

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

Stéphane Rondenay

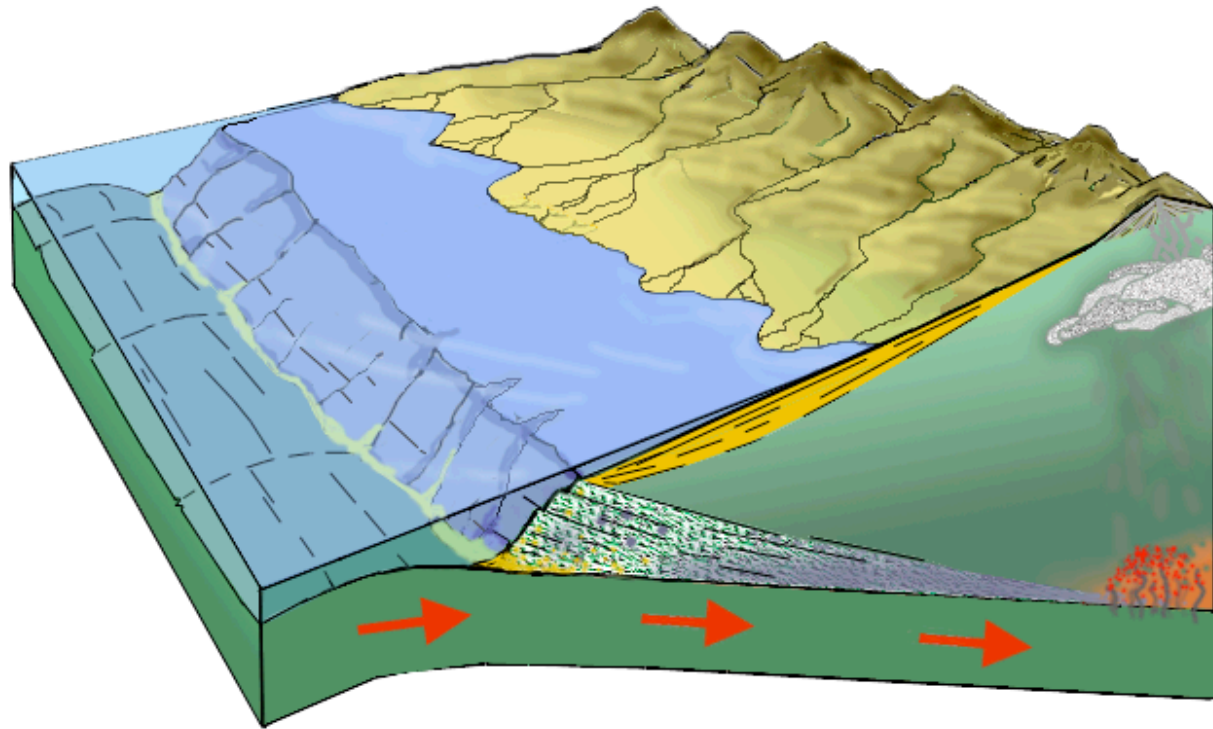


Universitetet i Bergen

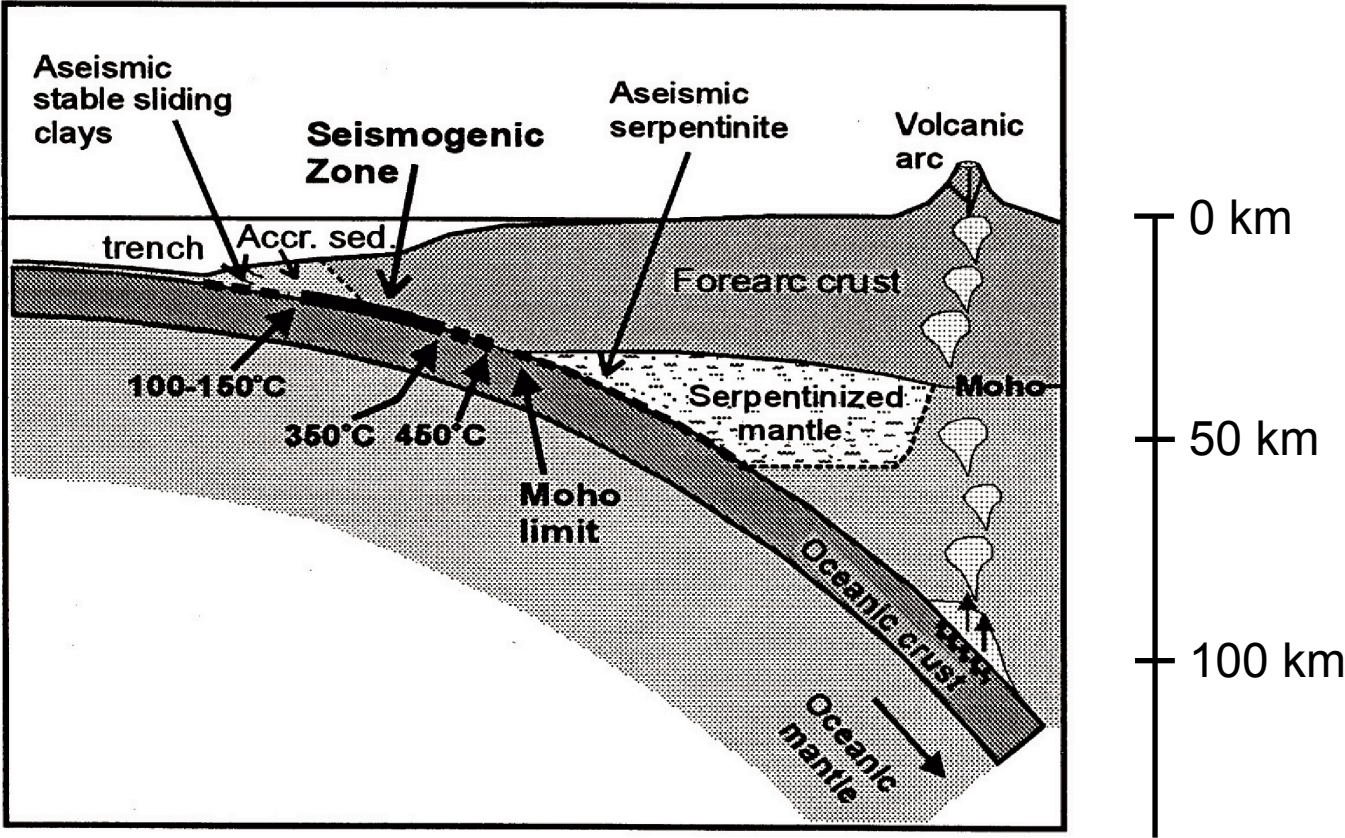
Collège de France, Paris, 19 November 2013

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

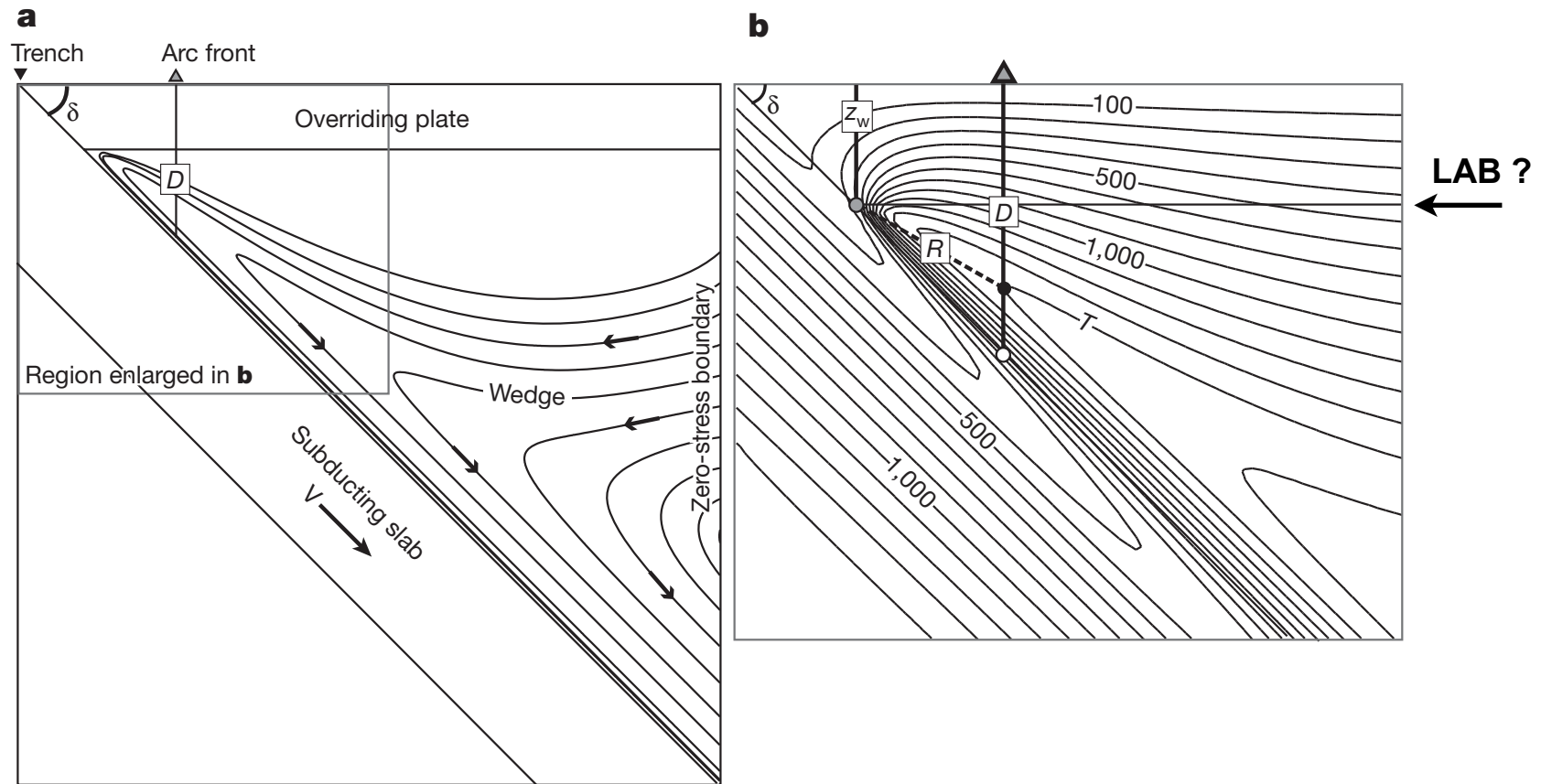
Subduction zone - where is the LAB?



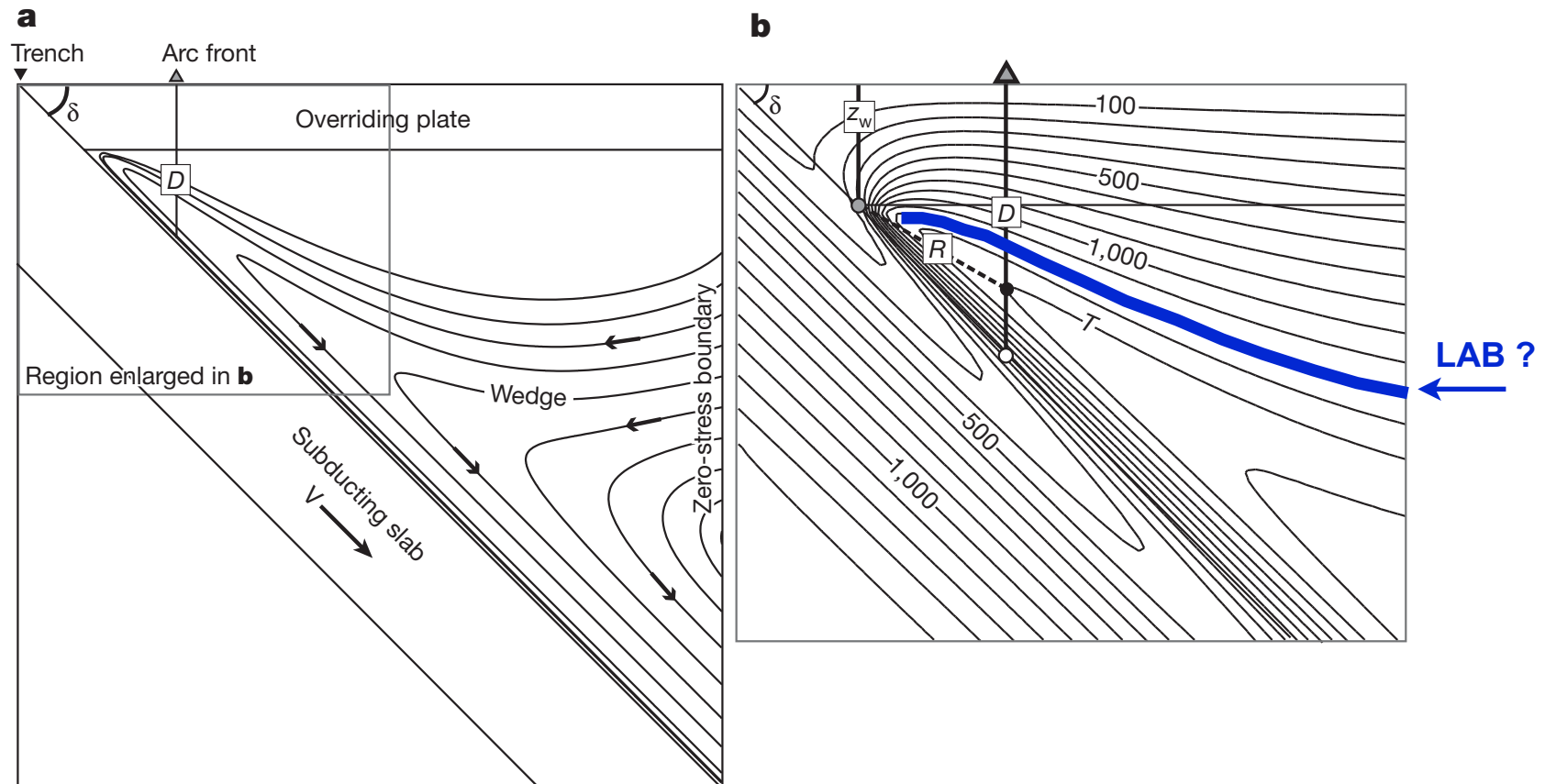
Subduction zone - where is the LAB?



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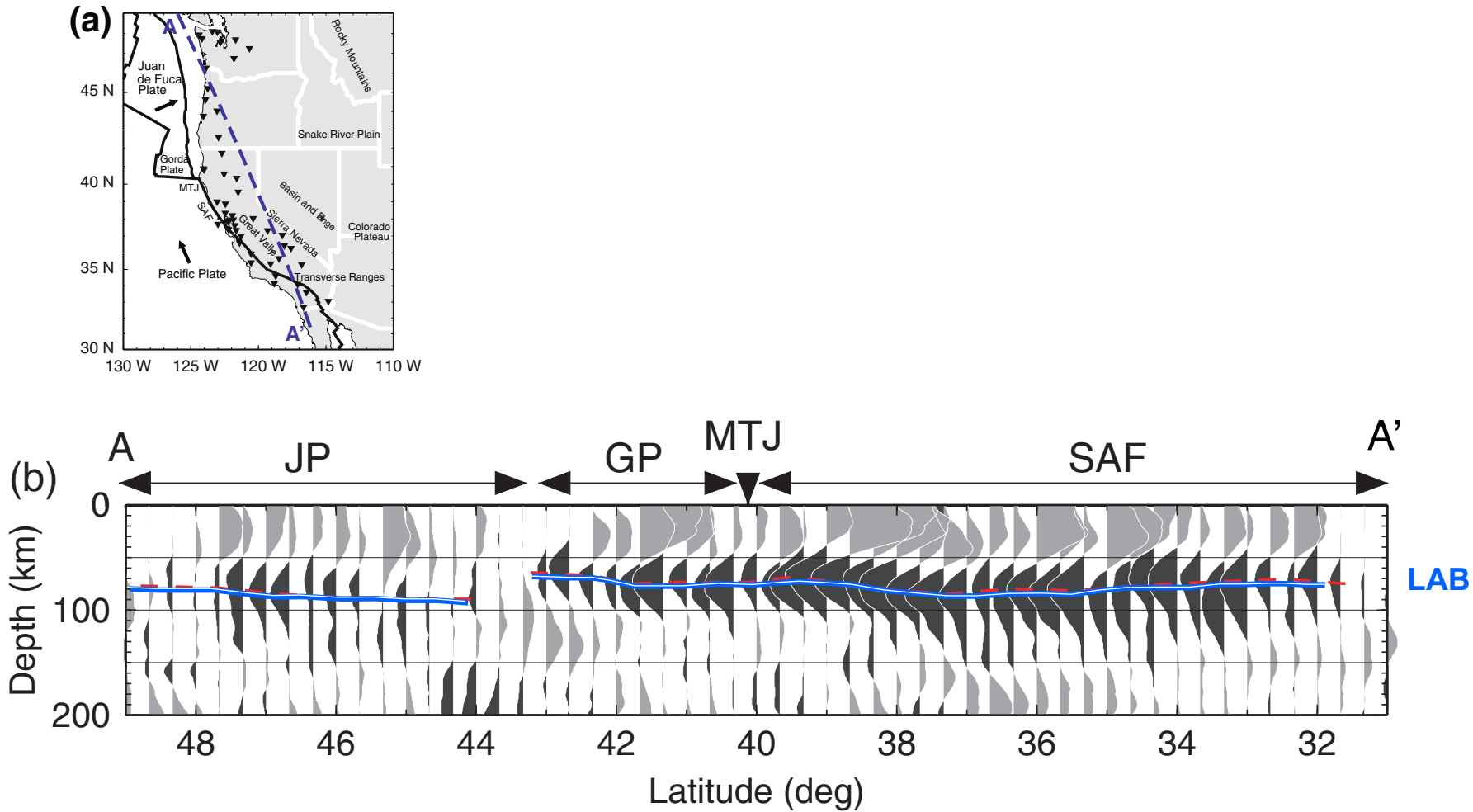


Subduction zone - where is the LAB?



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

The LAB - where is the subduction zone?



Outline

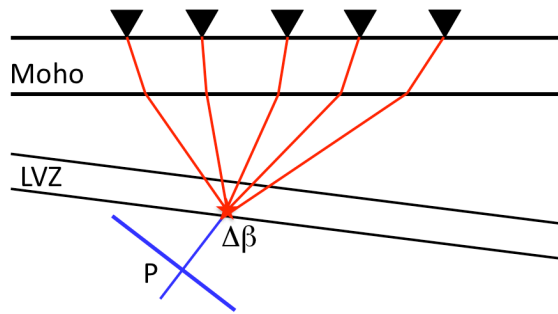
- Seismic methods
- The LAB of the subducted slab
- The LAB of the overriding plate
- LAB and mantle flow in the subduction system

Outline

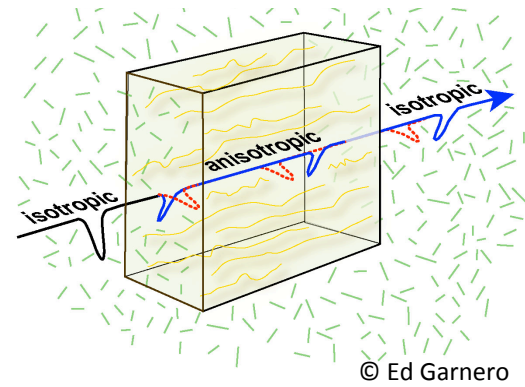
- **Seismic methods**
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Seismic methods

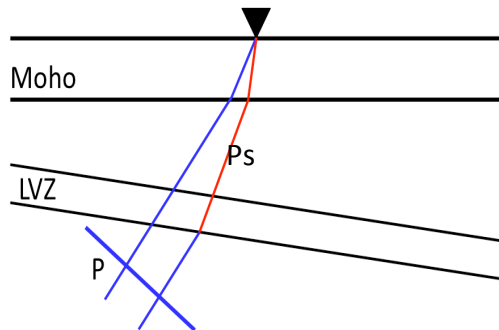
2D Teleseismic Migration



Shear-Wave Splitting



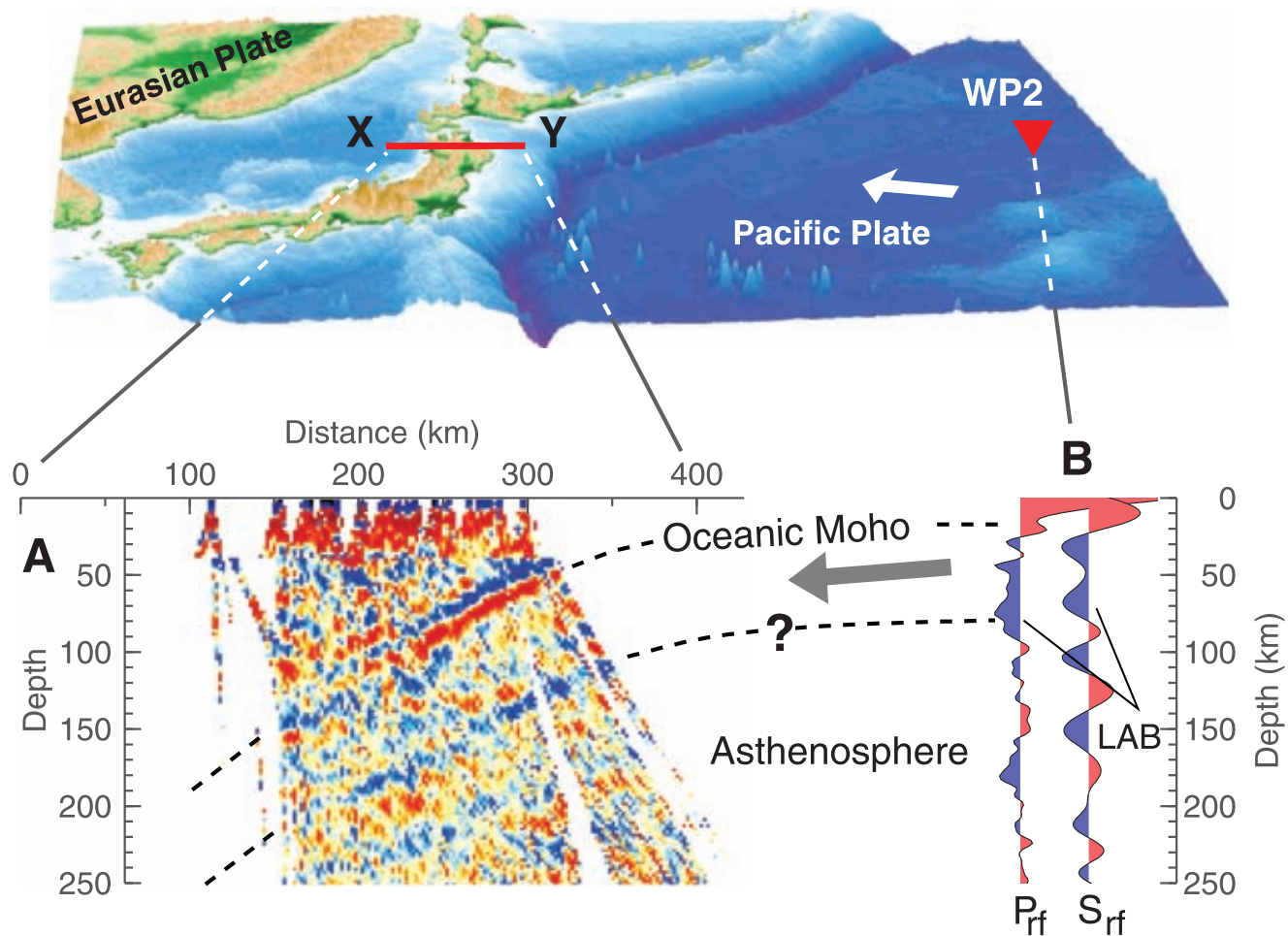
Receiver Functions



Outline

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

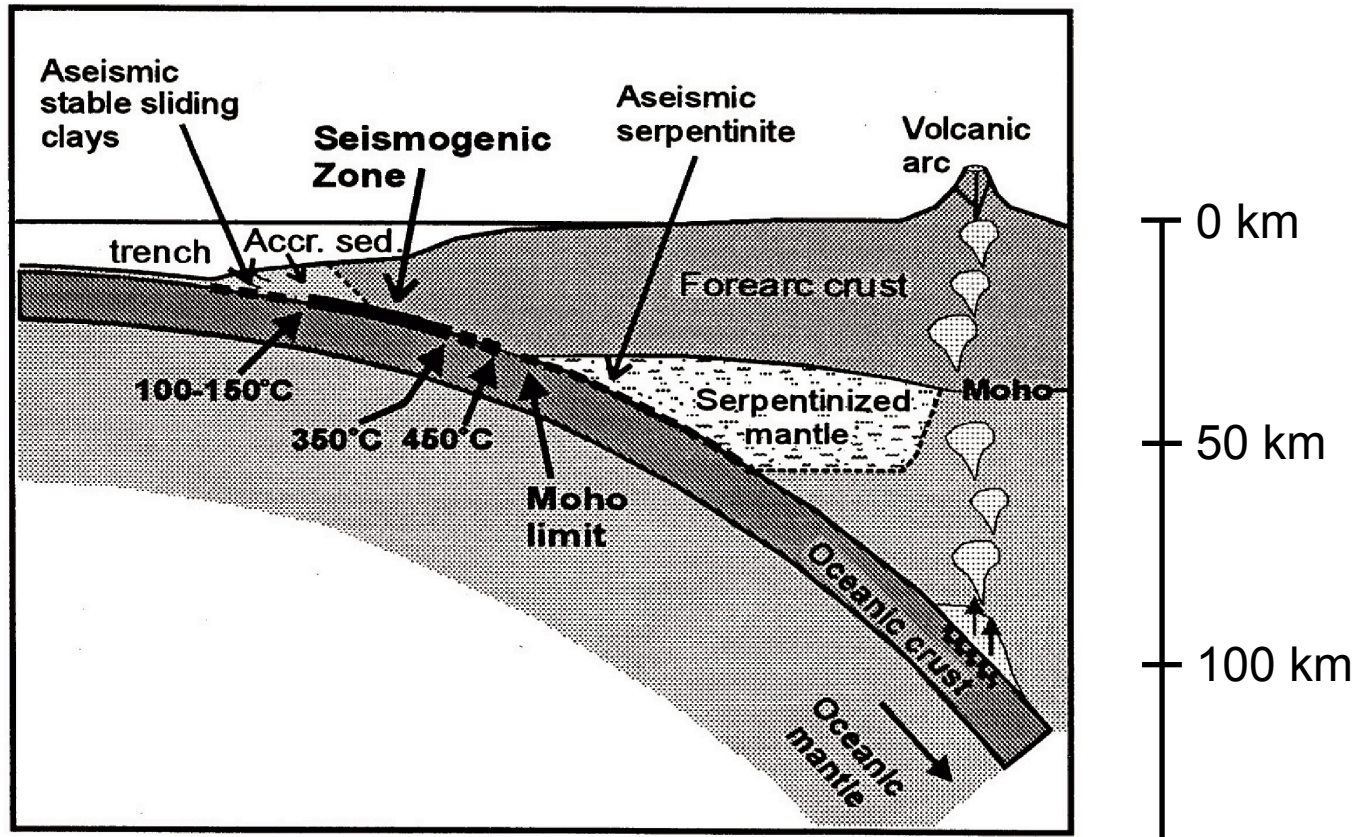
The LAB of the subducted slab



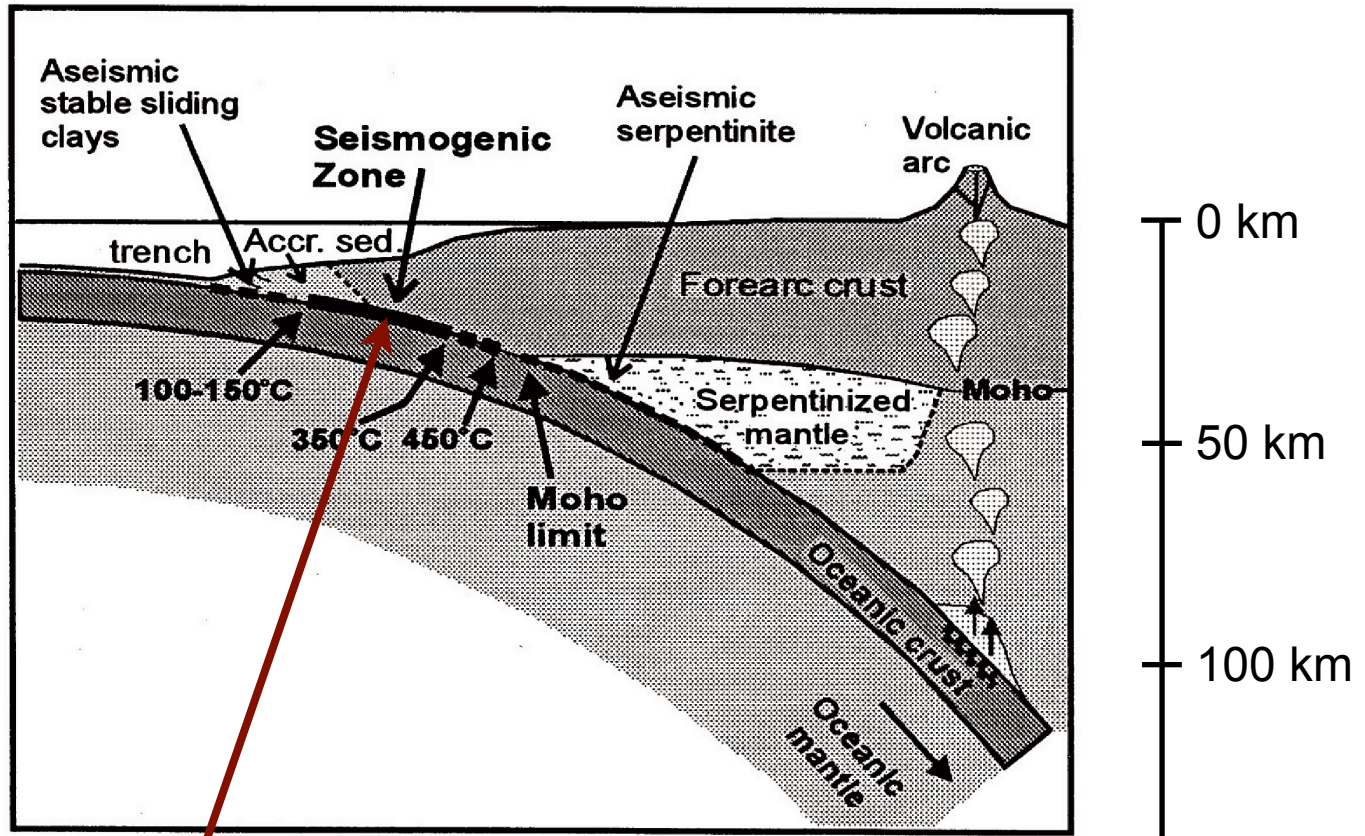
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- Seismic methods
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Where does the overriding LAB appear?

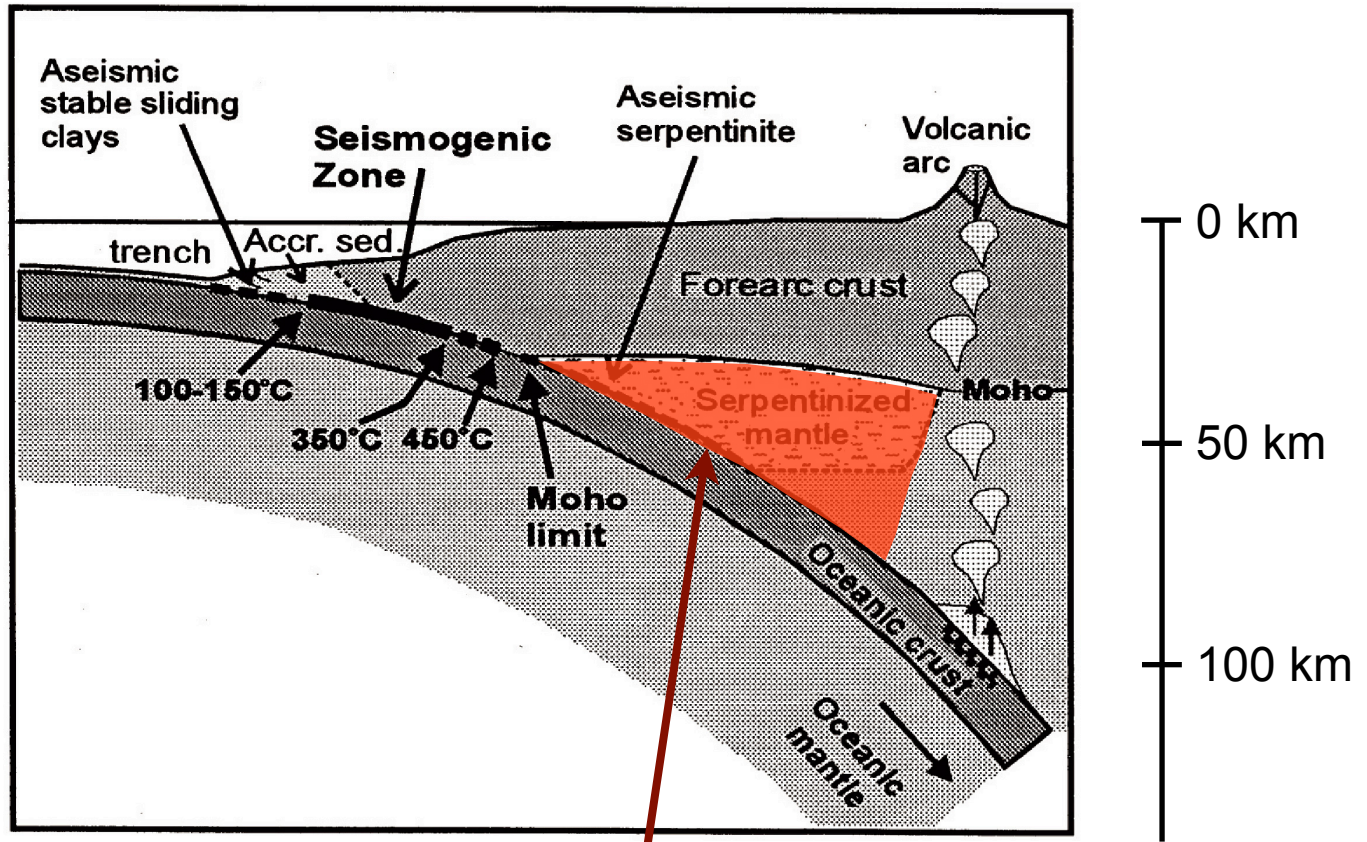


Where does the overriding LAB appear?



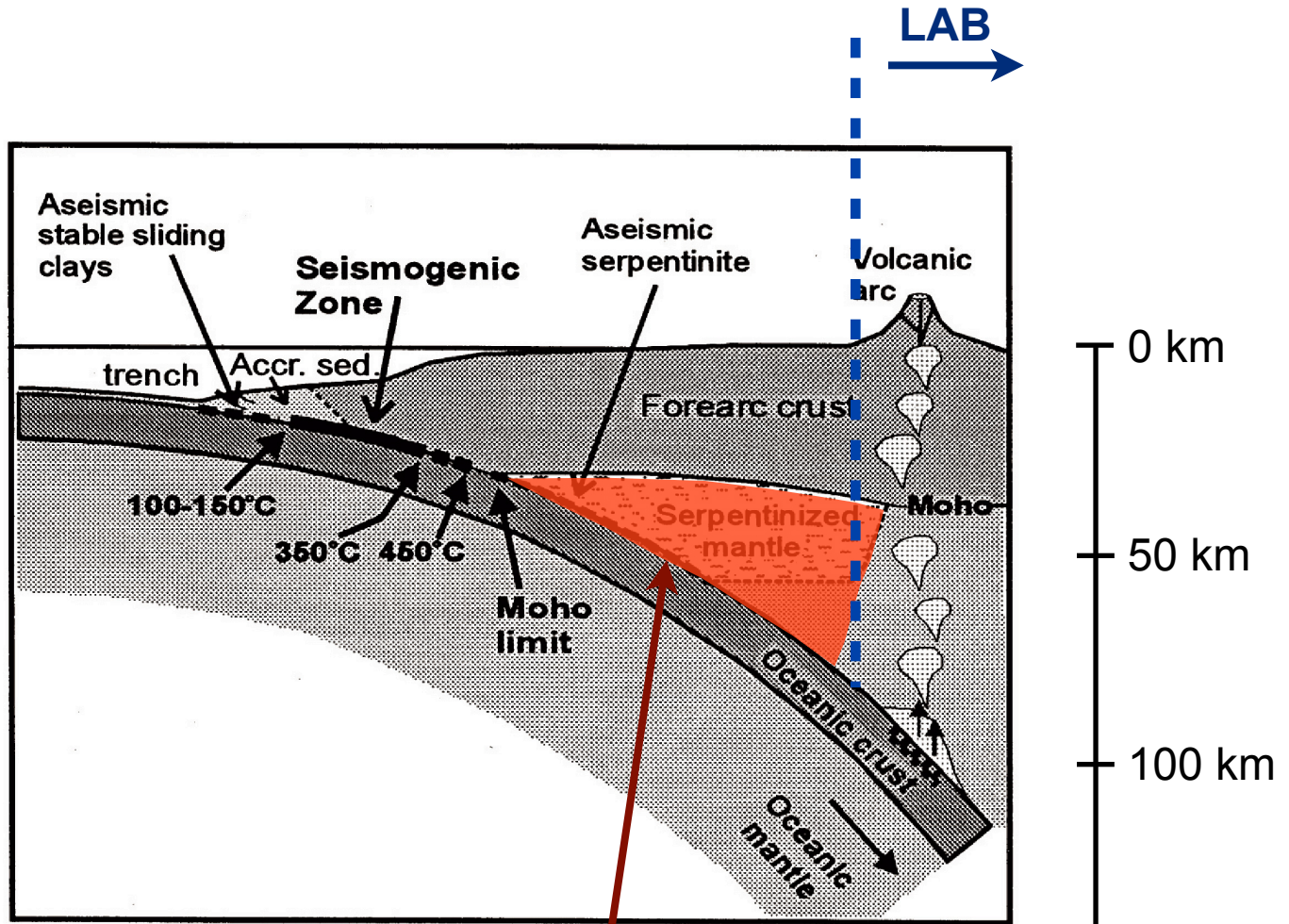
**Crust on crust =
no overriding LAB**

Where does the overriding LAB appear?



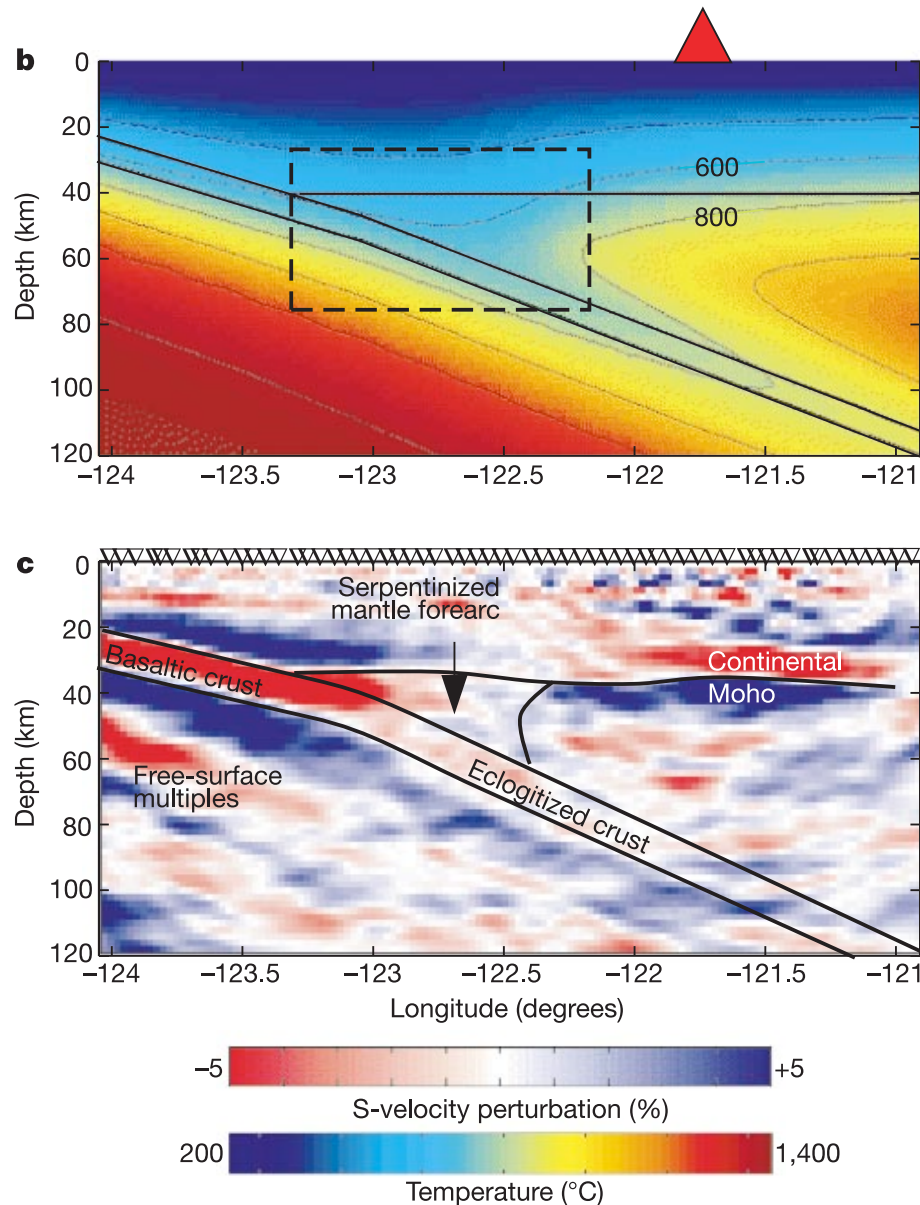
LAB killer!

Where does the overriding LAB appear?



LAB killer!

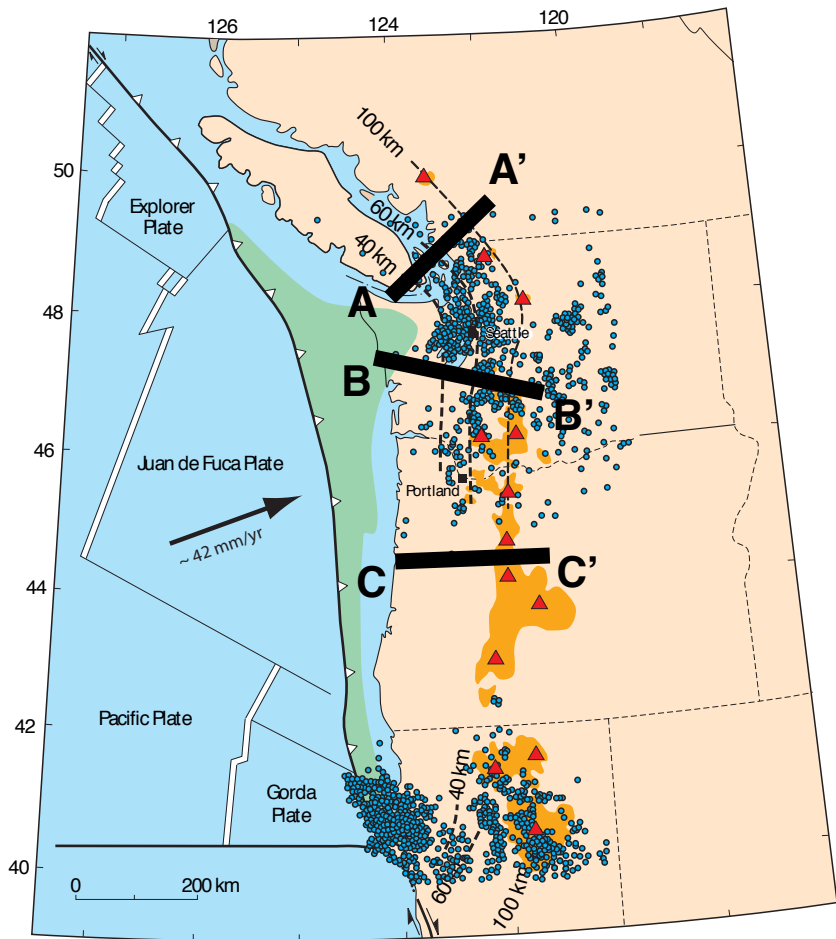
Where does the overriding LAB appear?



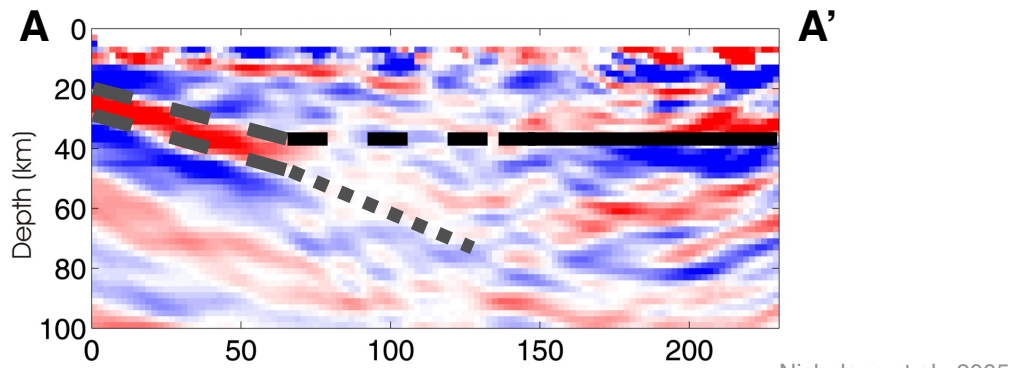
Rondenay et al., 2001

Bostock et al., 2002

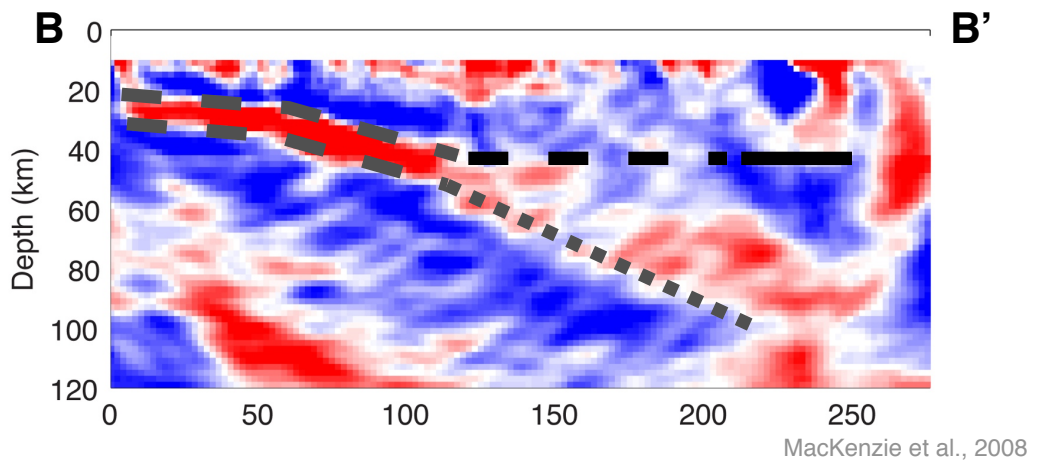
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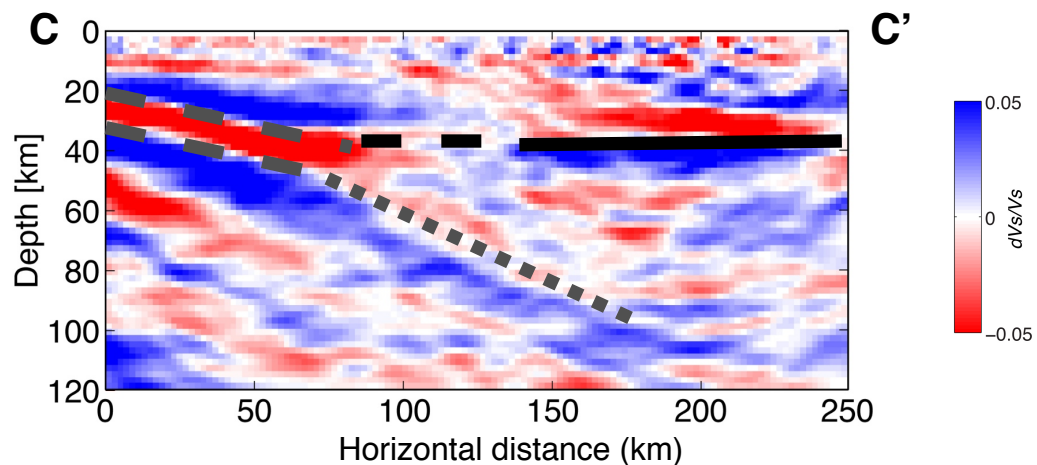
Romanyuk et al., 1998



Nicholson et al., 2005

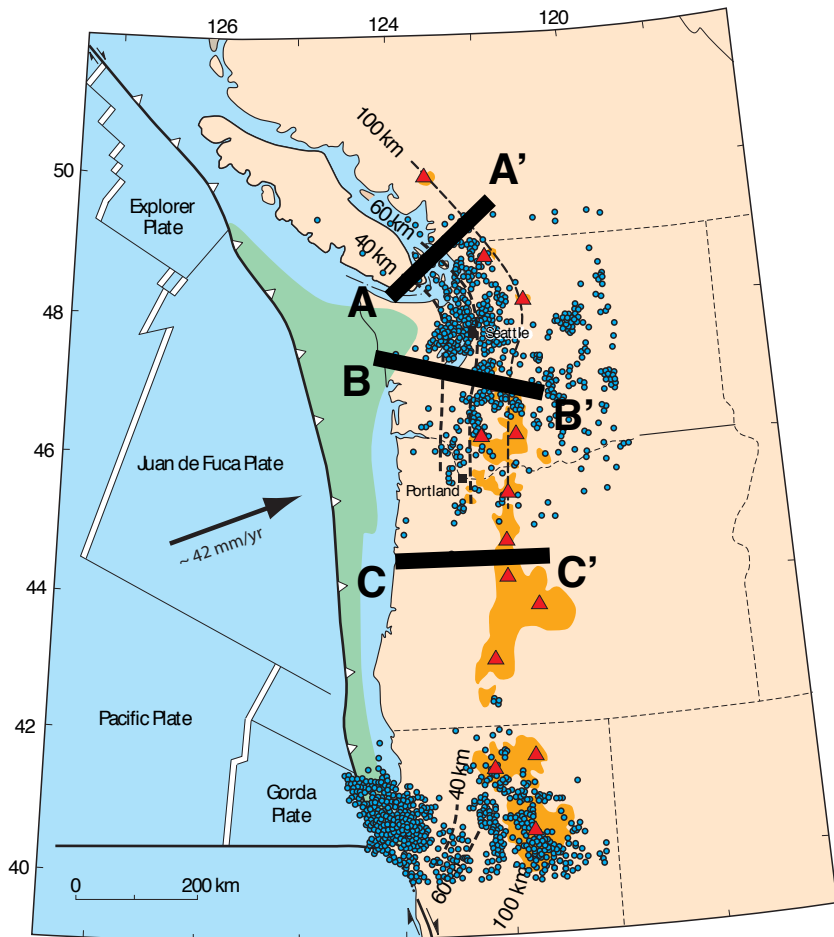


MacKenzie et al., 2008

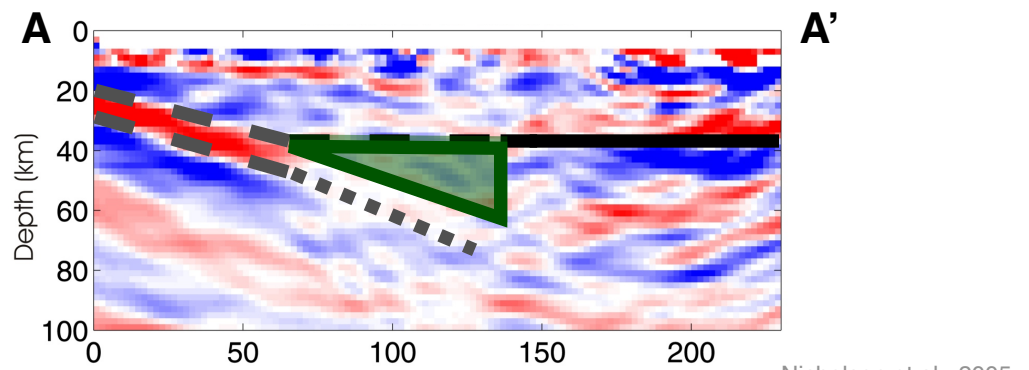


Rondenay et al., 2001

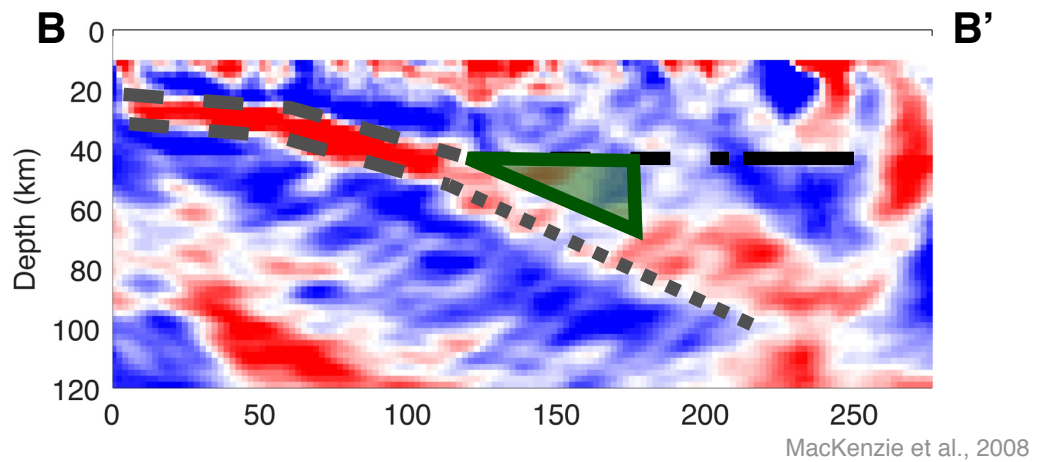
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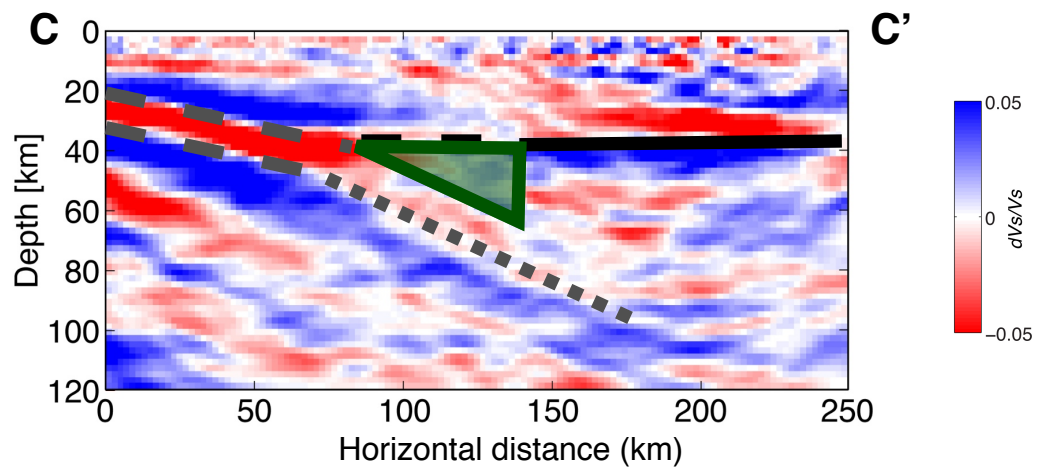
Romanyuk et al., 1998



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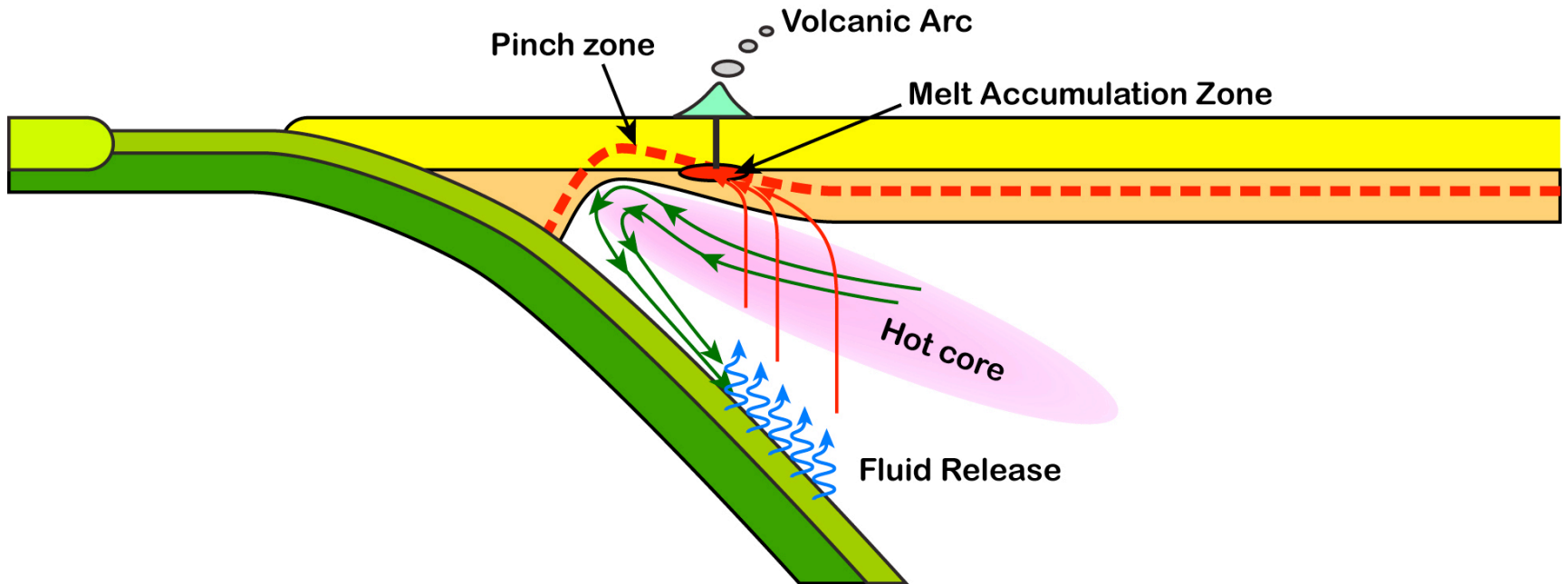


MacKenzie et al., 2008

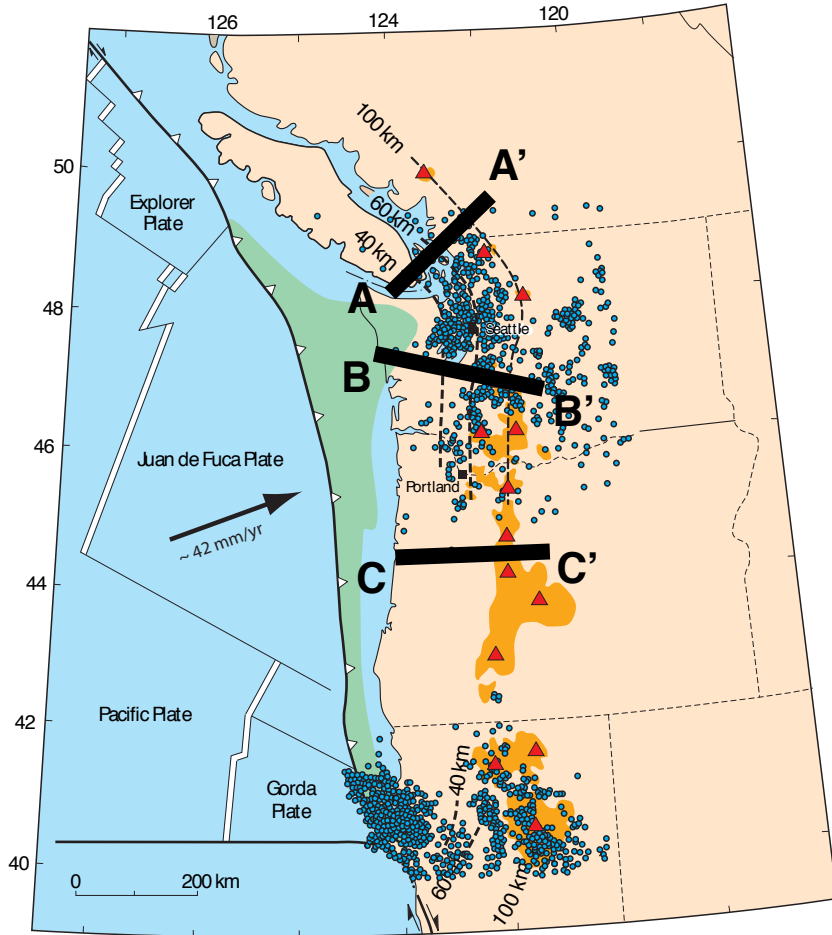


Rondenay et al., 2001

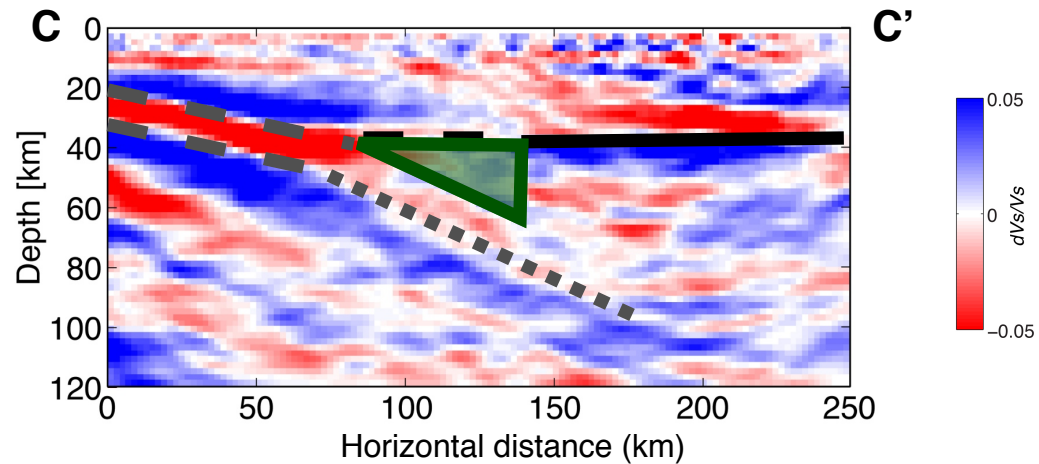
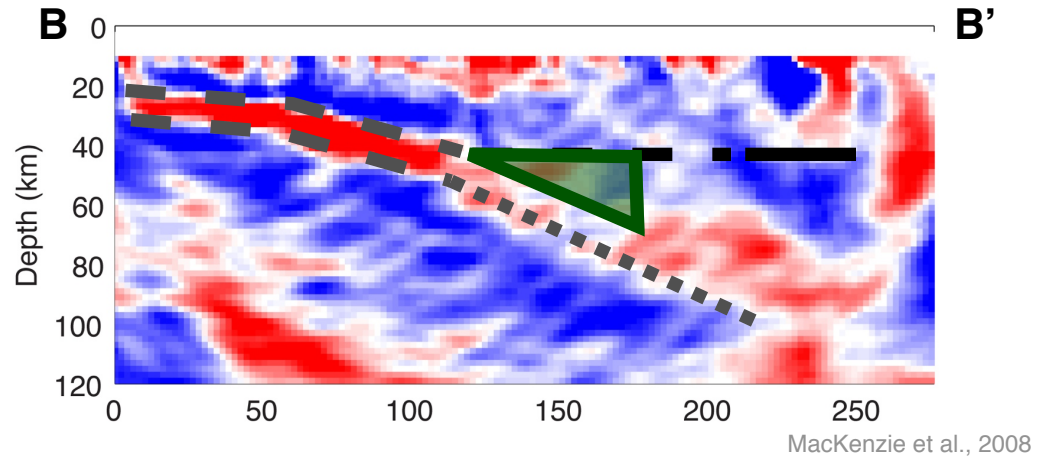
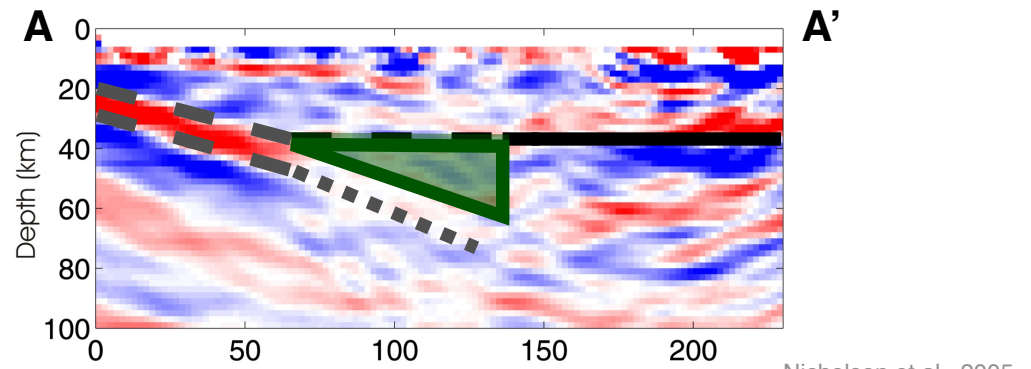
But do we see the LAB below the arc?



But do we see the LAB below the arc?

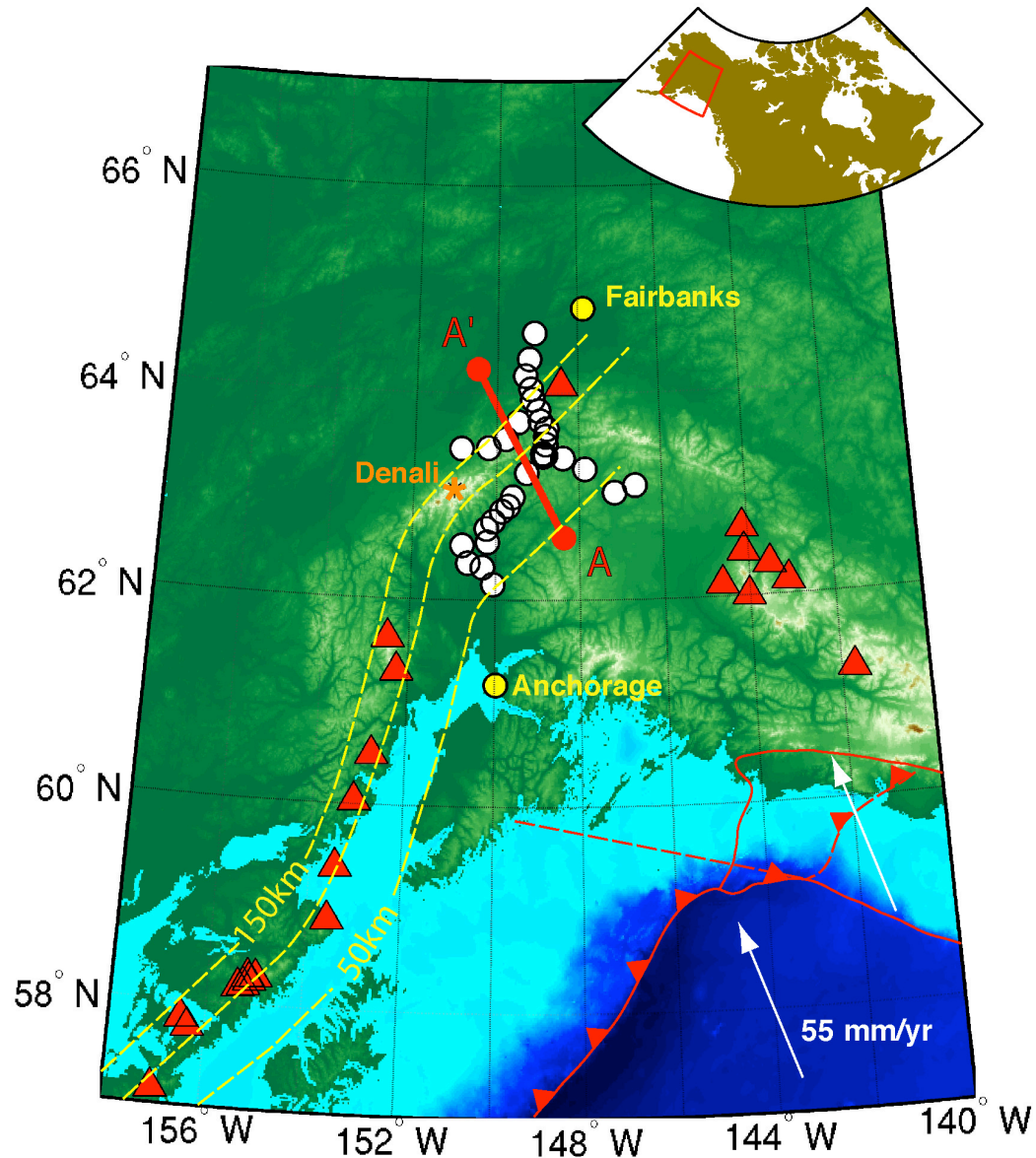


Romanyuk et al., 1998

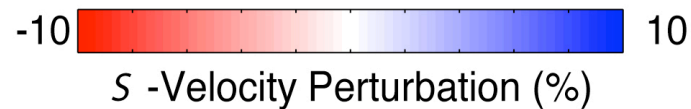
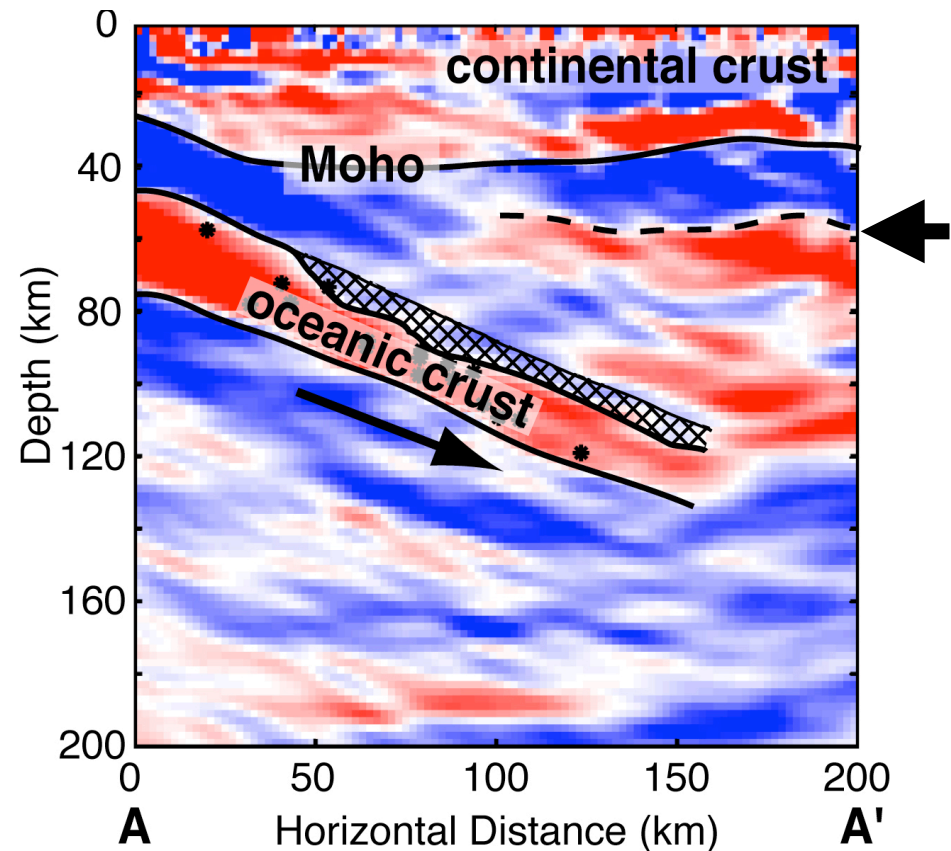
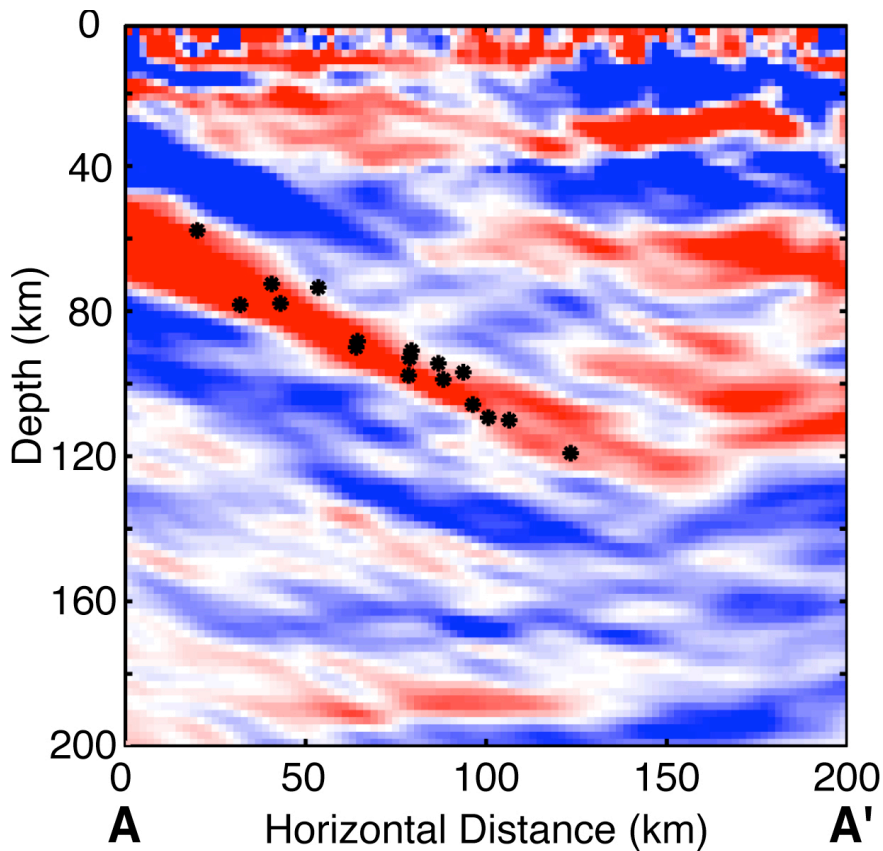


Rondenay et al., 2001

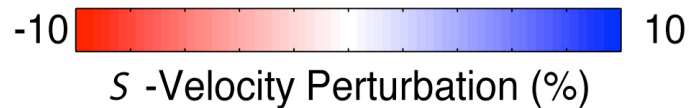
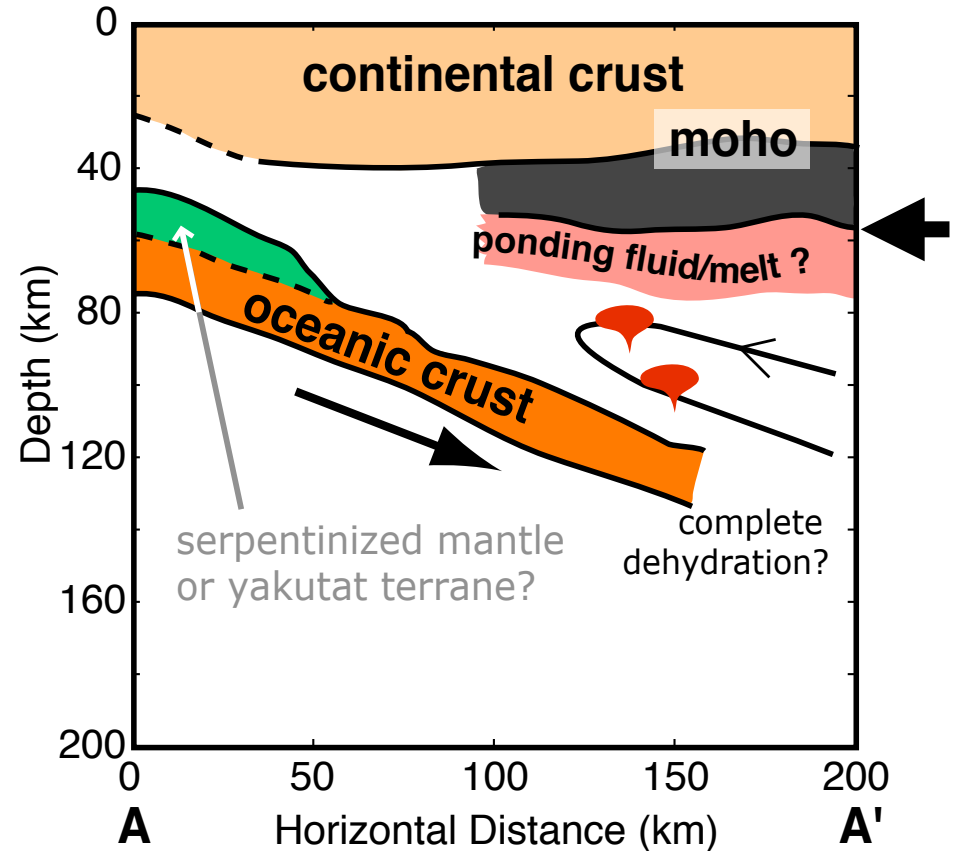
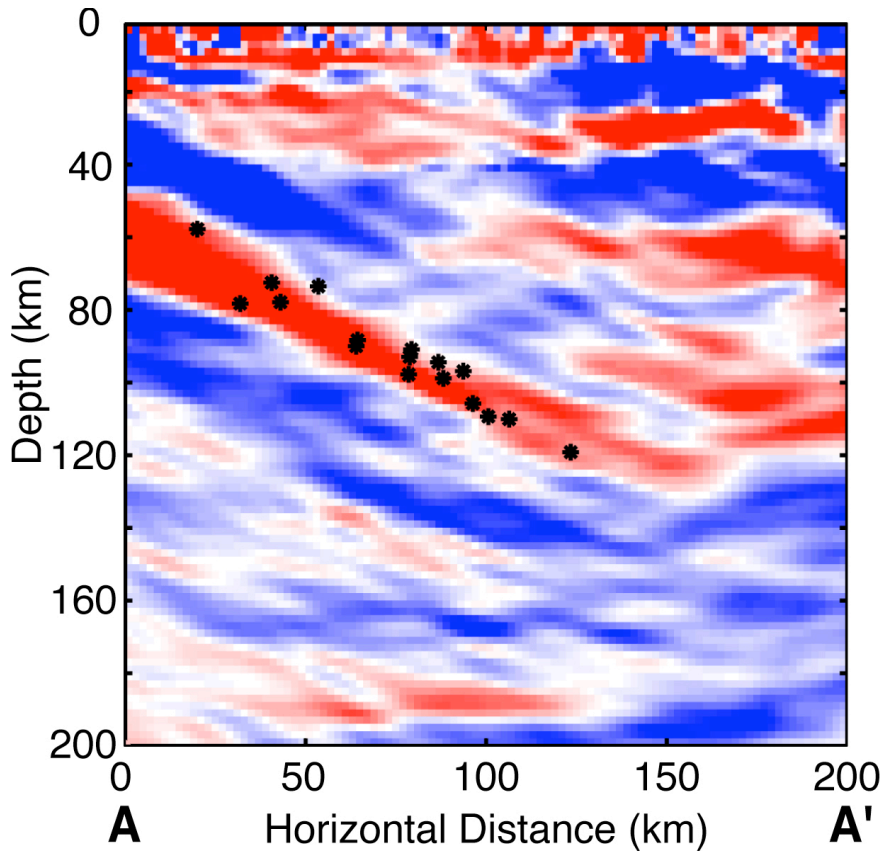
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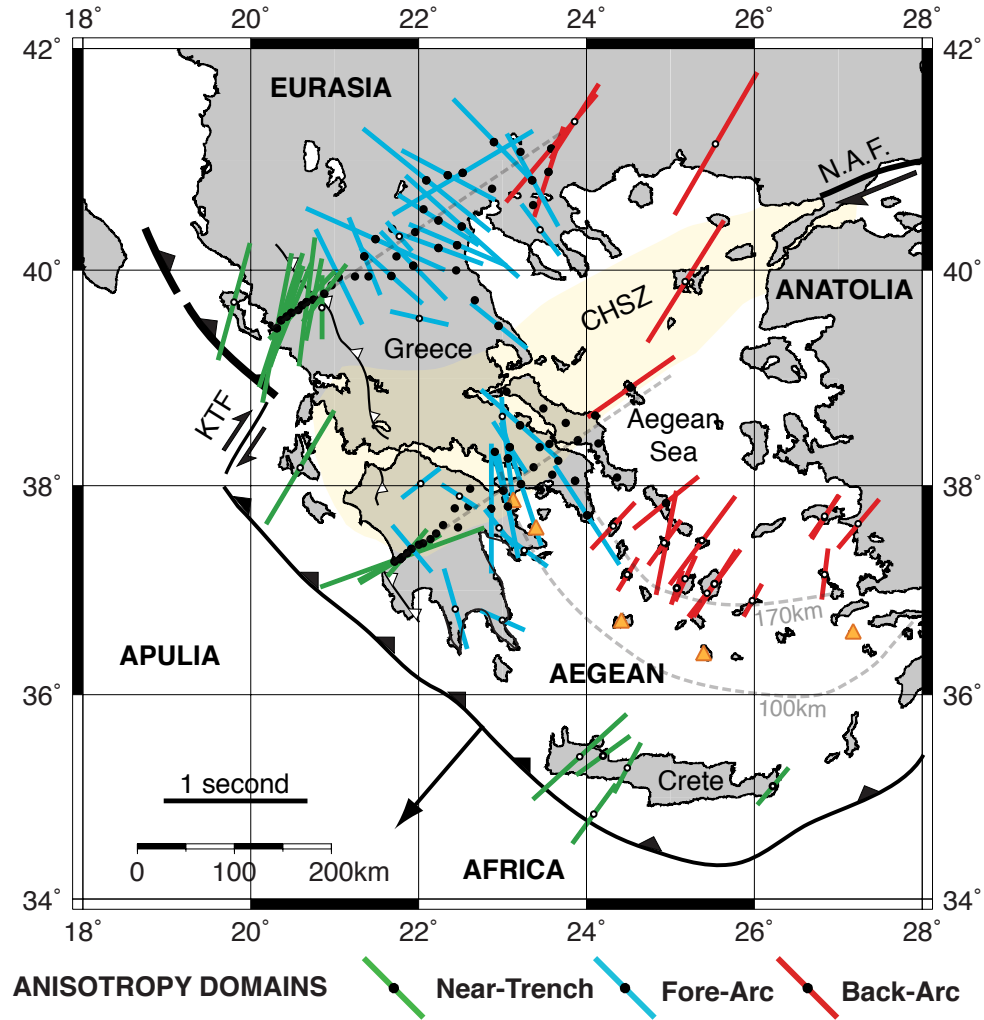
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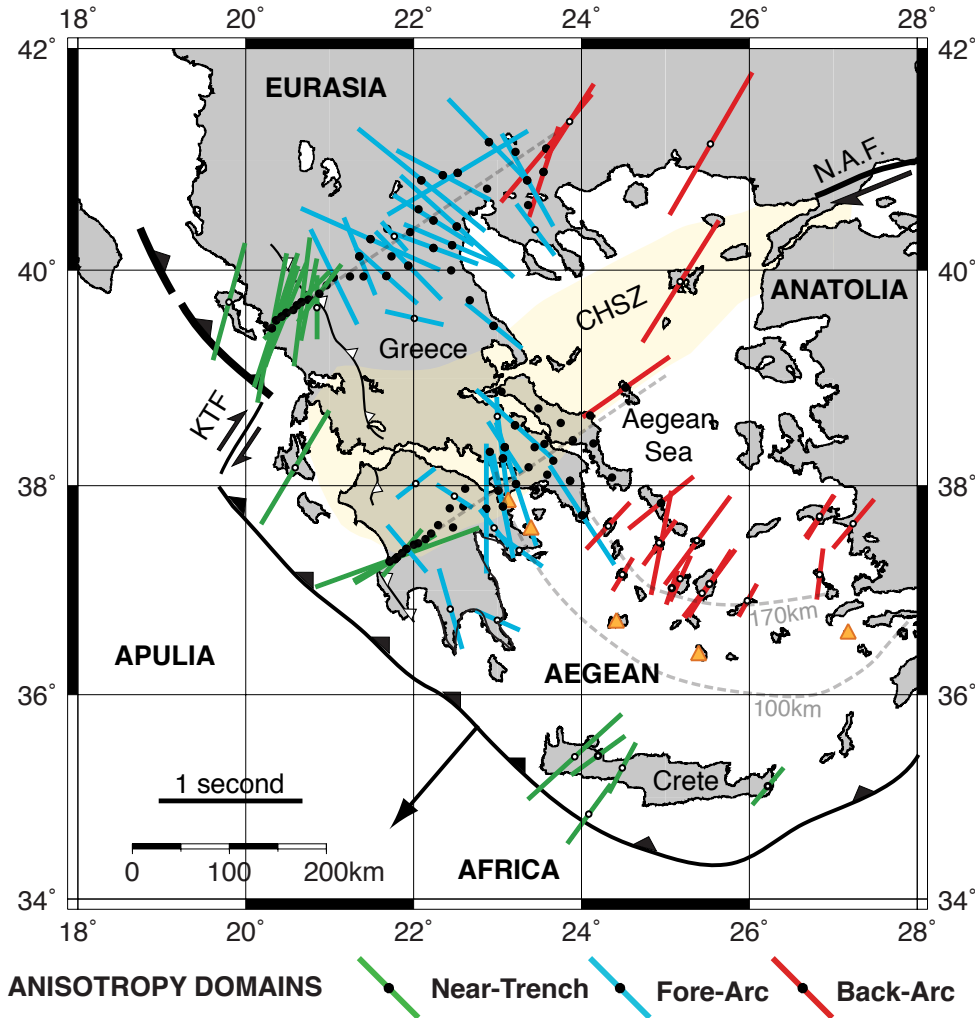
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LAB and mantle flow

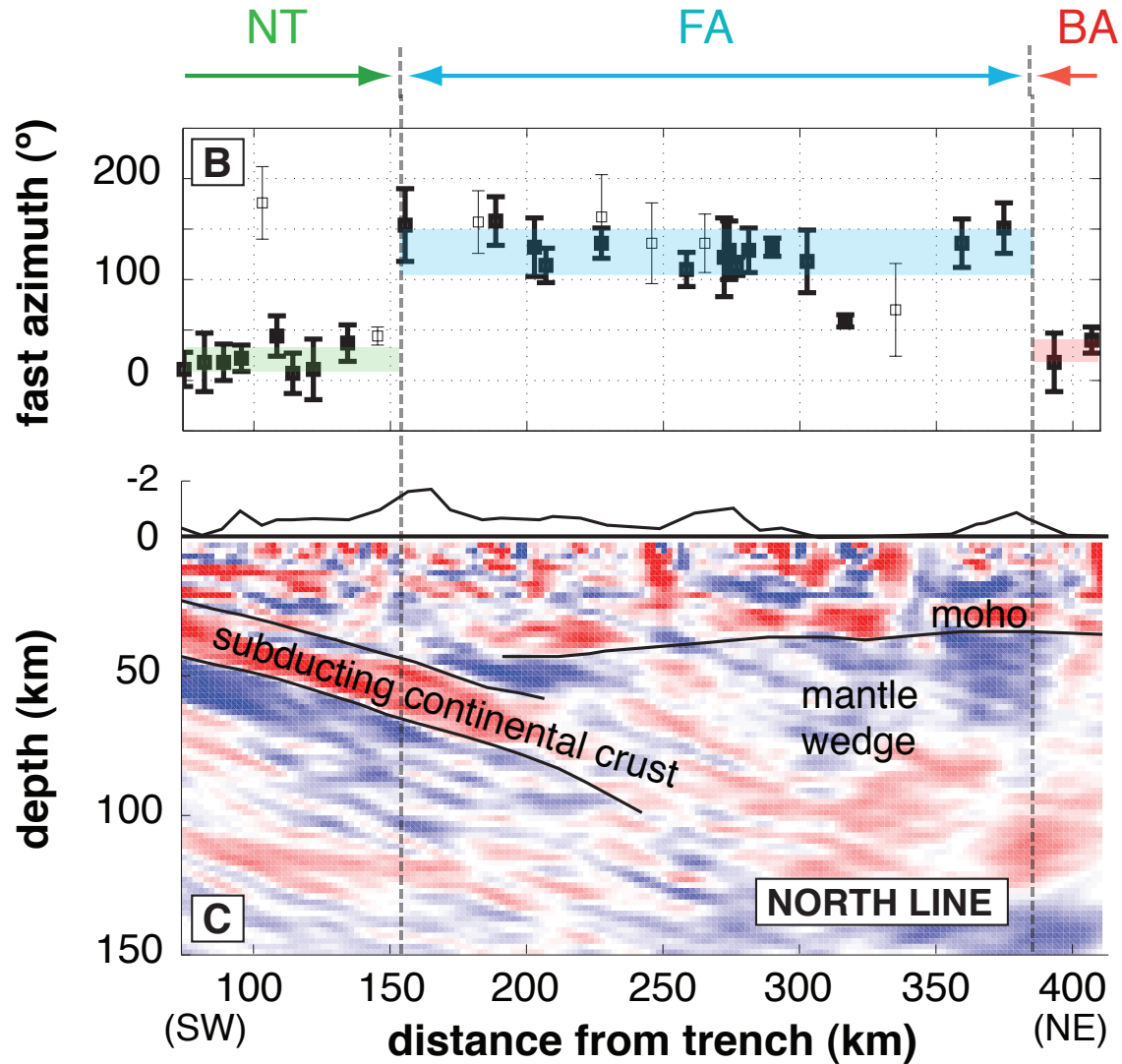


LAB and mantle flow

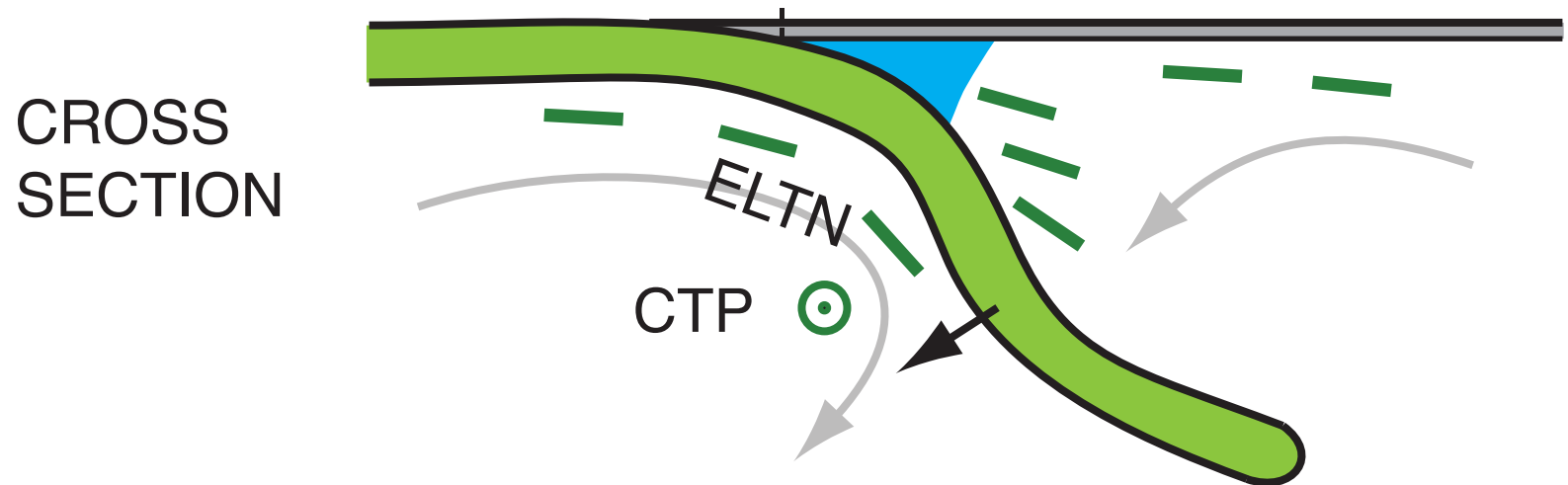


Don't categorize me: I am neither just a 'trench parallel' nor just a 'trench normal' anisotropy subduction zone, I am much more complex and intriguing!

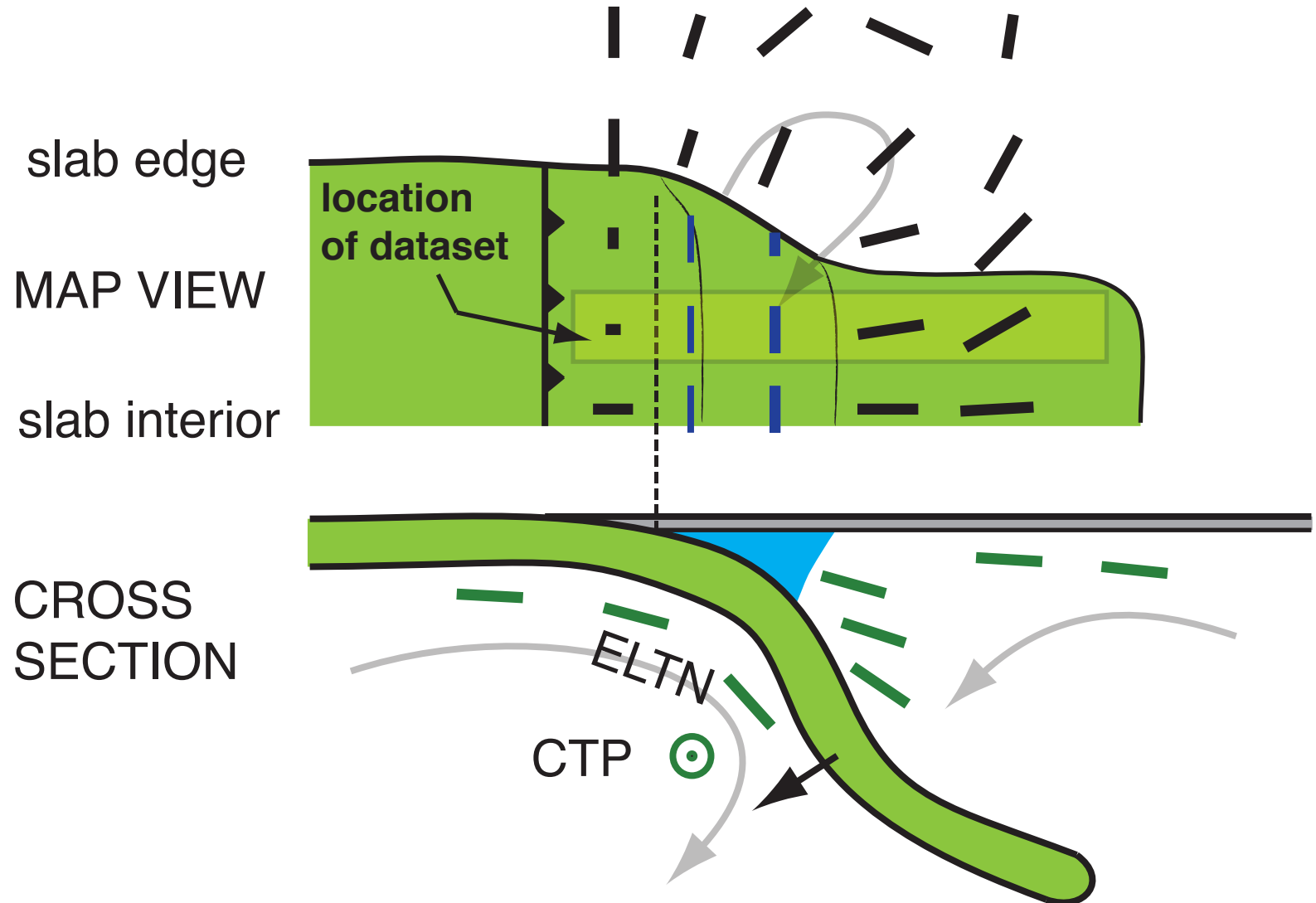
LAB and mantle flow



LAB and mantle flow



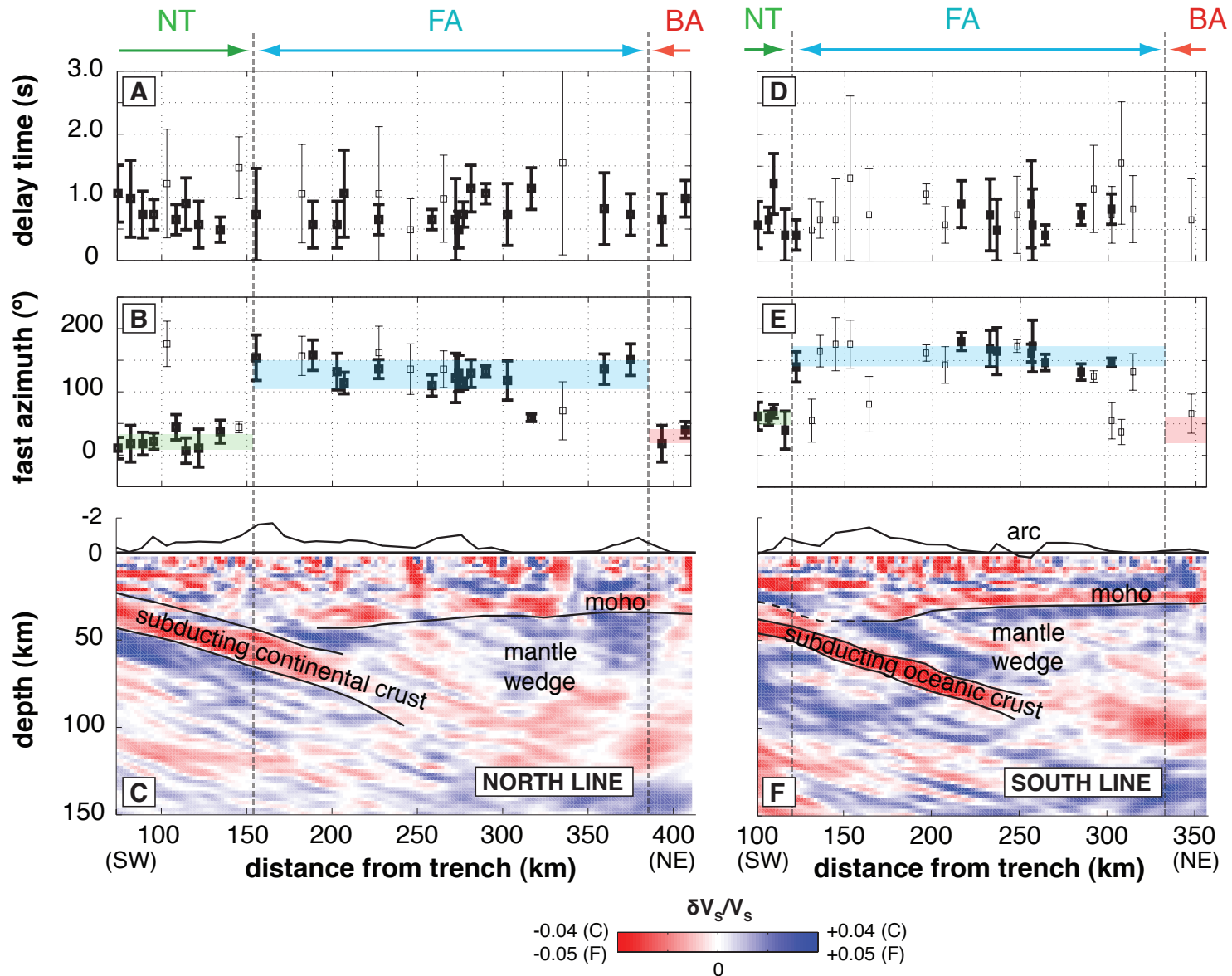
LAB and mantle flow



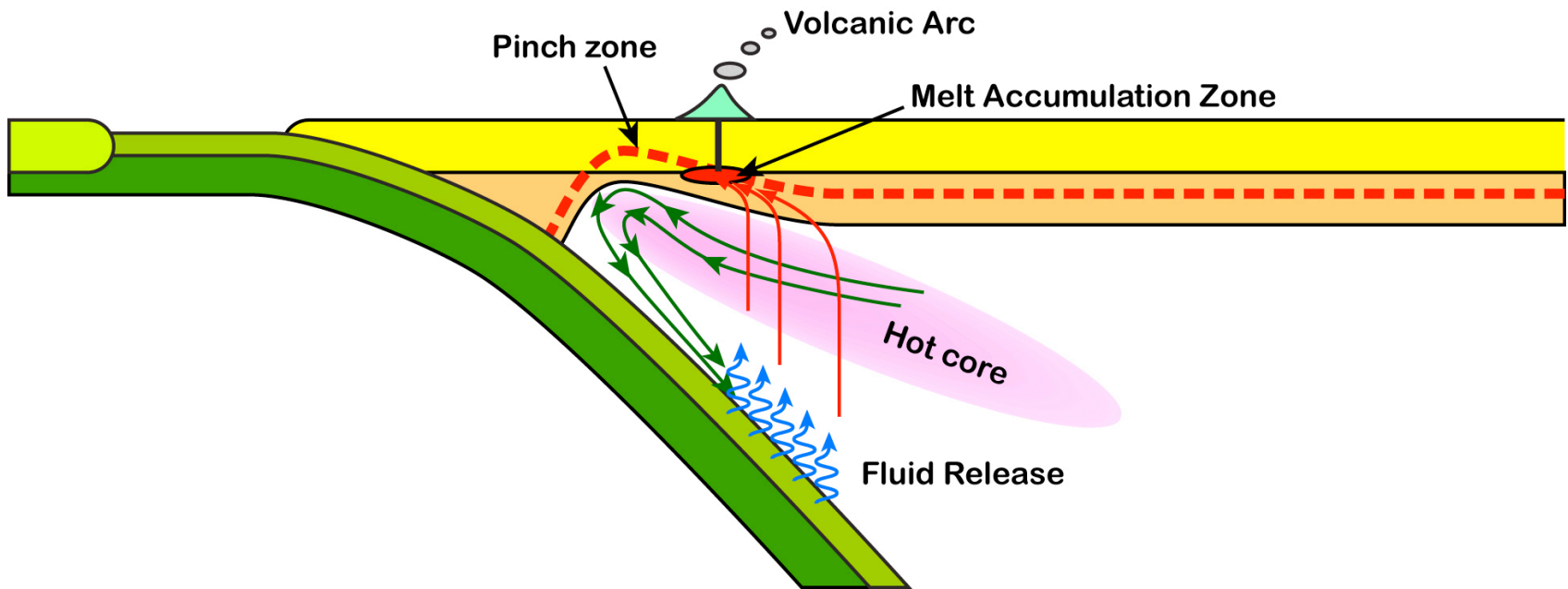
Concluding remarks and outlook

- 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)

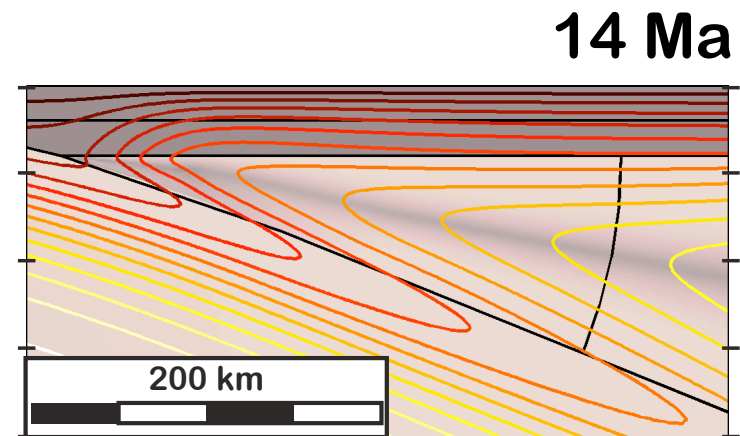
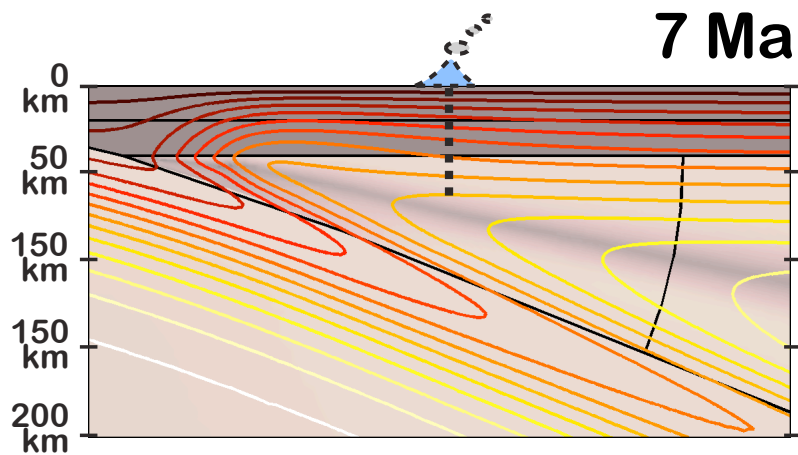
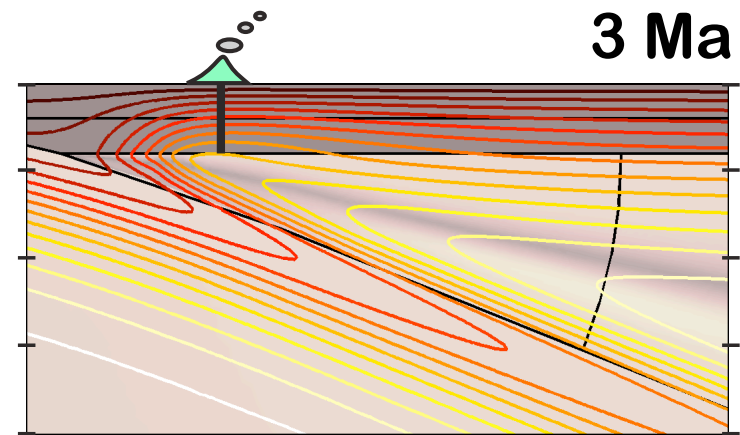
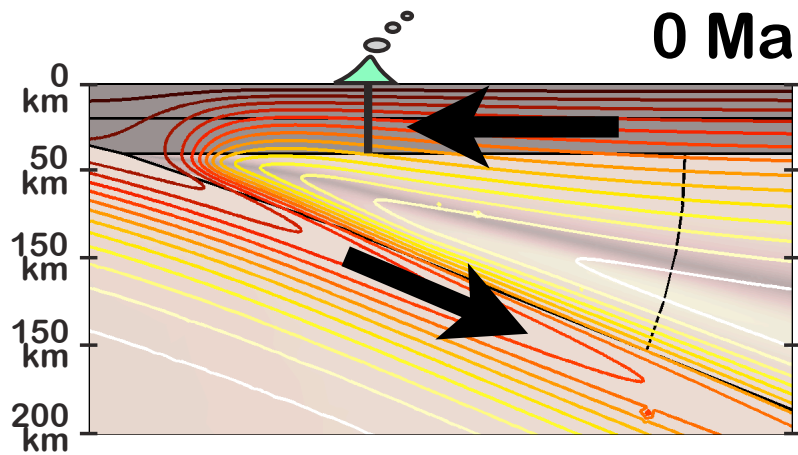
LAB and mantle flow



Thermal models: steady subduction

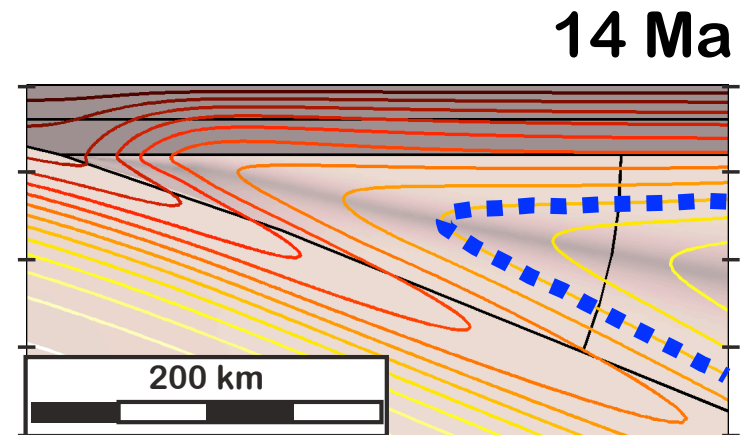
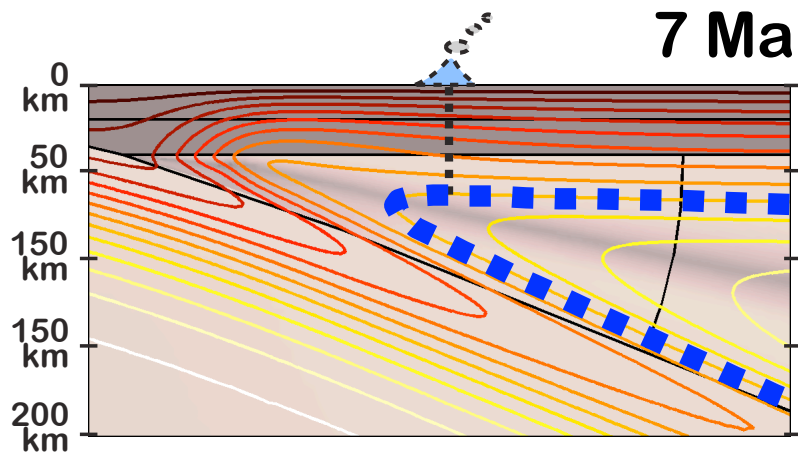
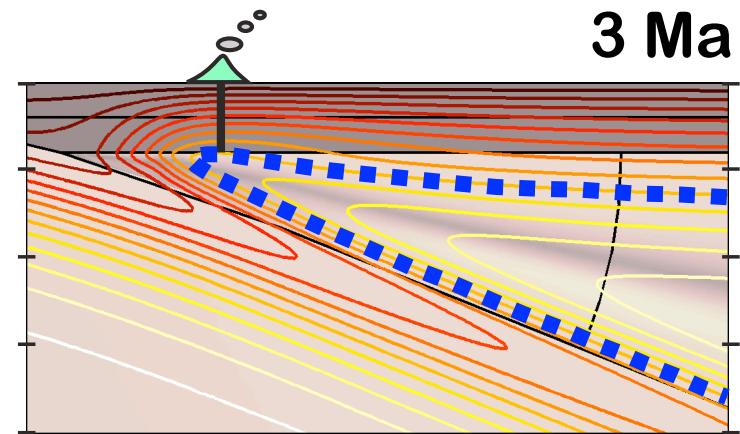
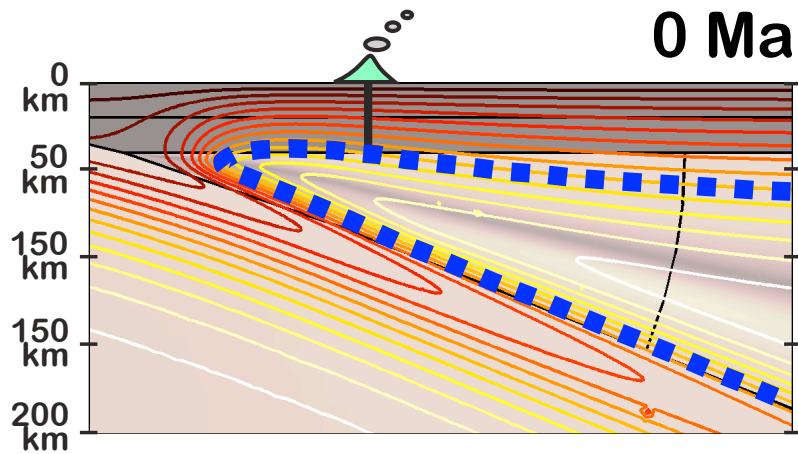


Thermal models: advancing slab



$$V_t/V_c=0.5$$

Thermal models: advancing slab



$$V_t/V_c=0.5$$

Thermal models: advancing slab

