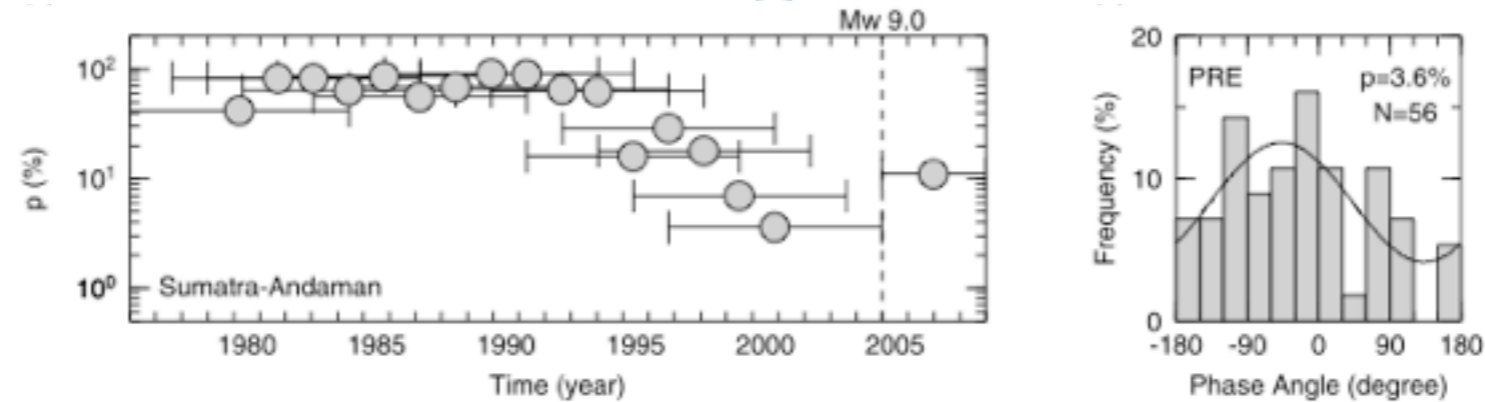


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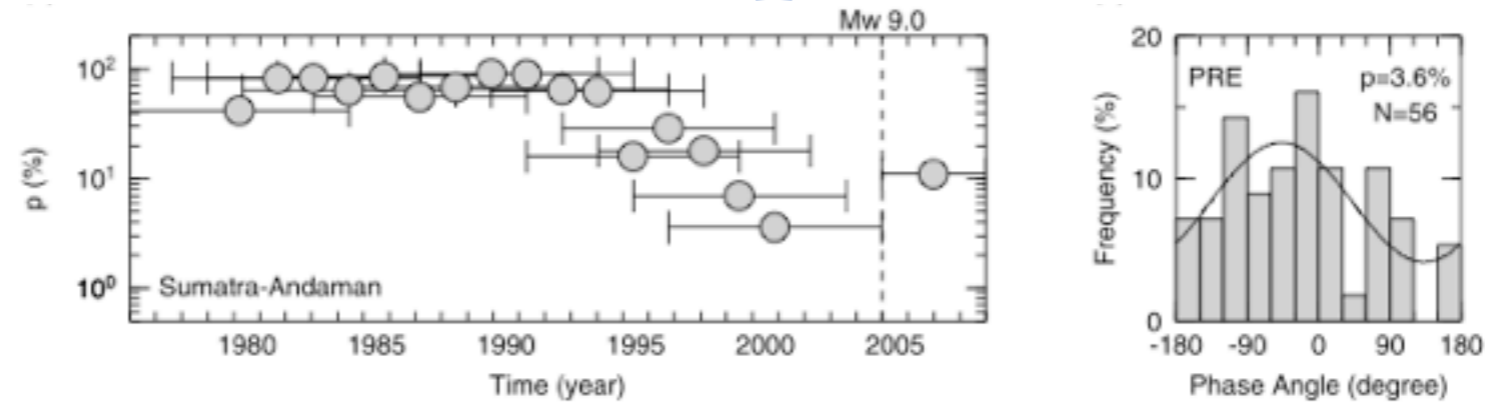


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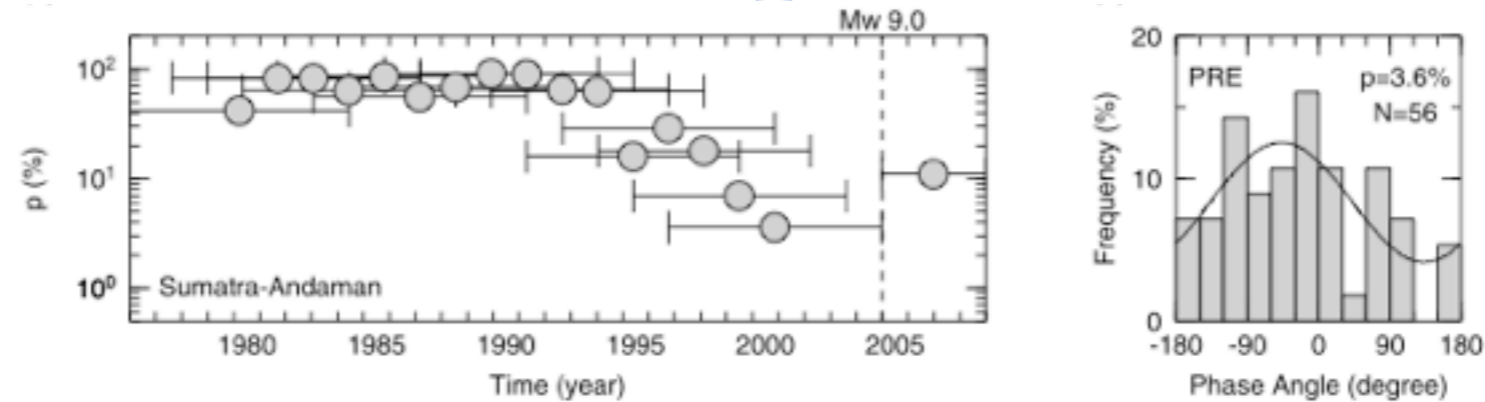


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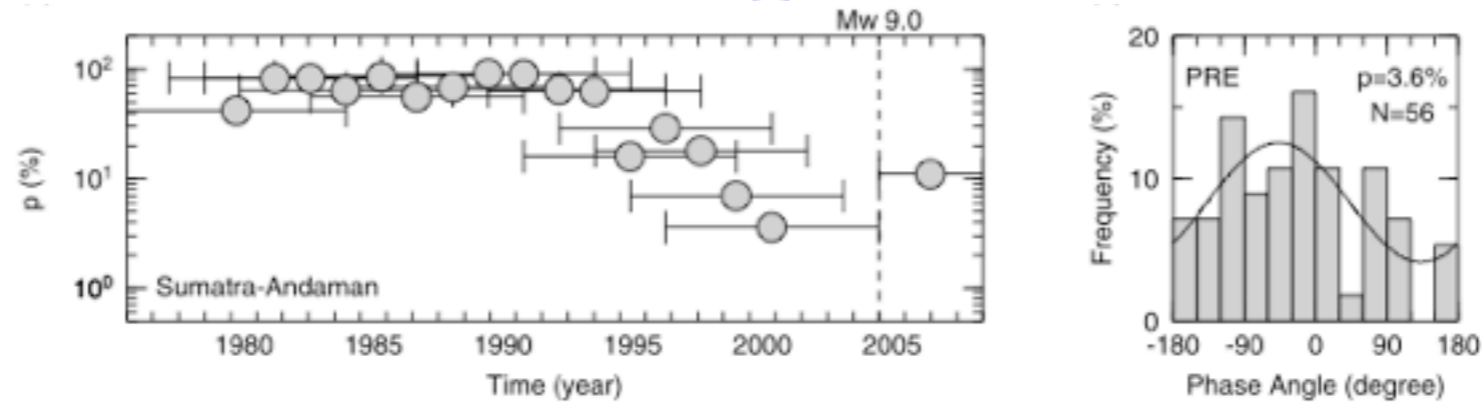


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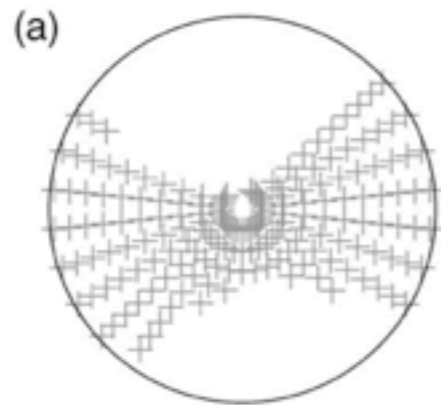
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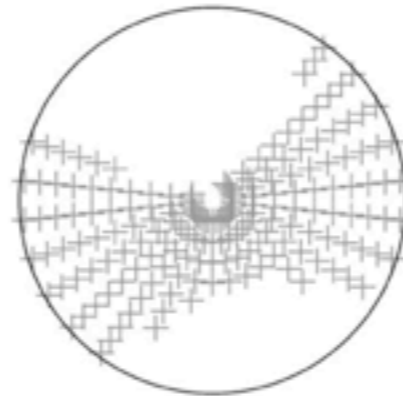
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- These could result from increased aseismic slip on the future fault plane, or the nucleation part of the future fault plane.

Focal mechanism evolution

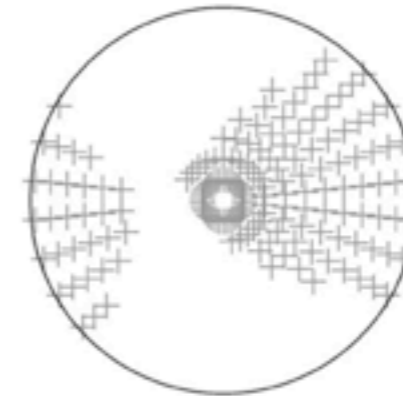
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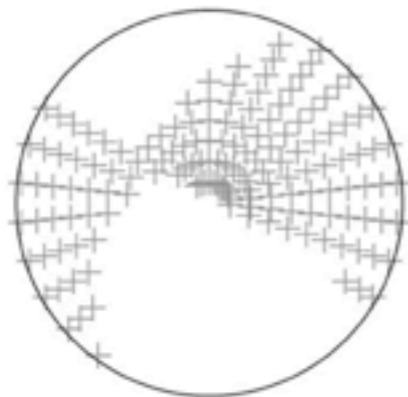
a: 1986/01/01-1990/12/31



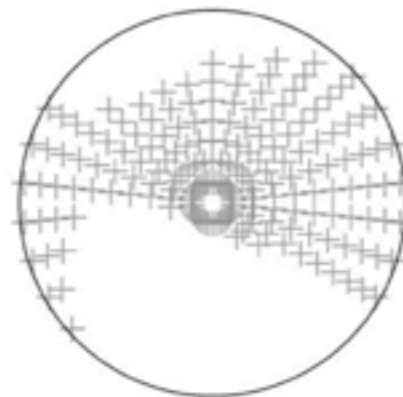
b: 1988/01/01-1992/12/31



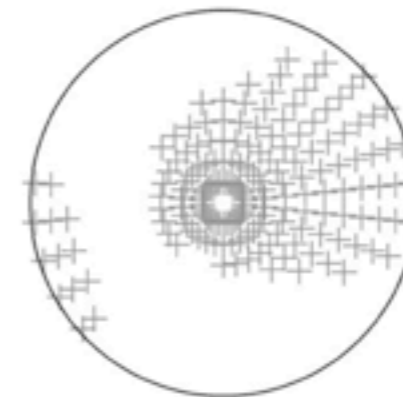
c: 1990/01/01-1994/12/31



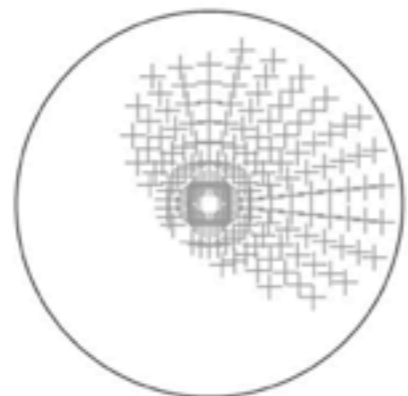
d: 1992/01/01-1996/12/31



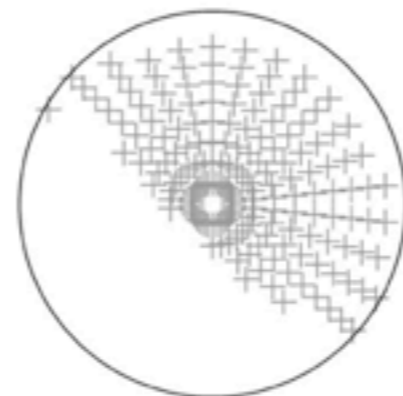
e: 1994/01/01-1998/12/31



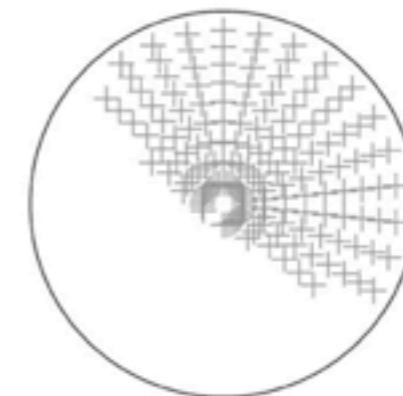
f: 1996/01/01-2000/12/31



g: 1998/01/01-2002/12/31

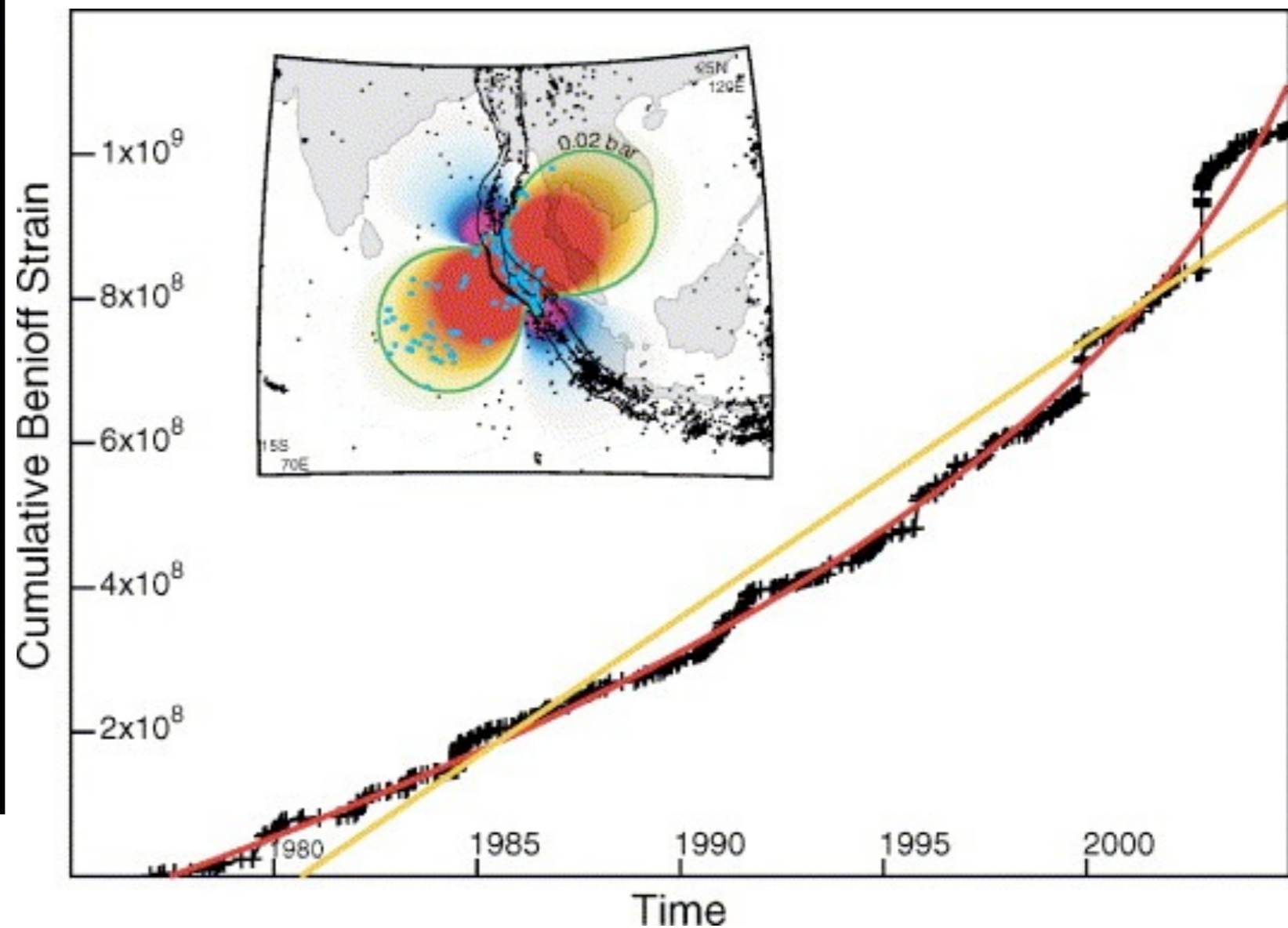
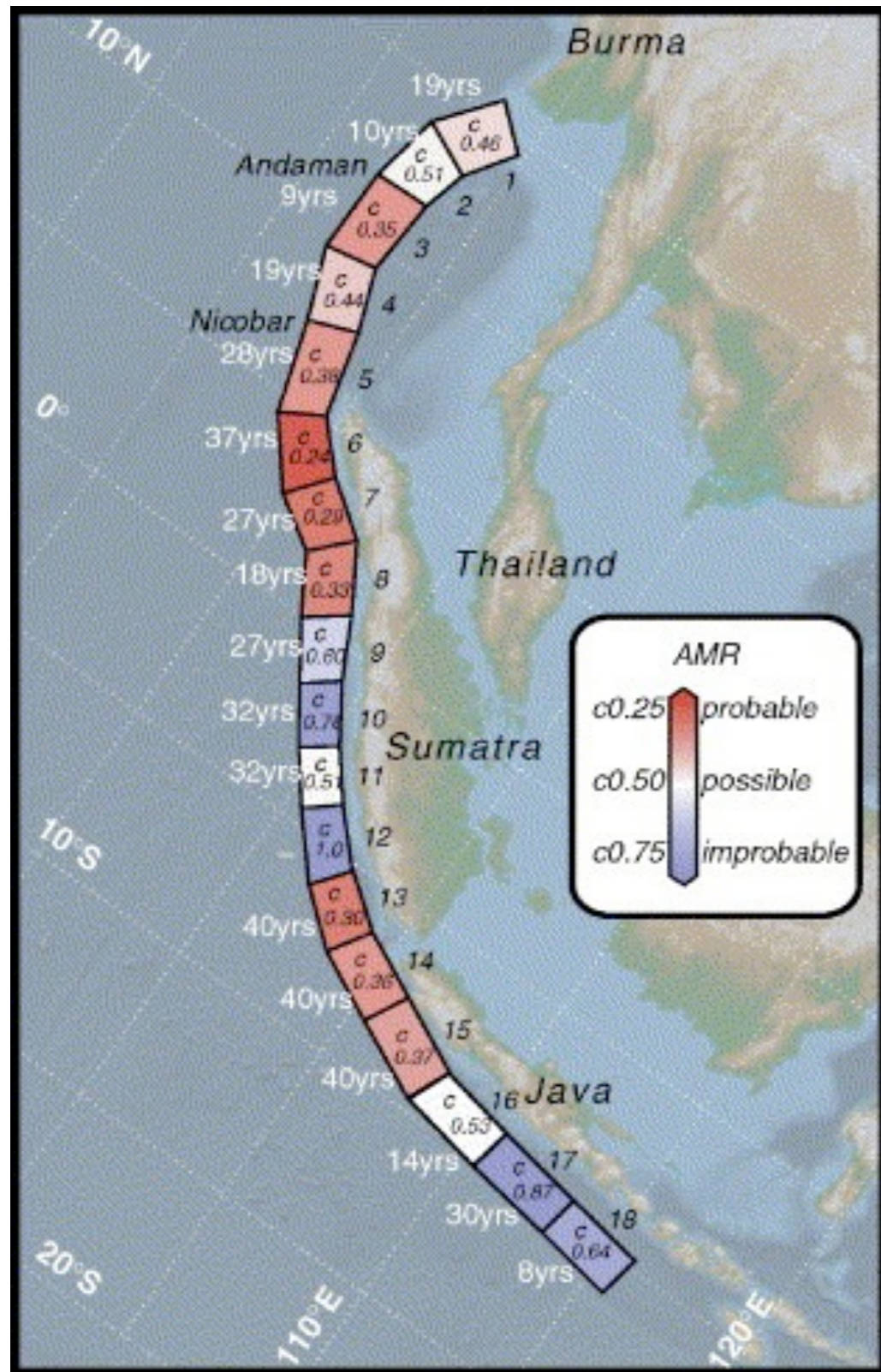


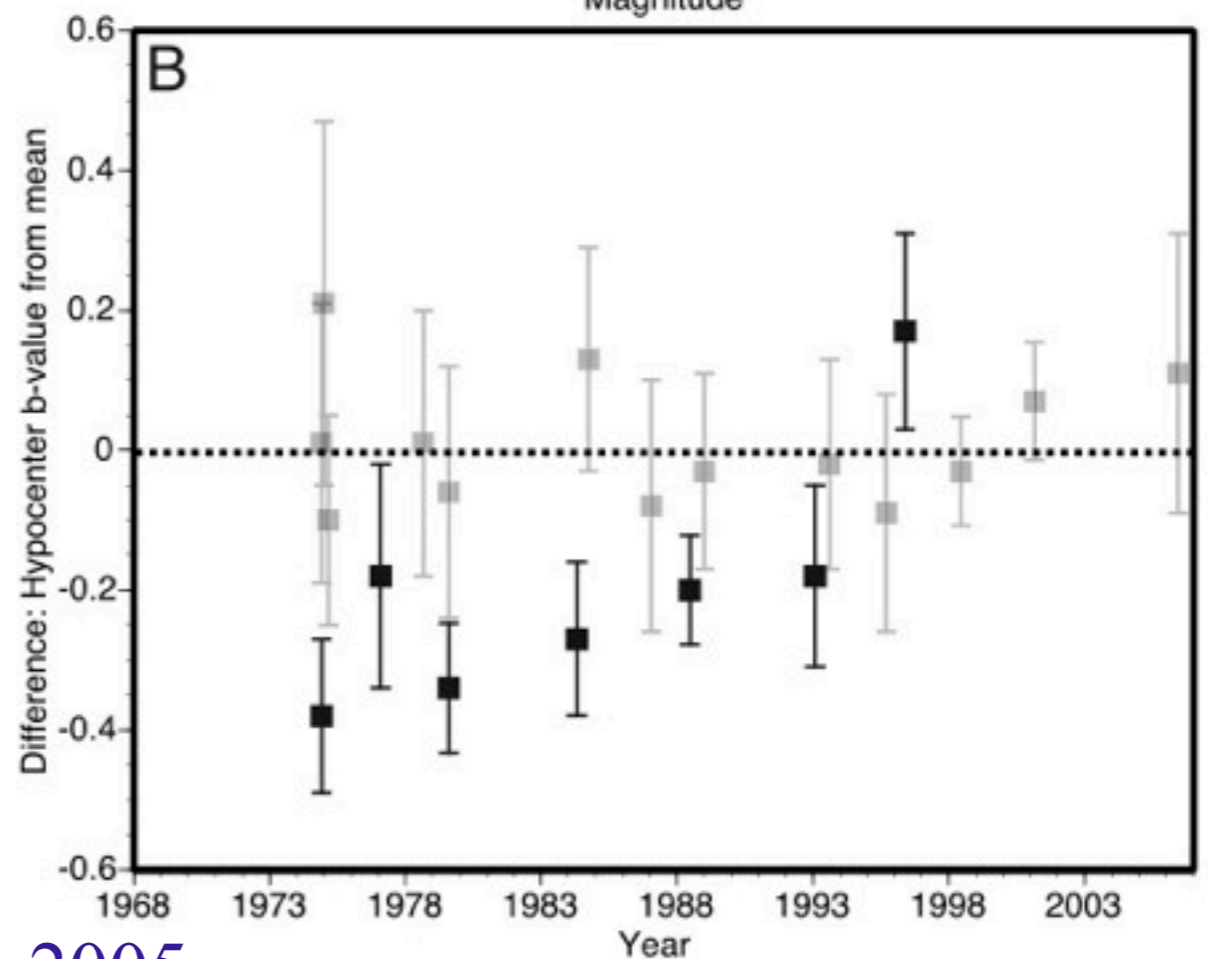
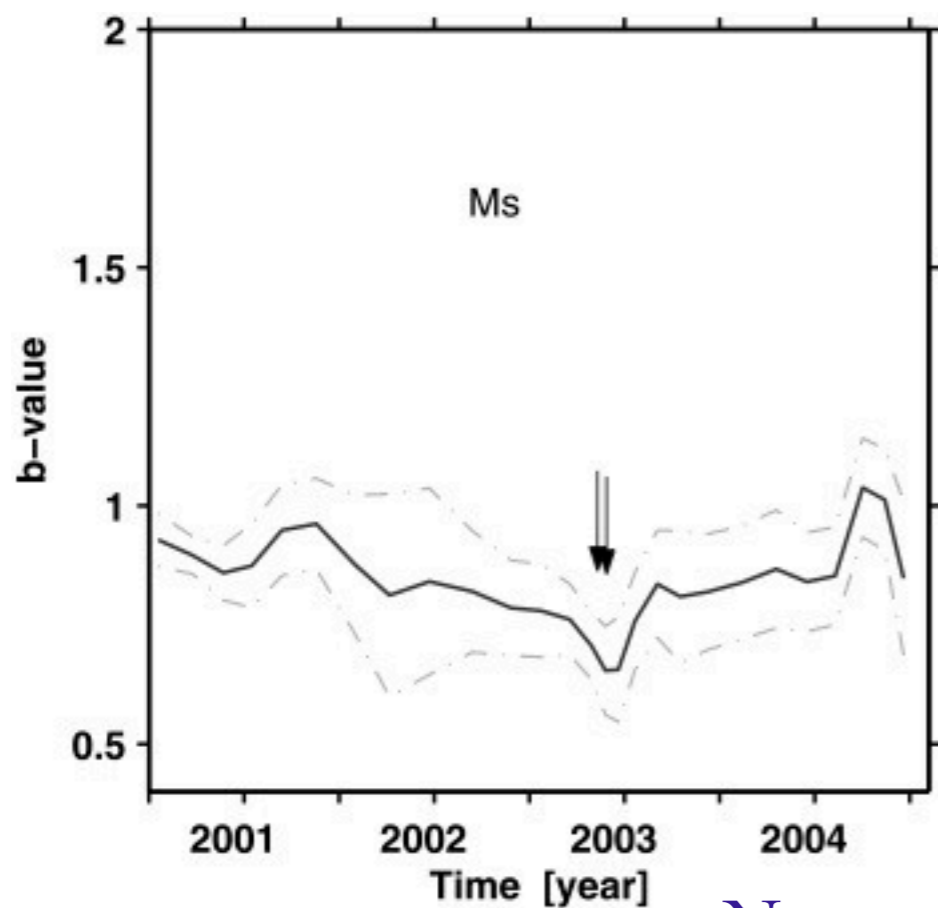
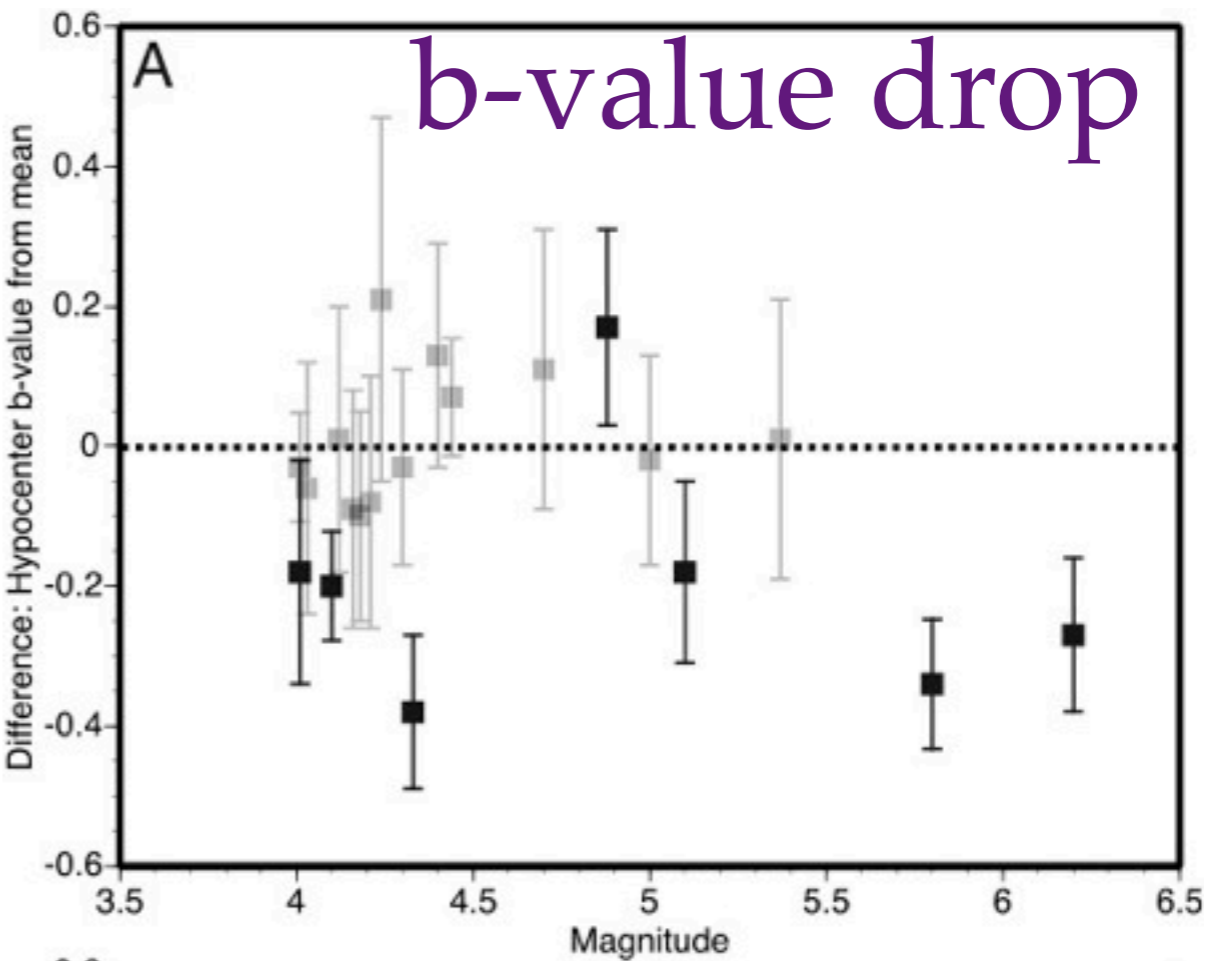
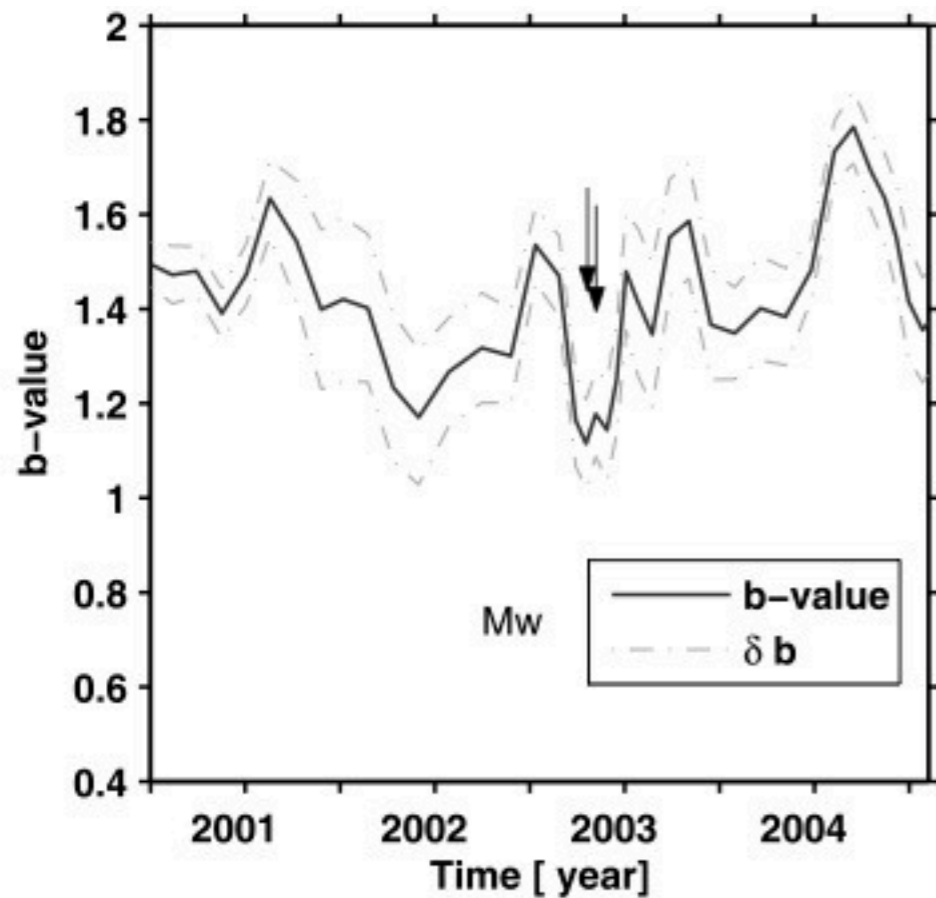
h: 5 years before the great
Indonesia earthquake



i: mainshock

AMR - Mignan, King, Bowman, et al.





Nuannin, GRL, 2005

Parsons, JGR, 2007

NOSTRADAMUS

State of the Inquiry



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- Several factors are a minor influence
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 - Not run-aways



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NOSTRADAMUS

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 - Can't rule out precursors
- My personal view:
 - Seismicity is most sensitive proxy for stressing and run-away processes, followed by geodesy, and
 - little evidence for precursors now, and hope is fading.

