

Postcards from the edge: Seismological insights into the lithosphere/asthenosphere system at subduction zones

Stéphane Rondenay

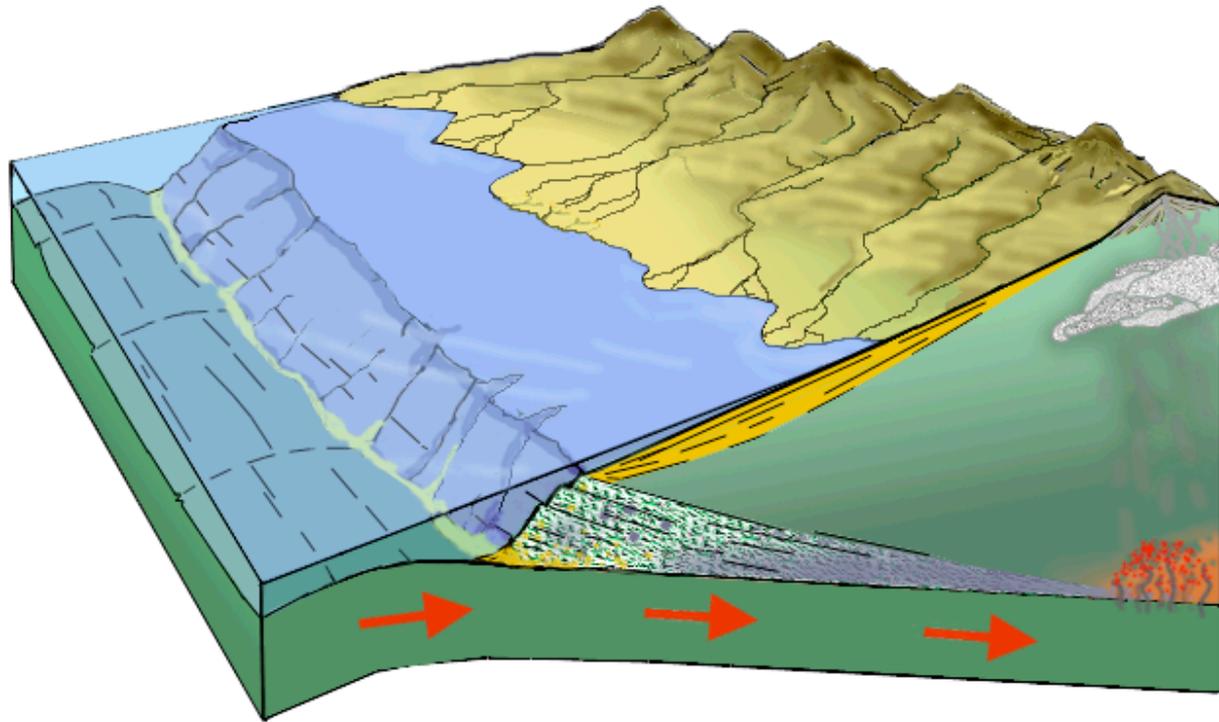


Universitetet i Bergen

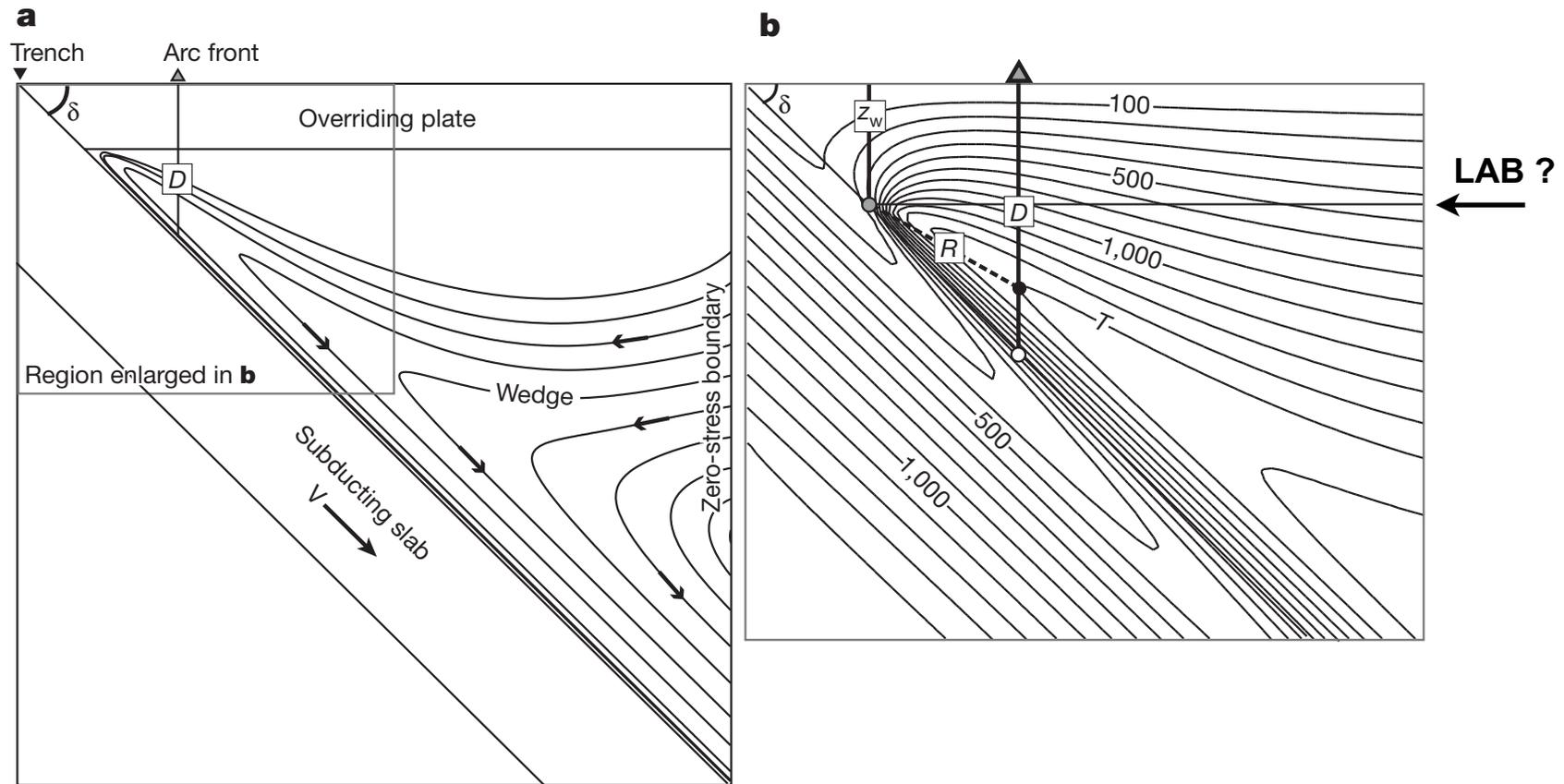
Collège de France, Paris, 19 November 2013

collaborators: M Bostock, G Abers, A Olive, P van Keken, L Montési, F Pearce, M Behn, S McGary

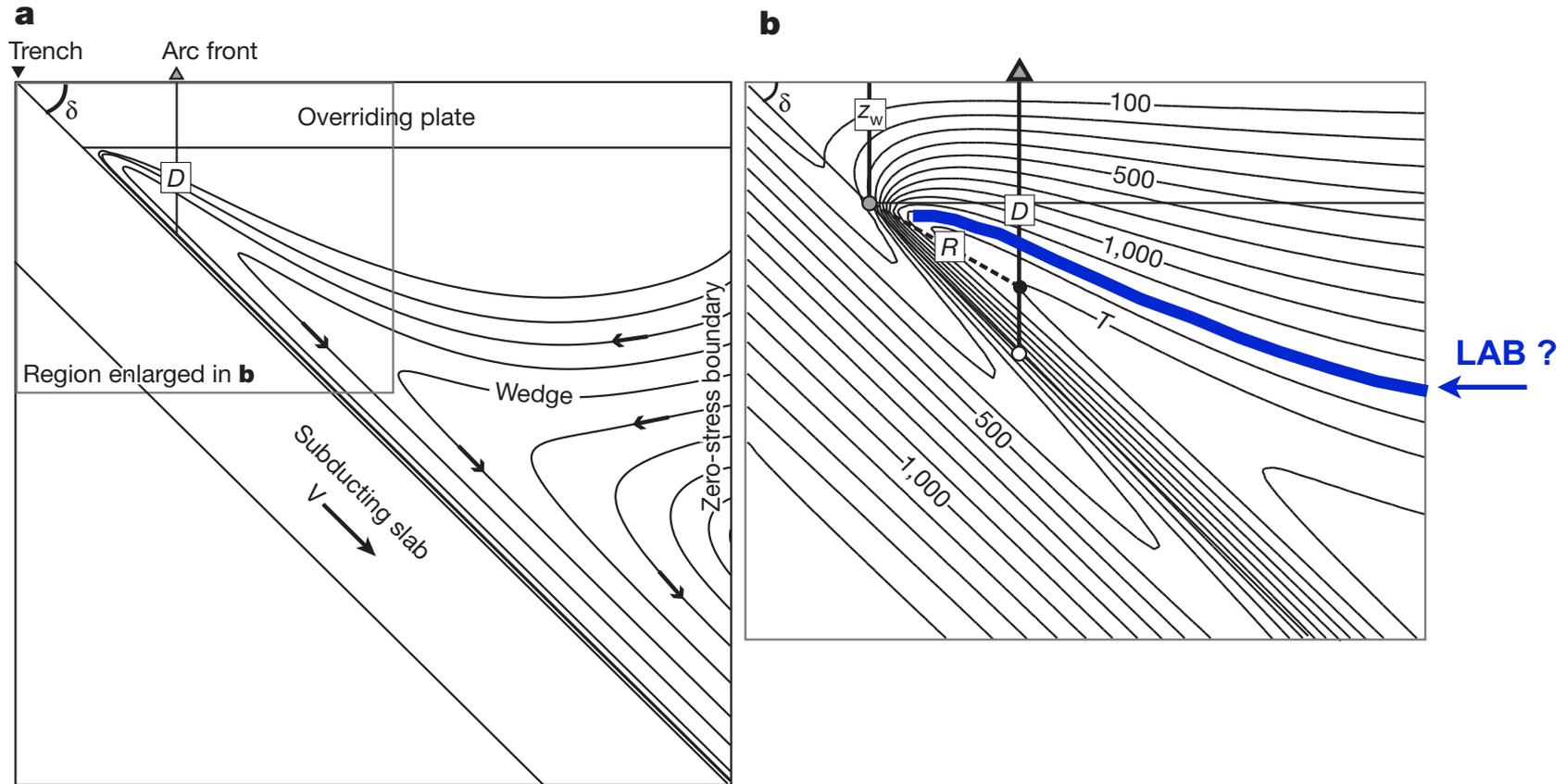
Subduction zone - where is the LAB?



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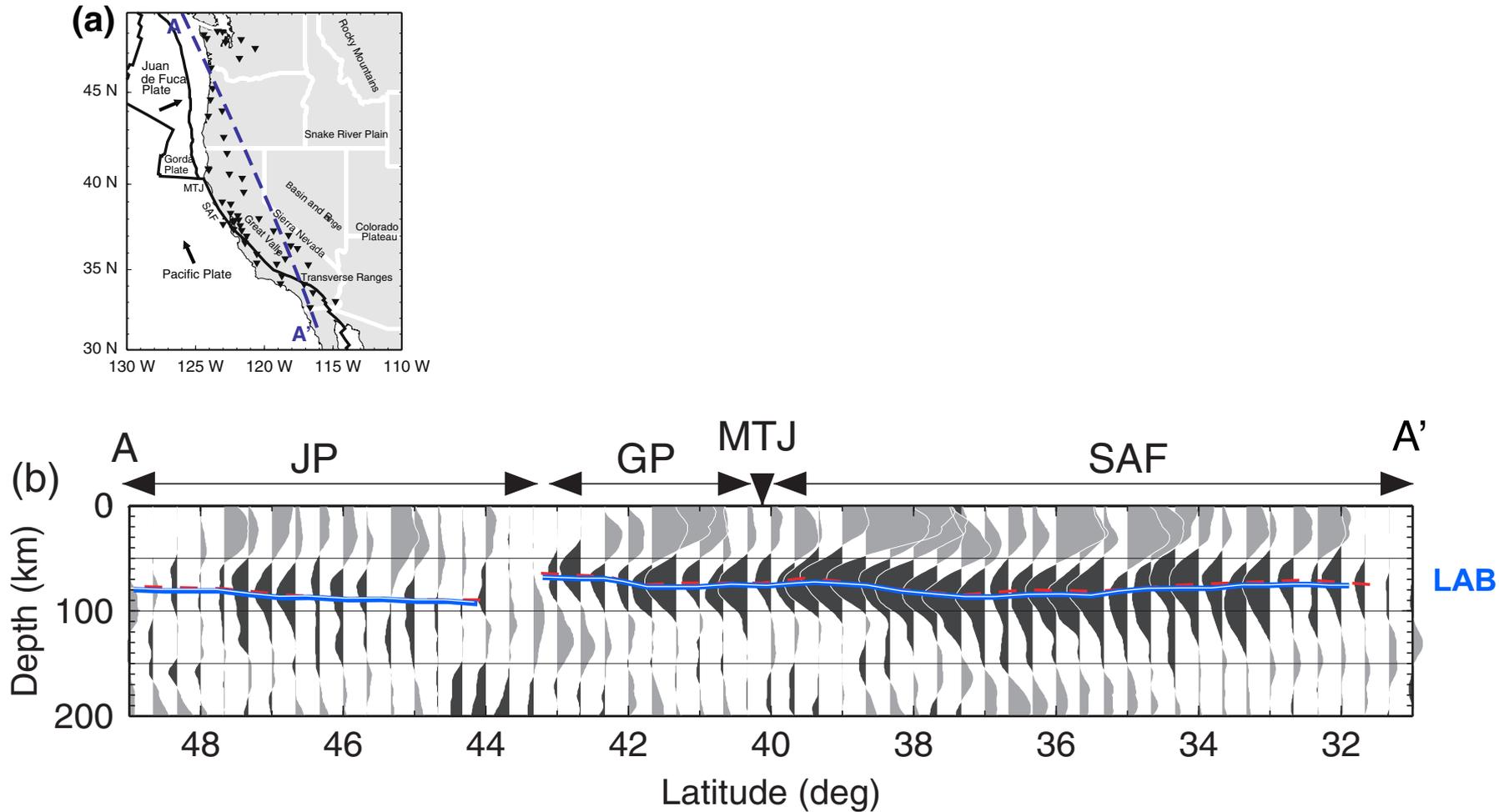


Subduction zone - where is the LAB?



Hypothesis: the LAB is the thermally-controlled transition from rigid plate to viscously flowing mantle

The LAB - where is the subduction zone?



Outline

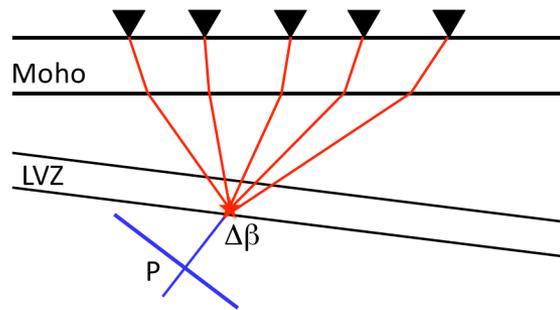
- Seismic methods
- The LAB of the subducted slab
- The LAB of the overriding plate
- LAB and mantle flow in the subduction system

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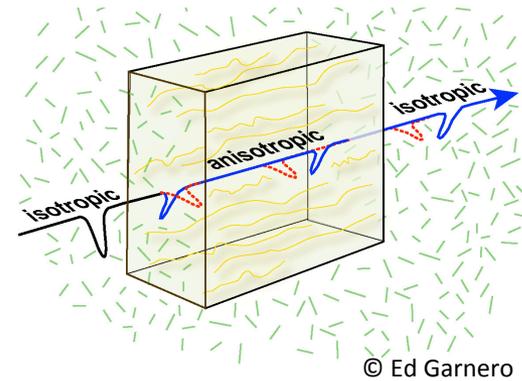
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Seismic methods

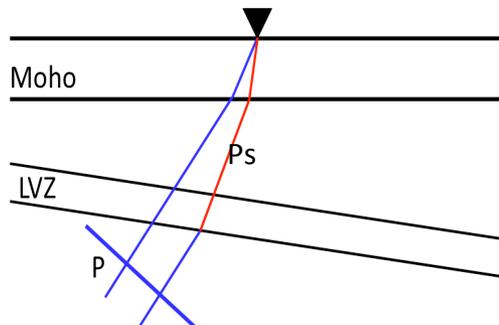
2D Teleseismic Migration



Shear-Wave Splitting



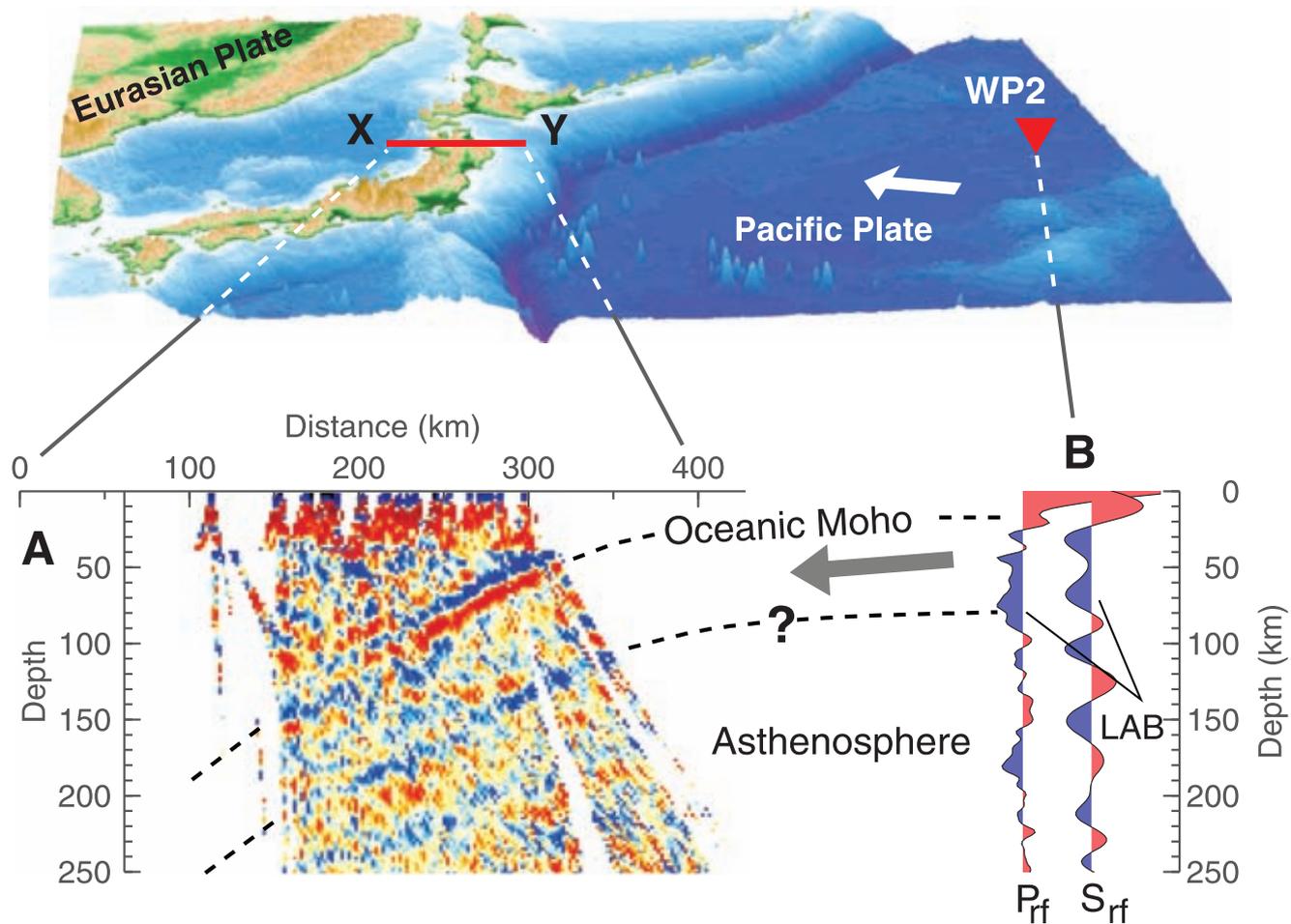
Receiver Functions



Outline

- Seismic methods
- **The LAB of the subducted slab**
- The LAB of the overriding plate
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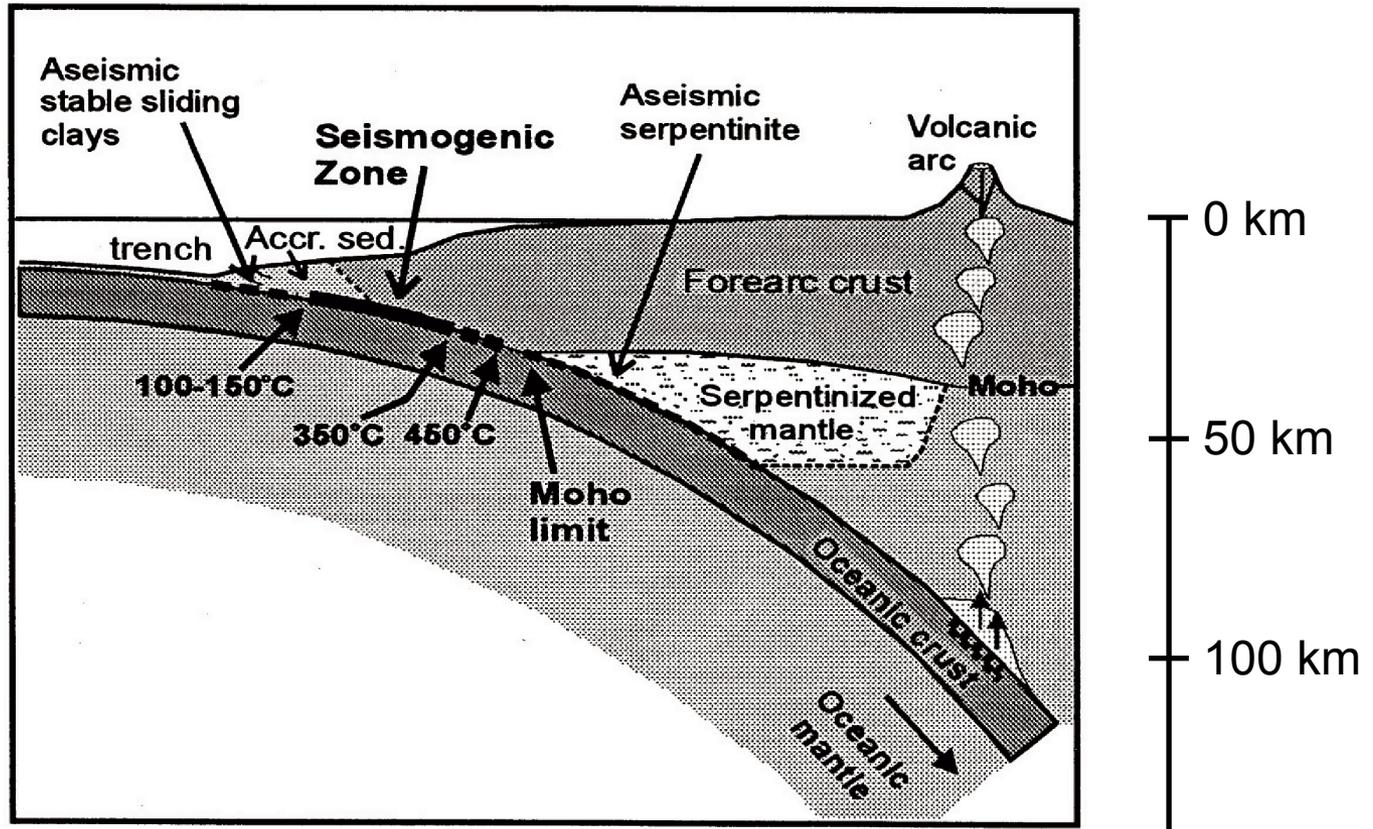
The LAB of the subducted slab



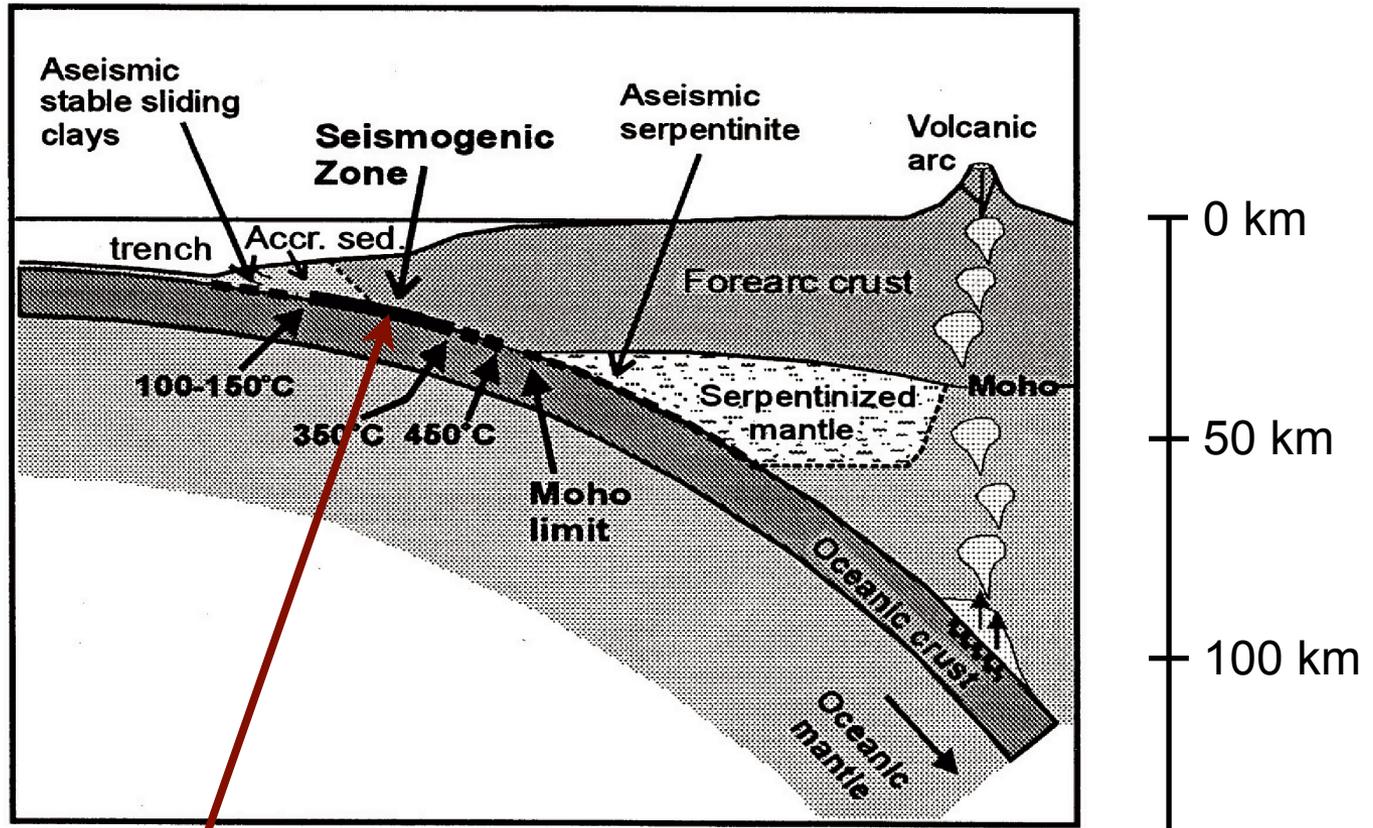
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- Seismic methods
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Where does the overriding LAB appear?

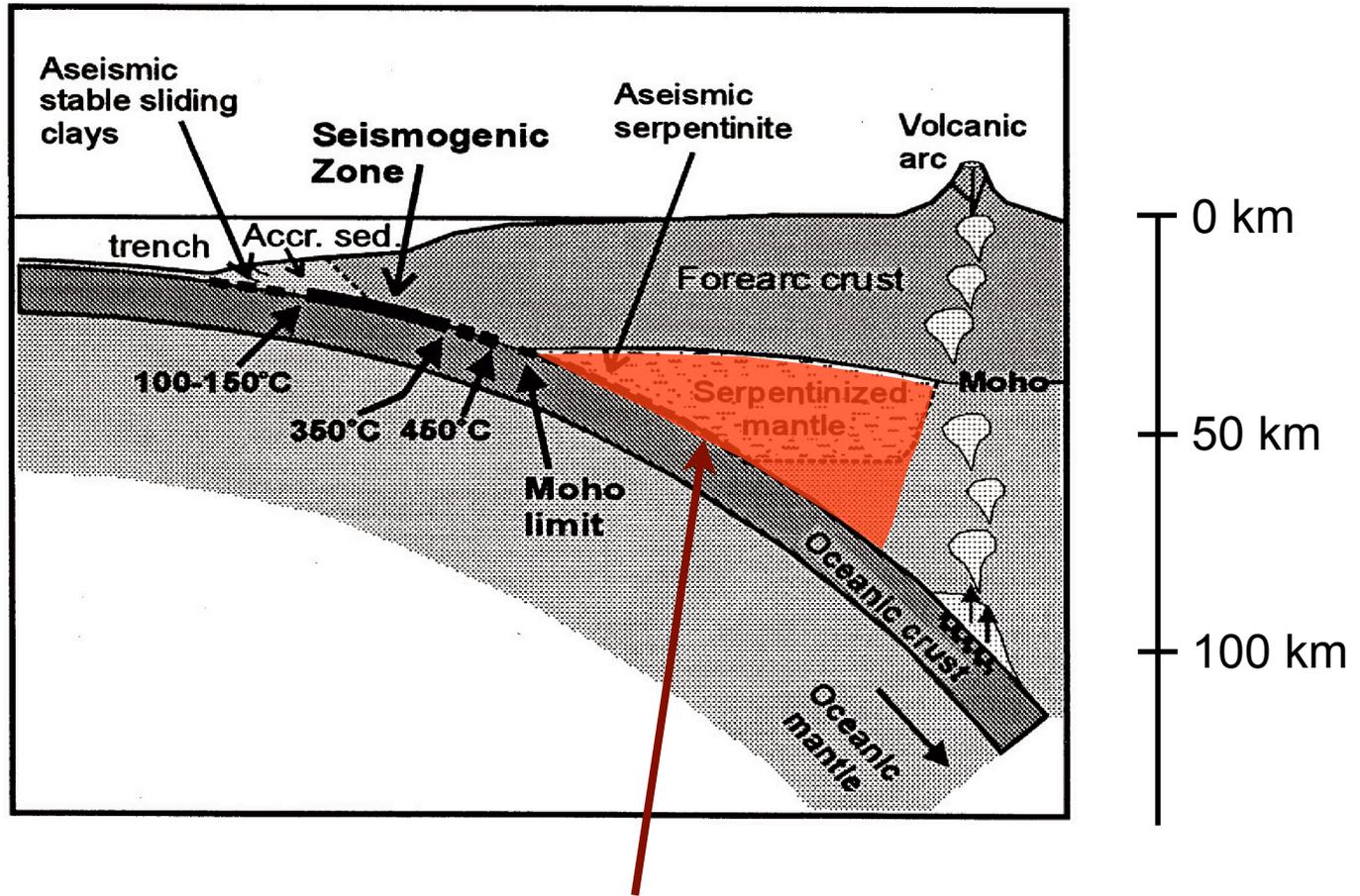


Where does the overriding LAB appear?



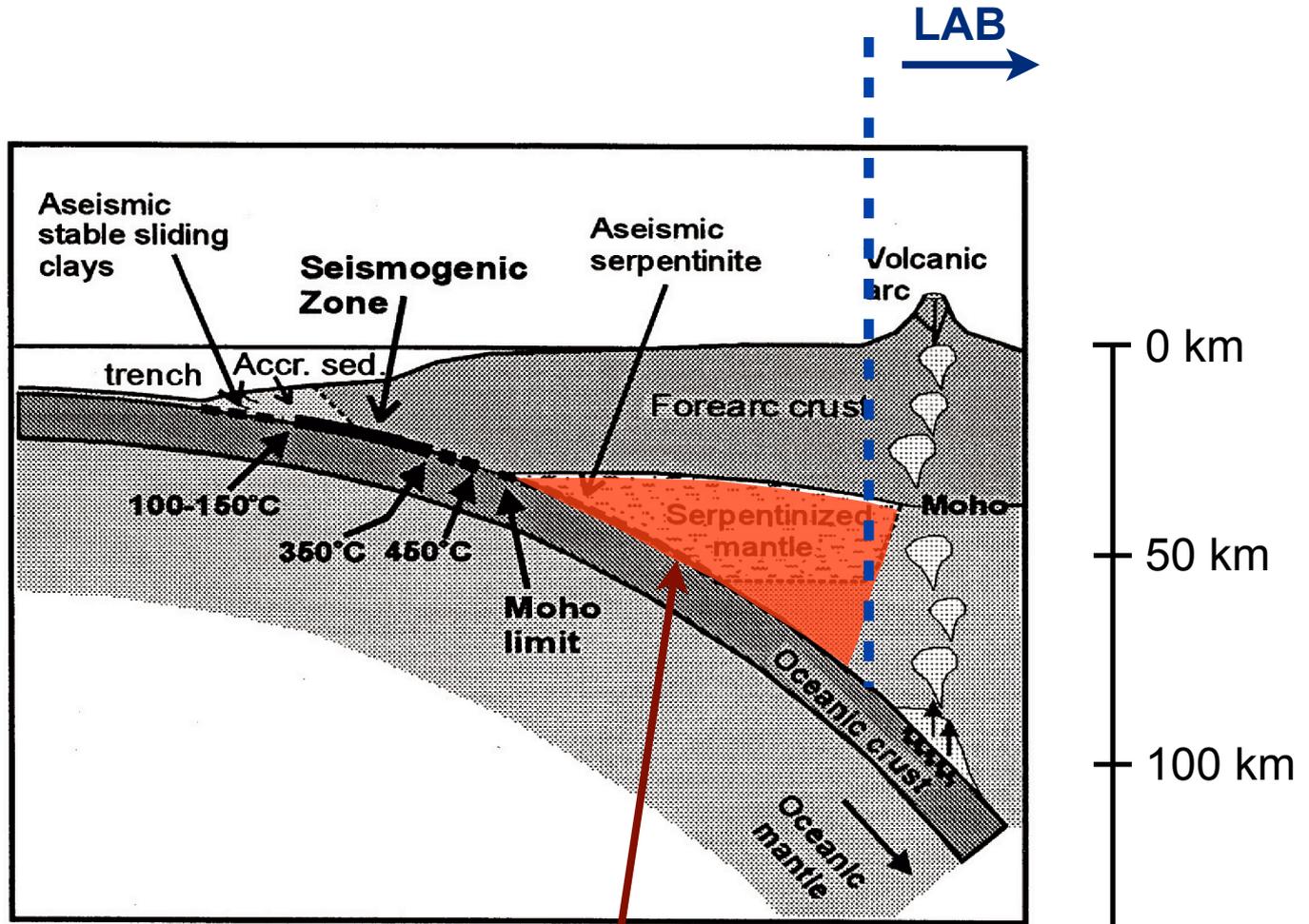
**Crust on crust =
no overriding LAB**

Where does the overriding LAB appear?



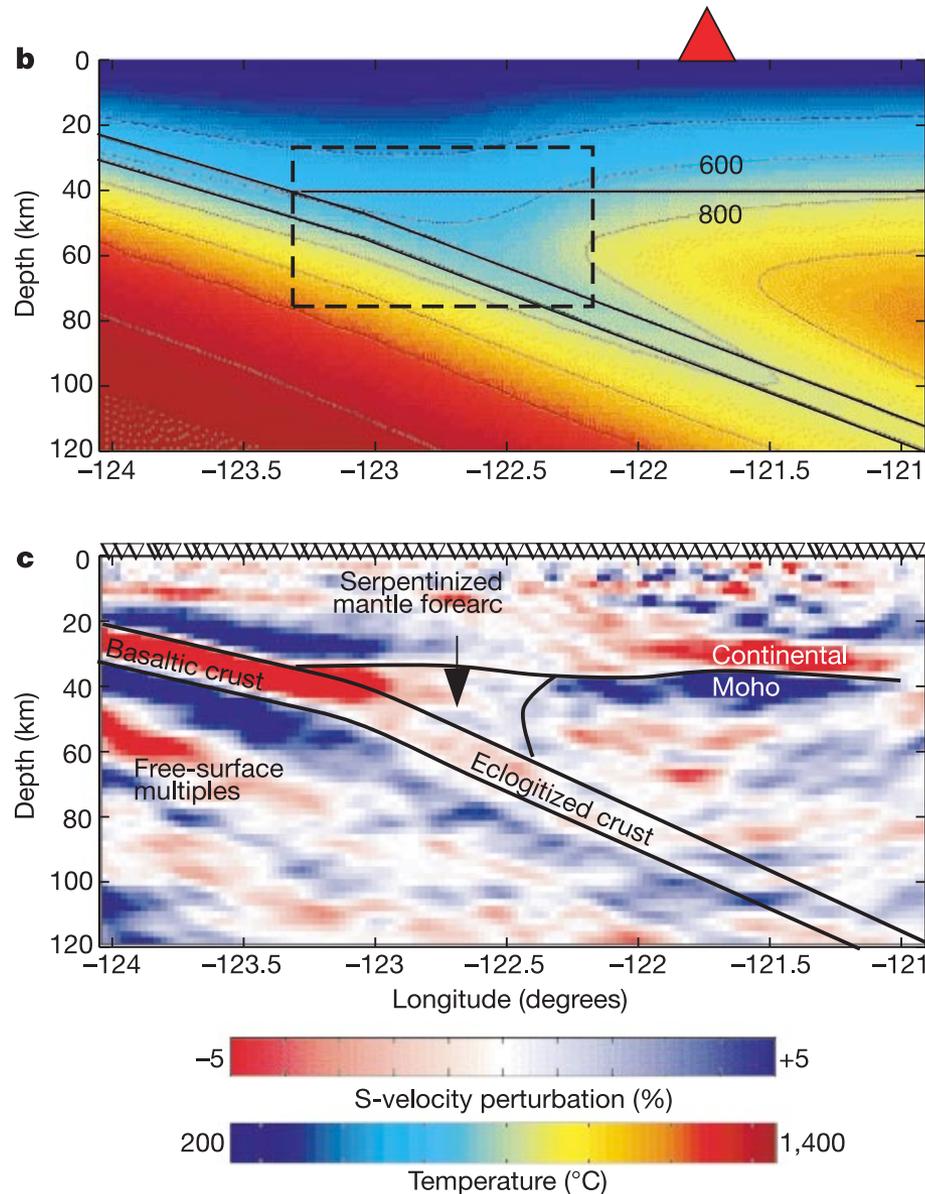
LAB killer!

Where does the overriding LAB appear?



LAB killer!

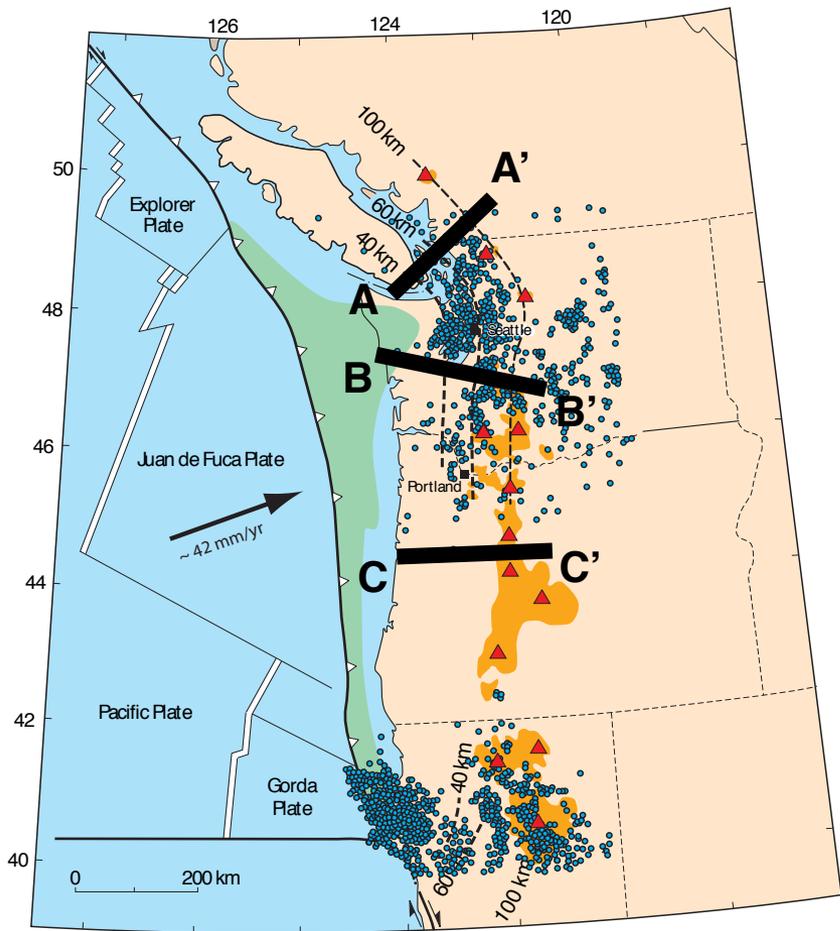
Where does the overriding LAB appear?



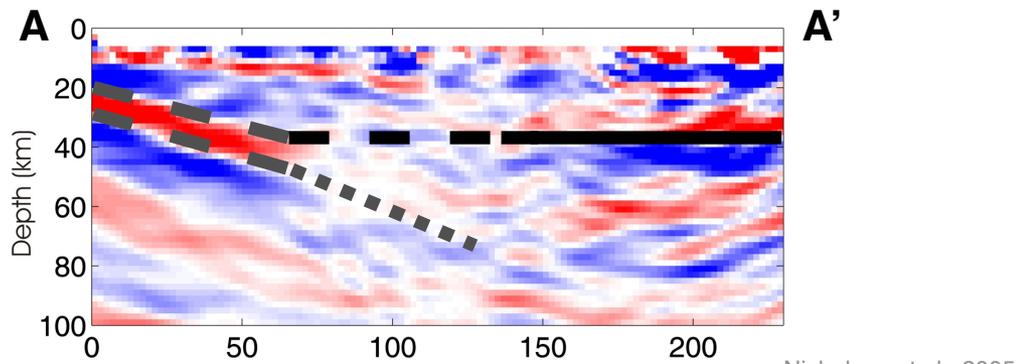
Rondenay et al., 2001

Bostock et al., 2002

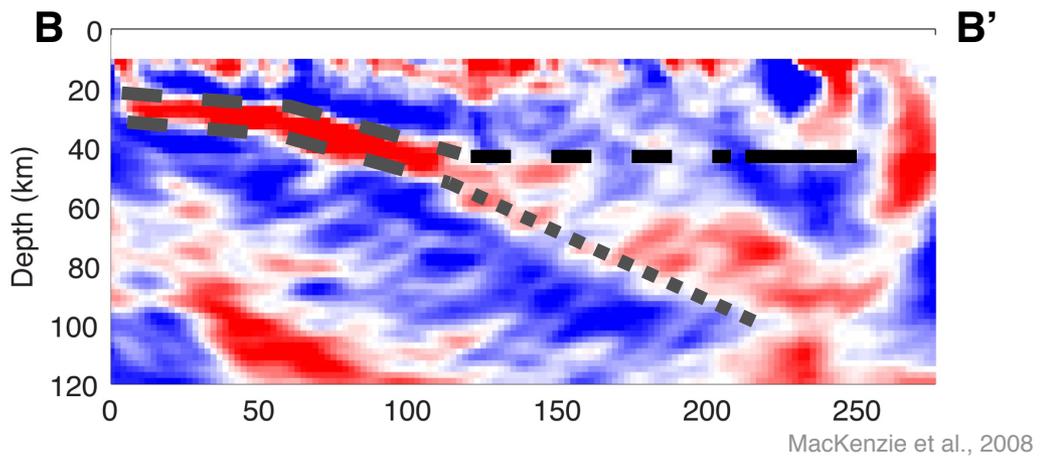
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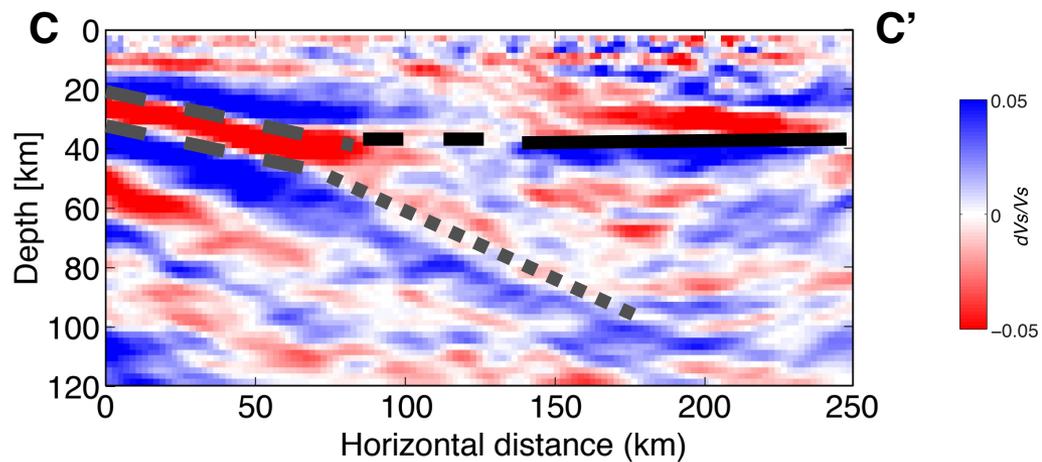
Romanyuk et al., 1998



Nicholson et al., 2005

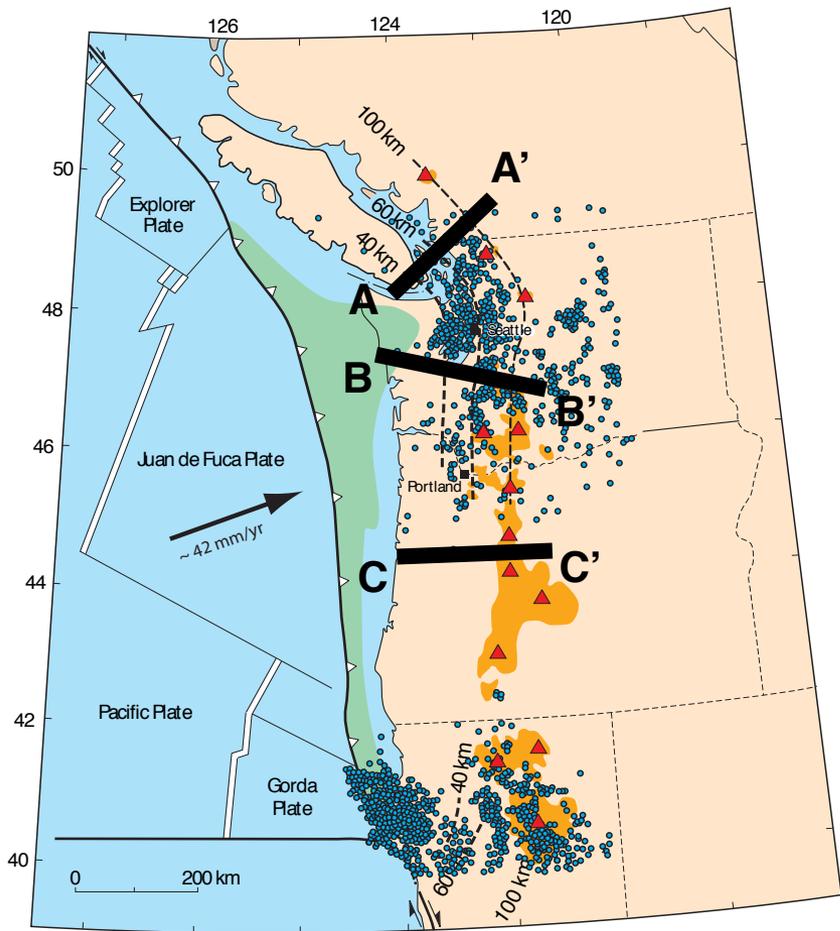


MacKenzie et al., 2008

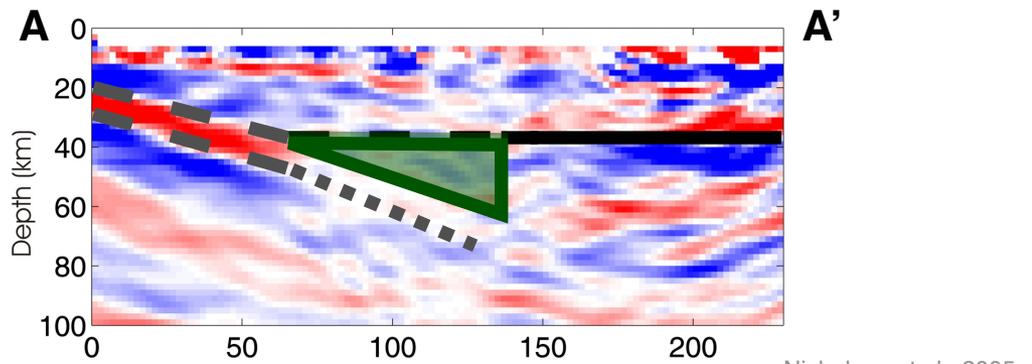


Rondenay et al., 2001

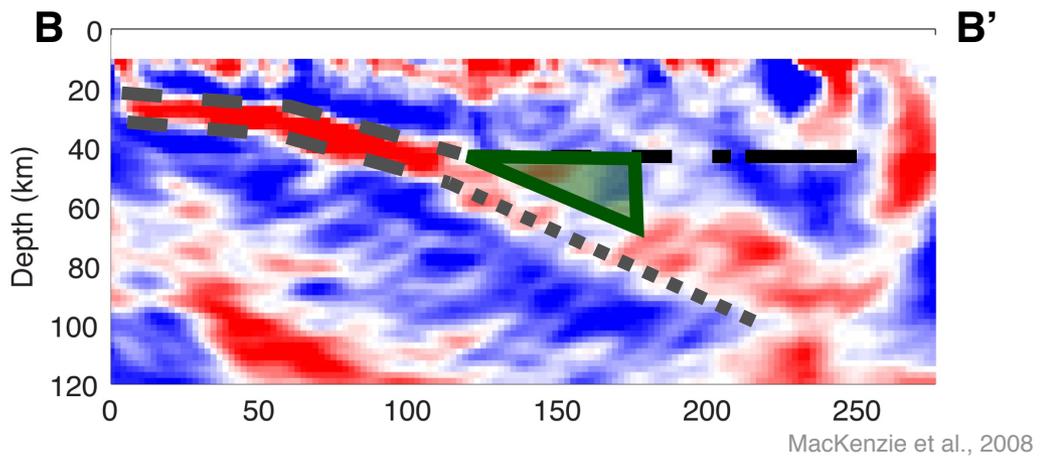
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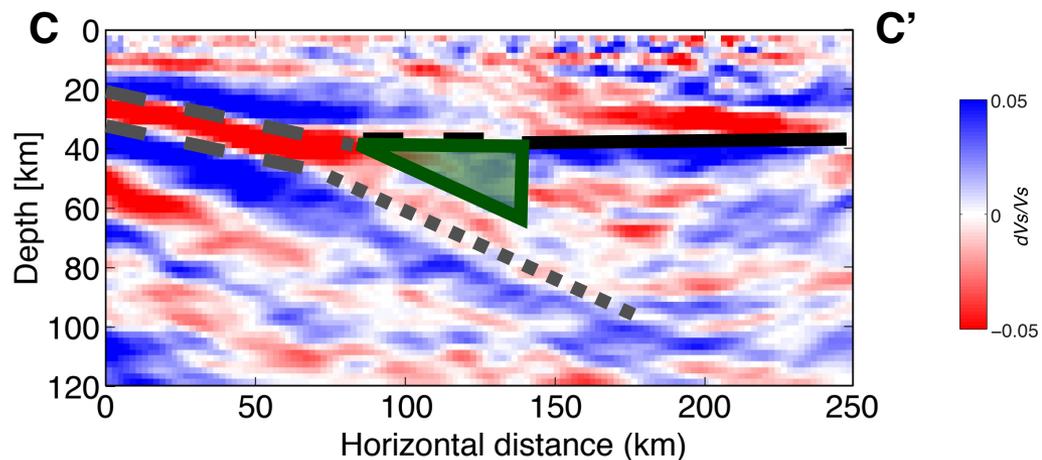
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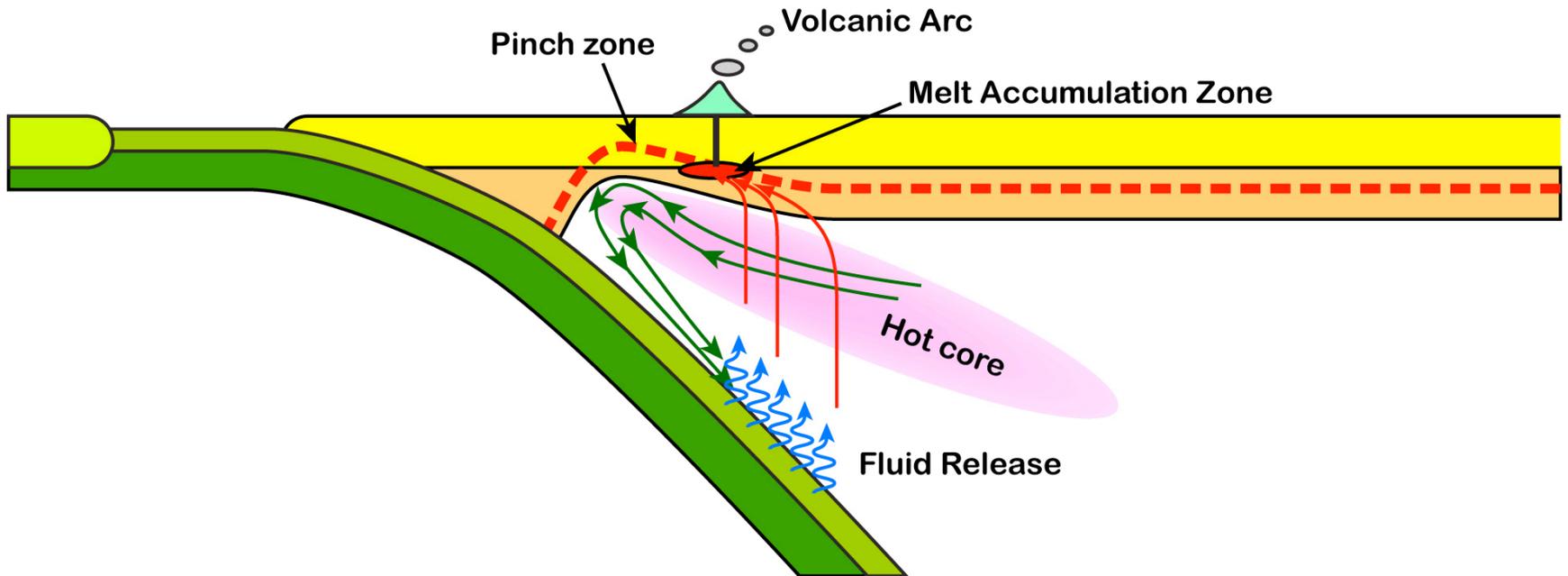


MacKenzie et al., 2008

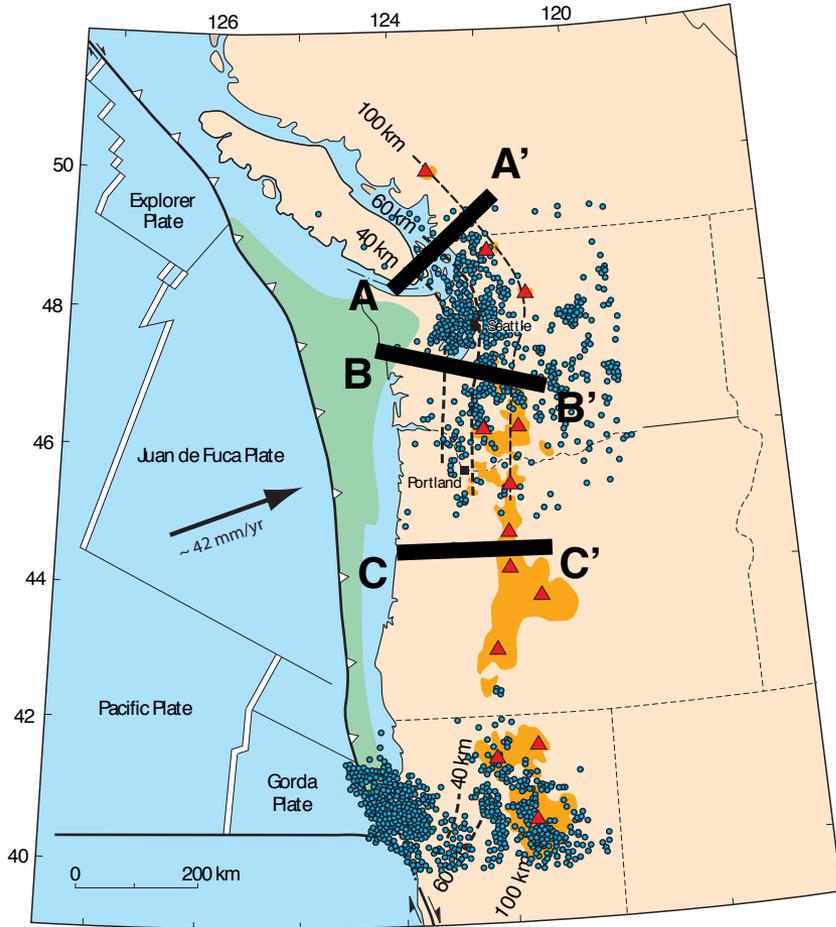


Rondenay et al., 2001

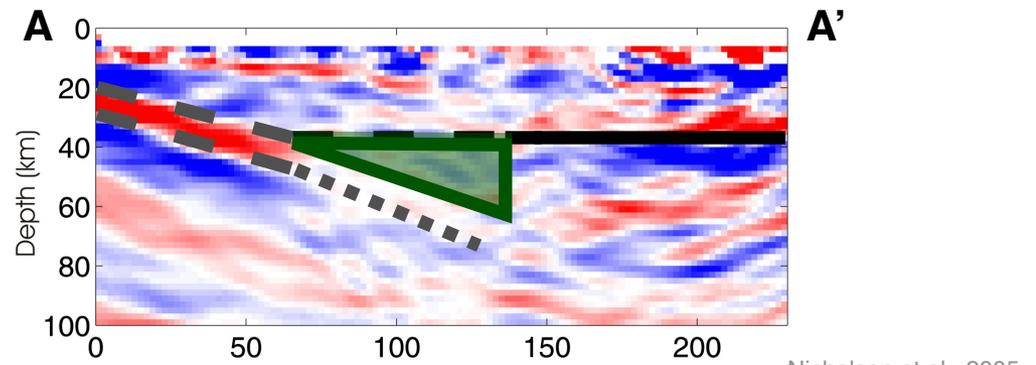
But do we see the LAB below the arc?



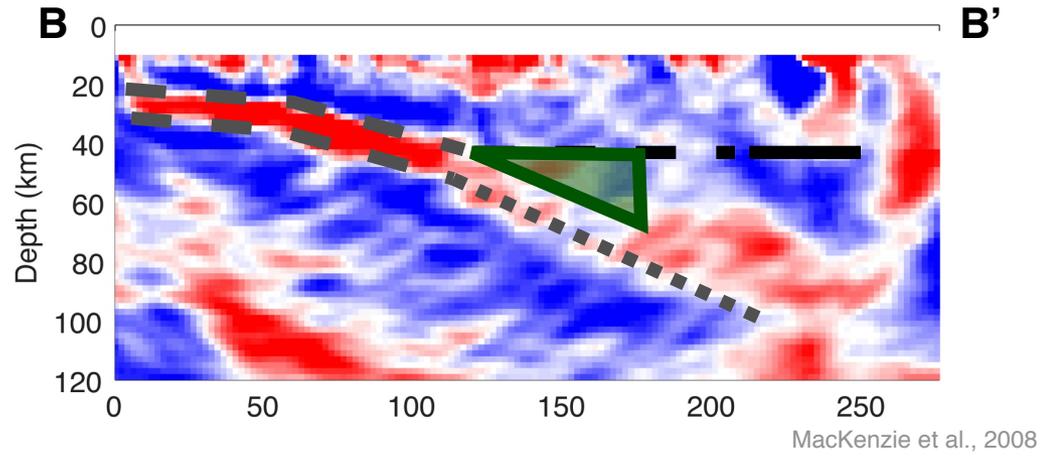
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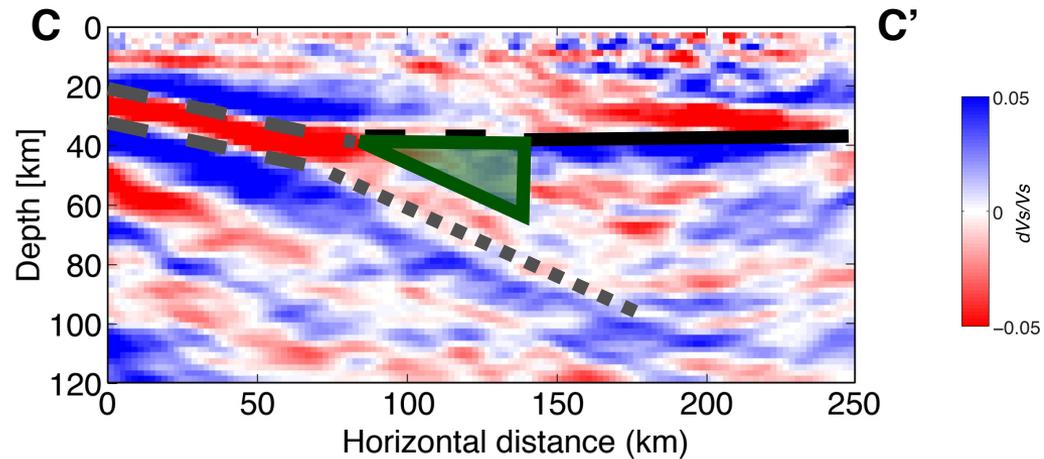
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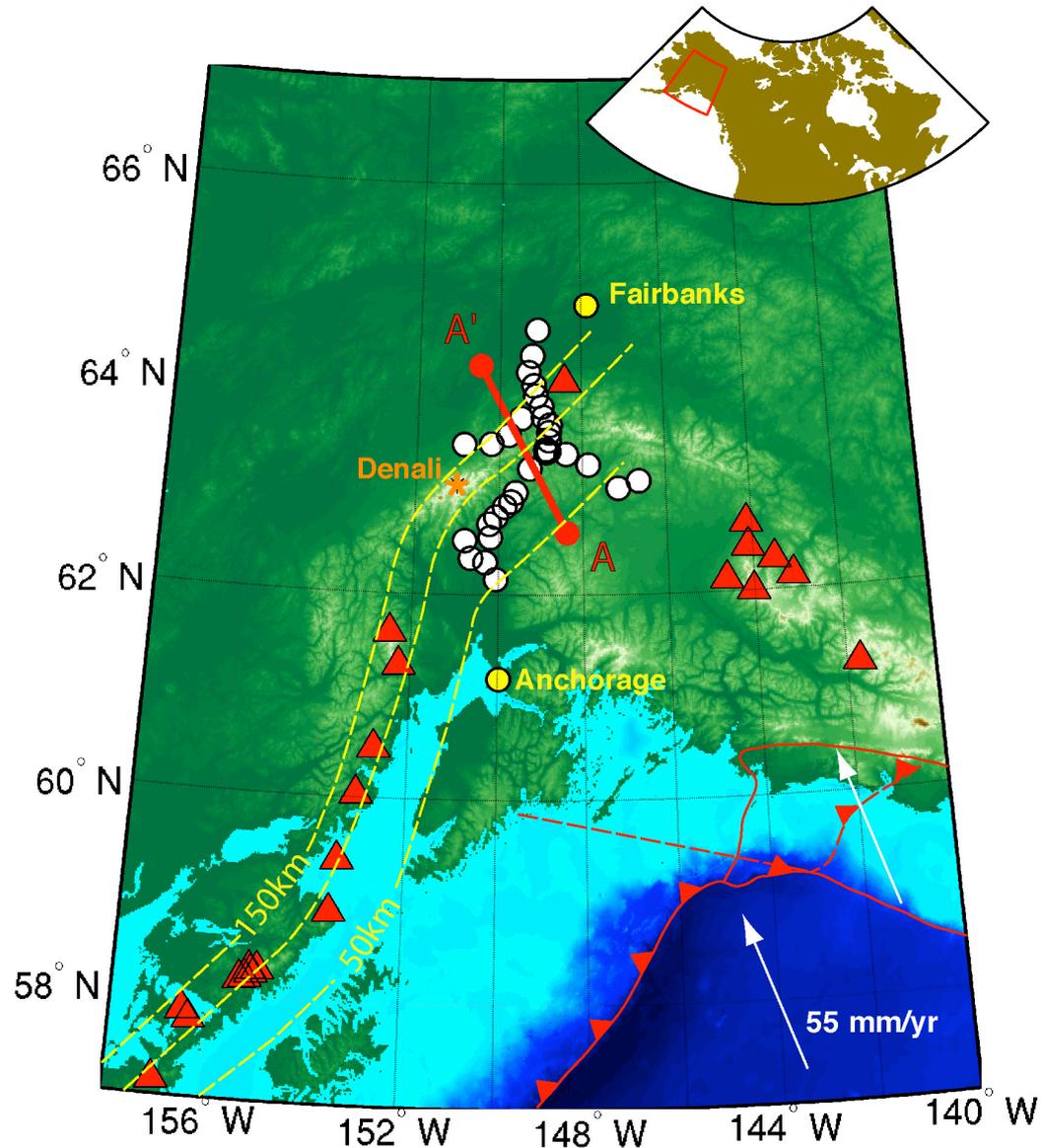


MacKenzie et al., 2008

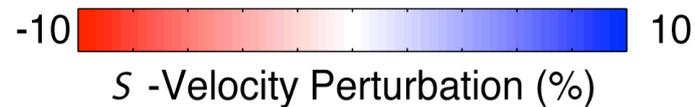
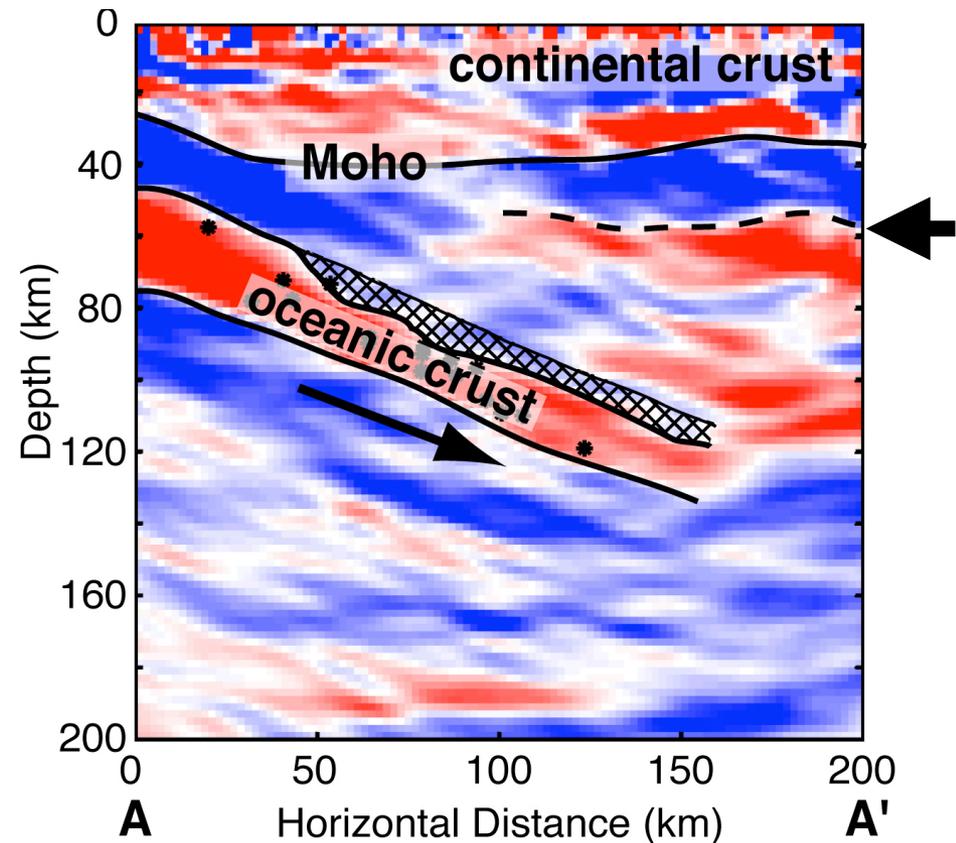
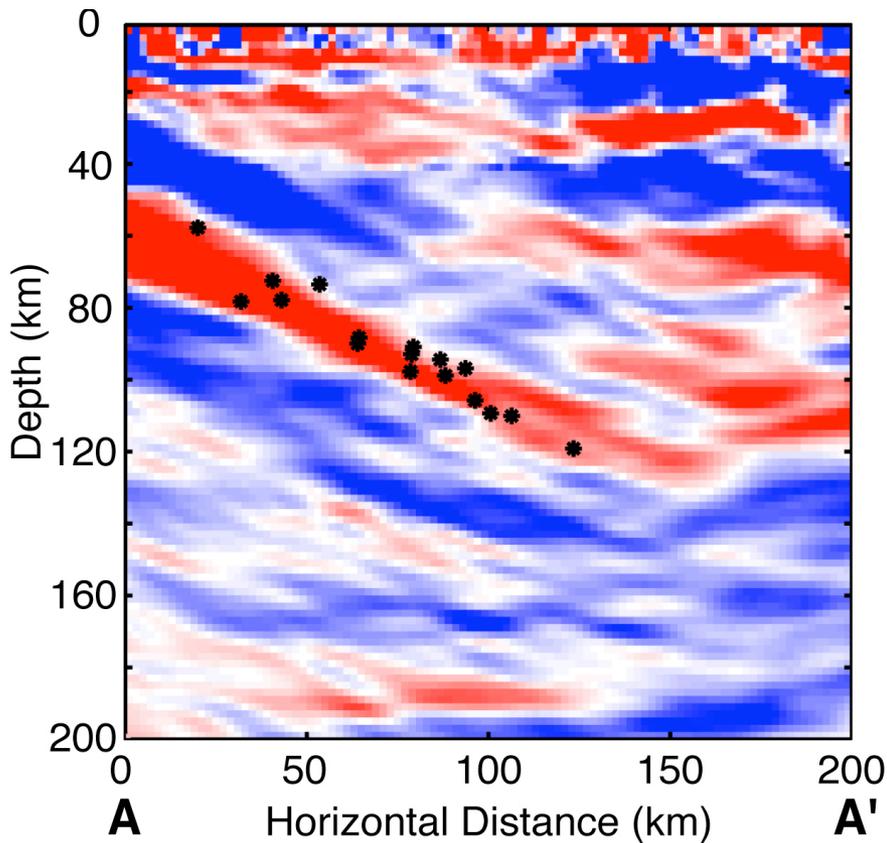


Rondenay et al., 2001

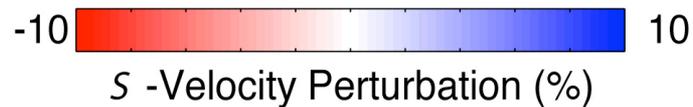
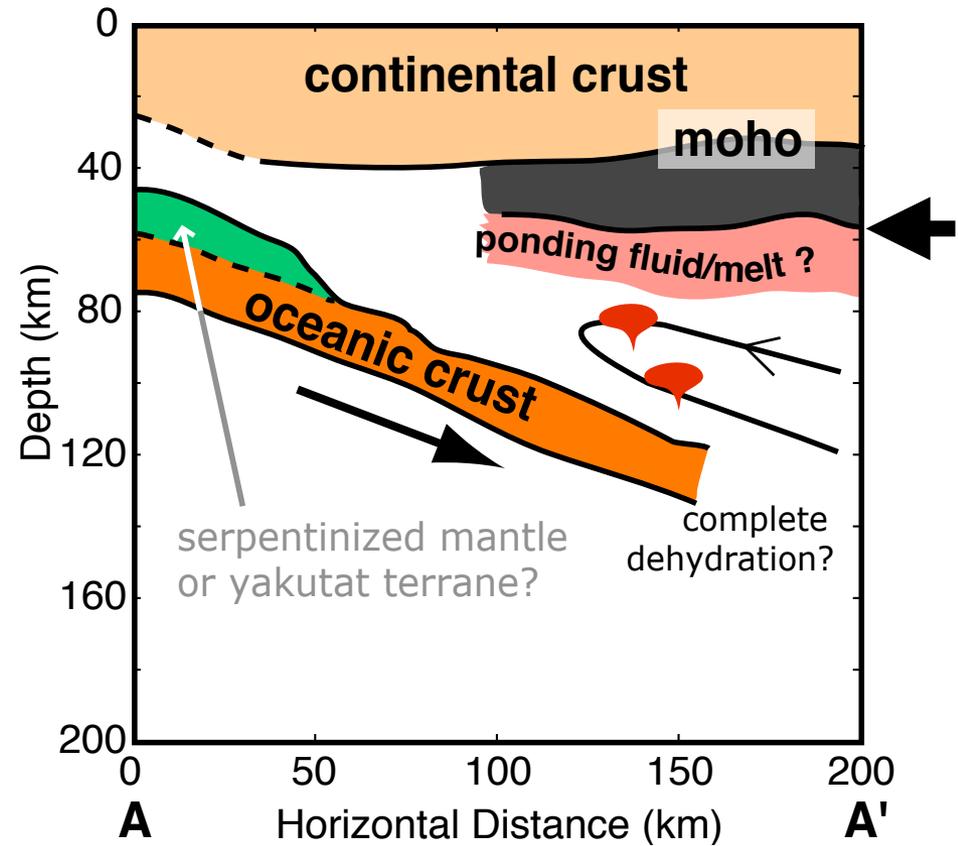
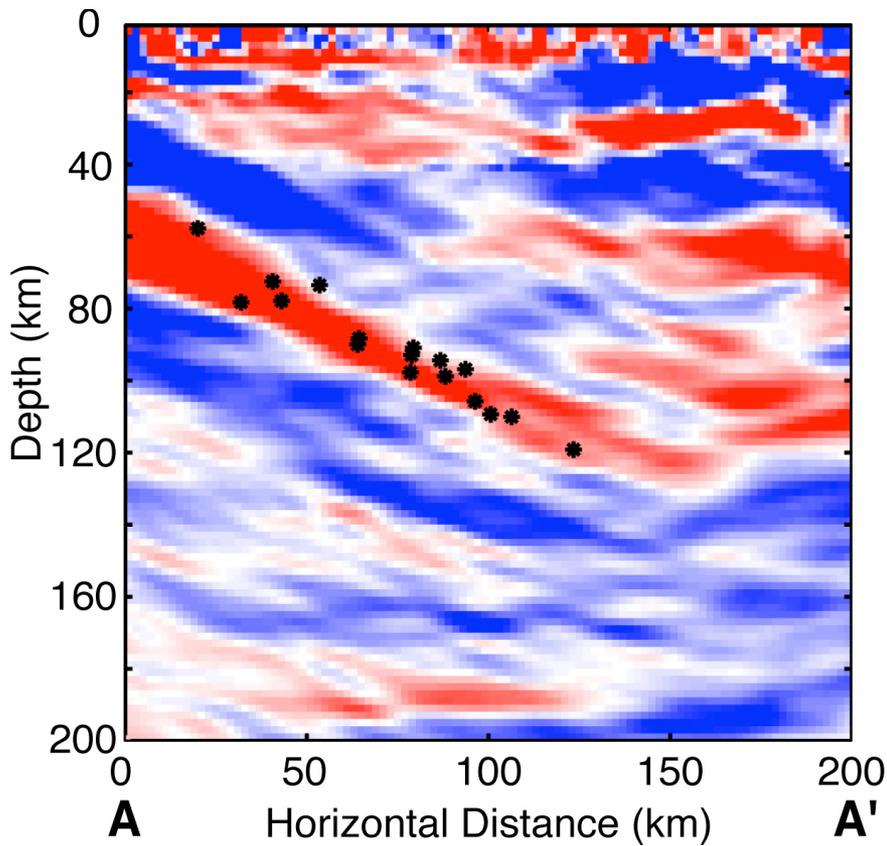
But do we see the LAB below the arc?



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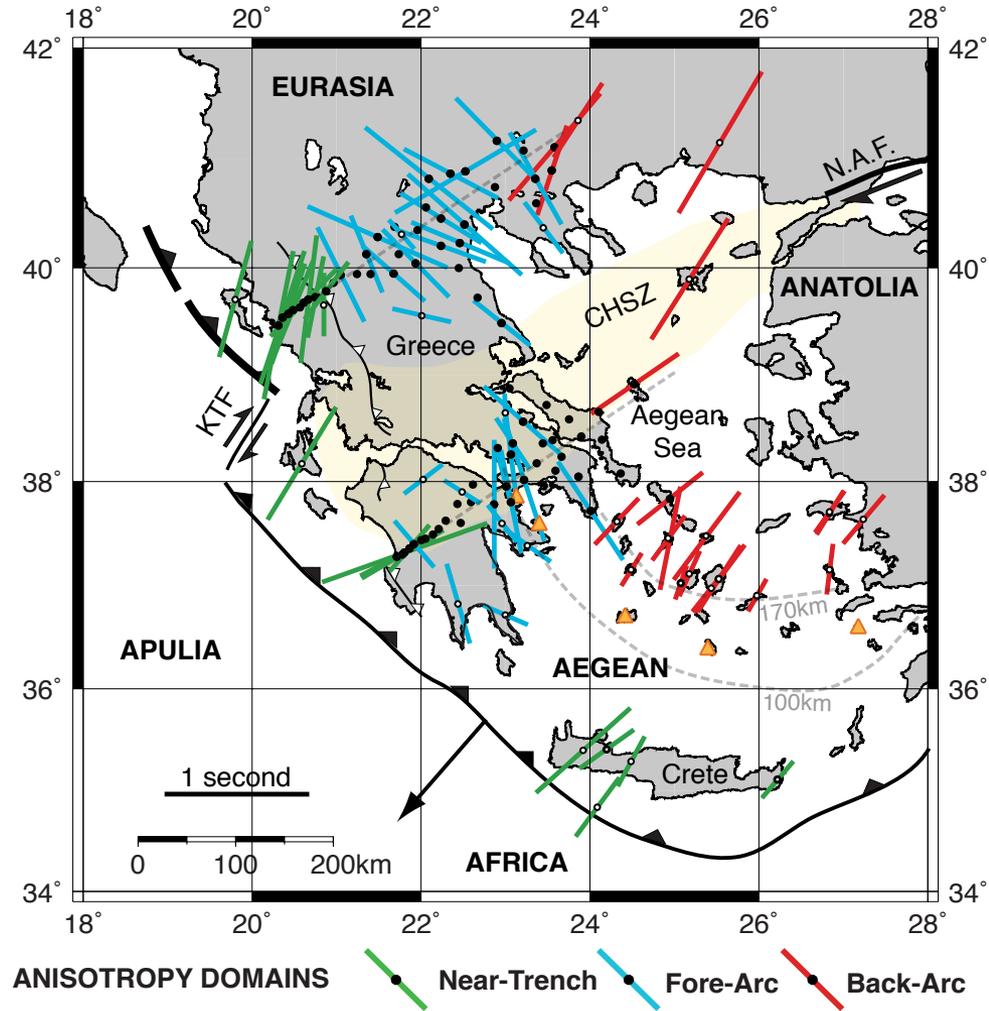
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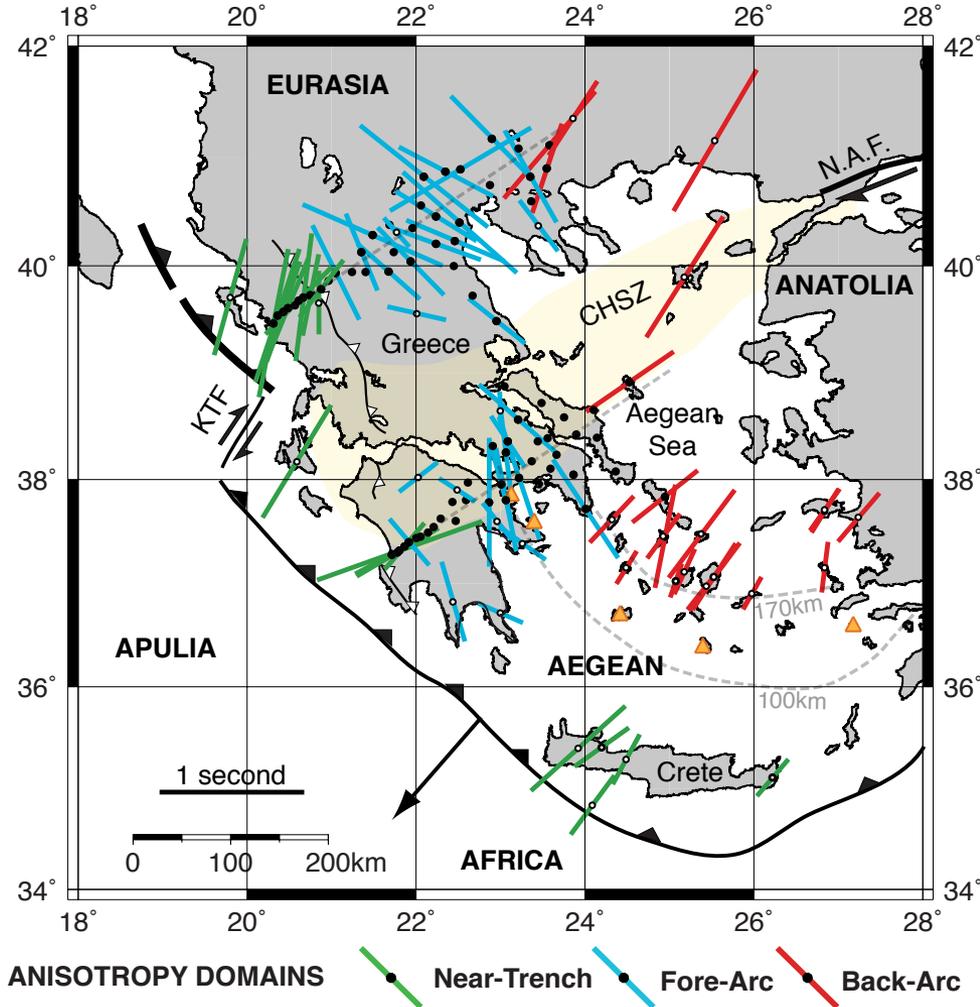
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LAB and mantle flow

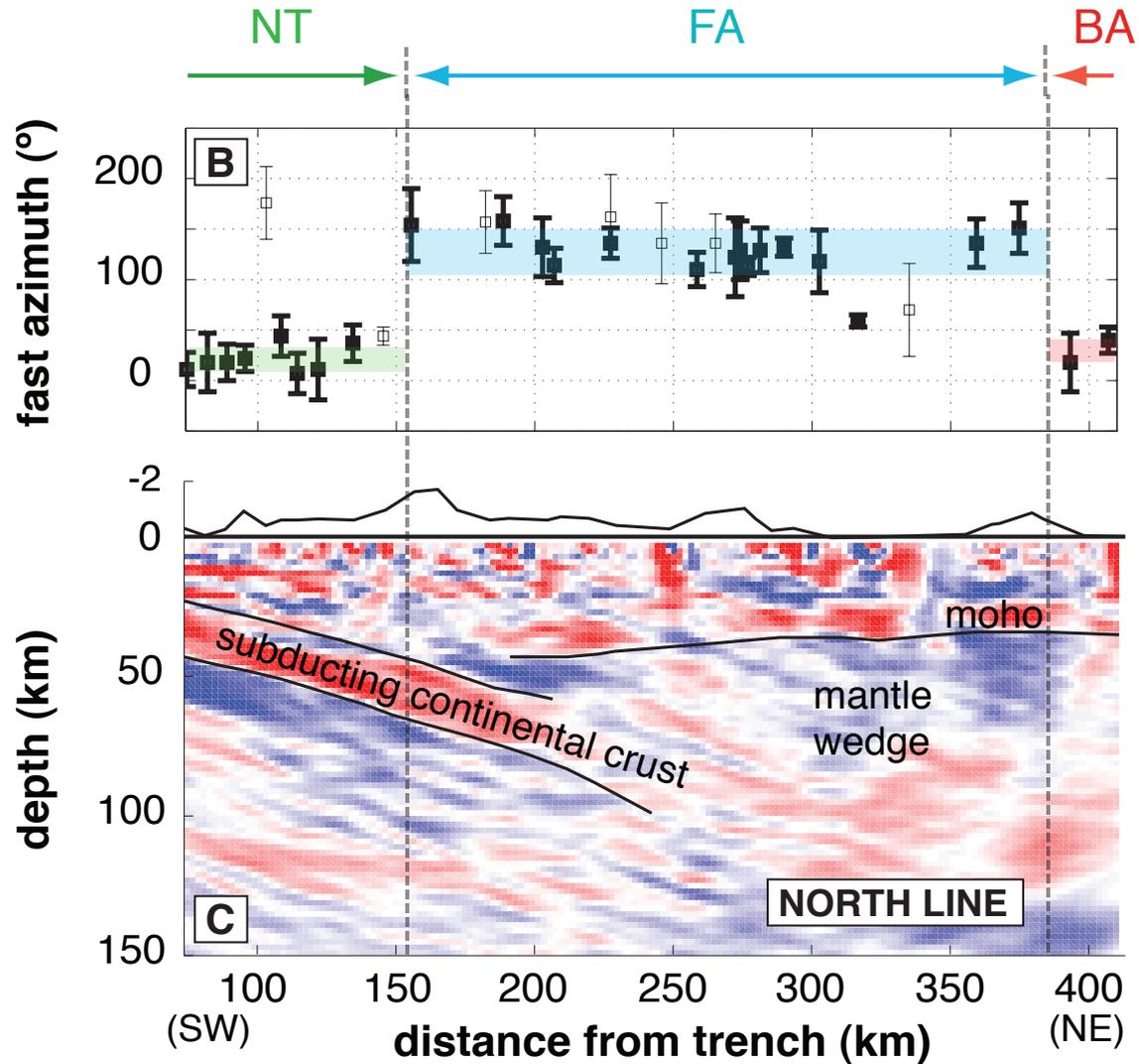


LAB and mantle flow

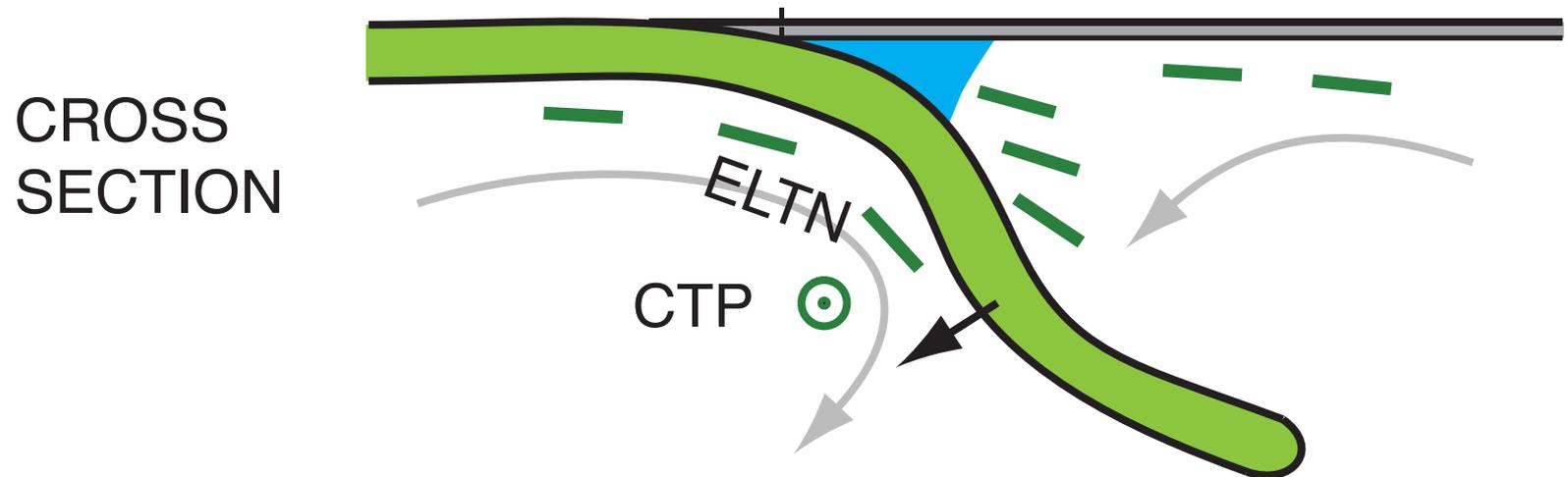


Don't categorize me: I am neither just a 'trench parallel' nor just a 'trench normal' anisotropy subduction zone, I am much more complex and intriguing!

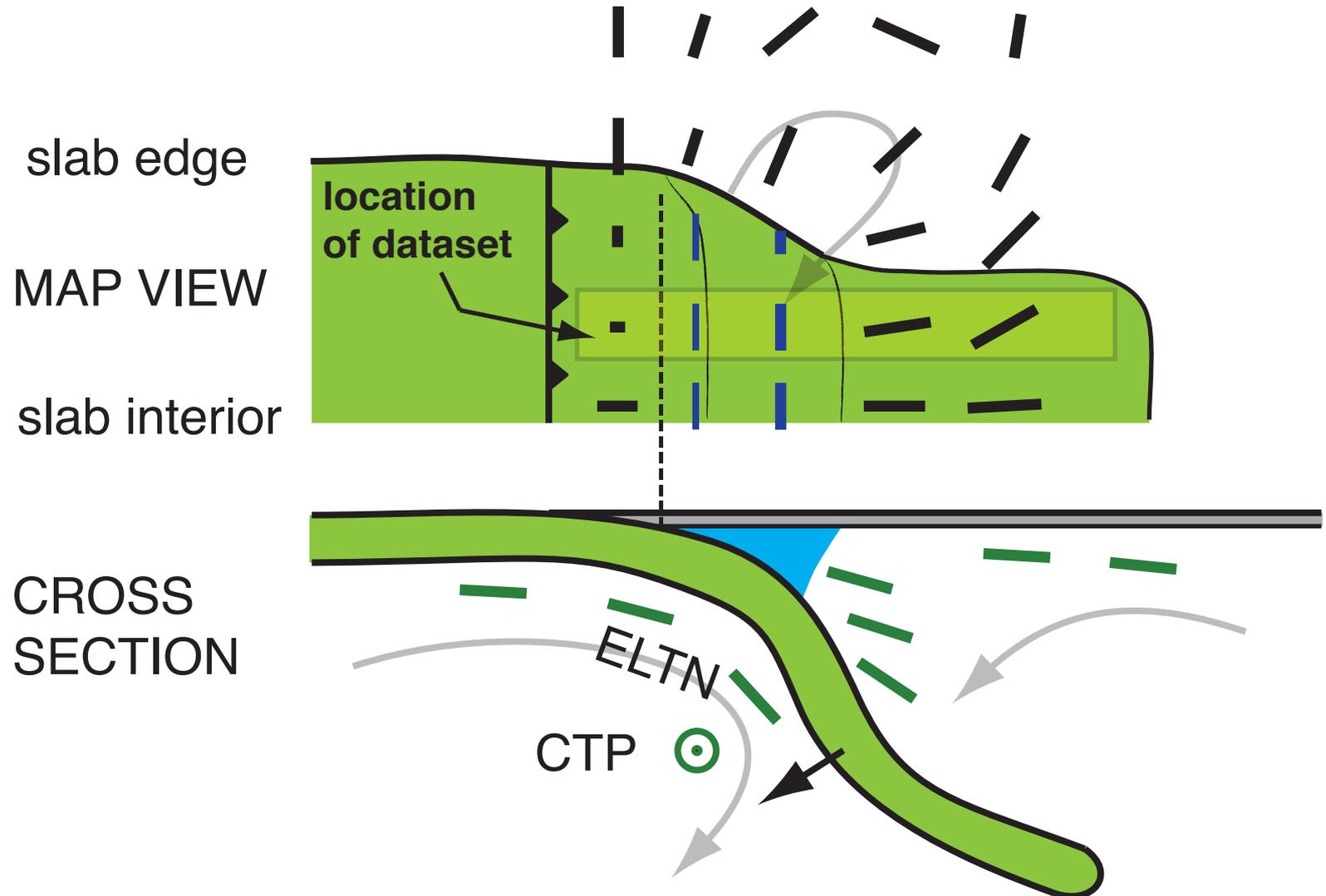
LAB and mantle flow



LAB and mantle flow



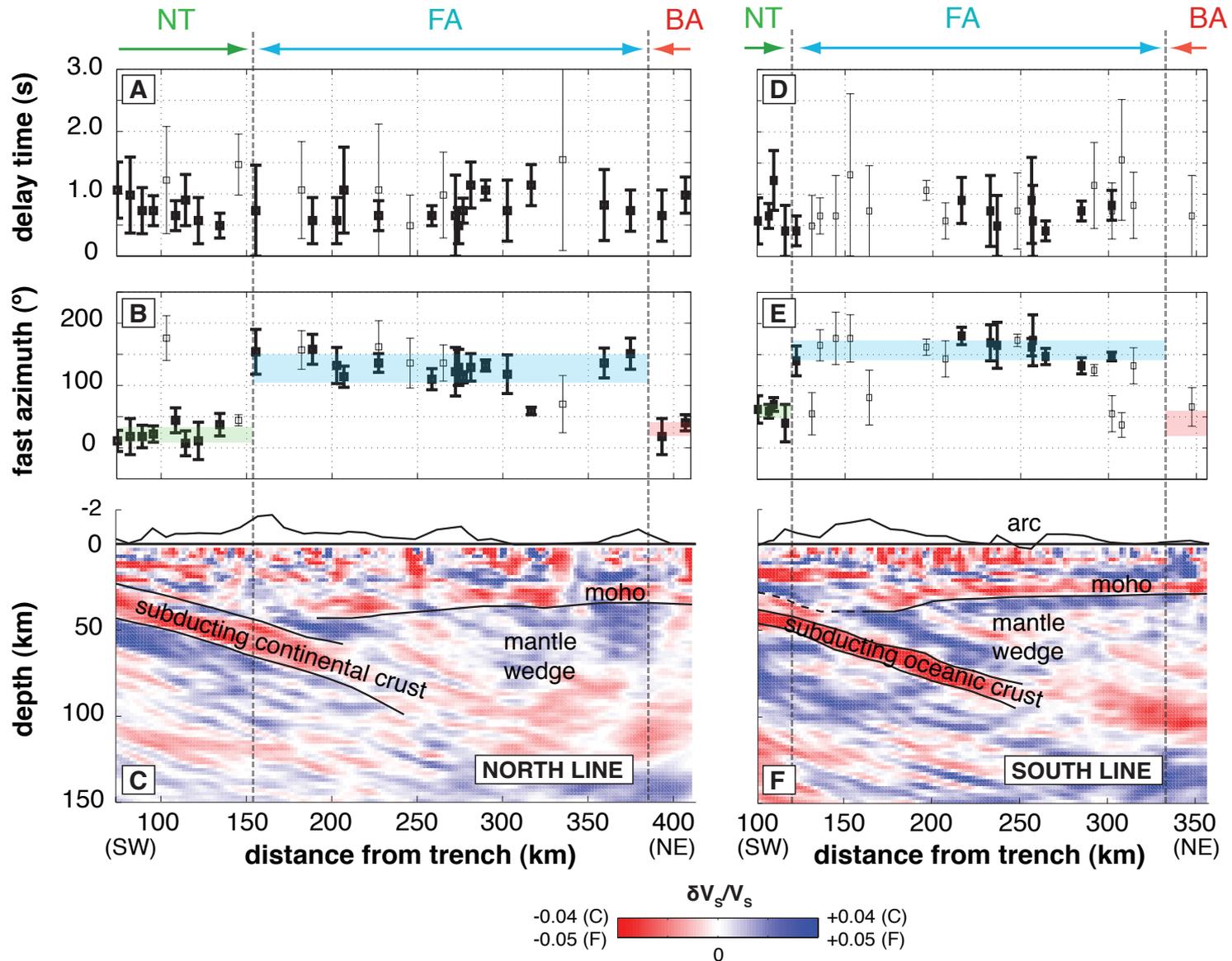
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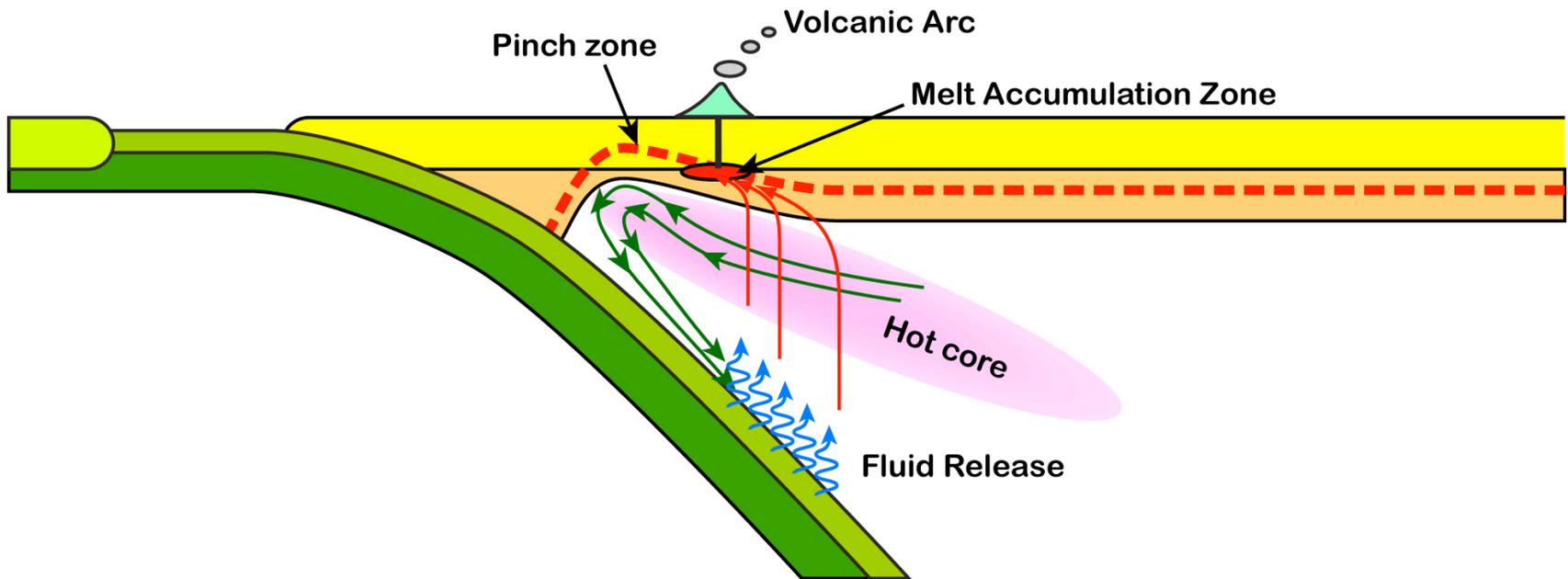
Concluding remarks and outlook

- The LAB and underlying mantle flow are laterally discontinuous at subduction zones, and local high-resolution seismic imaging techniques give us a glimpse of how the LAB system behaves
- The LAB of the subducted slab appears well defined, but plunges into the deeper mantle past the trench
- The LAB of the overriding plate effectively starts landward of the cold (potentially serpentinized) portion of the mantle wedge
- The LAB of the overriding plate is not clearly imaged by teleseismic converted-wave below the arc, except in the case of advancing slabs where melt/fluids might be ponding
- We still need to establish a link between the long-range LAB profiles over continents and oceanic slabs by combining local and regional imaging approaches (-> lateral extent of the influence of subduction zones on the LAB)

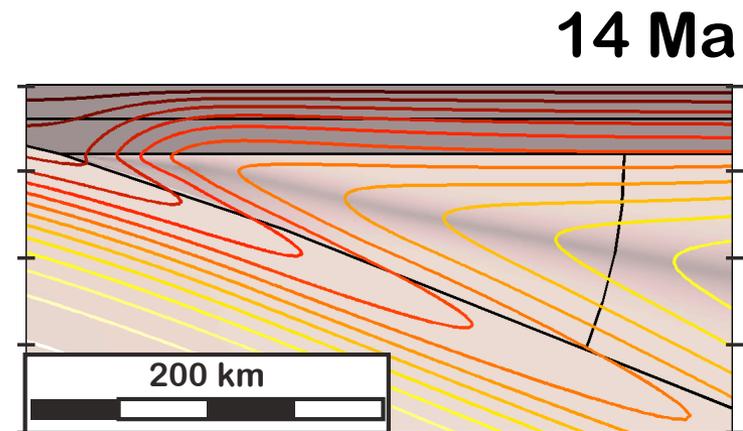
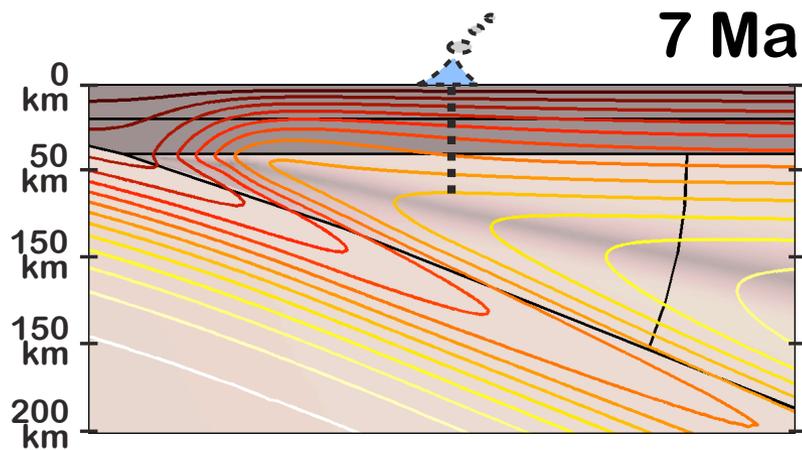
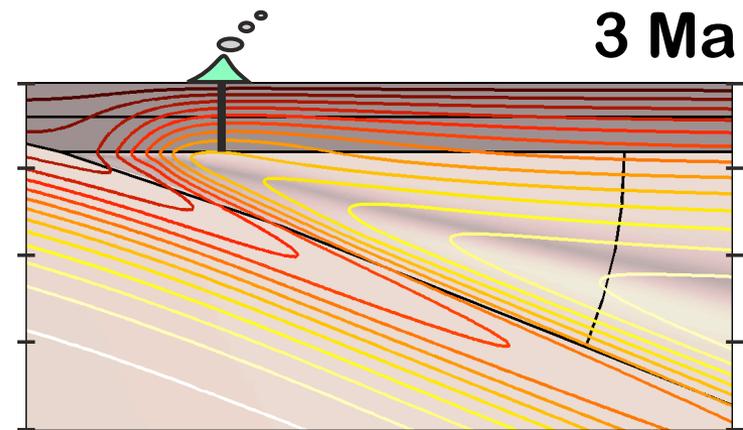
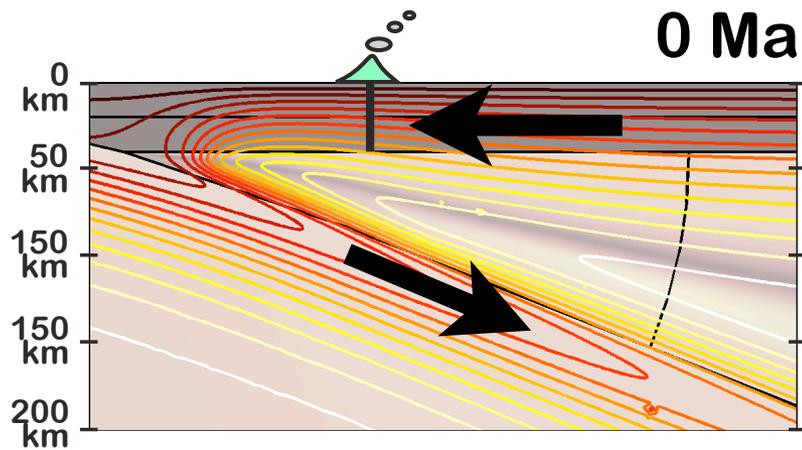
LAB and mantle flow



Thermal models: steady subduction

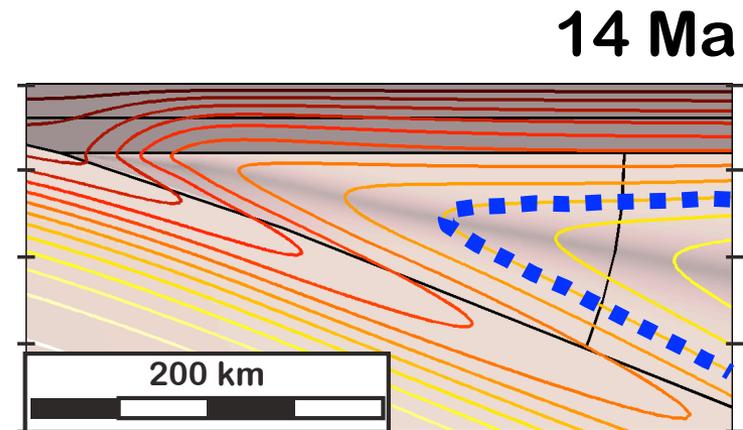
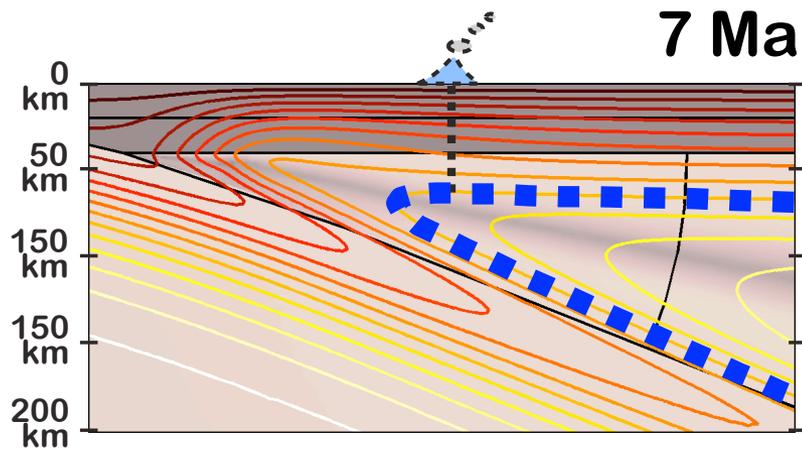
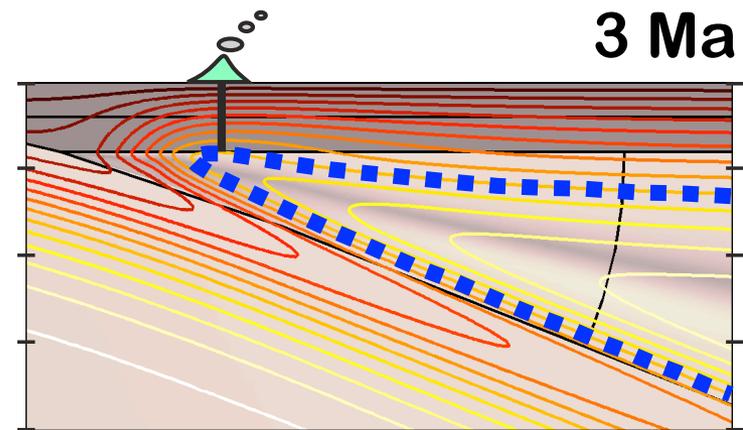
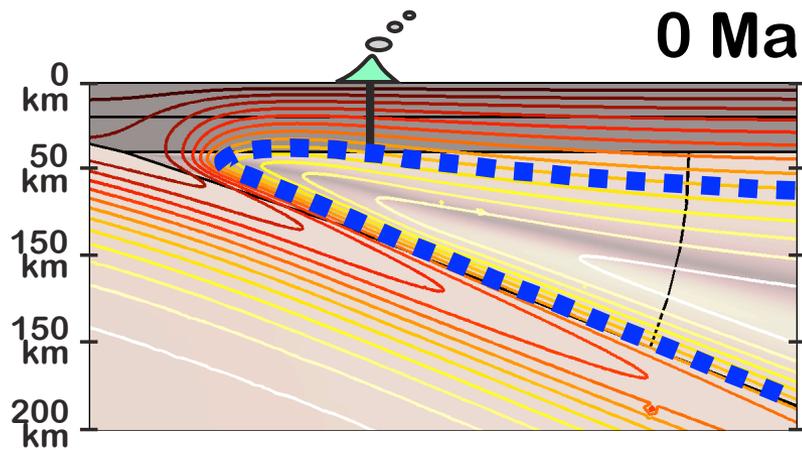


Thermal models: advancing slab



$$V_t/V_c=0.5$$

Thermal models: advancing slab



$$V_t/V_c=0.5$$

Thermal models: advancing slab

