Laramide-age growth of the Wyoming Craton

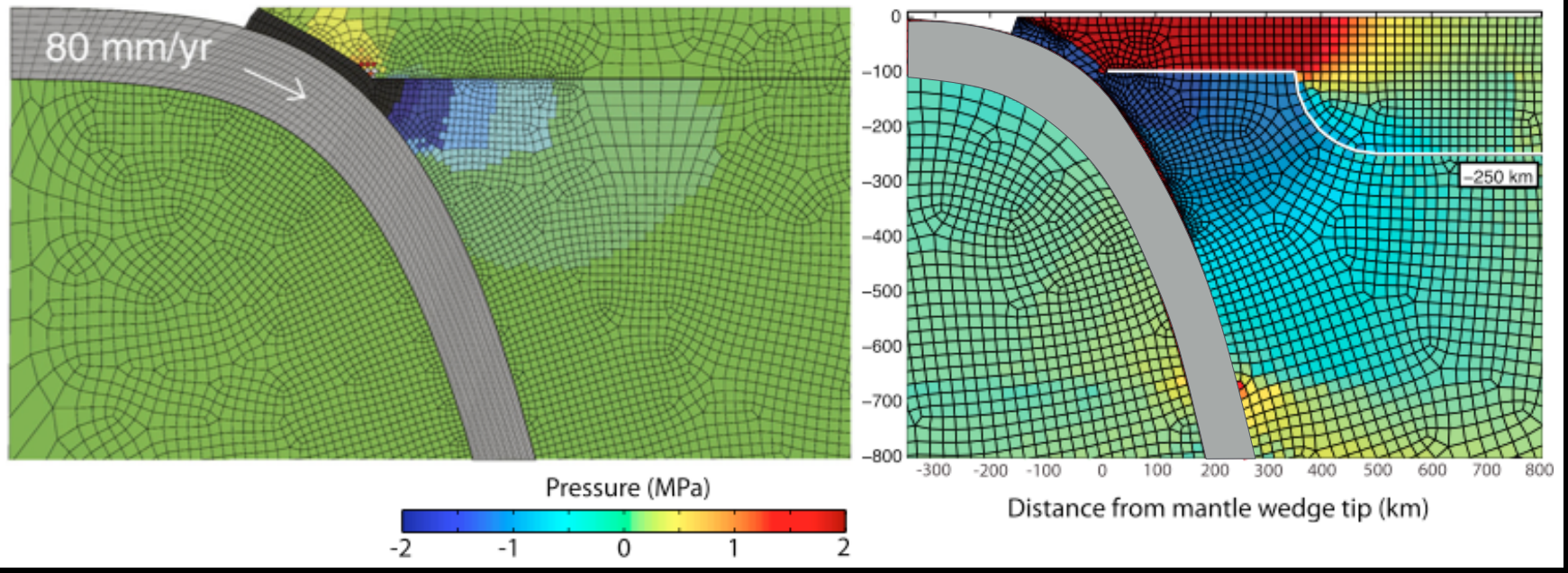
Gene Humphreys Brandon Schmandt Max Bezada

But first

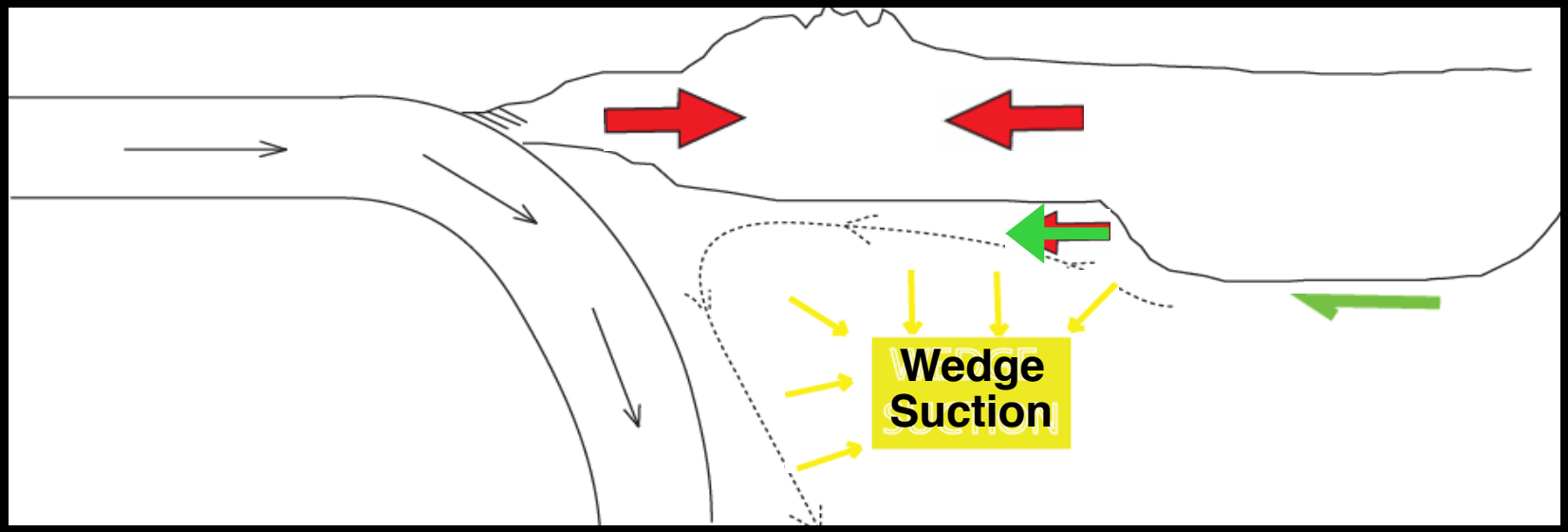
Two slides not related to my presentation

Root suck: The Influence of Cratonic Roots

O'Driscoll et al., 2009, 2012



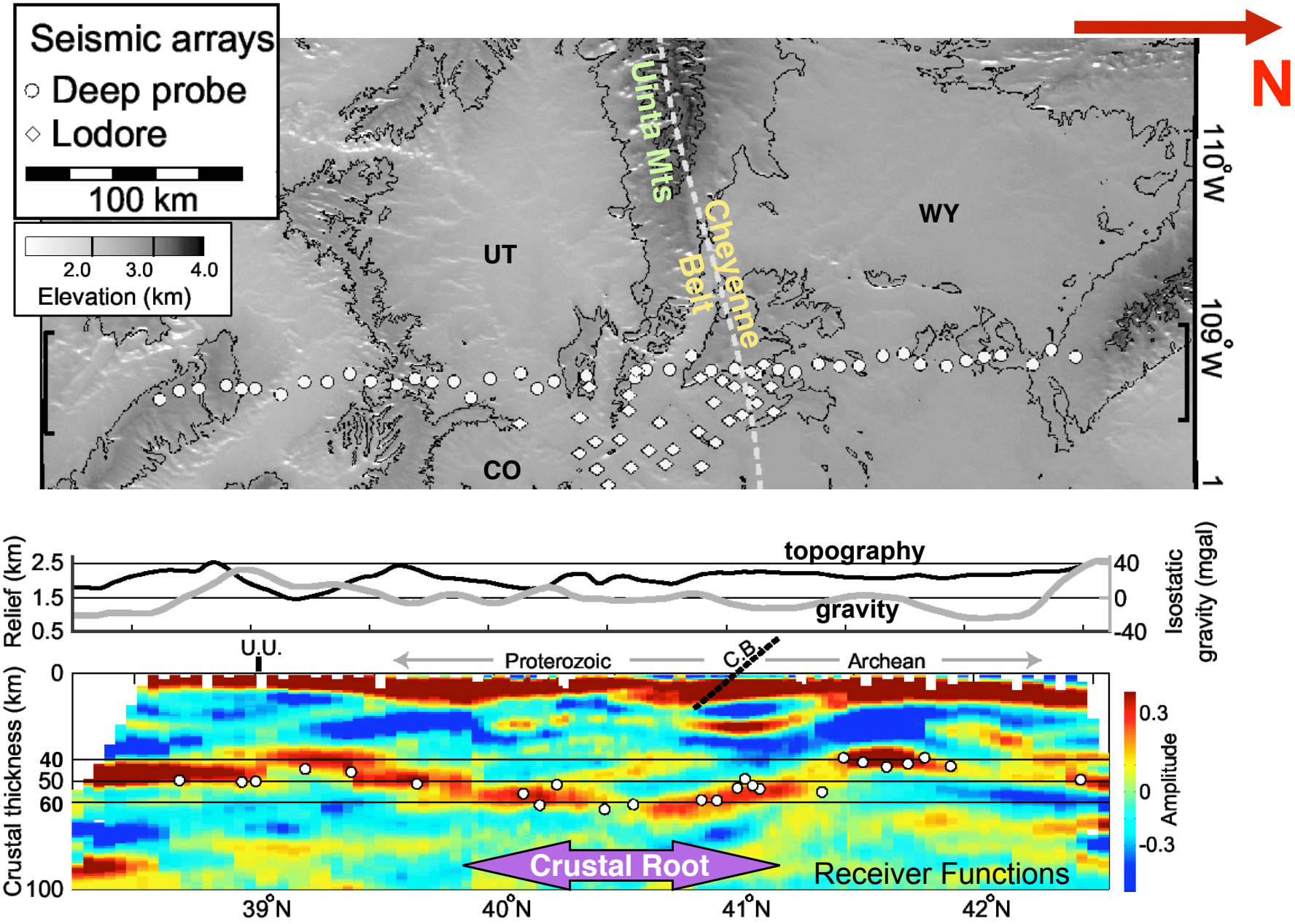
Effects of Cratonic Root



- **Lifts slab**
- **Pulls continent to left**
- **Compresses continent**

Suction in mantle wedge pulls on slab and continent → Enhanced compression in continent & Enhanced basal traction drives continental motion

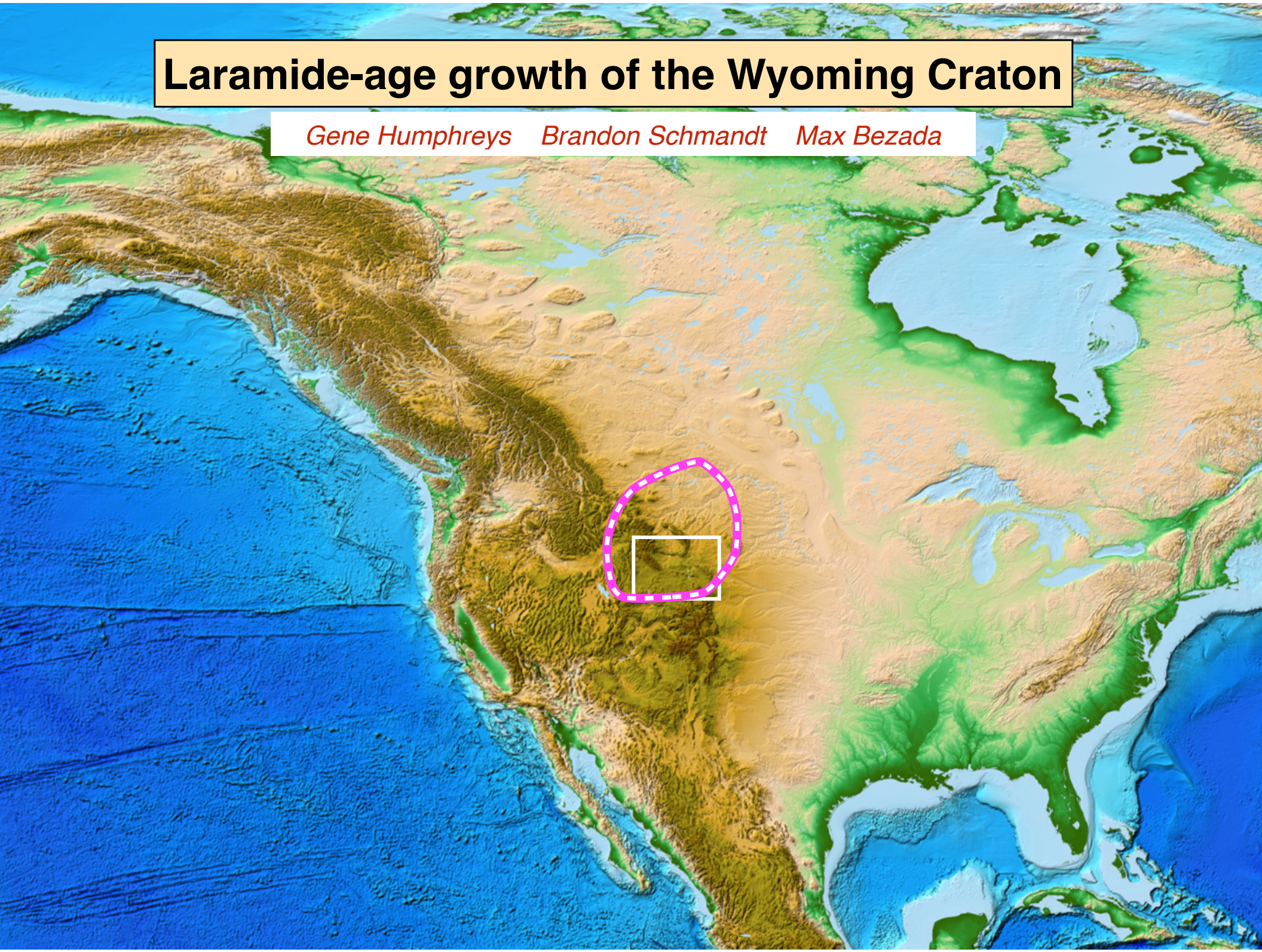
The Mountainless Root of the Cheyenne Belt



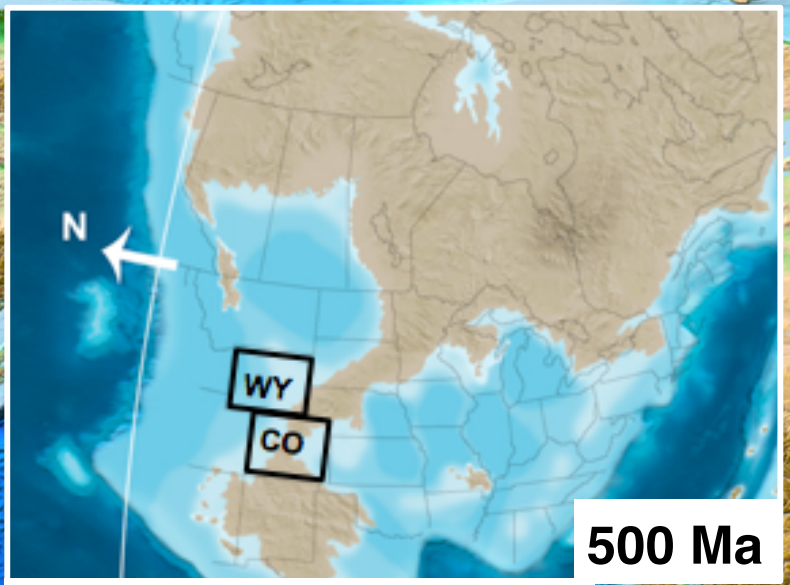
High density upper-most mantle (garnet rich?) is needed to hold crust down.

Laramide-age growth of the Wyoming Craton

Gene Humphreys *Brandon Schmandt* *Max Bezada*



Wyoming is recently elevated craton



Wyoming: near sea level for 100s of m.y.

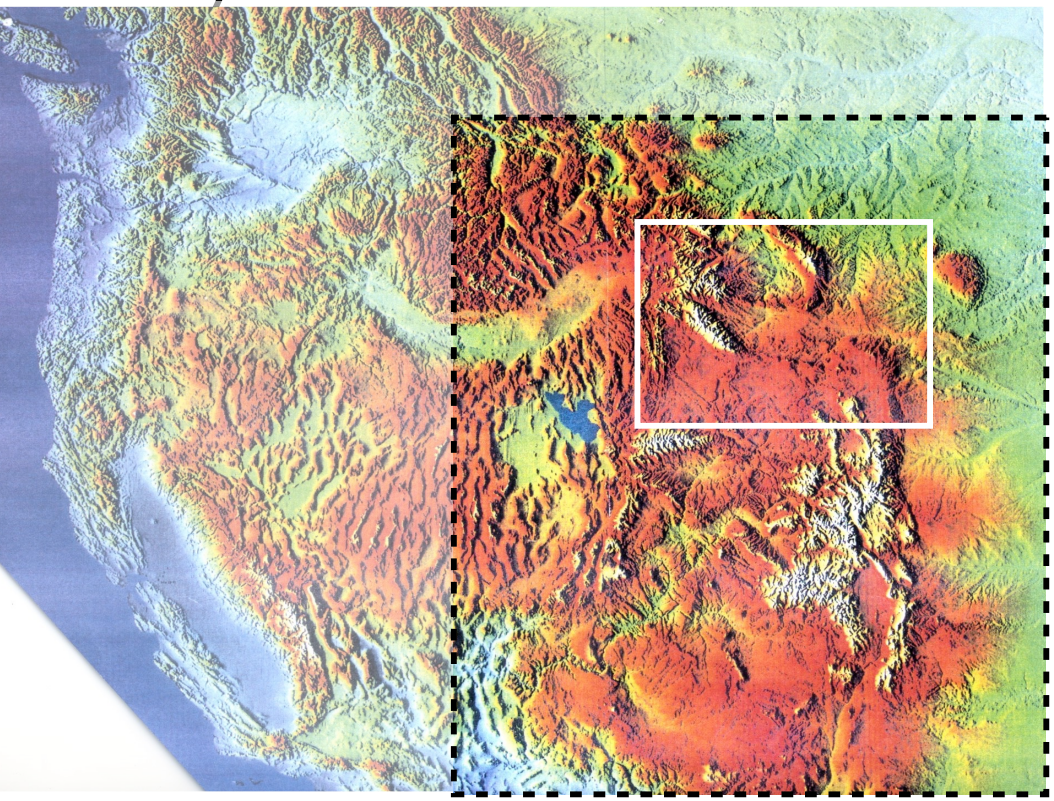
to get to the first of several problems with the WY craton

Now
Like all of the Rocky Mts
Wyoming elevated
~2 km since 80 Ma

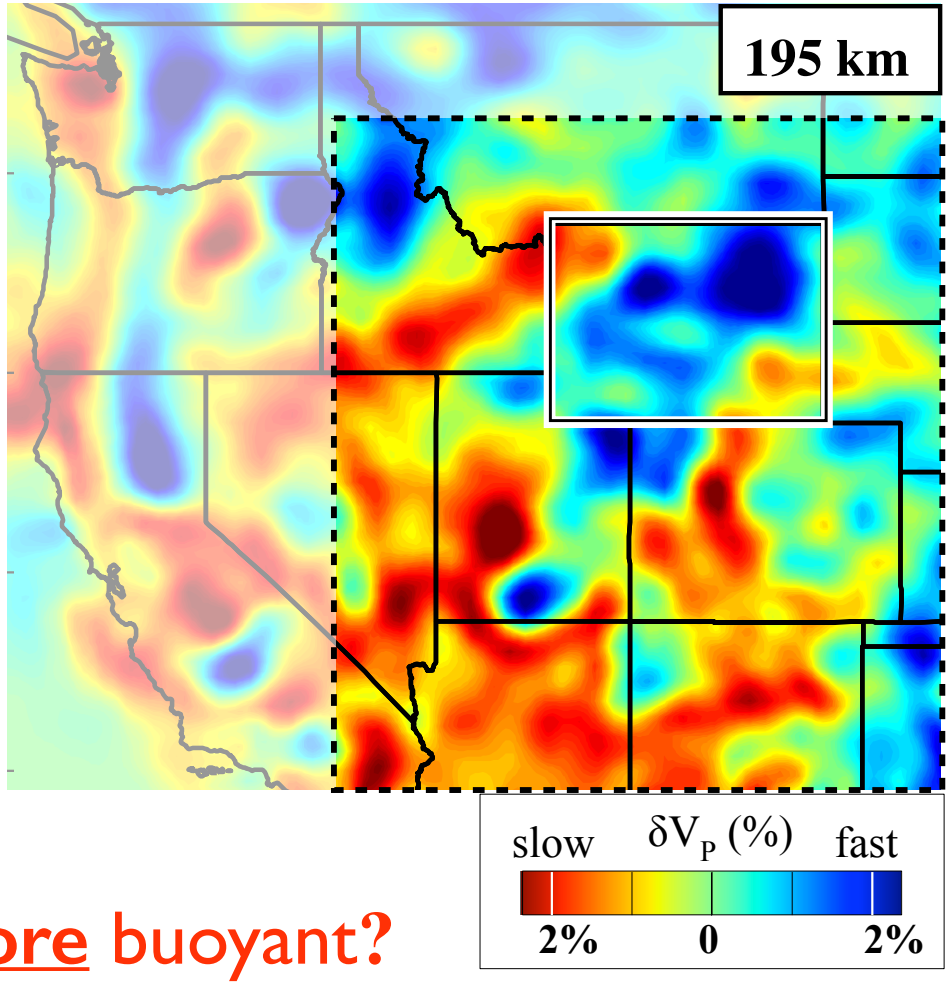
But…

Wyoming has cool mantle

Rocky Mts elevated since 80 Ma



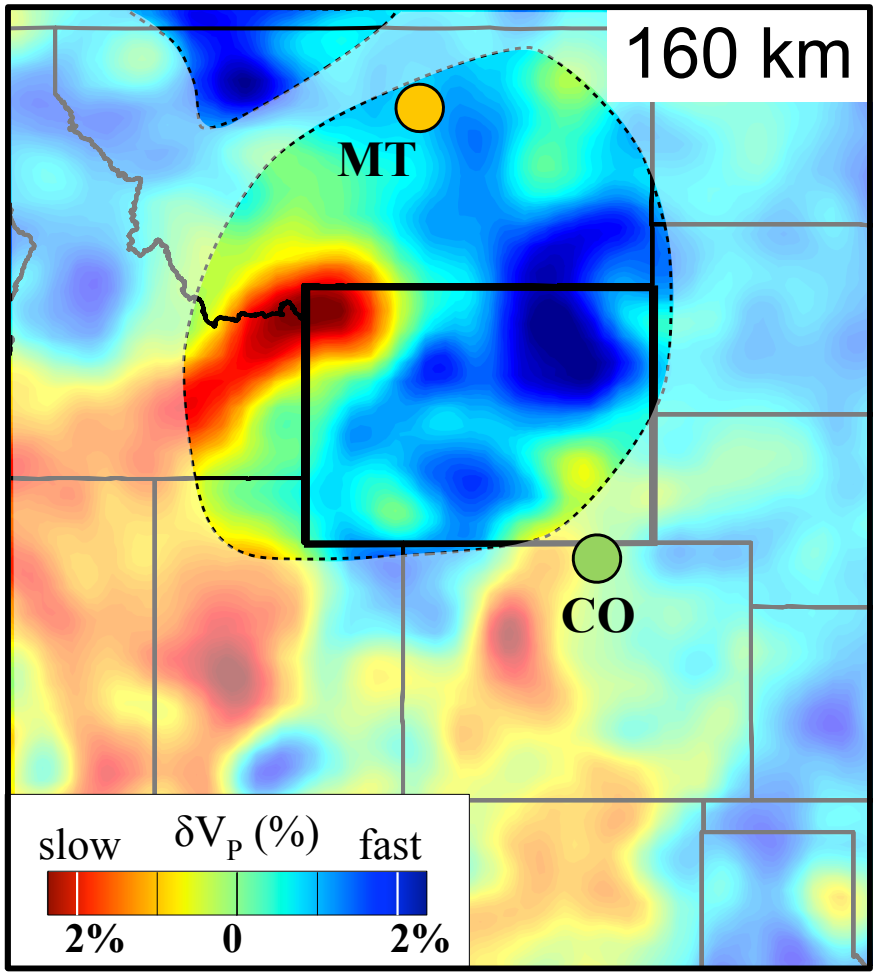
But, only Wyoming mantle is cool

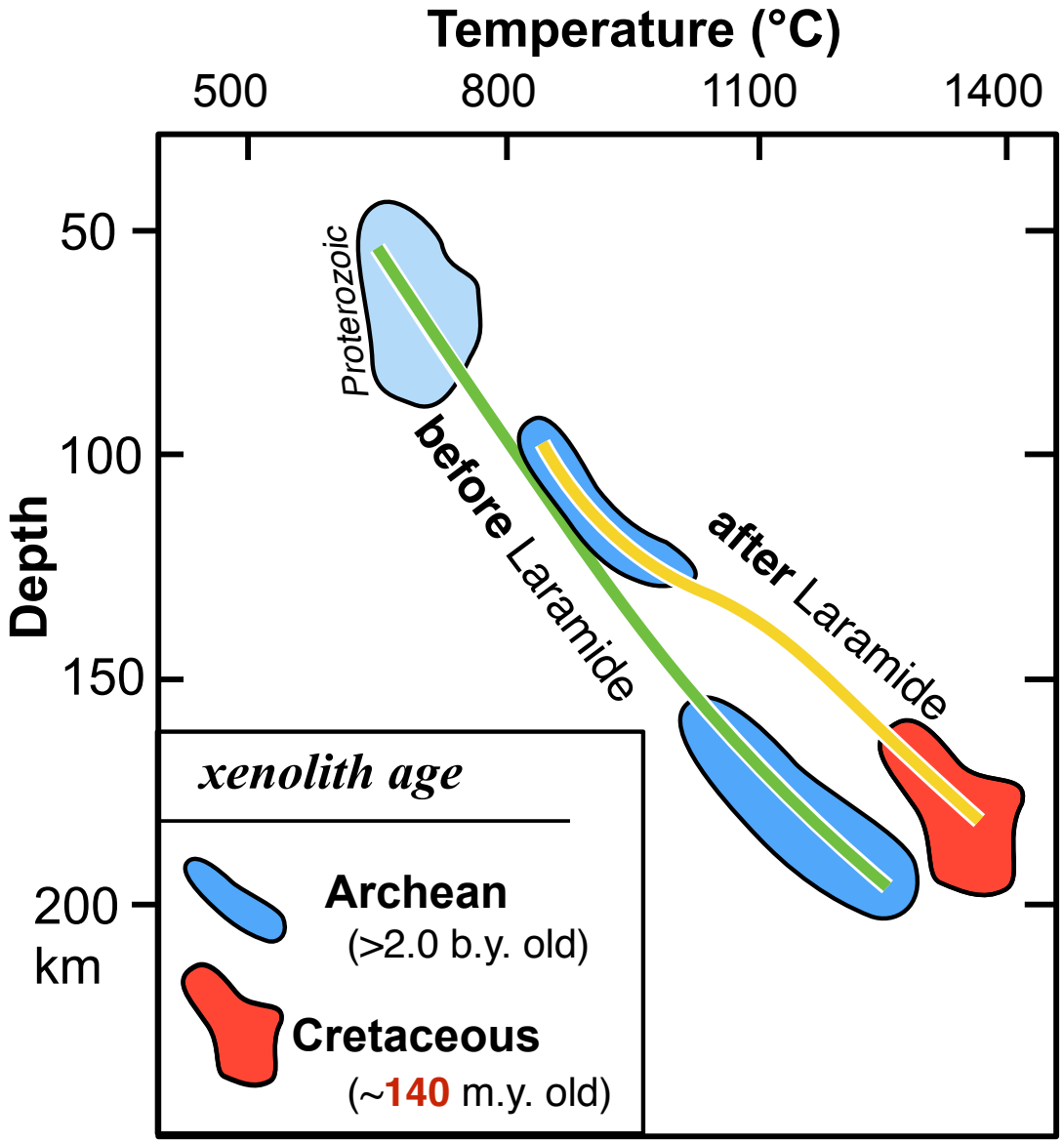


How to make craton more buoyant?

This is the *first* problem

Mantle Xenoliths





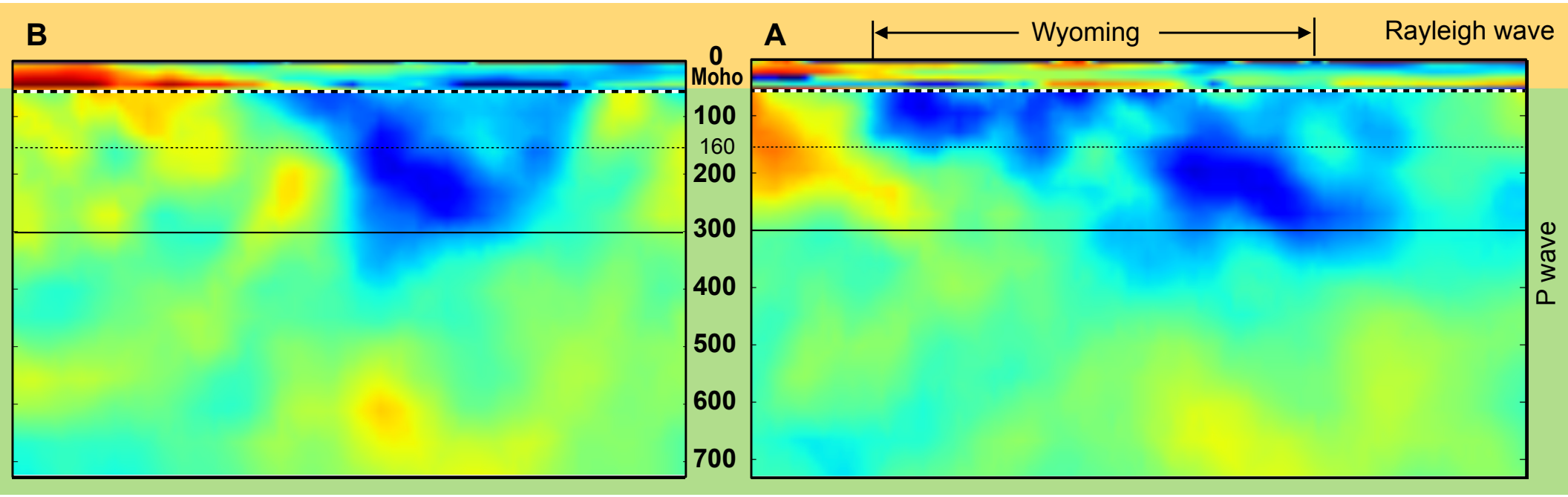
=> NA basal **truncation** shortly before eruption — to preserve cool mid-lithosphere geotherm

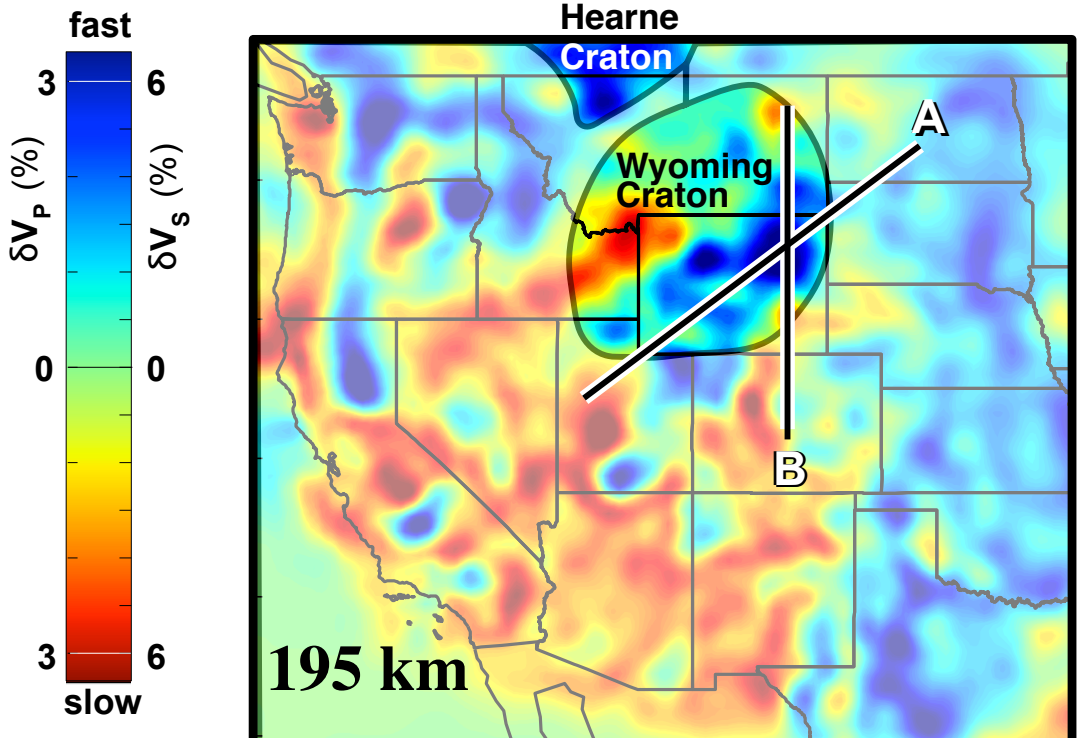
=> emplacement of **young** lithosphere — emplacement: 140-50 Ma old

(*it was made **hot**… now is cool*)

This is the *second* problem

Deep Wyoming lithosphere





Wyoming lithosphere is 300+ km deep:

> seems **to deep** for craton

> **correlates poorly** with craton shape

This is the *third* problem

…**So**, how do you

remove the base of a craton

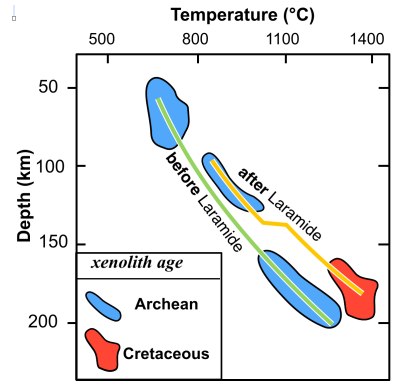
and

emplace a large volume of <u>cool</u> <u>buoyant</u> mantle

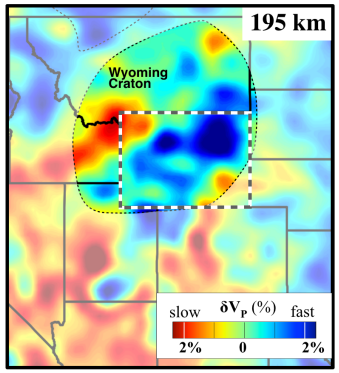
deep beneath the continental interior sometime in the last ~100 m.y.

?

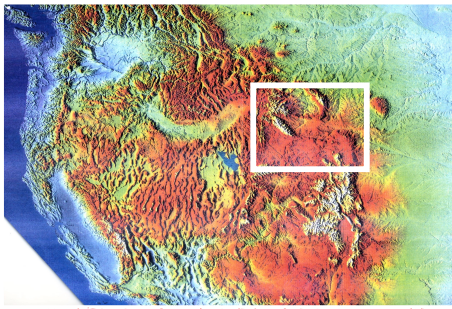
Young base



Cool



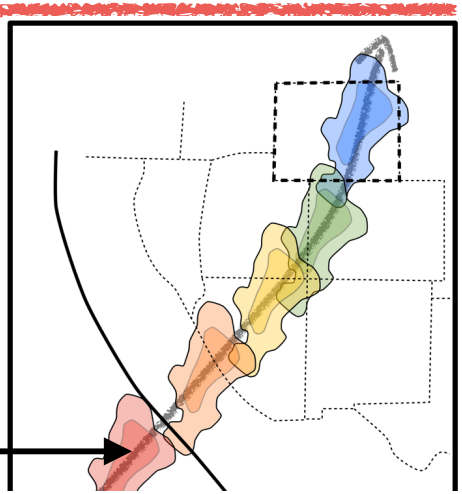
Young uplift



Answer:

add an ocean plateau

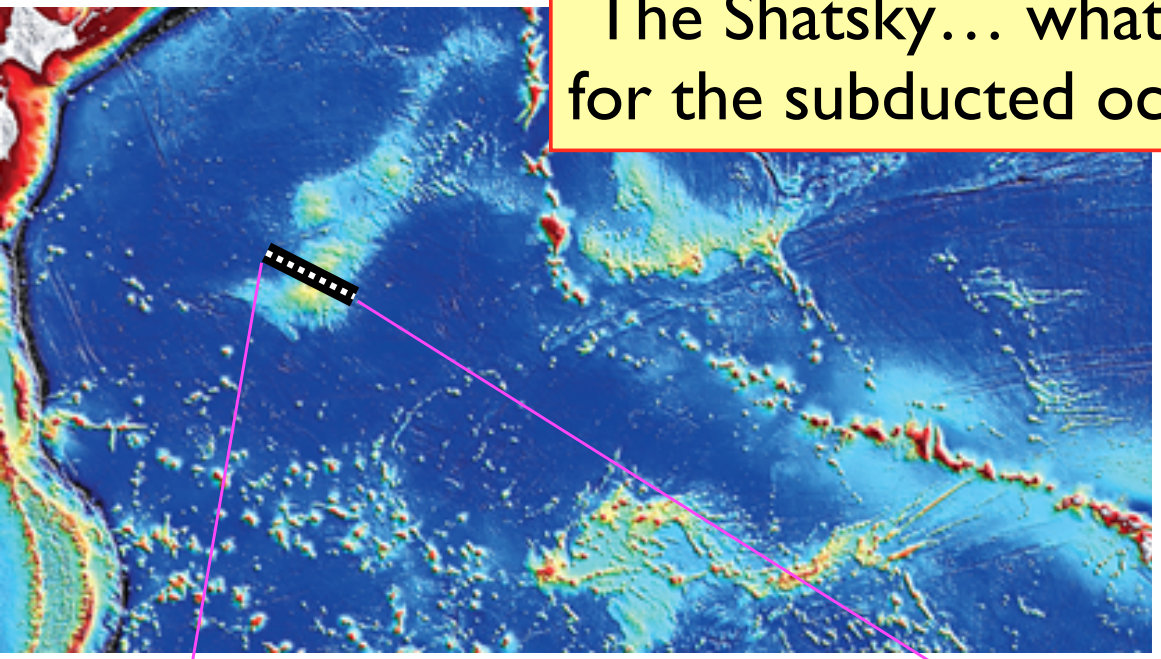
during Laramide flat-slab subduction



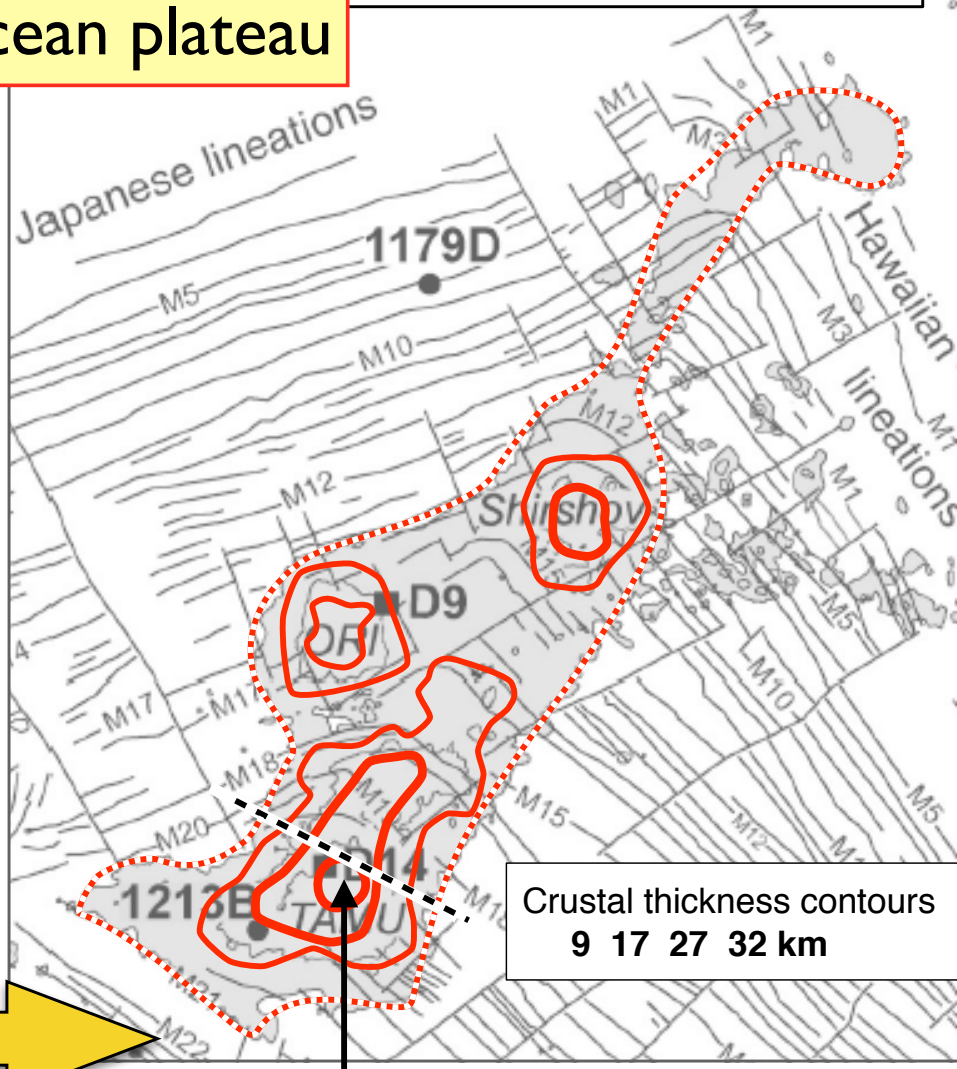
Shatsky conjugate

The Shatsky Rise ocean plateau

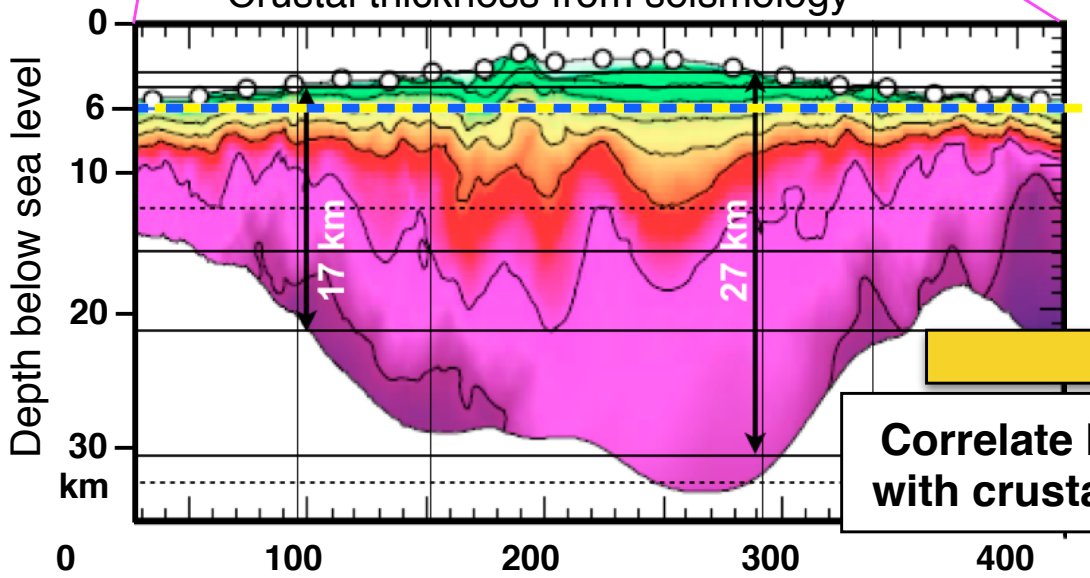
The Shatsky… what to expect for the subducted ocean plateau



al thickness, from bathymetry



Crustal thickness from seismology



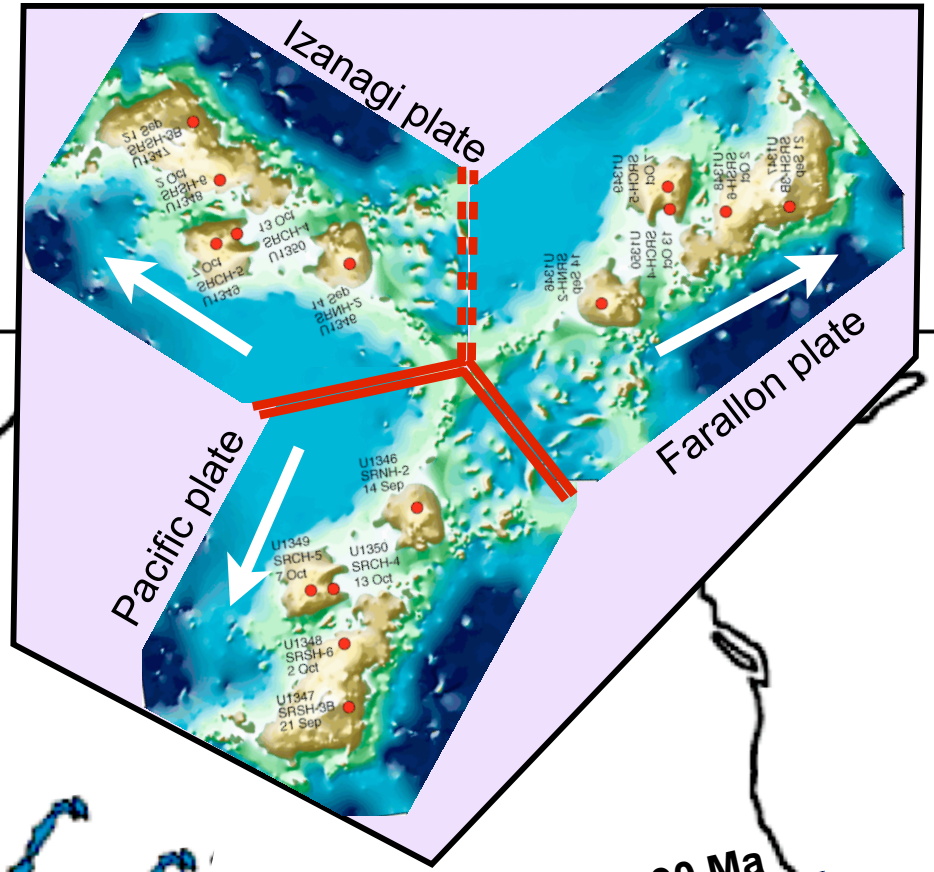
Correlate bathymetry with crustal thickness

Tamu: Earth's largest volcano

Most of the plateau is basalt-depleted (buoyant) mantle

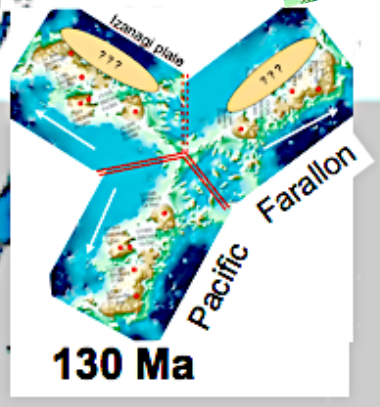
this is going to be the important thing

Shatsky's conjugates



0 Ma
10 Ma
20 Ma
40 Ma
80 Ma
100 Ma

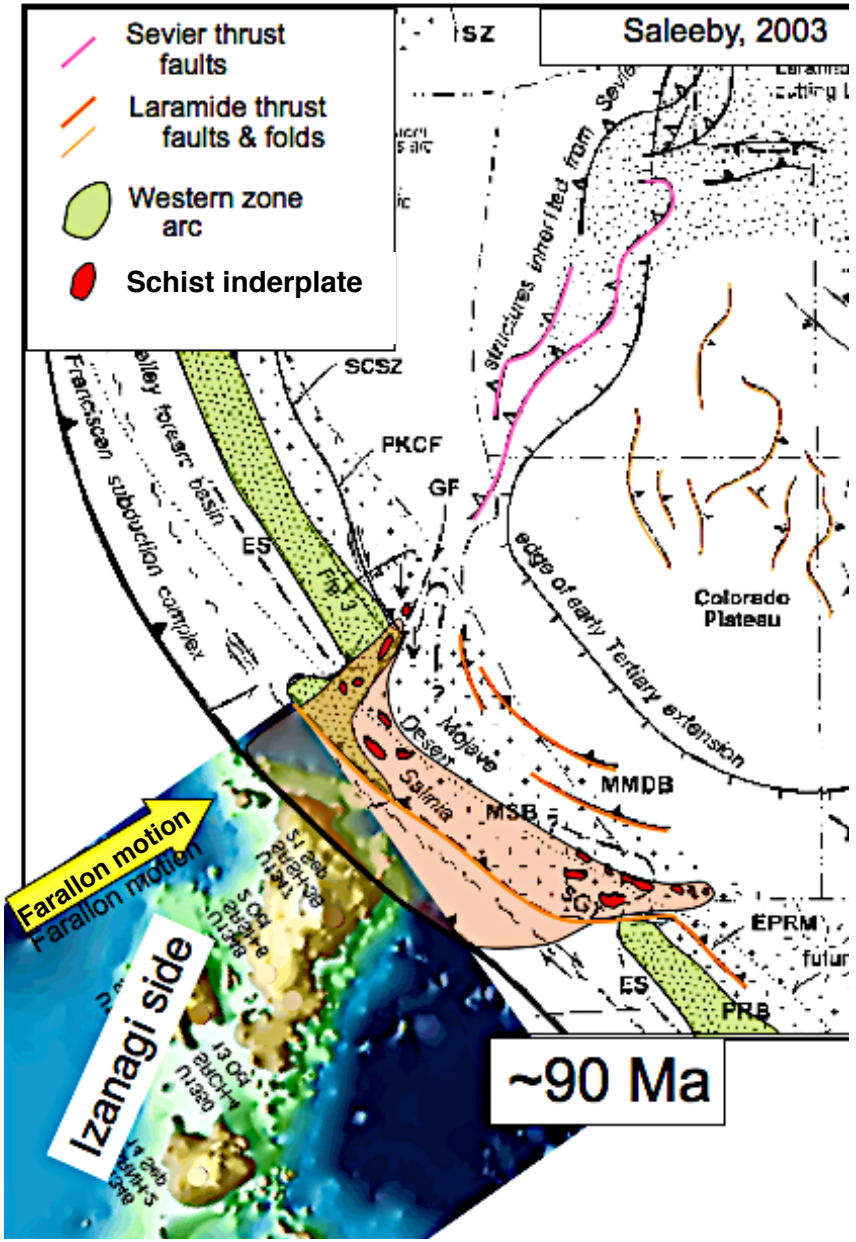
90 Ma



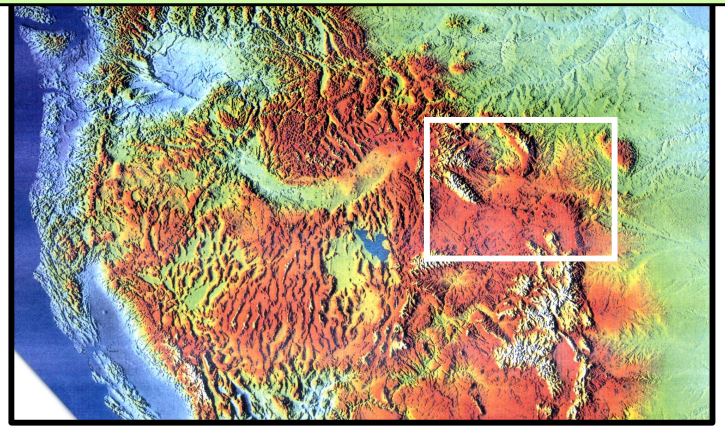
From plate motion models

Subduction of Shatsky conjugate…

…with its crust

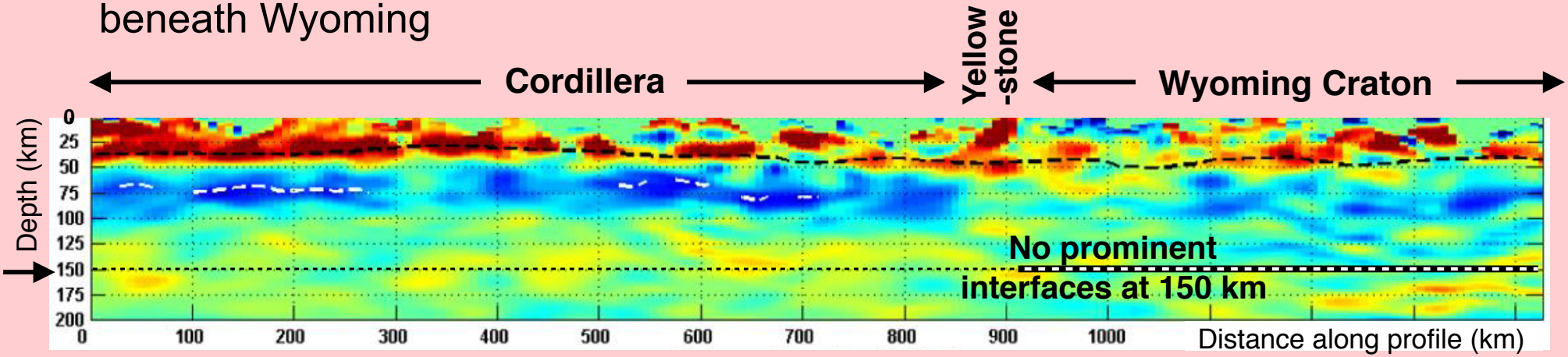


BUT… the ocean plateau crust is <u>not</u> beneath Wyoming



Wyoming's high elevation =>
no eclogetic ocean crust
beneath Wyoming

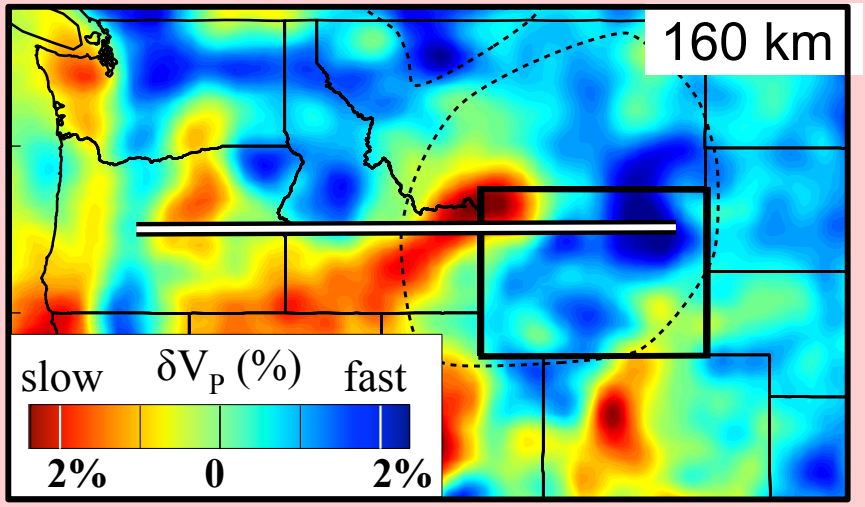
Receiver functions =>
no basaltic ocean crust
beneath Wyoming



from Hopper et al. 2014

xenoliths: only rare eclogite, no basalt

Shatsky conjugate's crust was lost somewhere between California and Wyoming

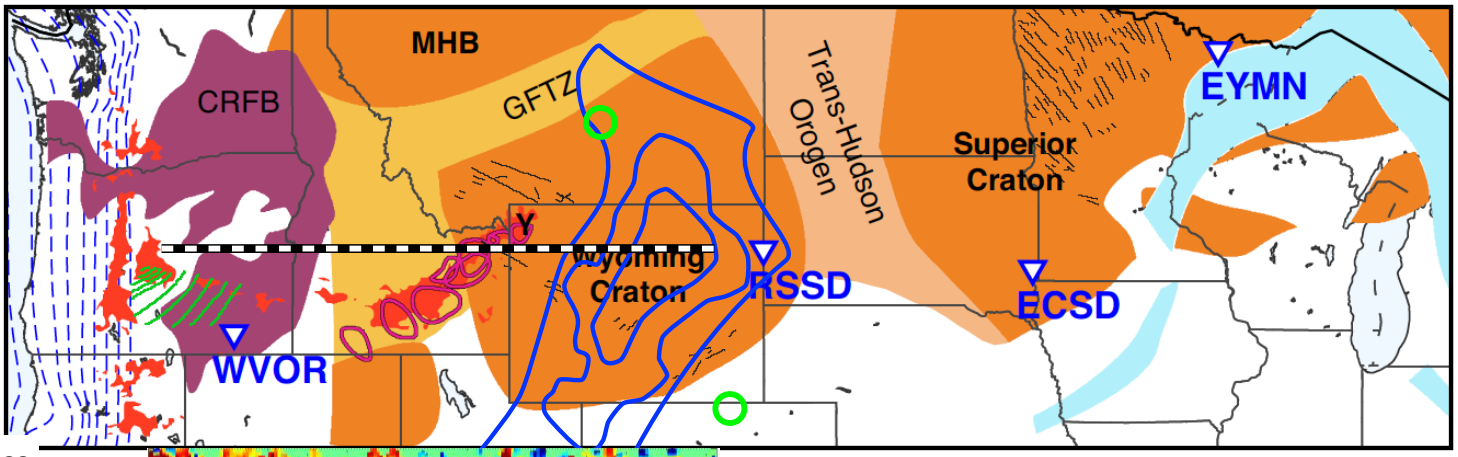


Where is the plateau crust?

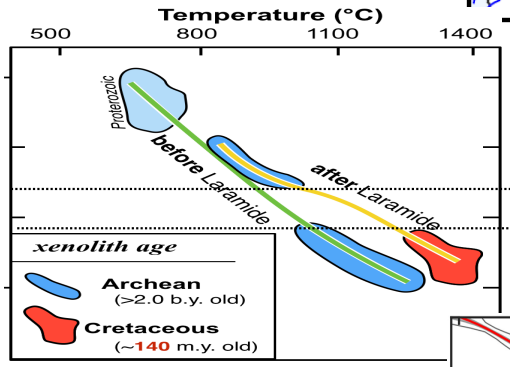
You can make your own story

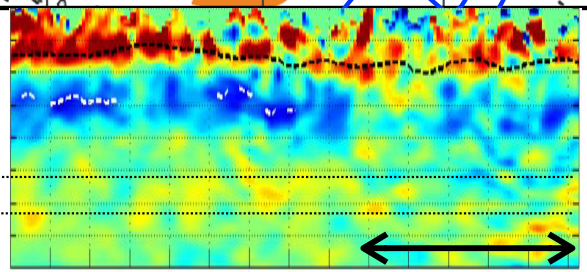
Over beer I can tell you mine

On basal erosion of the Wyoming craton

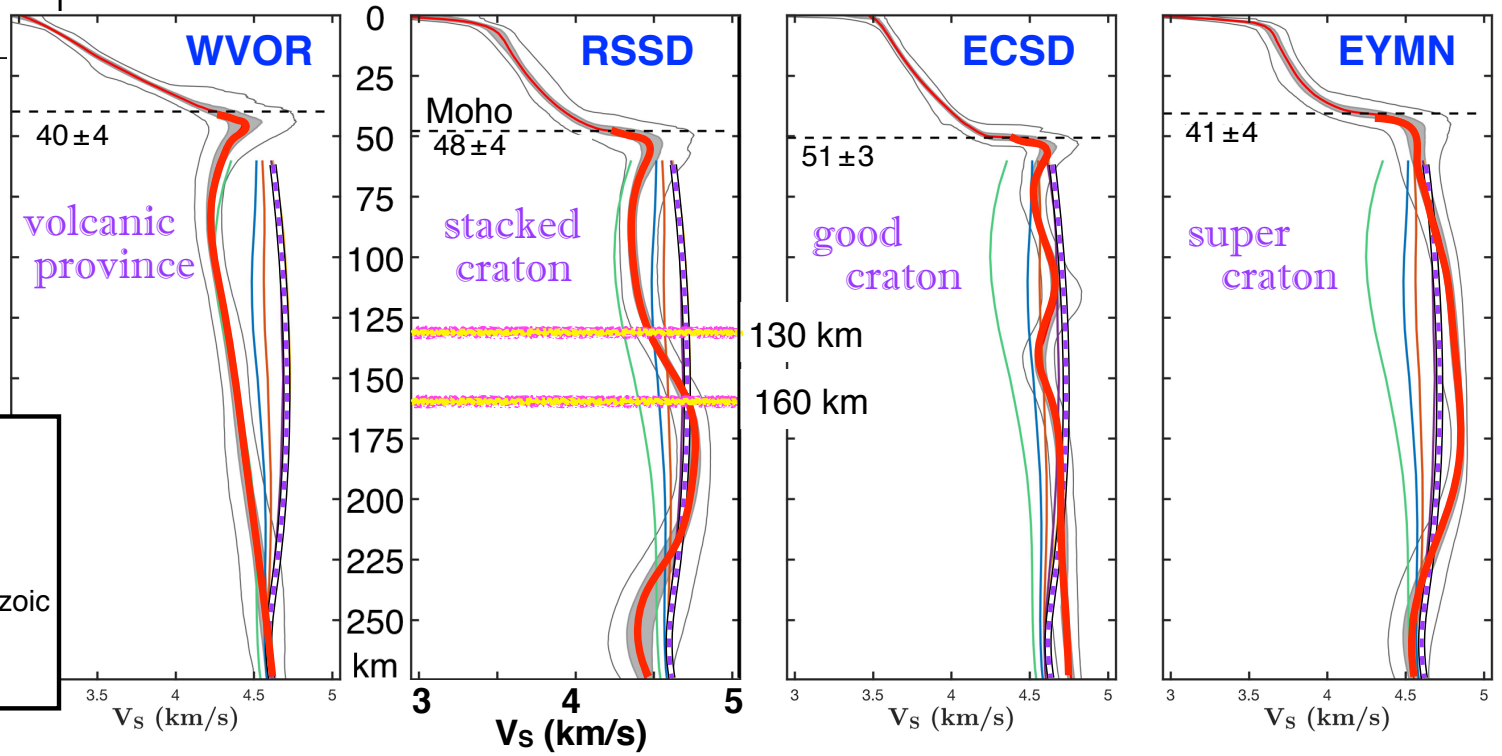


Xenolith evidence for erosion



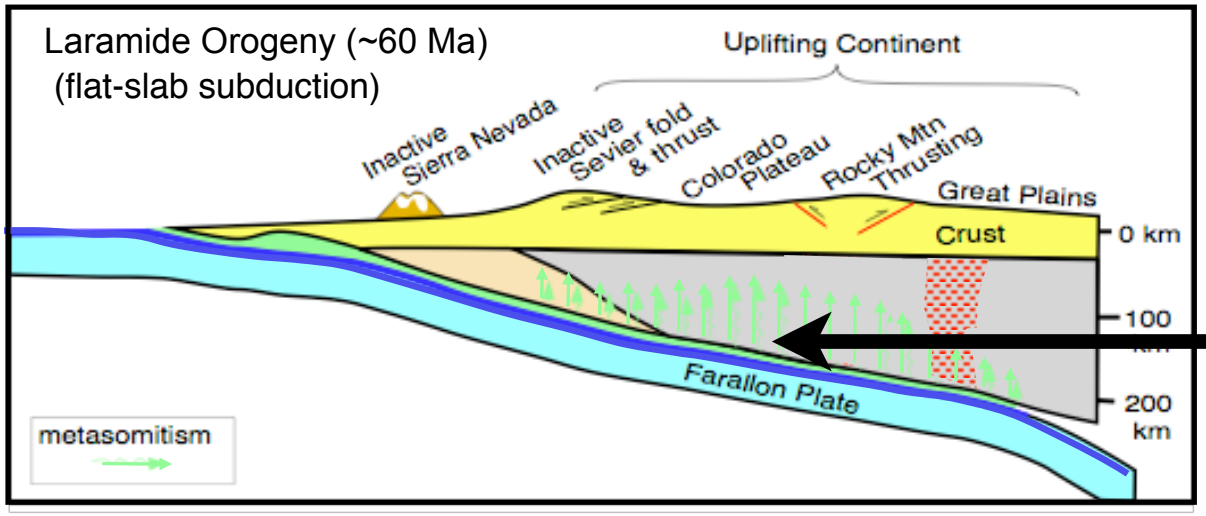


Recent V_S velocity (Eilon et al., 2018)



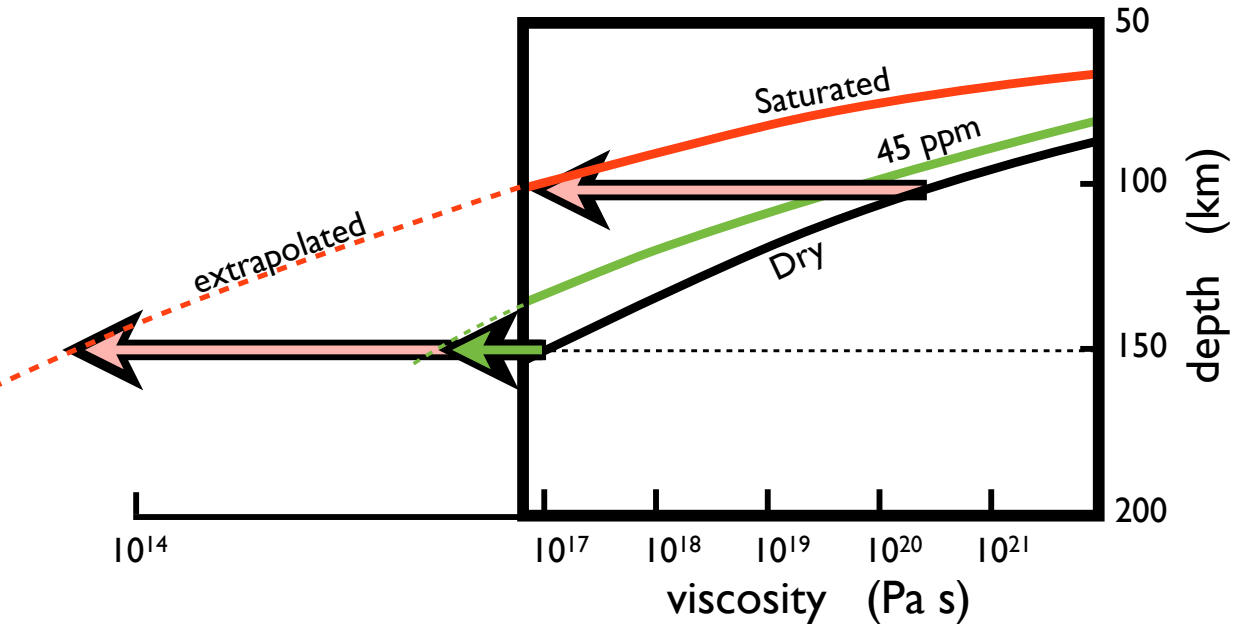
Reference profiles
- Mid-ocean Ridge
- Phanerozoic
- Late Proterozoic
- Early-Mid Proterozoic
- Archean
- V_S

Erosion of basal North America



Weaken and transport basal lithos with subducting slab

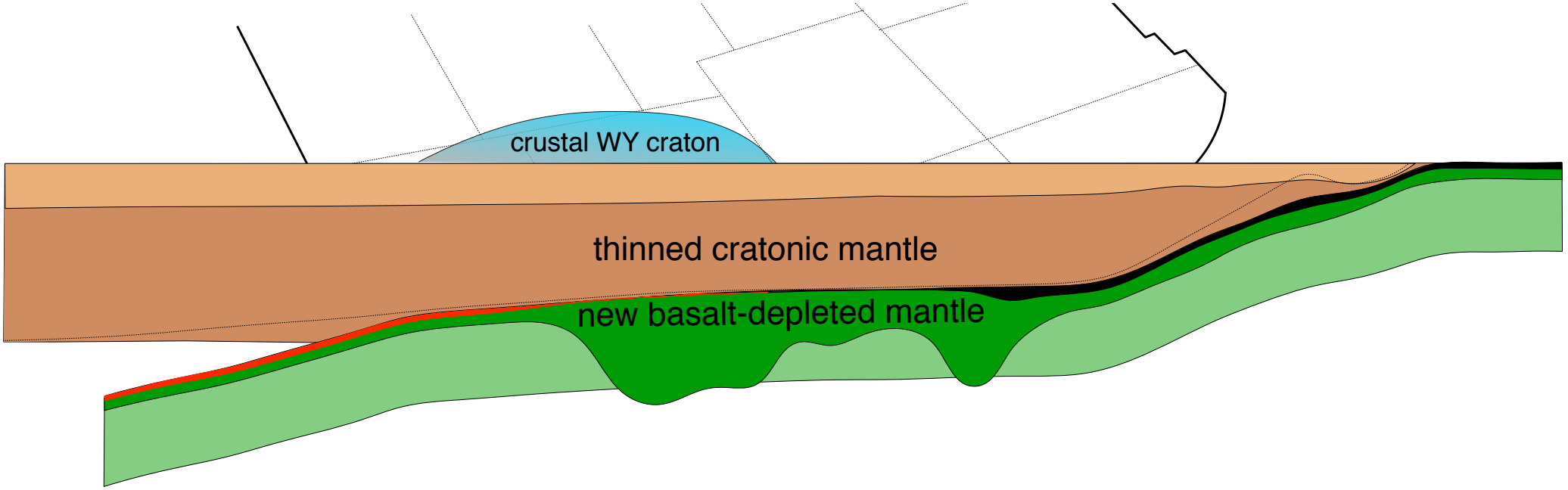
For the Colorado Plateau,
viscosity reduction as a function of water content

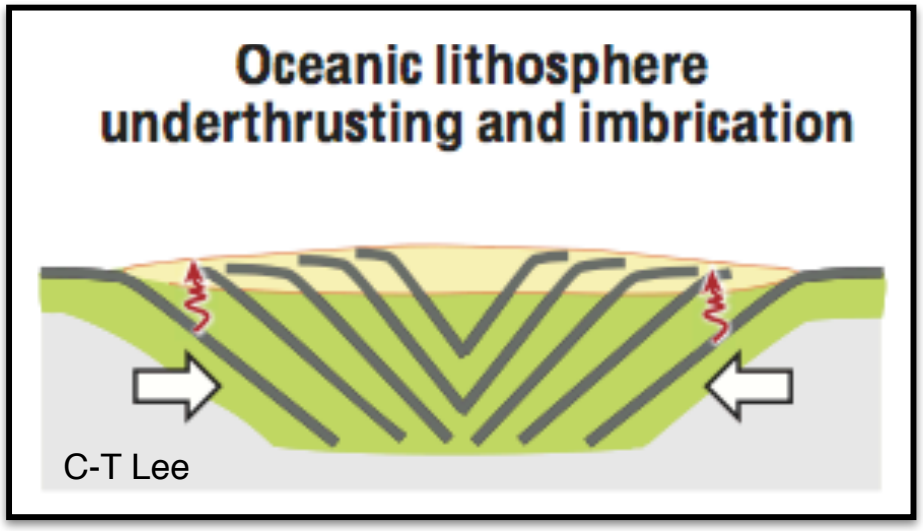


Calculations give viscosity reductions of **1** to **several** orders of magnitude (depending on amount of water)

Li et al. (2008): erosion of basal Colorado Plateau by >10 km

Modern craton growth by under-accretion



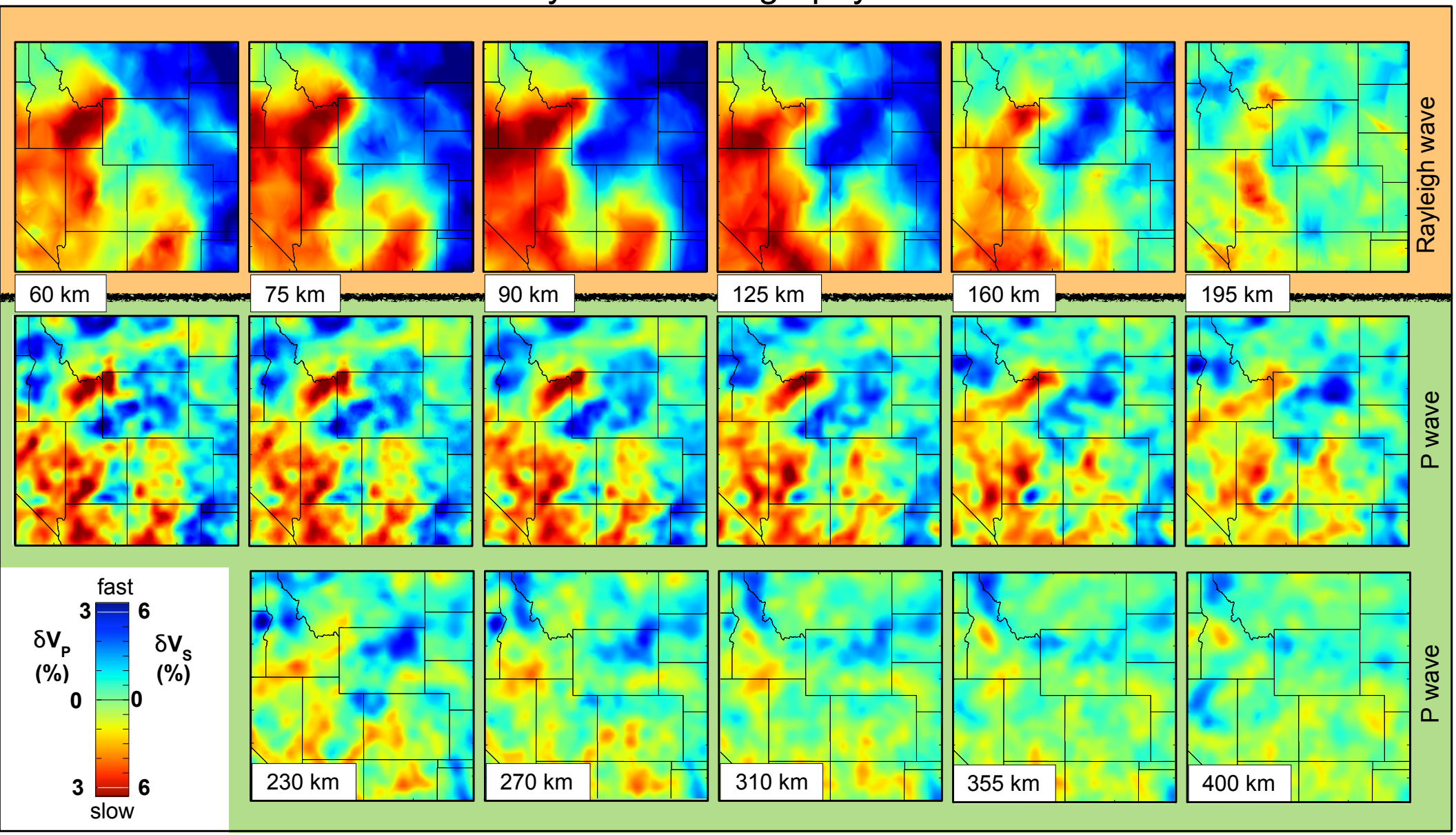


"Slab-stacking" model for creation of Archean craton

Archean craton is basalt-depleted mantle with the crust missing

END

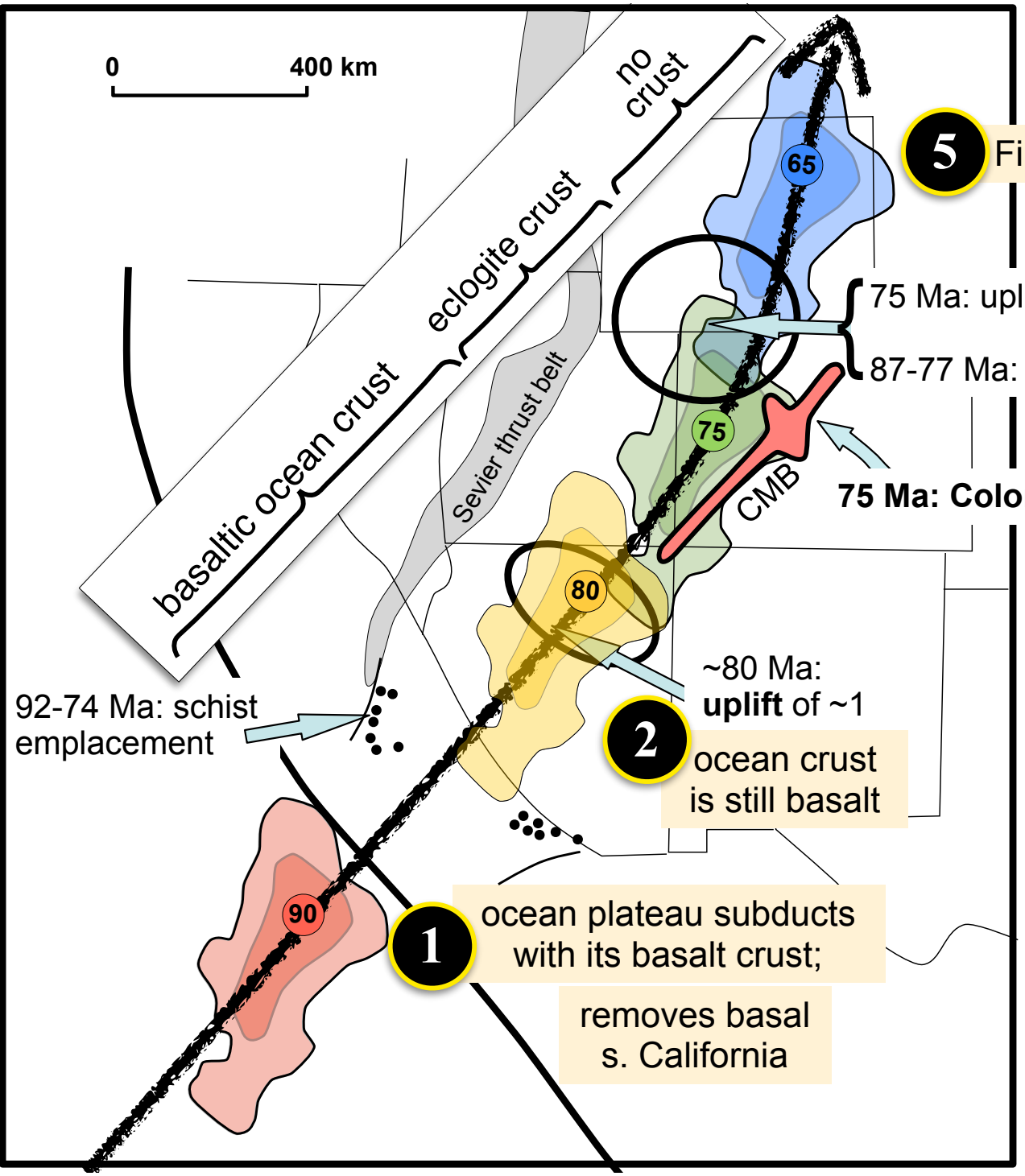
Surface wave and Body wave Tomography of western U.S. interior



Where is the plateau crust?

You can make your own story

Here is mine



5 Finally, it stops

75 Ma: uplift begins

4 eclogite gets away (through the CMB?)

87-77 Ma: subsidence

3 crust transforms to eclogite…

75 Ma: Colorado Mineral Belt starts

92-74 Ma: schist emplacement

~80 Ma: **uplift** of ~1

2 ocean crust is still basalt

1 ocean plateau subducts with its basalt crust;

removes basal s. California