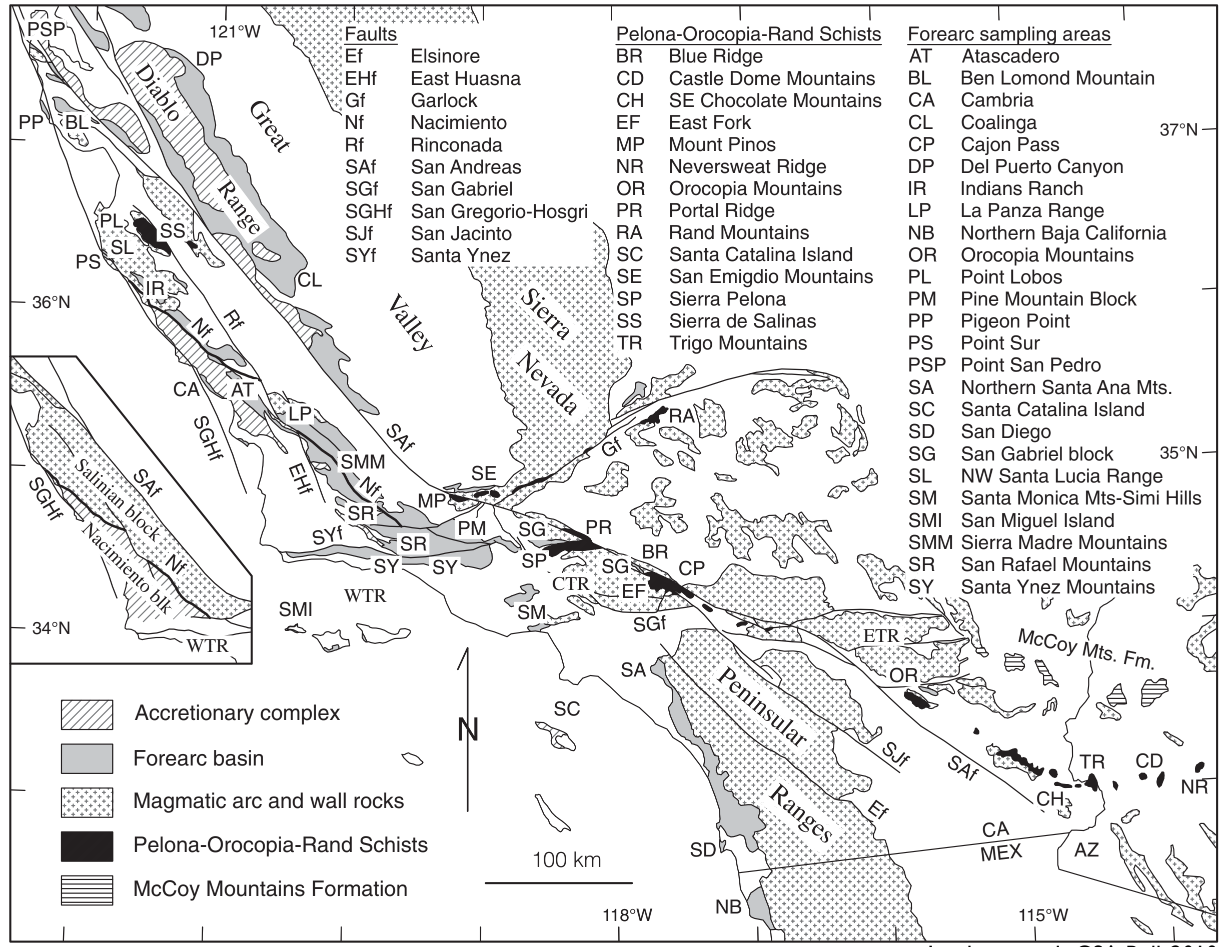


Jacobson et al., GSA Bull, 2010

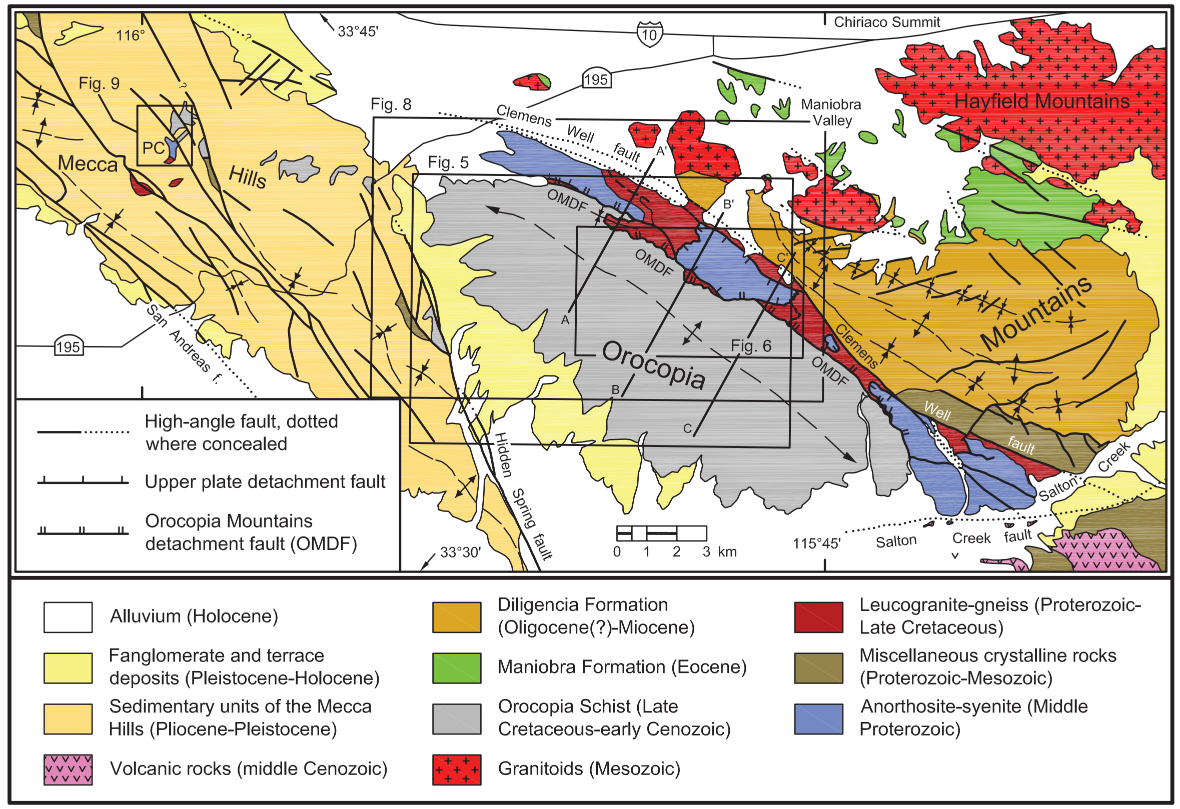
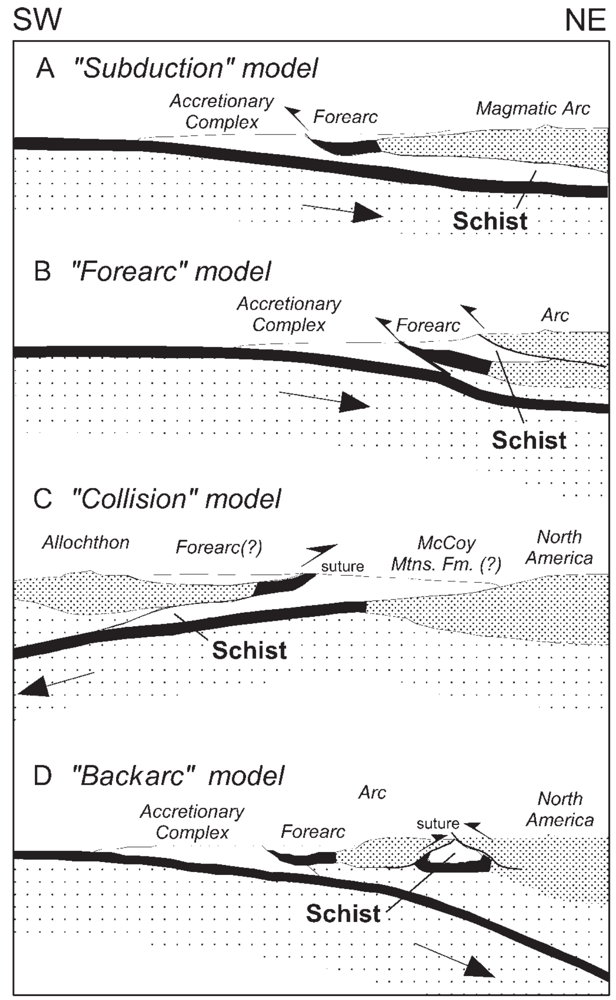


Figure 3. Geology of the Orocopia Mountains and vicinity (after Crowell, 1975). Contacts within the northwestern half of the upper plate of the Orocopia Mountains detachment fault were modified based on this study. Those in the southeastern half were modified based on the work of Ebert (2004). Lines A–A′ to C–C′ indicate locations of cross sections illustrated in Figure 4. PC—Painted Canyon.

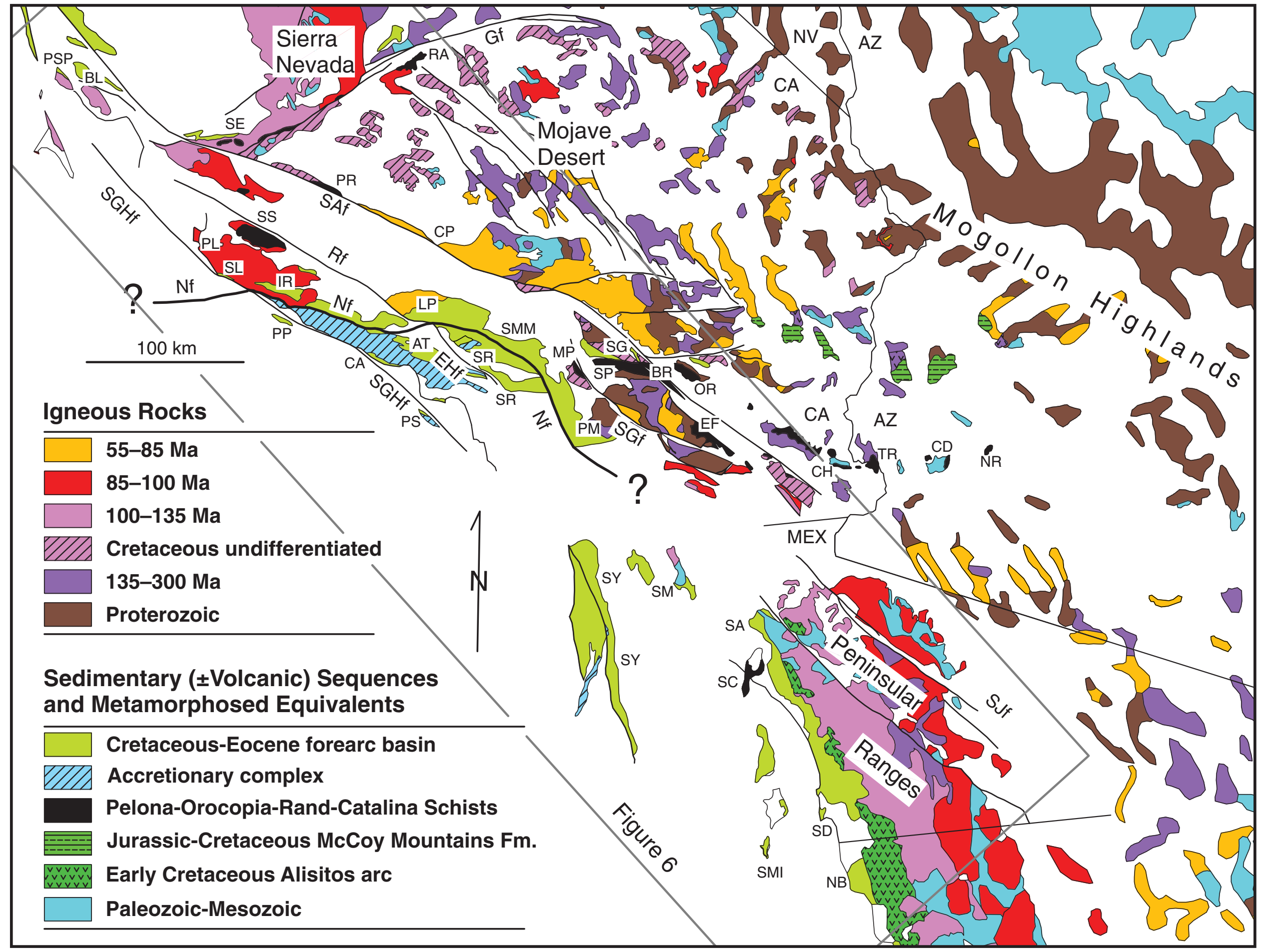
Jacobson et al., GSA SP 419, 2007

A reminder of typical geology. Schists are meta-turbidites with some metabasite, chert and serpentinite. Inverse mmic gradients often found but modern exposure is typically under extensional fault systems. "The Pelona-Orocopia-Rand schists consist of 90% or more quartzo-feldspathic schist presumably derived from turbidite sandstone (Ehlig, 1958, 1981; Haxel and Dillon, 1978; Jacobson et al., 1988, 1996; Haxel et al., 1987, 2002). The schists also include up to 10% metabasite, along with minor amounts of Fe-Mn meta- chert, marble, serpentinite, and talc-actinolite rock. Metamorphism occurred under conditions of moderately high pressure relative to tem- perature. Mineral assemblages lie mostly within the greenschist and albite-epidote amphibolite facies but locally extend into the epidote-blue- schist and upper amphibolite facies (Ehlig, 1981; Haxel and Dillon, 1978; Graham and Powell, 1984; Jacobson and Sorensen, 1986; Jacobson et al., 1988; Kidder and Ducea, 2006). Inverted metamorphic zonations are typical. Initial em- placement of the schists is attributed to a Late Cretaceous–early Cenozoic low-angle fault sys- tem referred to as the Vincent–Chocolate Moun- tains thrust (Haxel and Dillon, 1978). However, most present-day contacts between the schists and North American upper plate appear to be low-angle normal faults related to exhumation of the schists, either shortly after underthrust- ing or during middle Cenozoic extension (Frost et al., 1982; Hamilton, 1988; Jacobson et al., 1988, 2002, 2007; Malin et al., 1995; Wood and Saleeby, 1997; Haxel et al., 2002)."-Jacobson et al., 2010



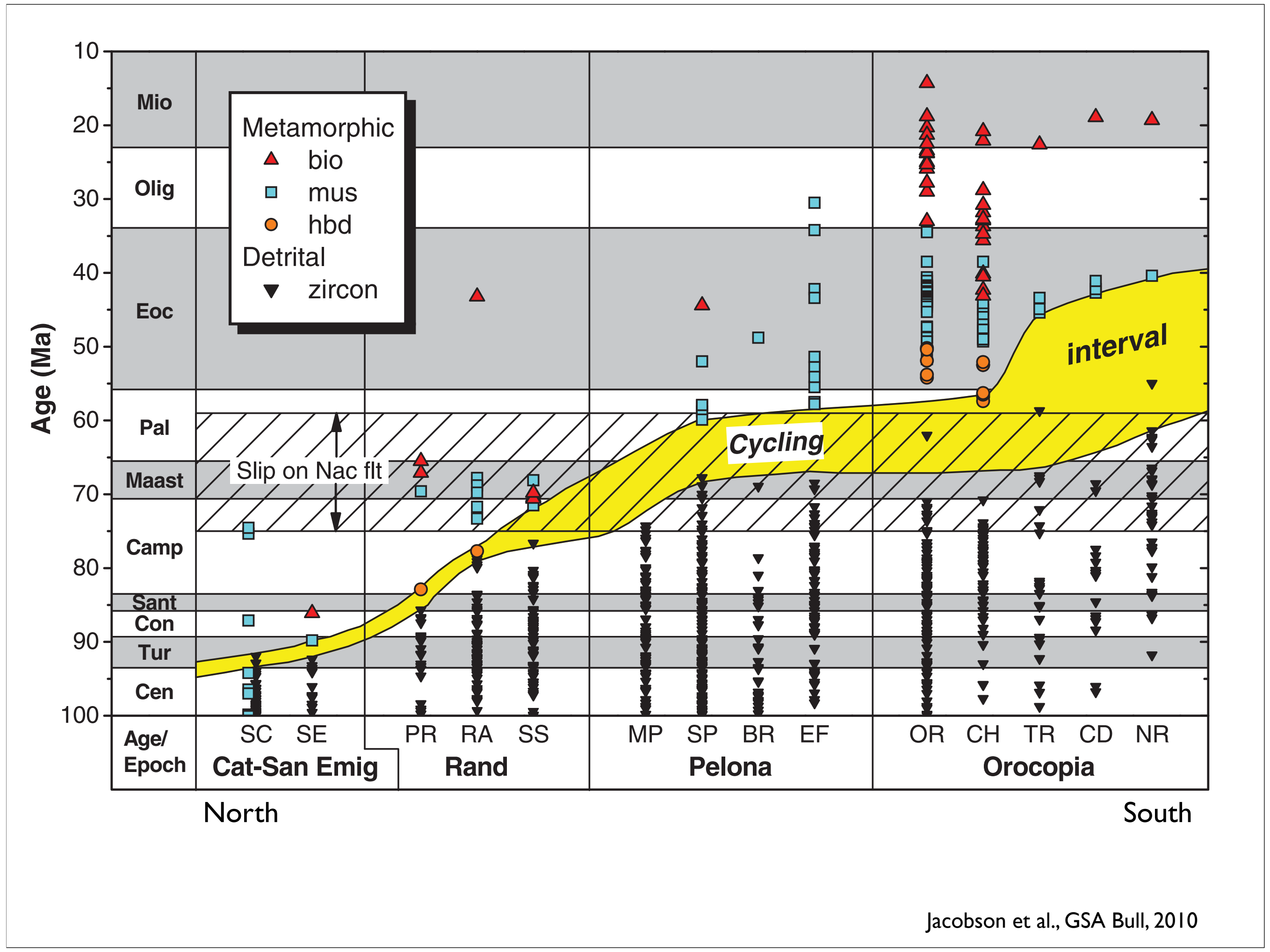
Grove et al., GSA SP 374, 2003

All of these are compressional so not concerned with how these are exhumed but environment where they were created.

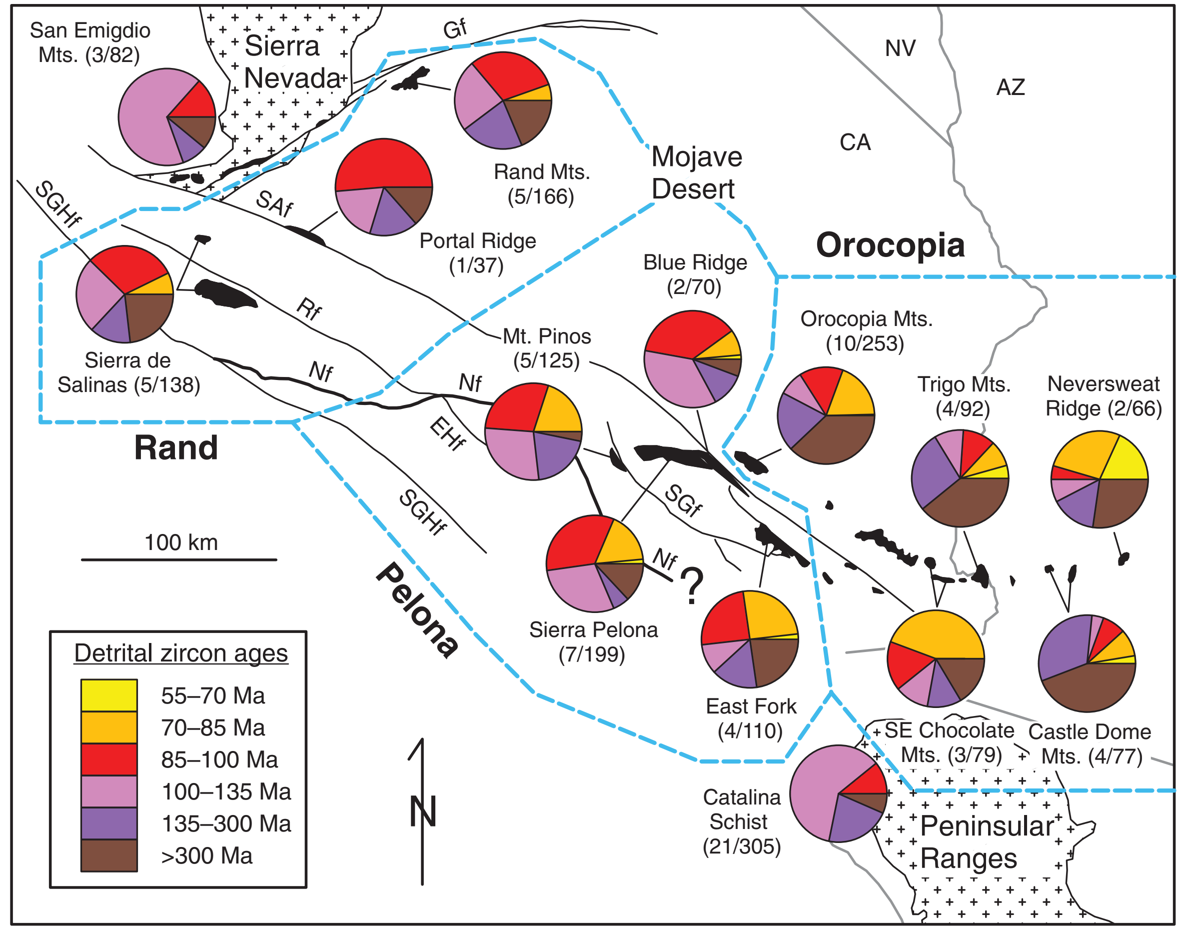


Jacobson et al., GSA Bull, 2010

restored for late Cz deformation

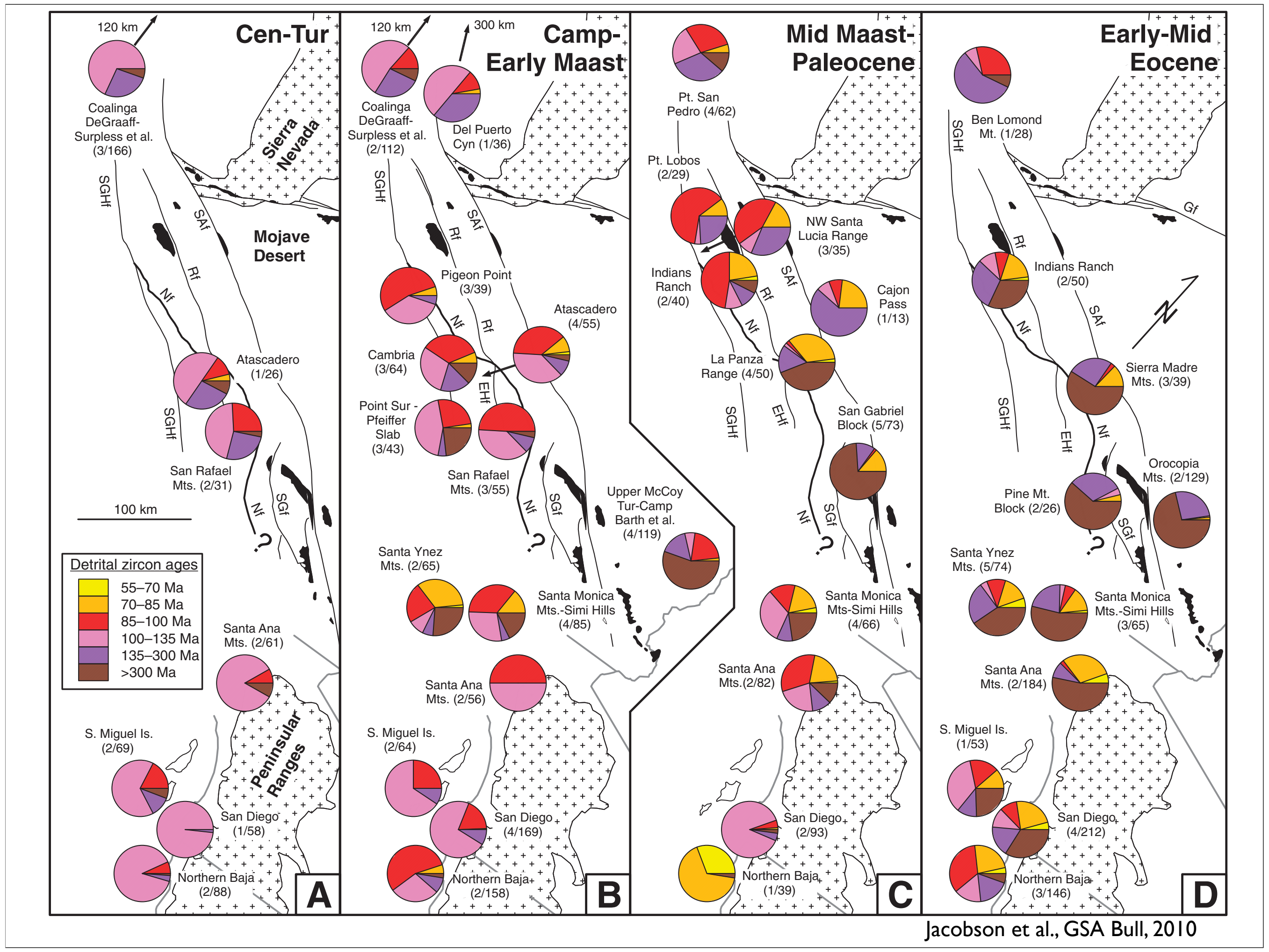


Constraints on emplacement. mmic ages are cooling, detrital zircons are deposition.

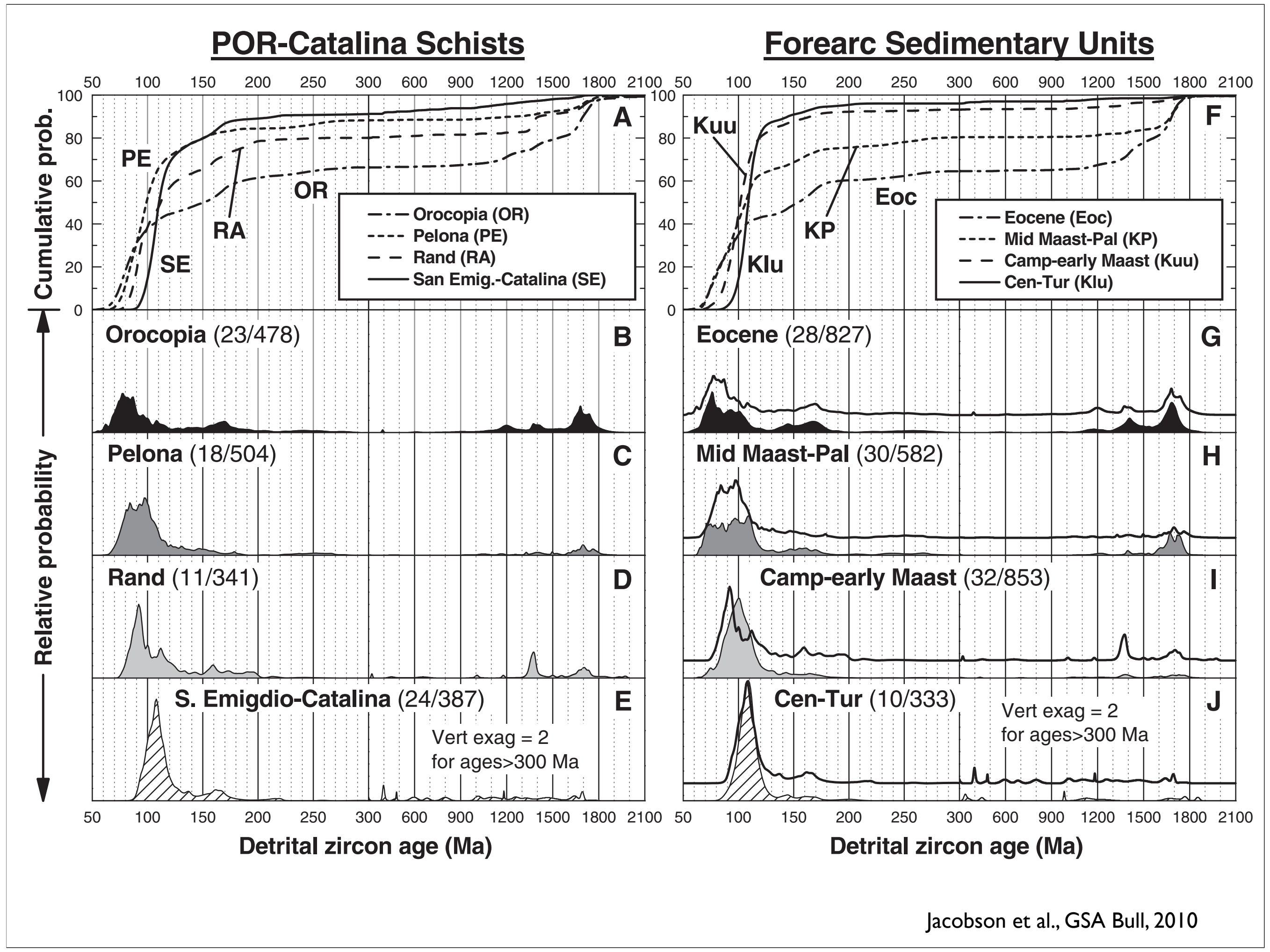


Jacobson et al., GSA Bull, 2010

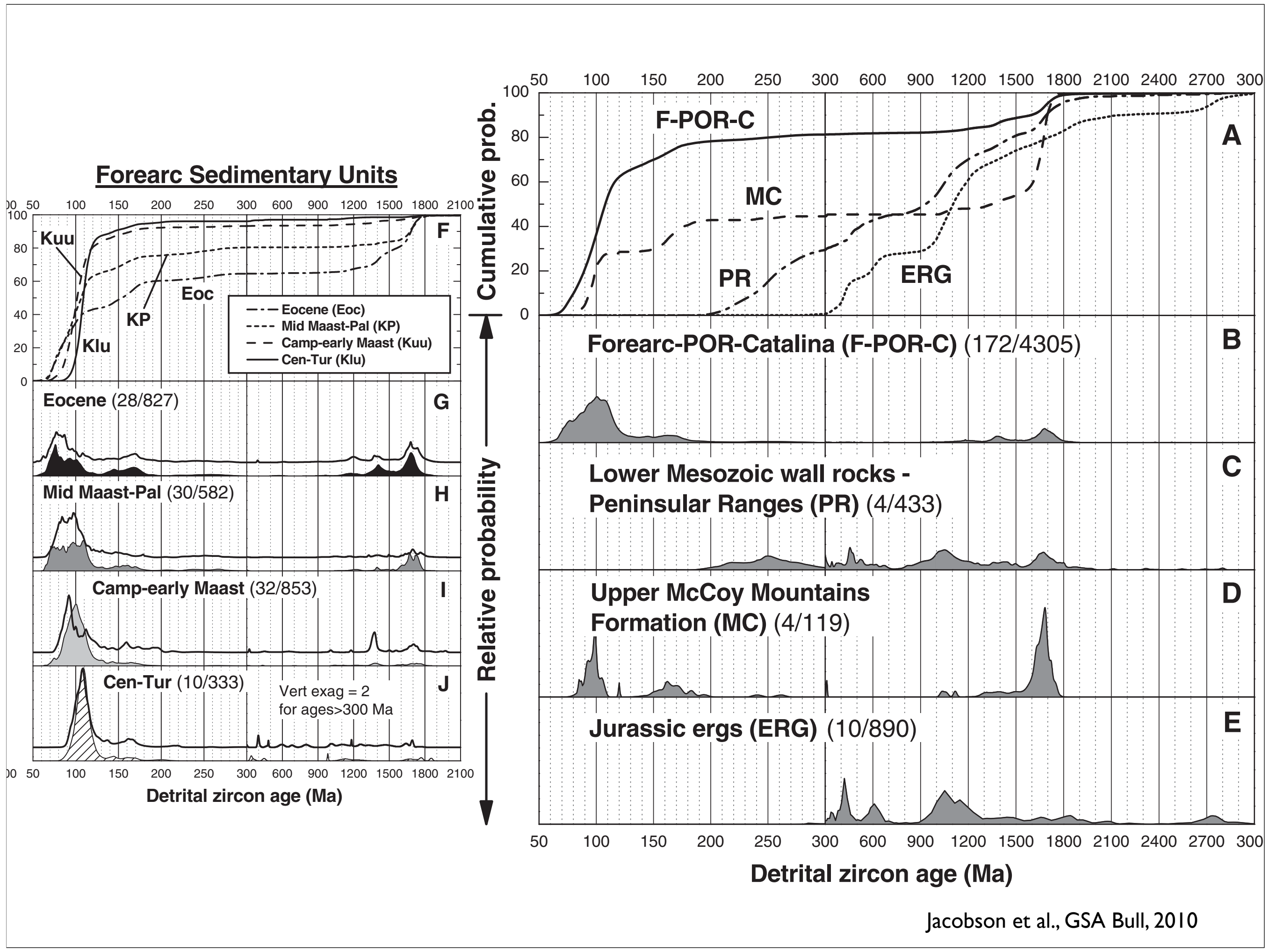
So where did this stuff come from? After all, a bunch of really old zircons so obviously not just a pile of ocean floor material



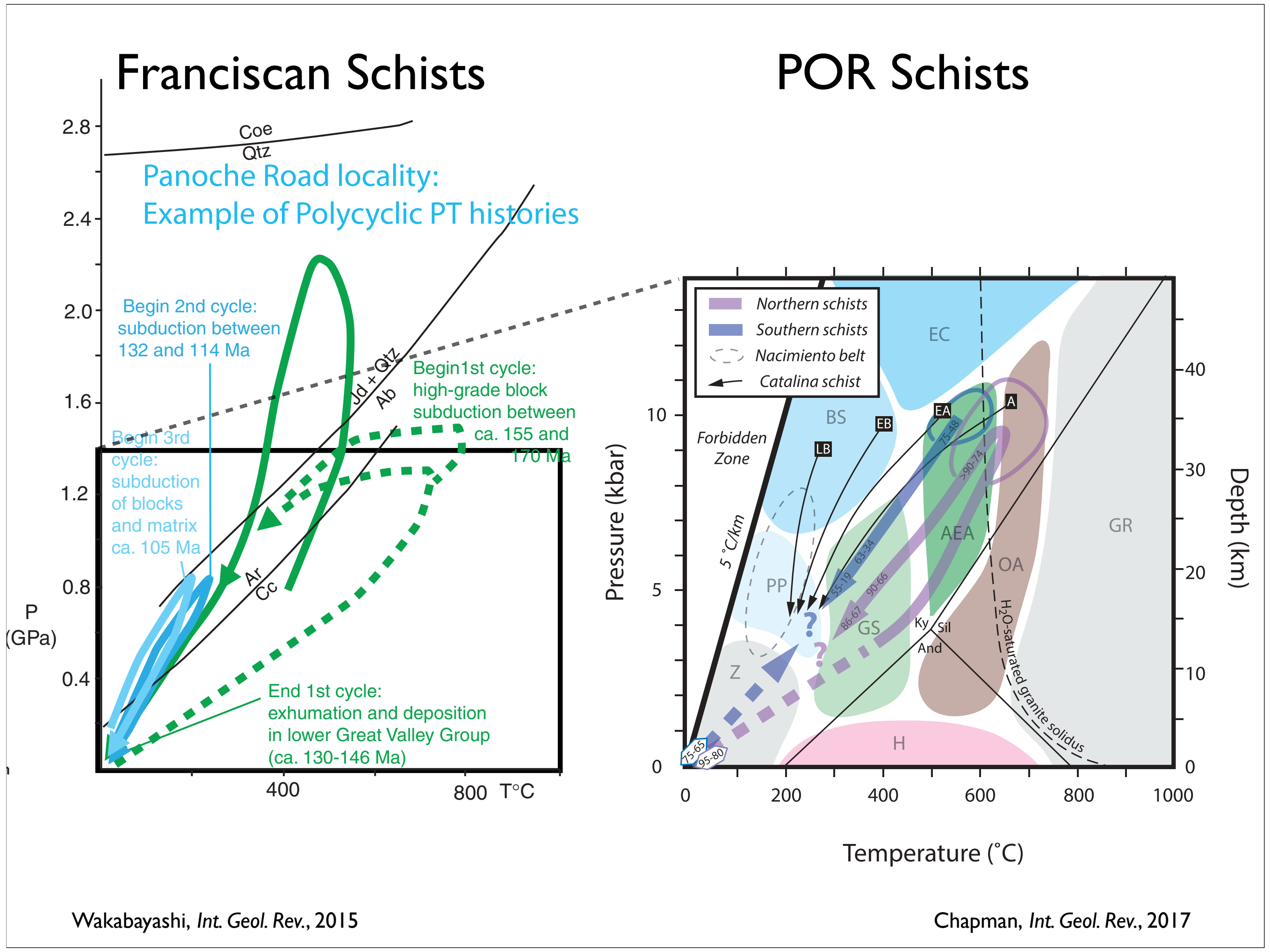
Forearc sediments show changes in the relative contributions of zircons through time (note that the numbers in () are sites/zircons).



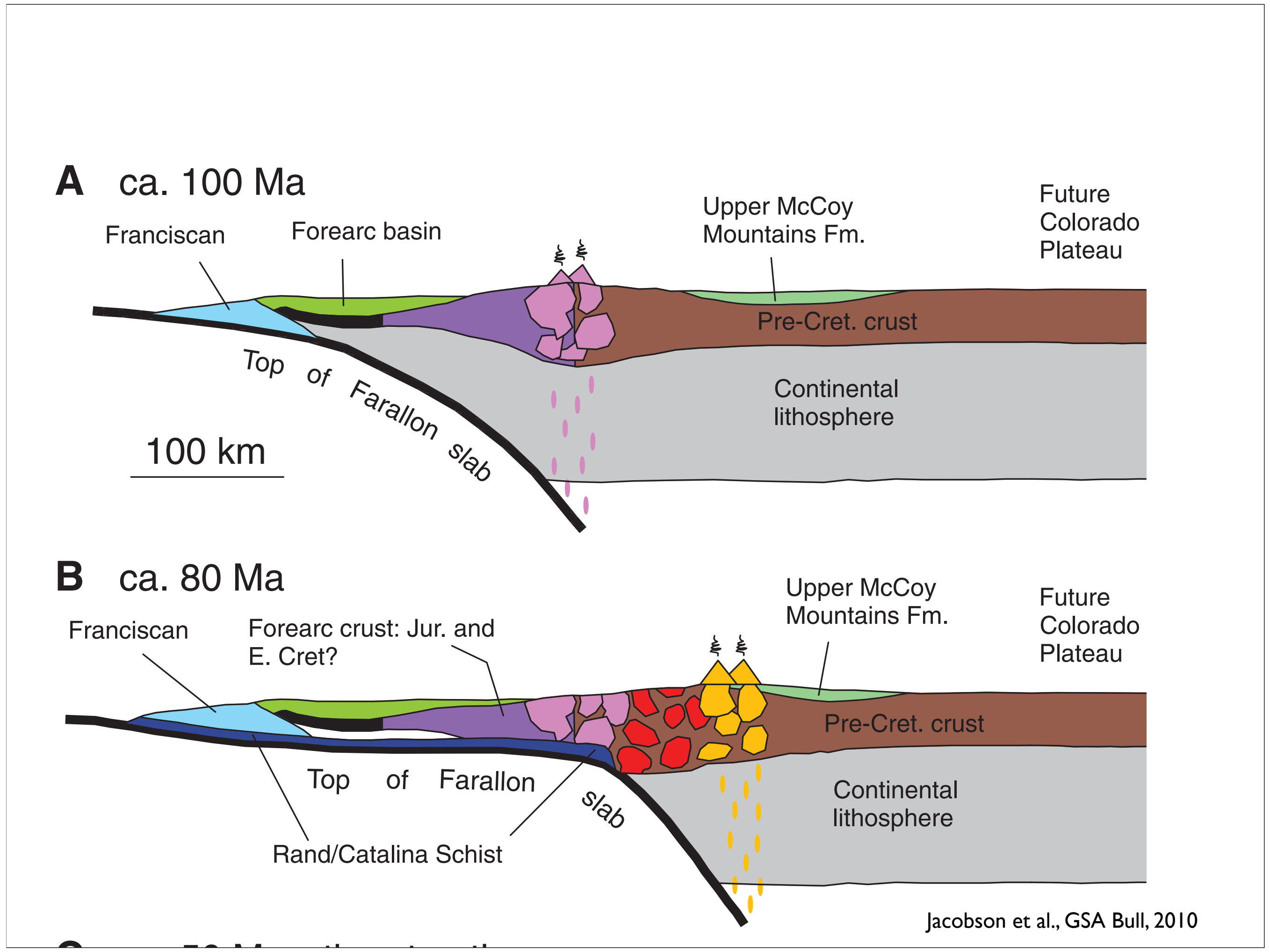
From the previous sets of info suggests that the schists are tightly tied to the forearc sequences



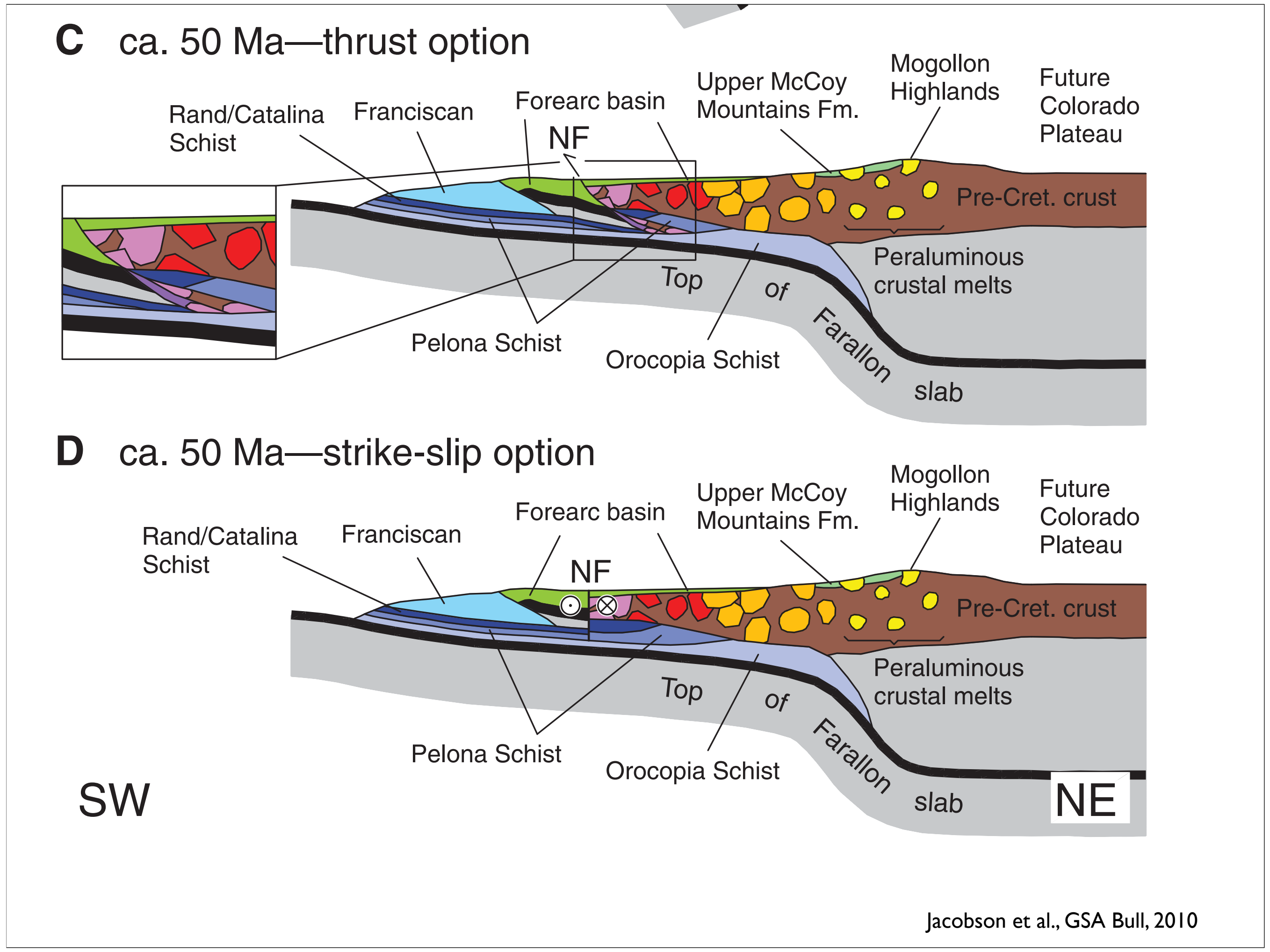
in contrast, foreland sequences are quite different.



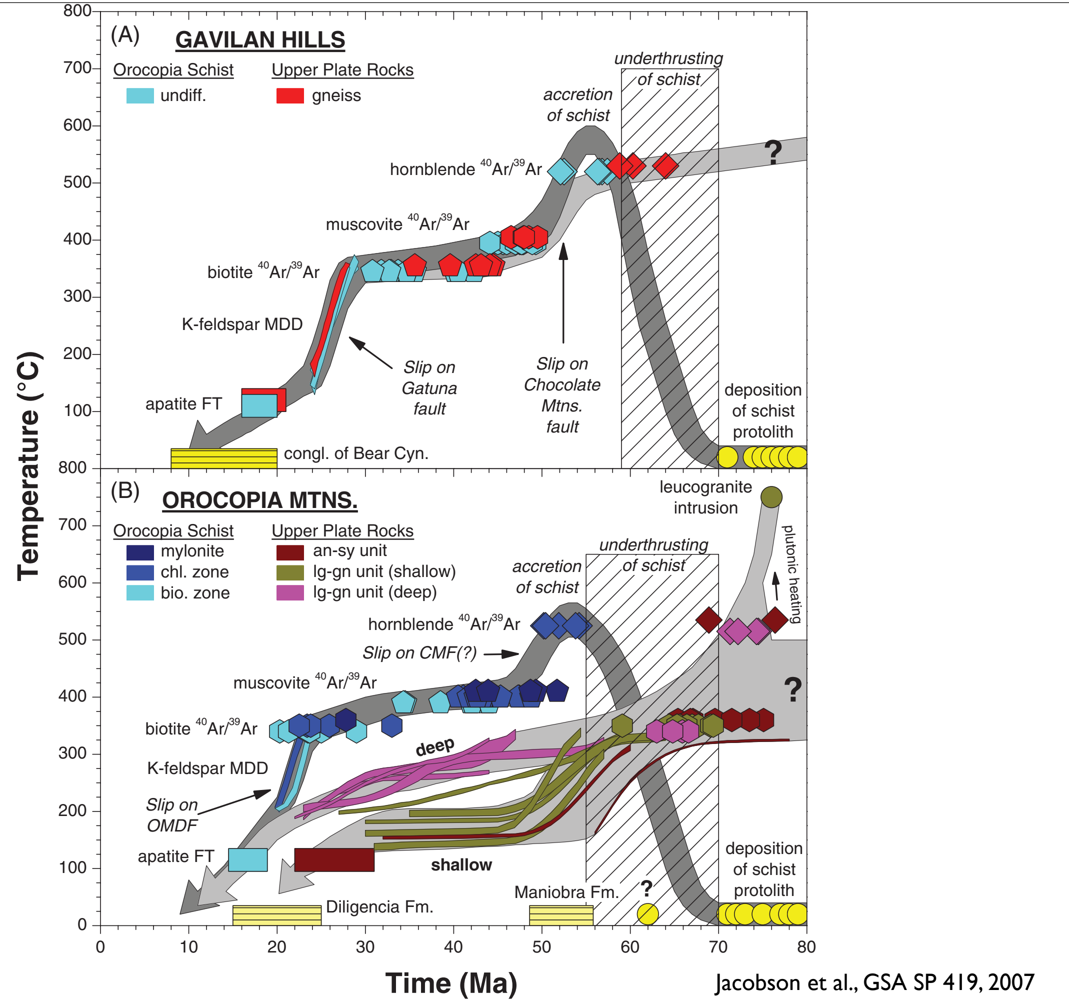
POR Schists are hotter than most Franciscan schists (blue curves at left). Also usually have an inverted metamorphic gradient.



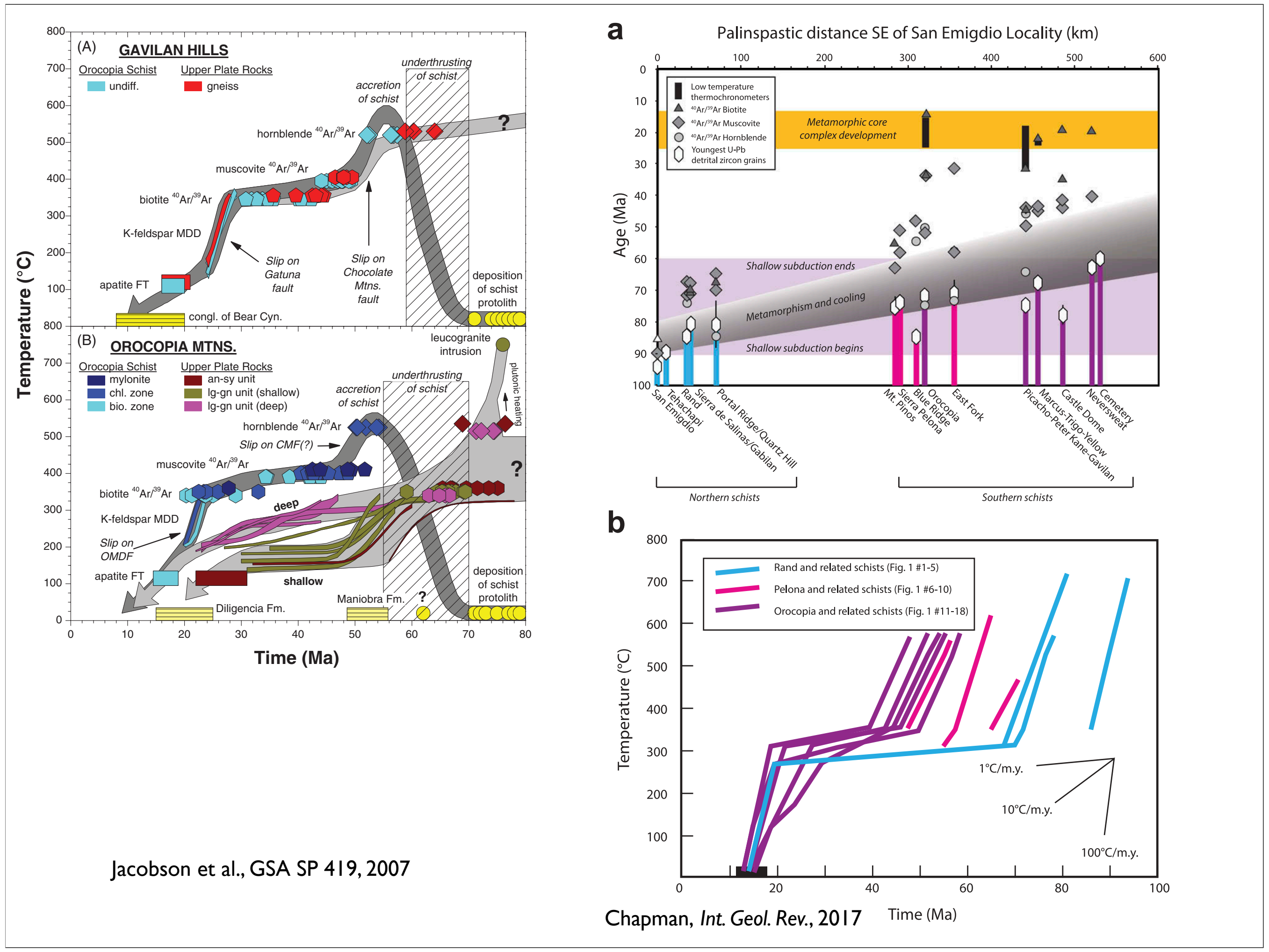
Here’s the puzzle to me: WHY would seds go down when the slab FLATTENS? (Slab flattening is itself attested to by the removal of the lower crust, which we haven’t discussed)



Second puzzle: Why would these rocks be cooling at this time?

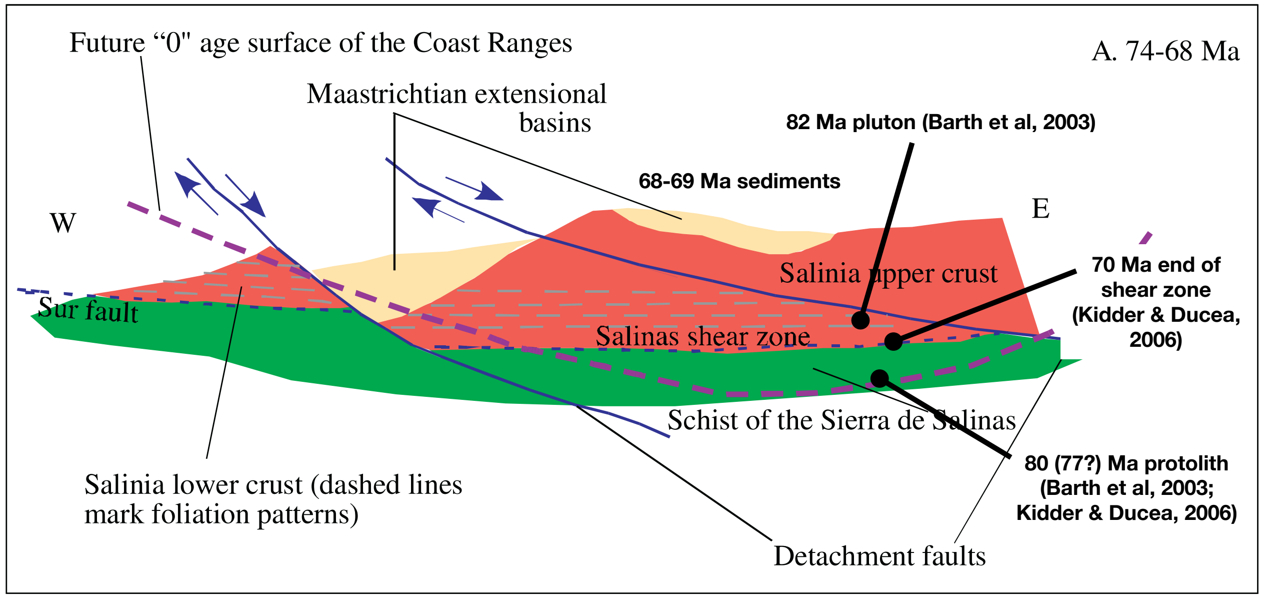


An important component is the cooling history, indicating episodic normal faulting



Chapman suggests this is common to all the POR schists…which seems a bit curious. Note that this is the opposite of isothermal decompression—this is rapid cooling.
Some zircon dates being pushed back due to overgrowths.

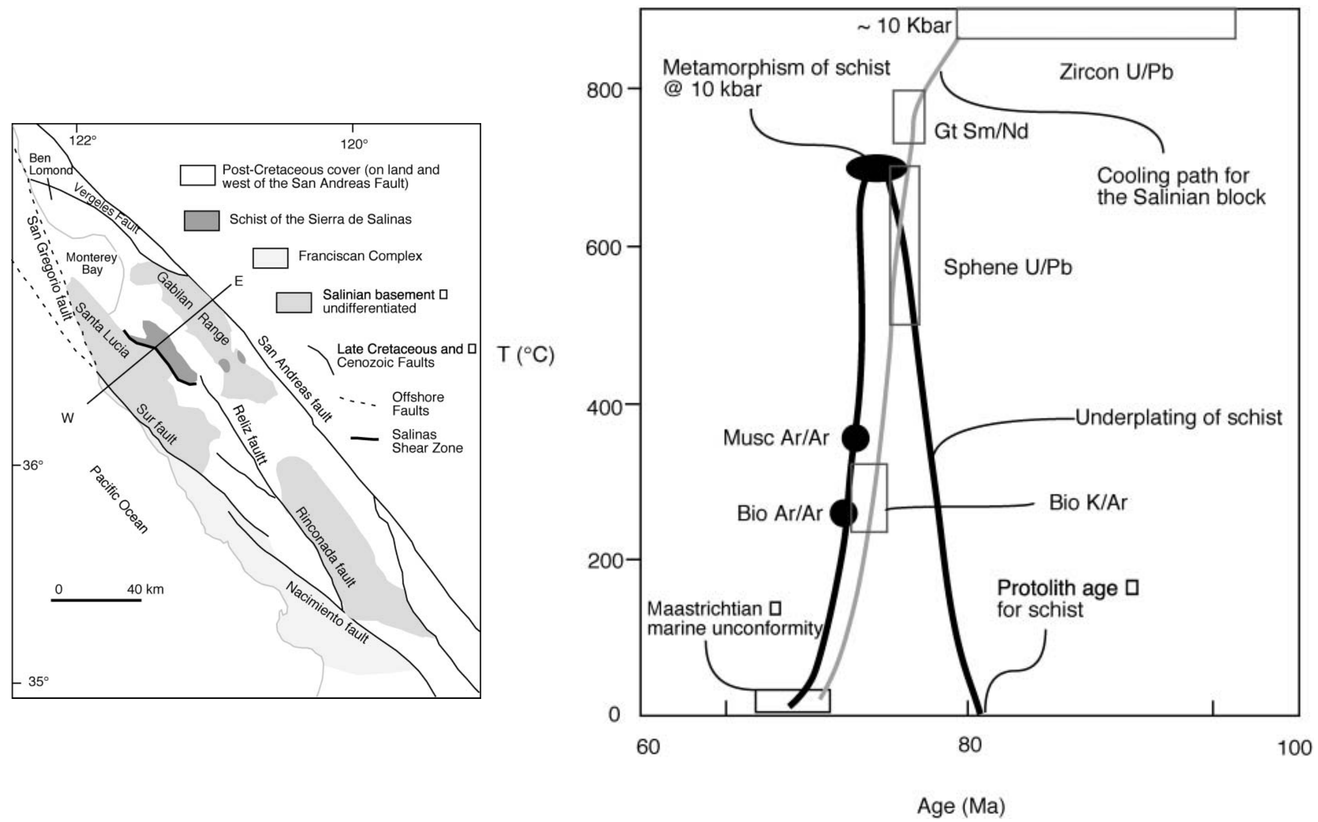
Salinian Schist timing



Ducea and Chapman, *Earth Sci. Rev.,* 2018, after Ducea et al., 2007

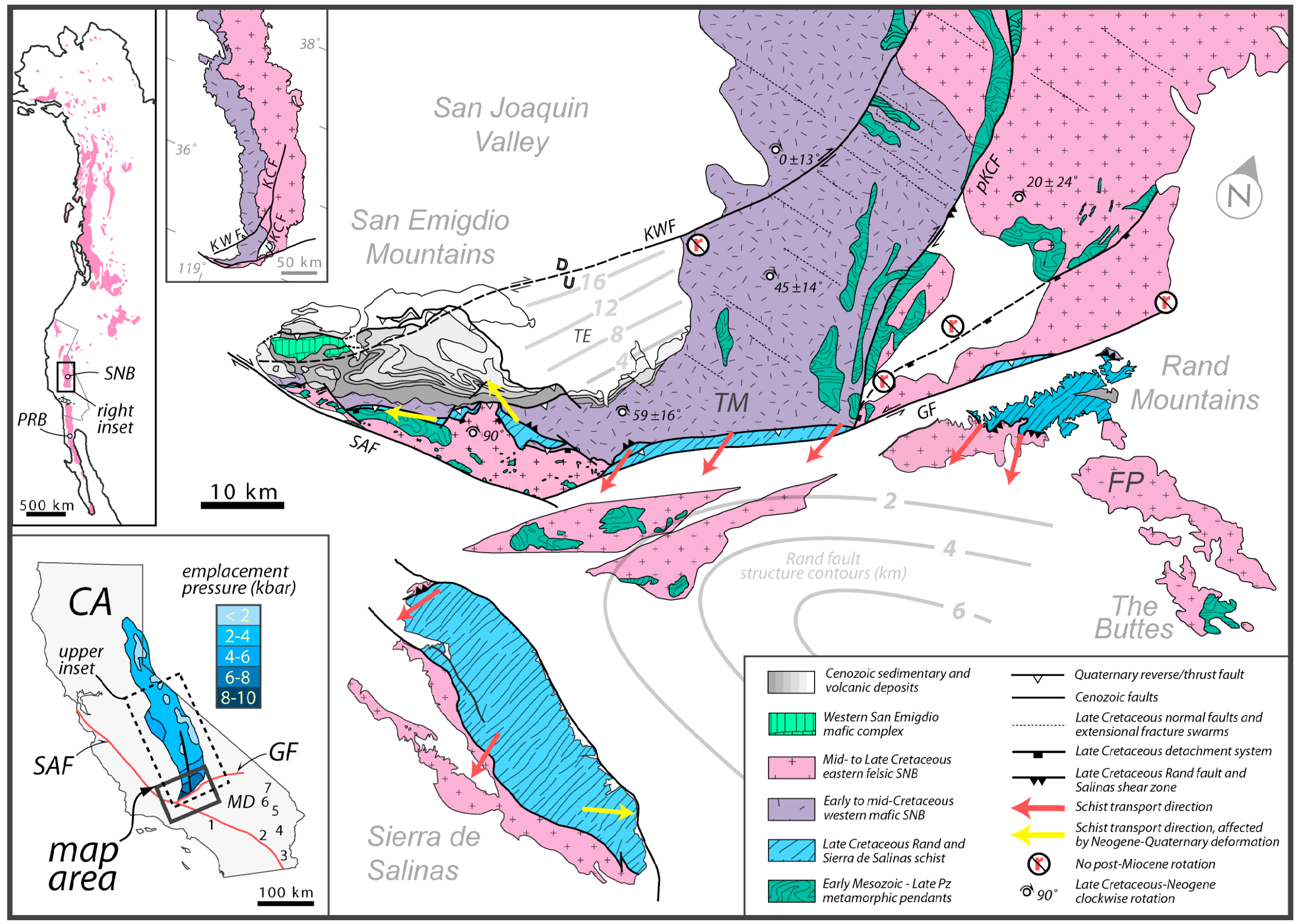
Chapman et al., Tectonics, 2010

This is very rapid, perhaps reaching the surface in under 2 m.y.



Ducea et al., Int'l Geol. Rev., 2009

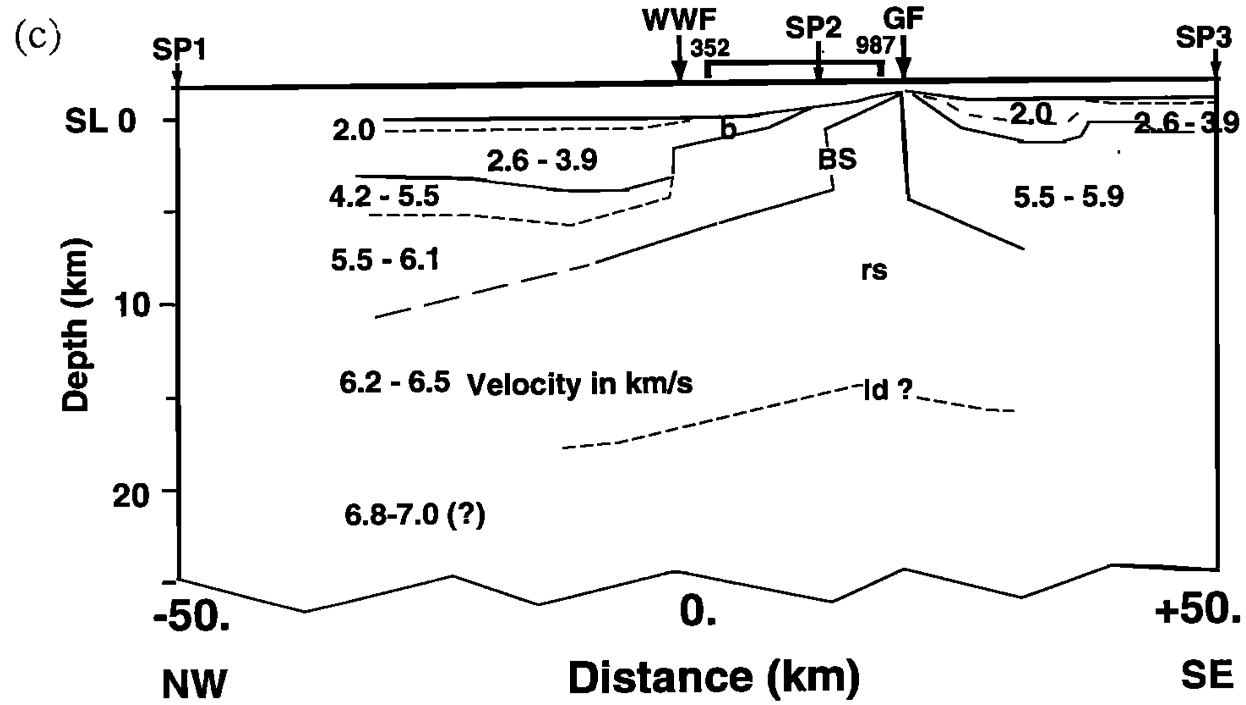
Consider for instance the Sierra de Salinas schist (part of Rand schist group in previous analysis). Other half of the story has to be rapid unroofing.



Chapman et al., Tectonics, 2010

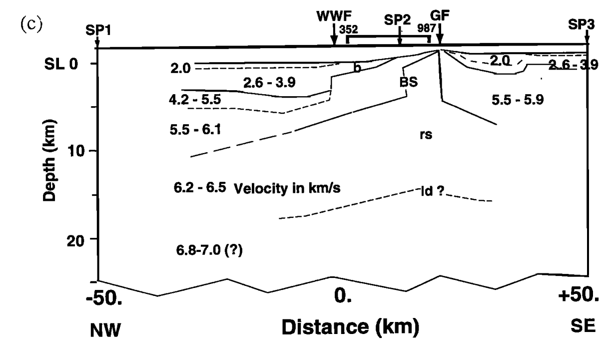
Part of that story is the fact that the schists are emplaced against the middle crust

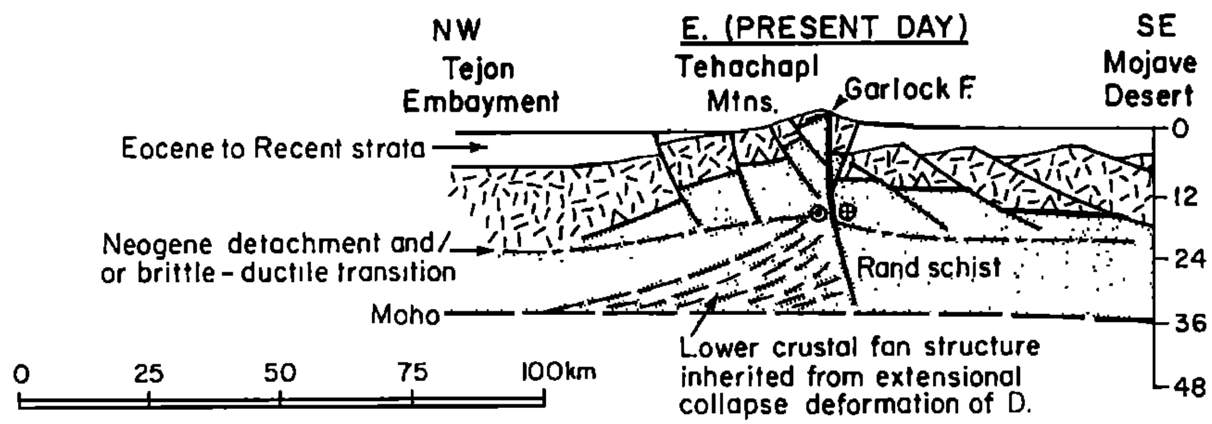
Profile across Tehachapi Mtns



Malin et al., JGR 1995

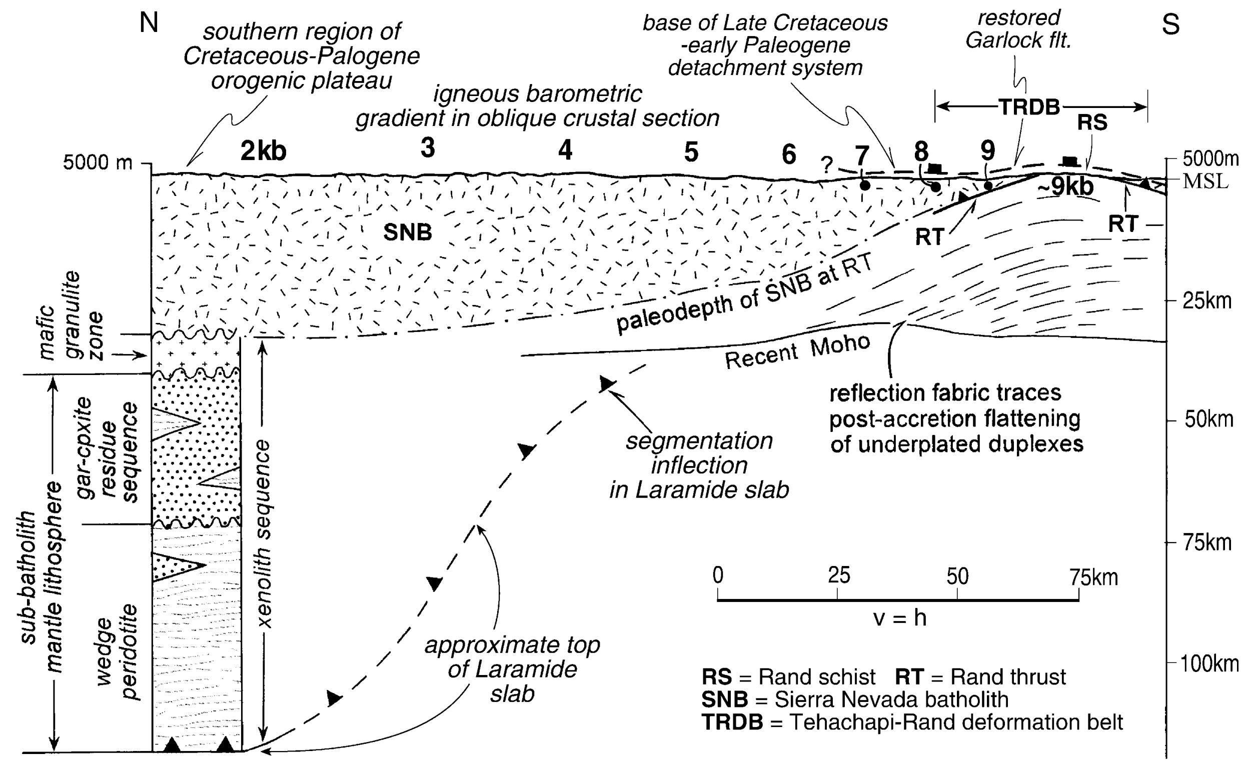
Profile across Tehachapi Mtns



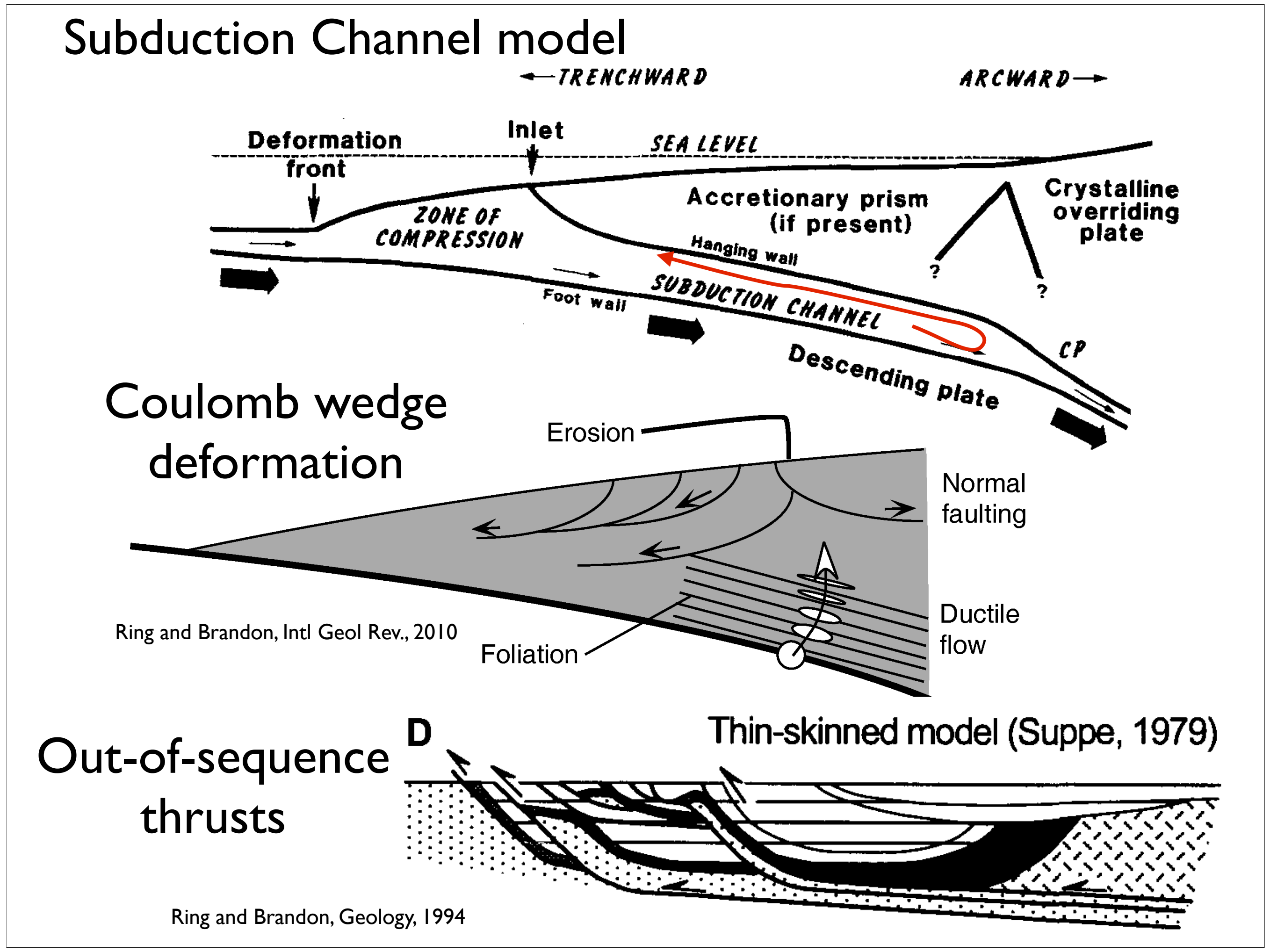


Malin et al., JGR 1995

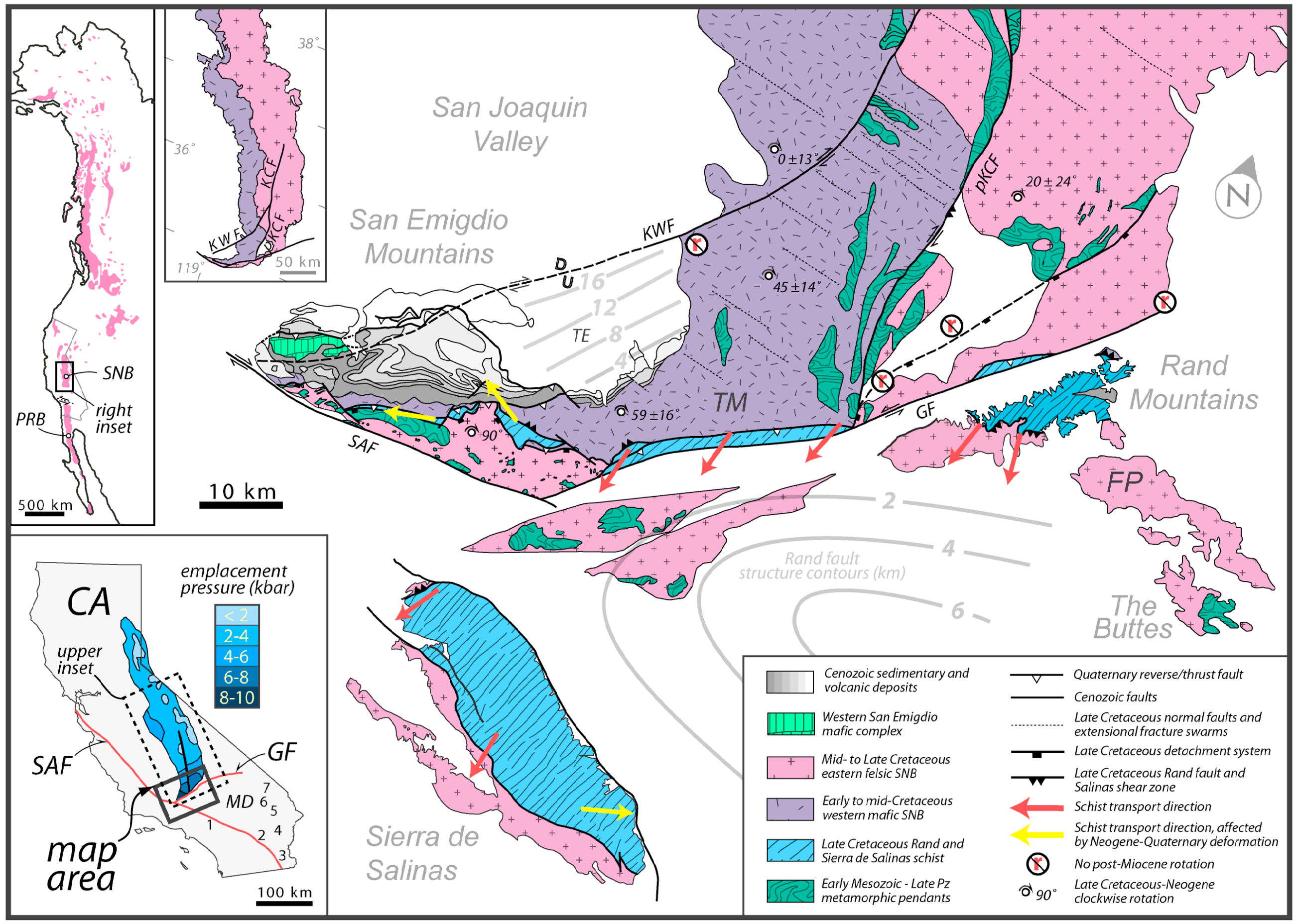
Profile across Tehachapi Mtns into Sierra



Saleeby, GSA Bull, 2003



Subduction channel model--stuff goes back up when too much was going down...maybe best for things like blueschist knockers and the like. Wholesale deformation of the wedge



Chapman et al., Tectonics, 2010

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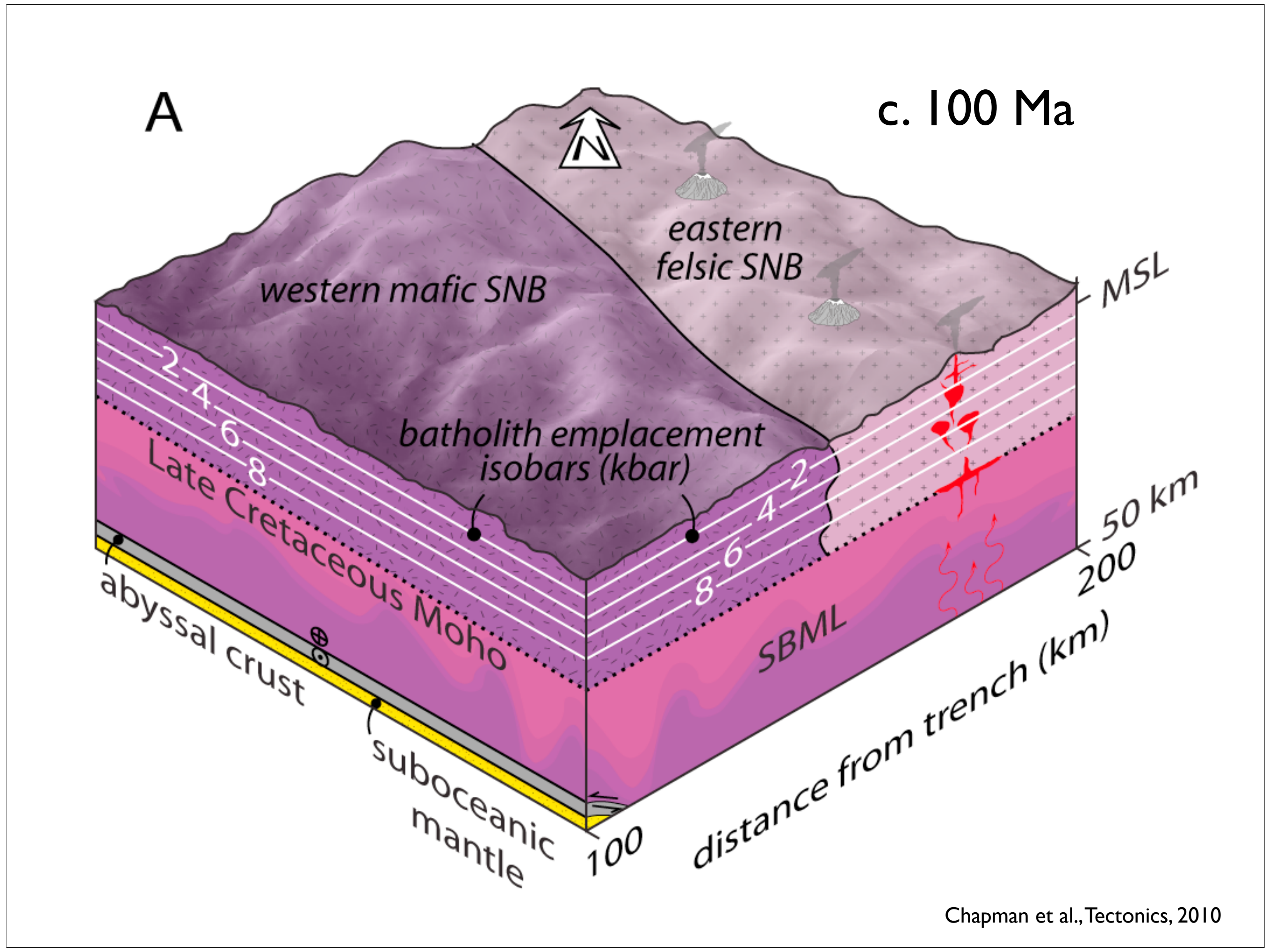
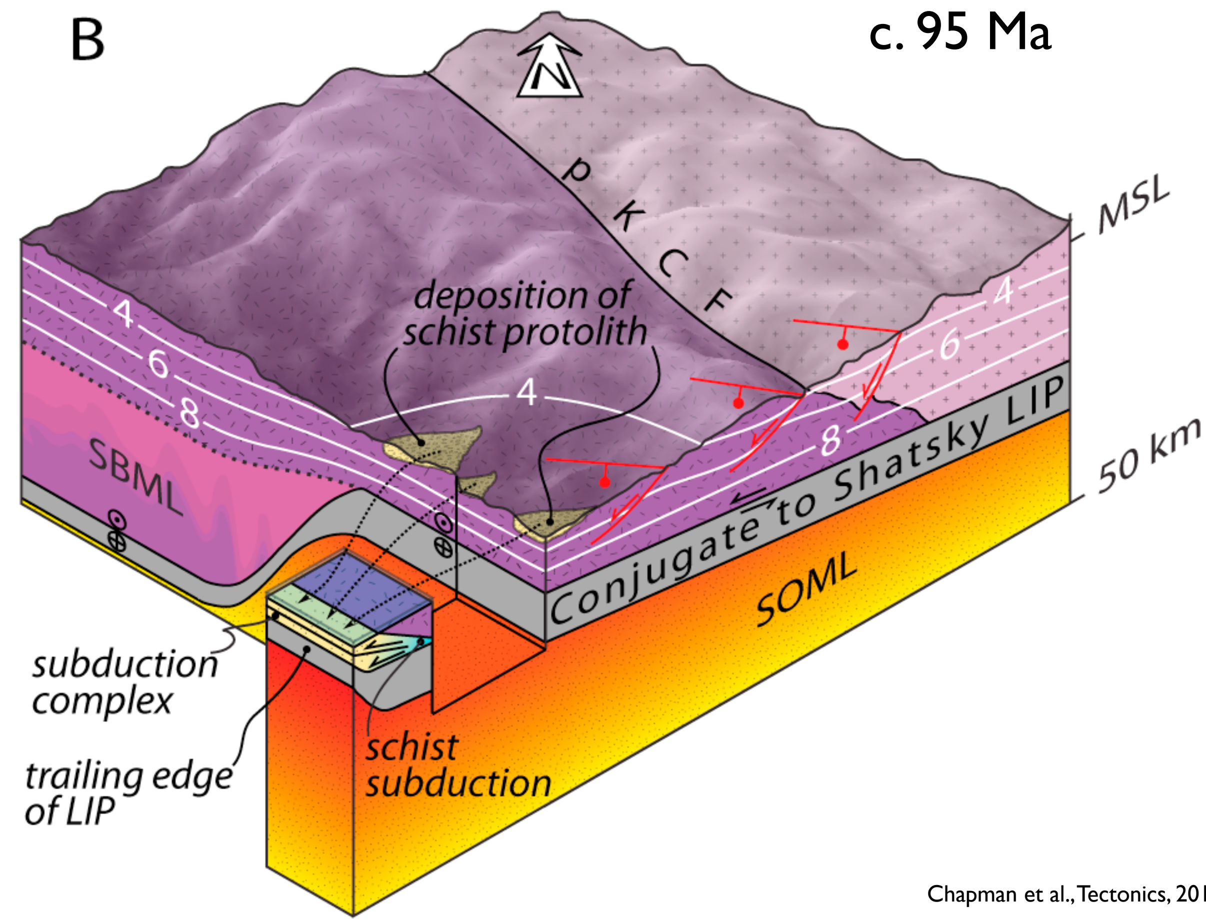
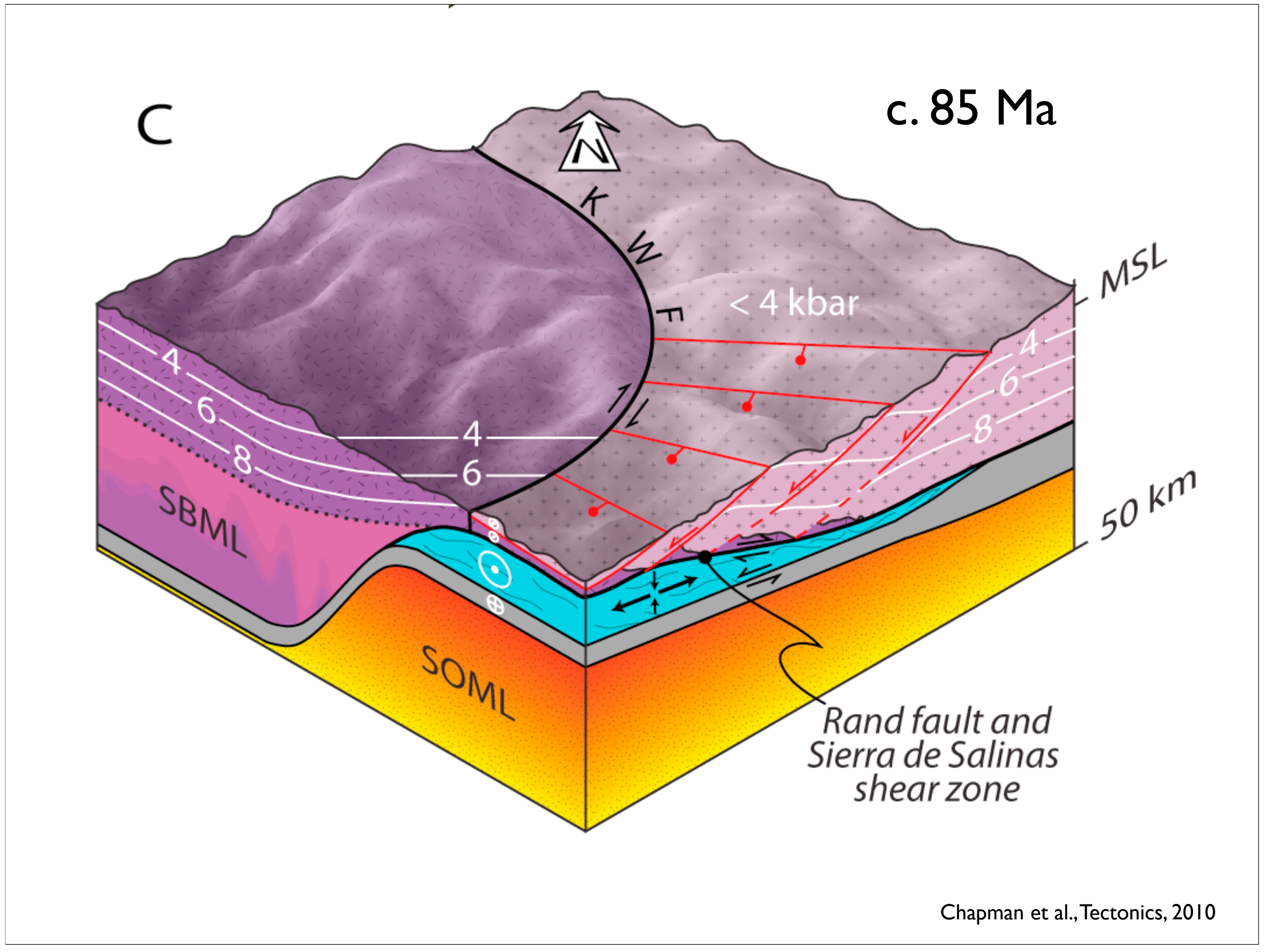


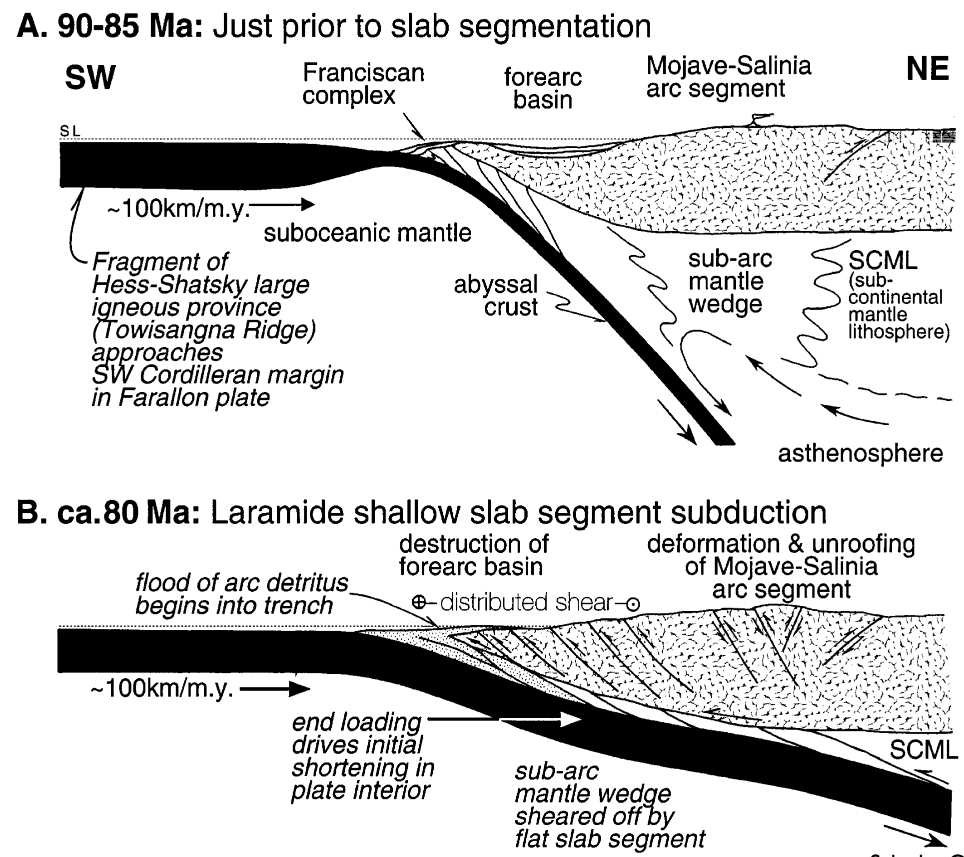
Chapman et al. worked with detailed structural info



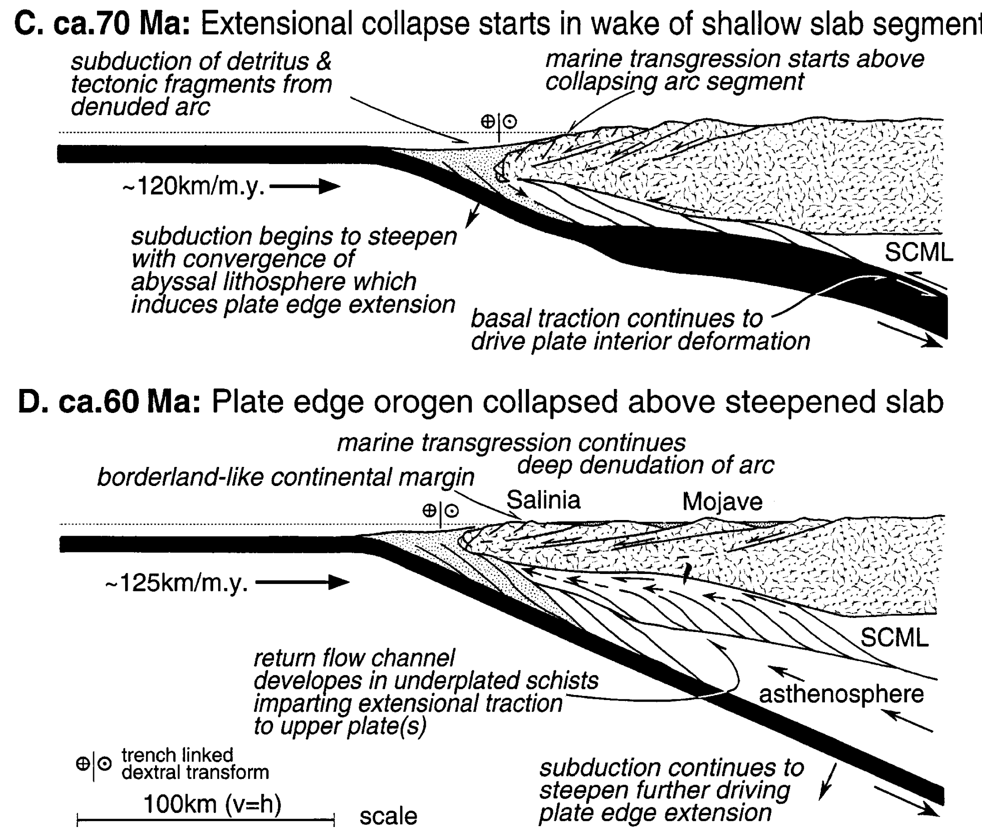
Chapman et al., Tectonics, 2010



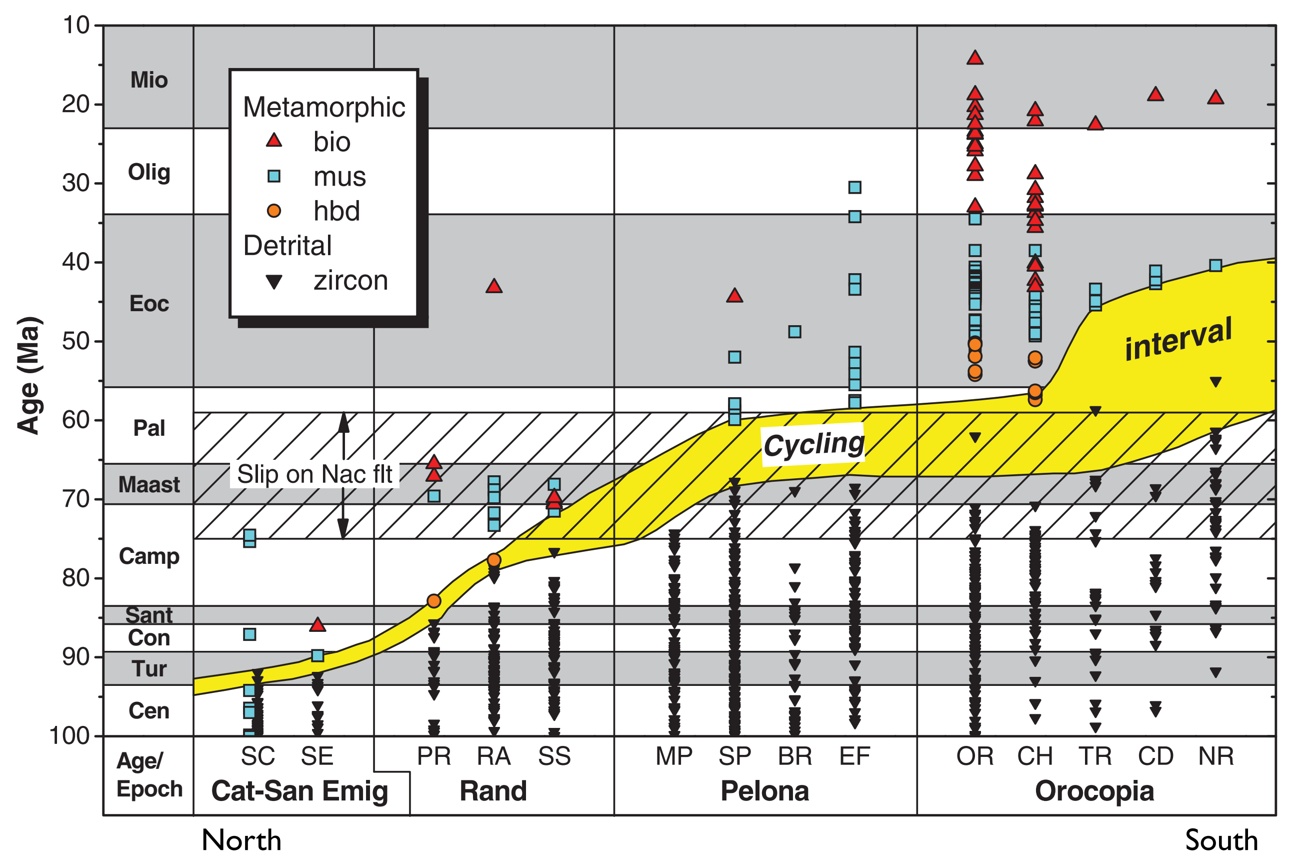
Note timing and substantial normal faulting.



Saleeby, GSA Bull 2003

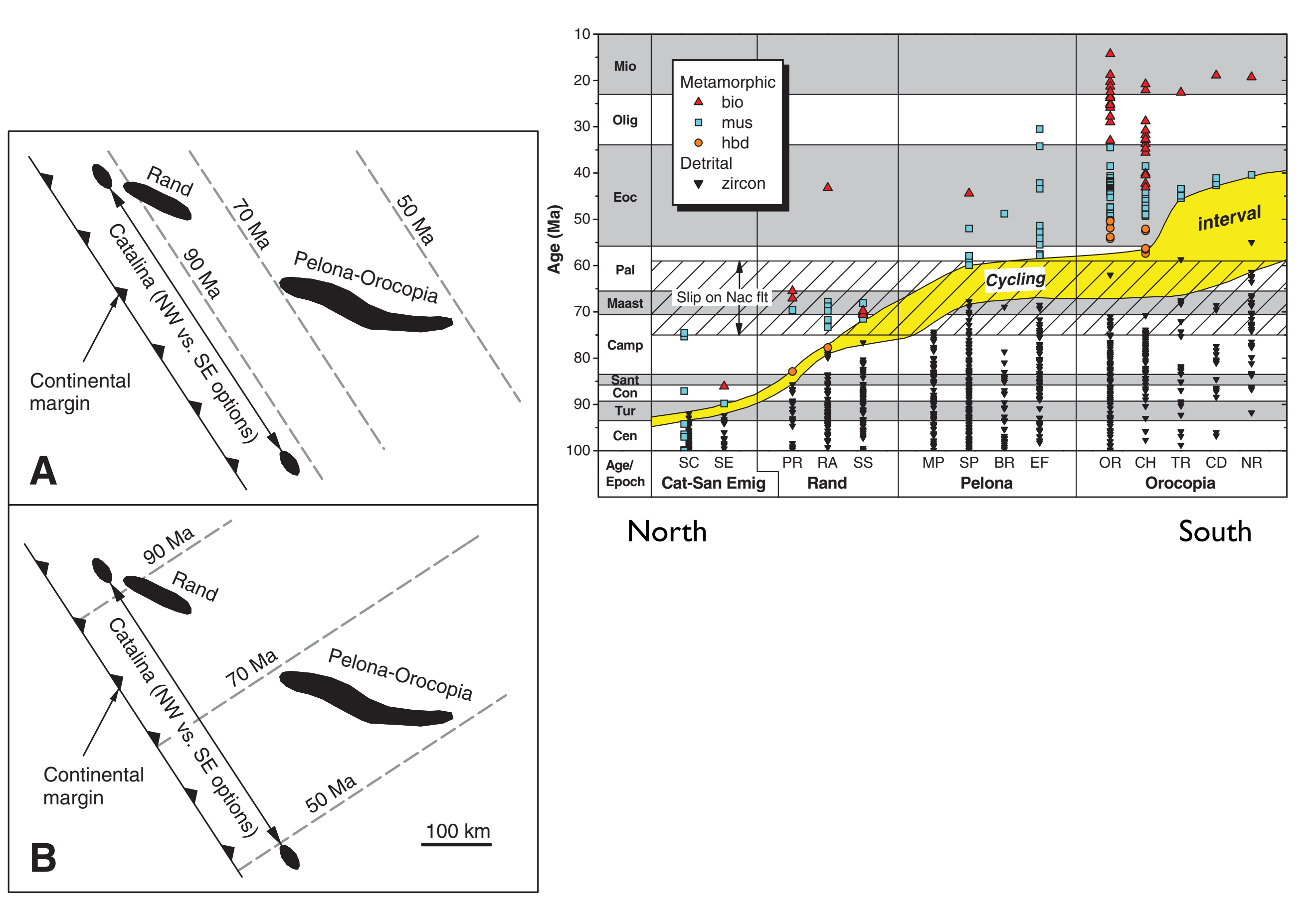


Saleeby, GSA Bull 2003



Jacobson et al., GSA Bull, 2010

Would seem if this is driven by plateau subduction that we have 40-50 m.y. of such subduction...



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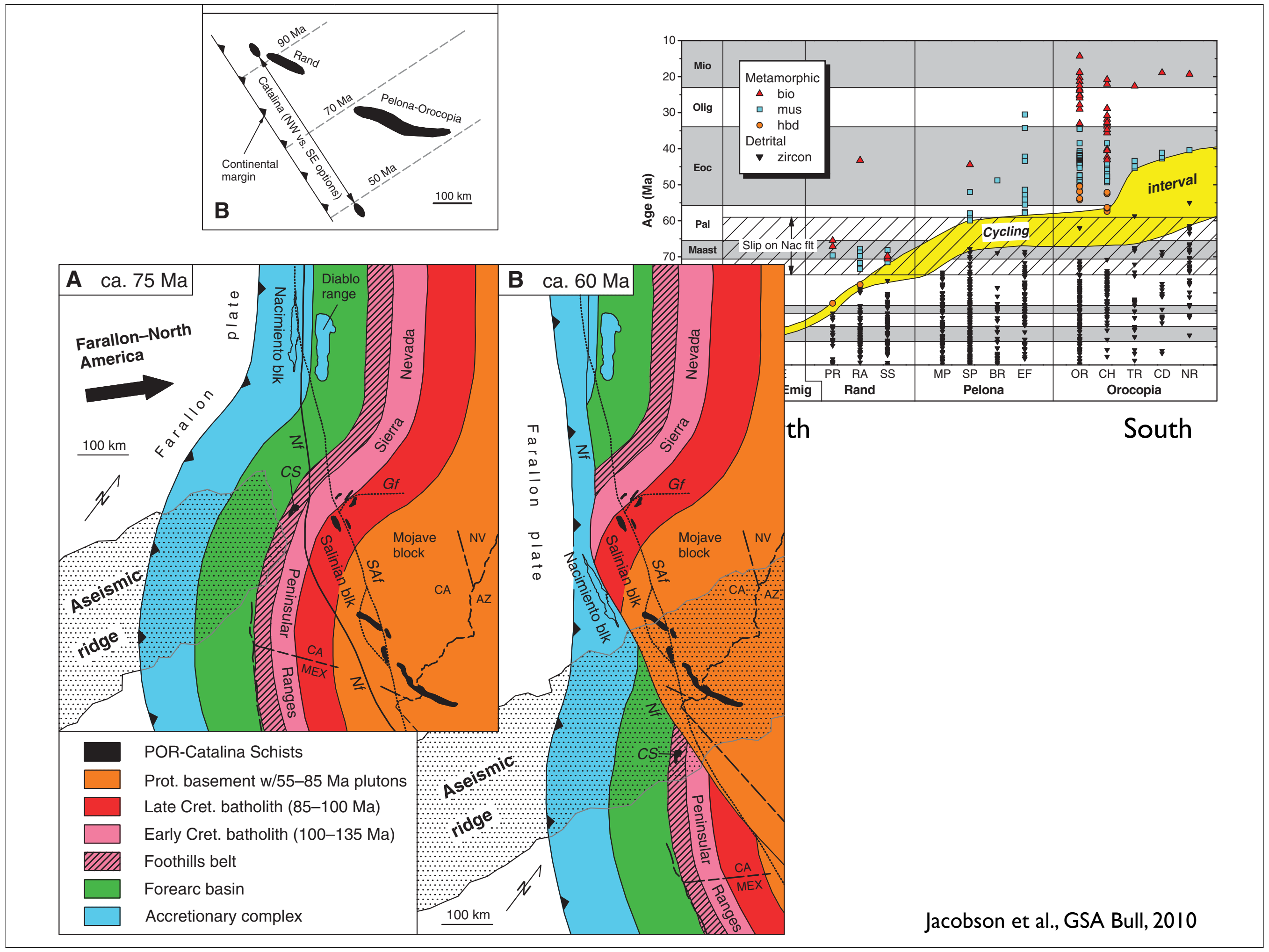
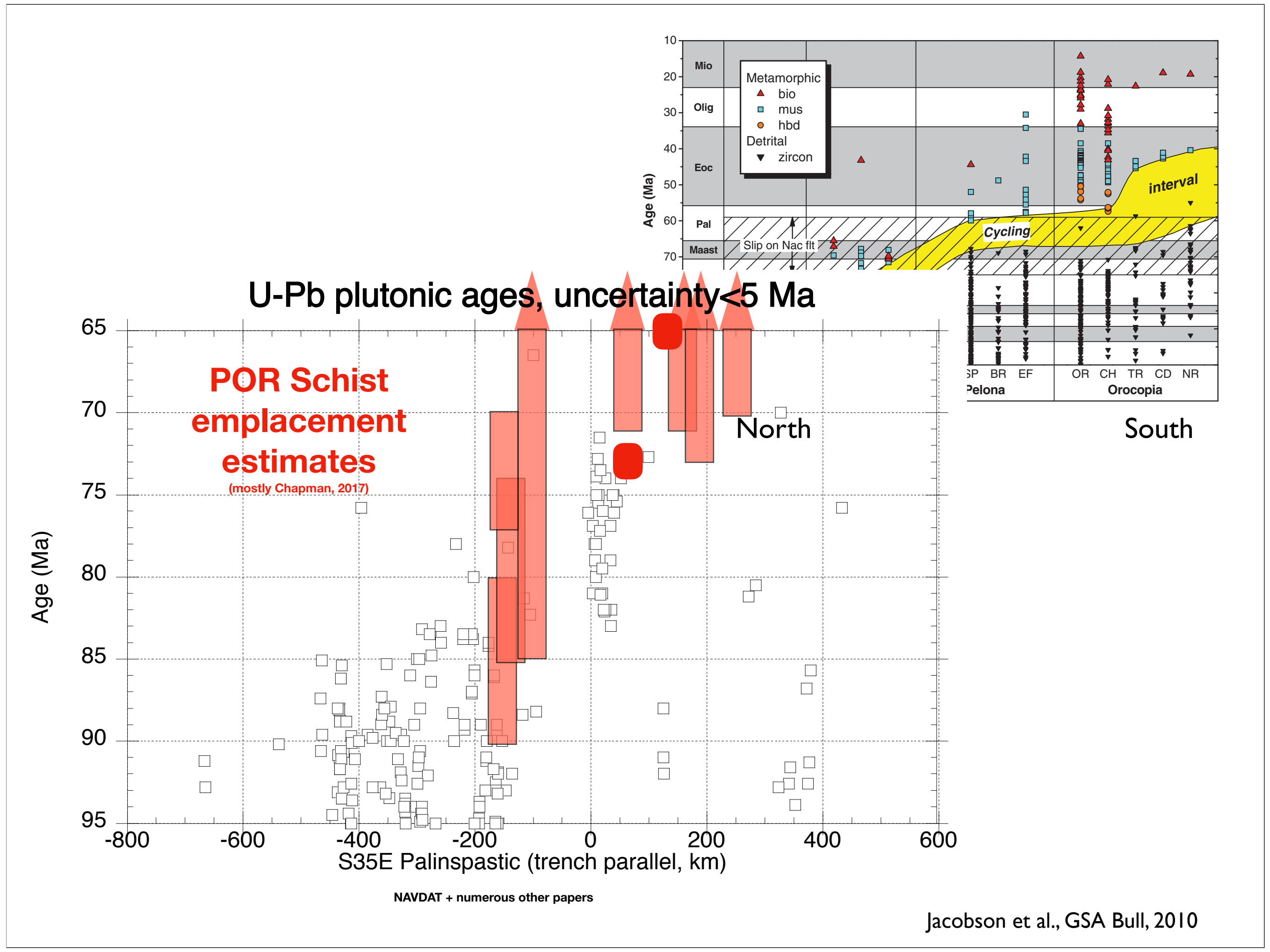
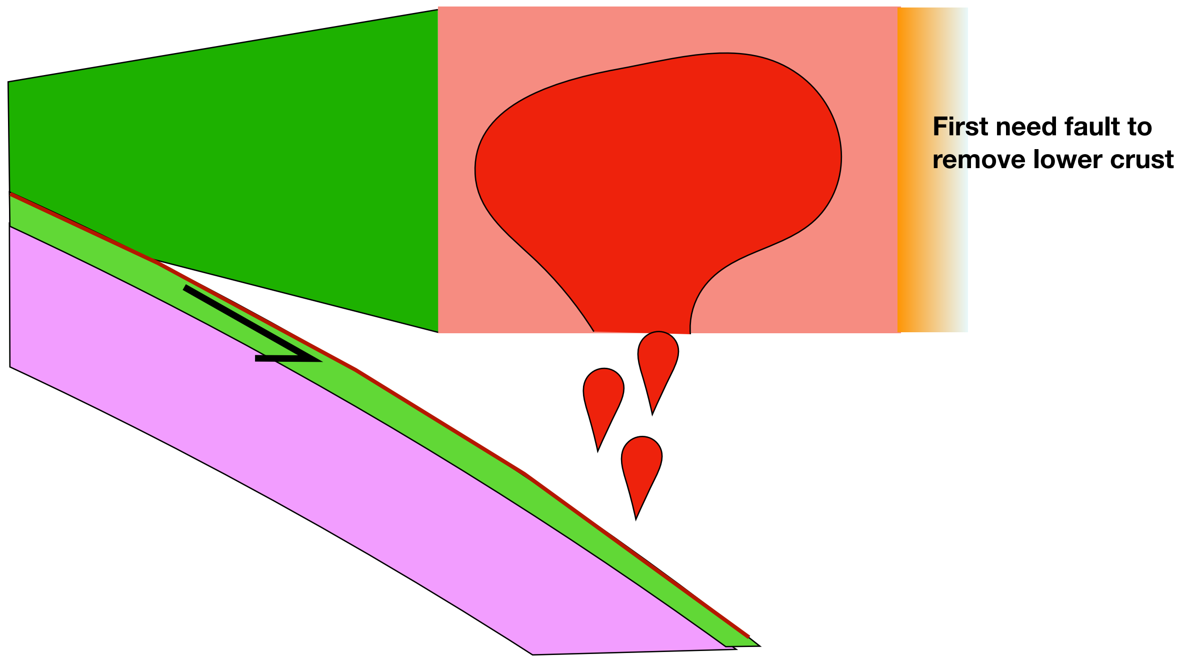


Jacobson imagine a long ridge hitting obliquely.



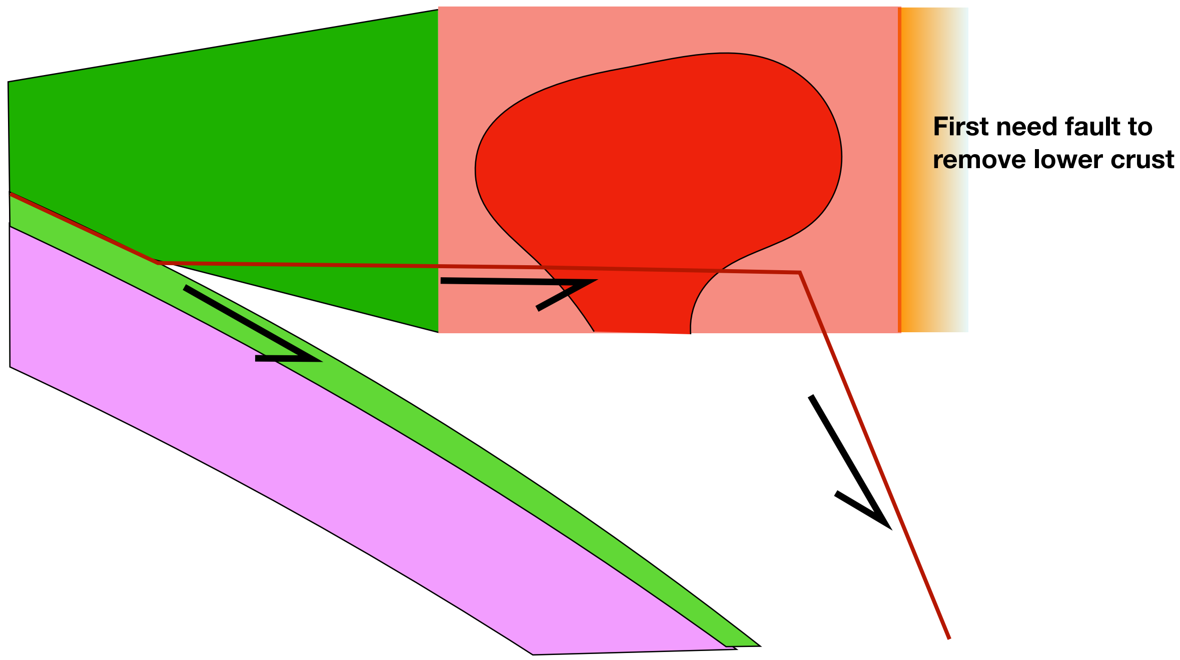
From Jones, GSA talk, 2019. Heavy red dots are Plomosas (73 Ma, Seymour et al., 2018) and Cemetery Ridge (65 Ma, Jacobson et al., 2017). Note P-O schists come in right as magmatism dies while Rand schists seem to potentially overlap with arc.

How to Emplace a Schist?

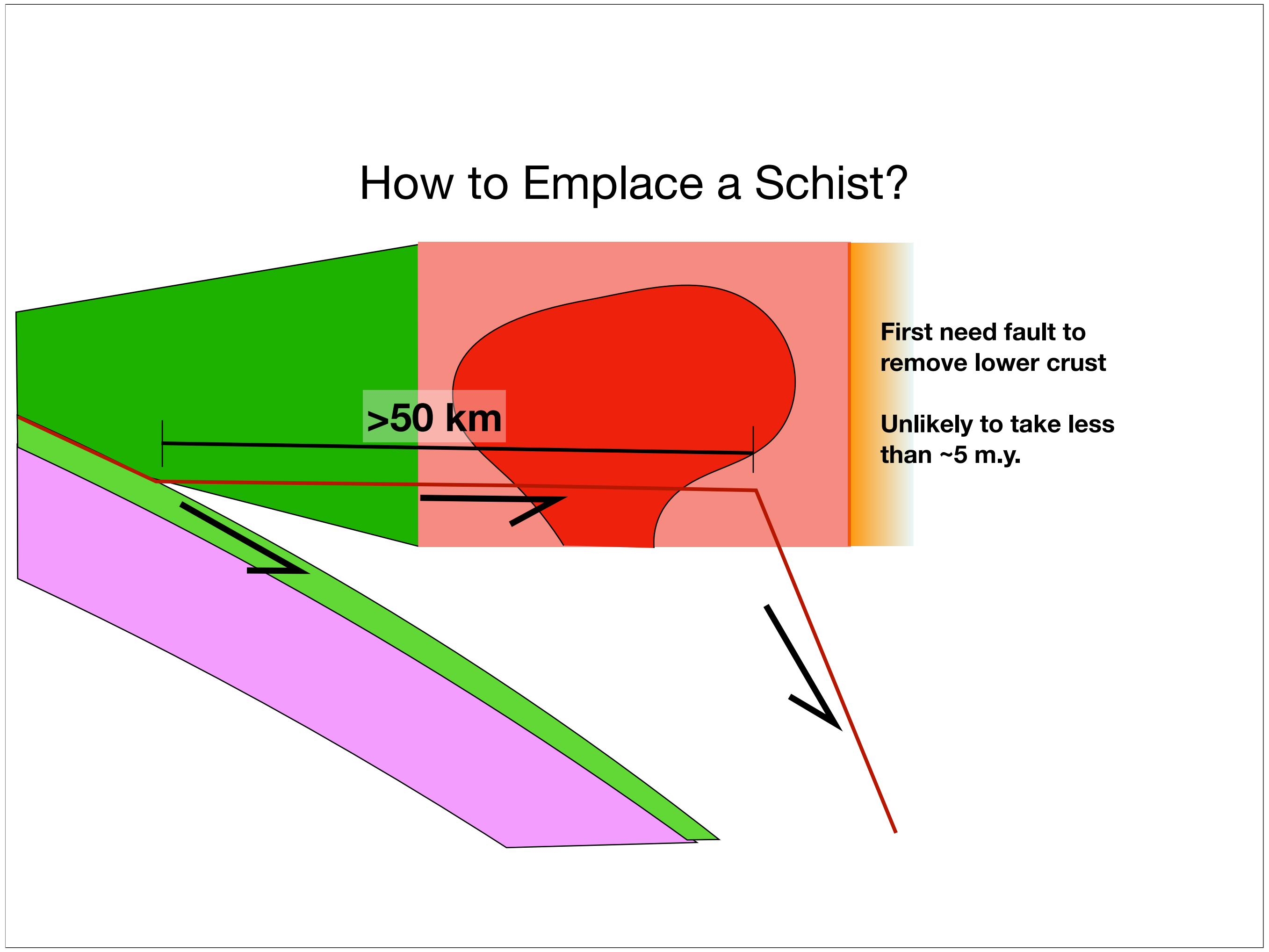


So how would this work? A schematic exploration…

How to Emplace a Schist?



If rising up, need to remove no less than 50 km of material that was under the arc. Sideways that much or more (dip unlikely more than 45 degrees by this point). Hard to do in under 5 m.y.



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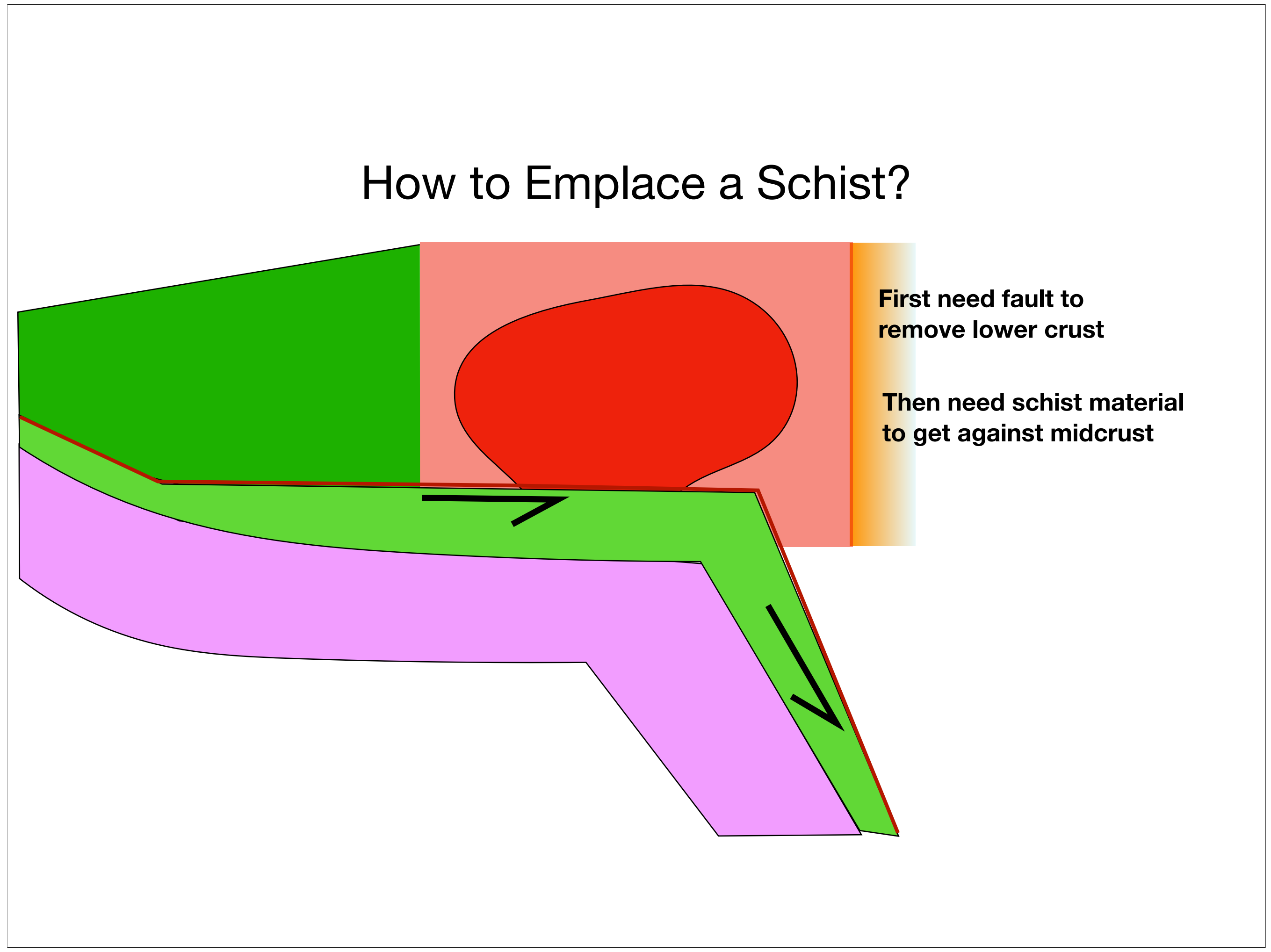
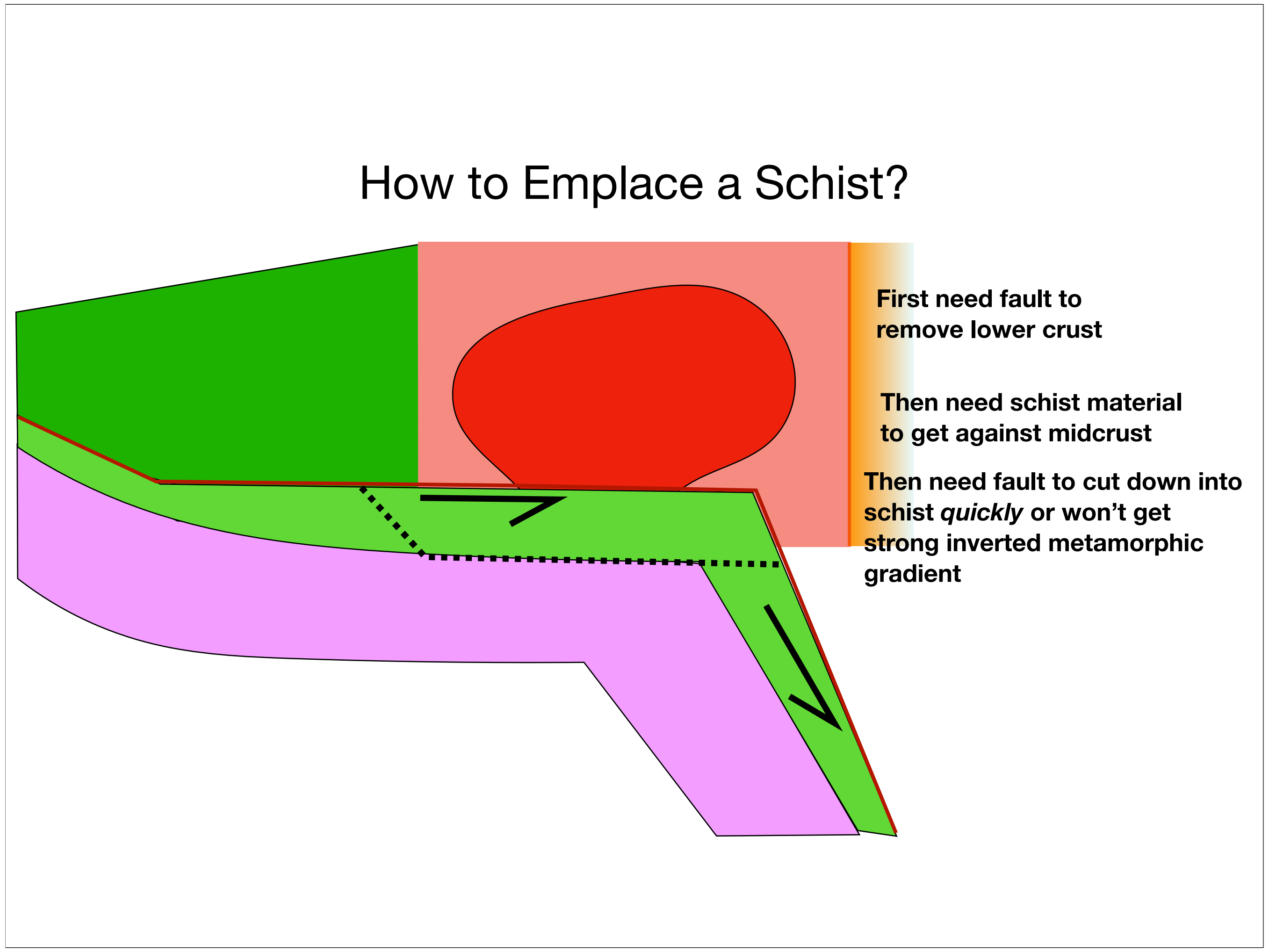
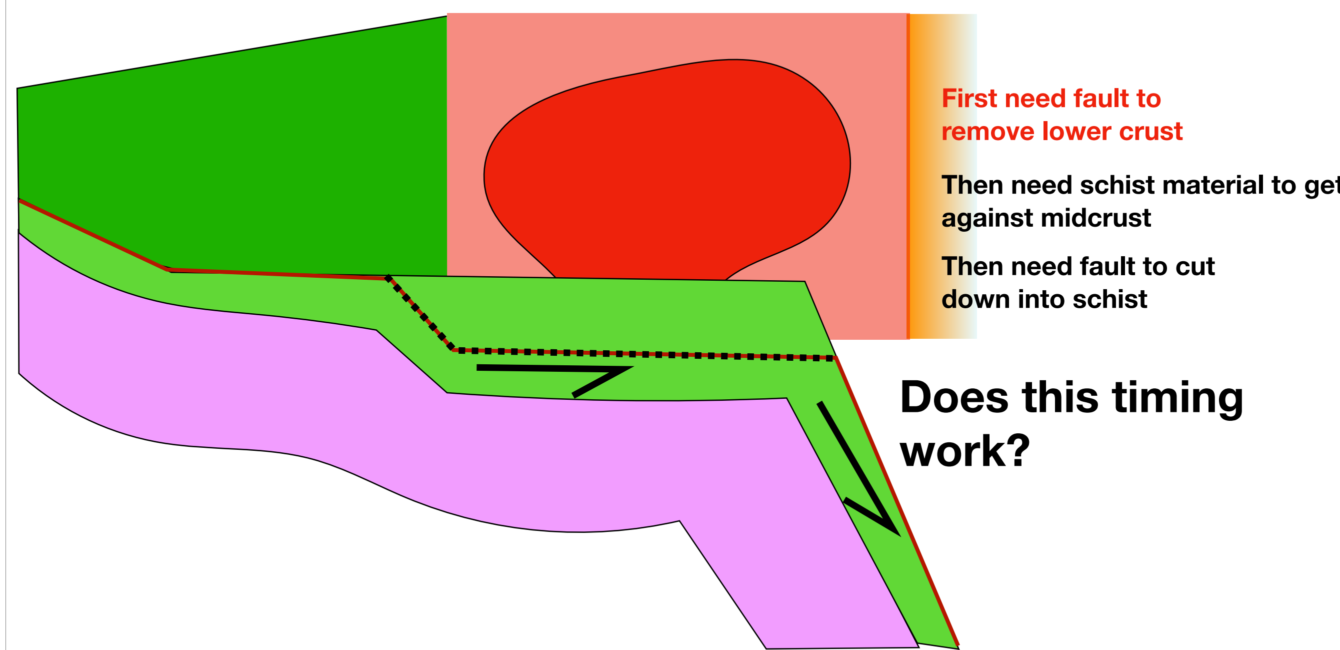


Inverted metamorphic gradient in schists hard to do if schists keep traveling past the pluton. Note that I haven't worried about moving schists down and back up, as is generally inferred.

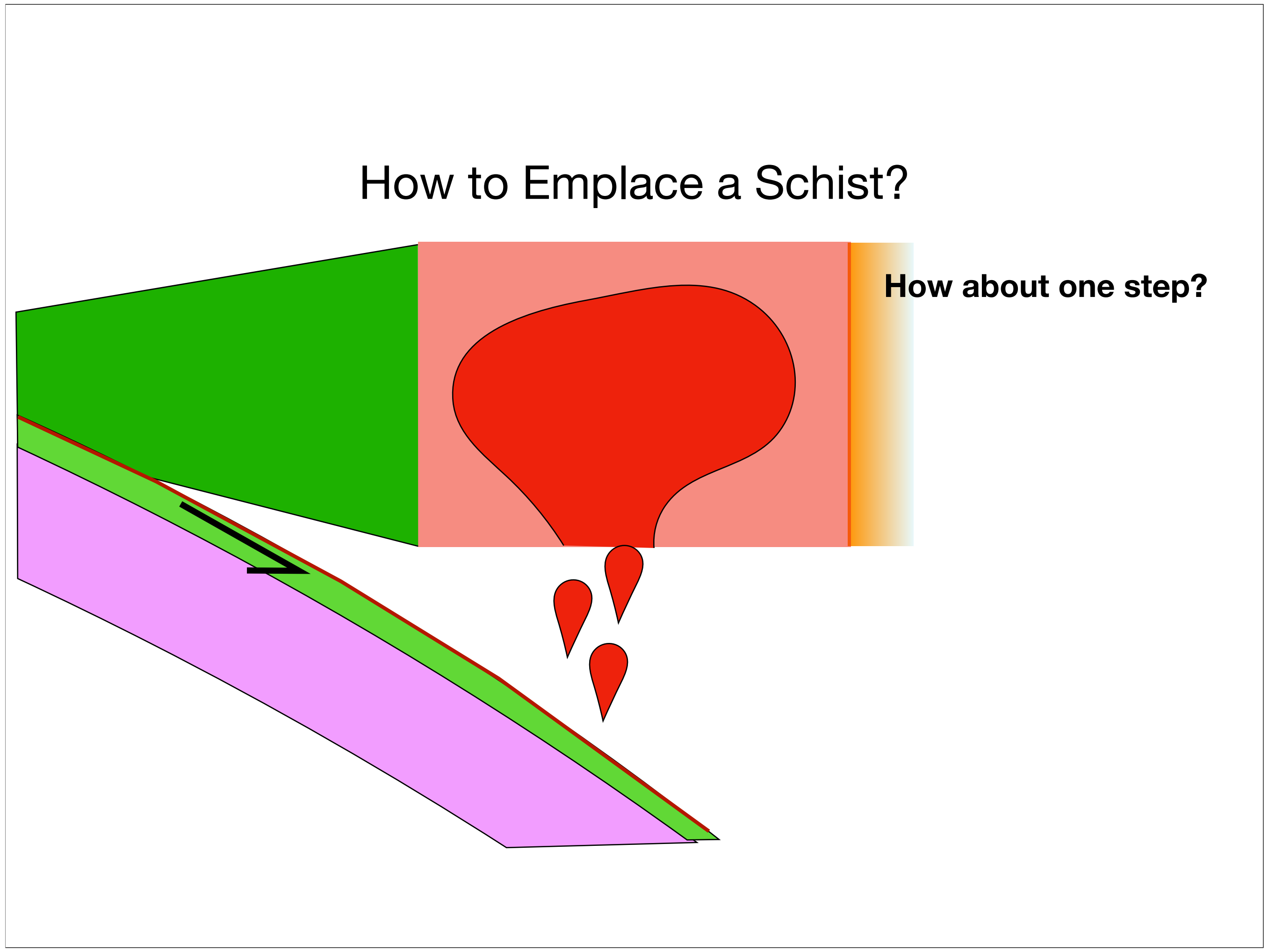


Quick cut downward shortly after thrust cut up.

How to Emplace a Schist?

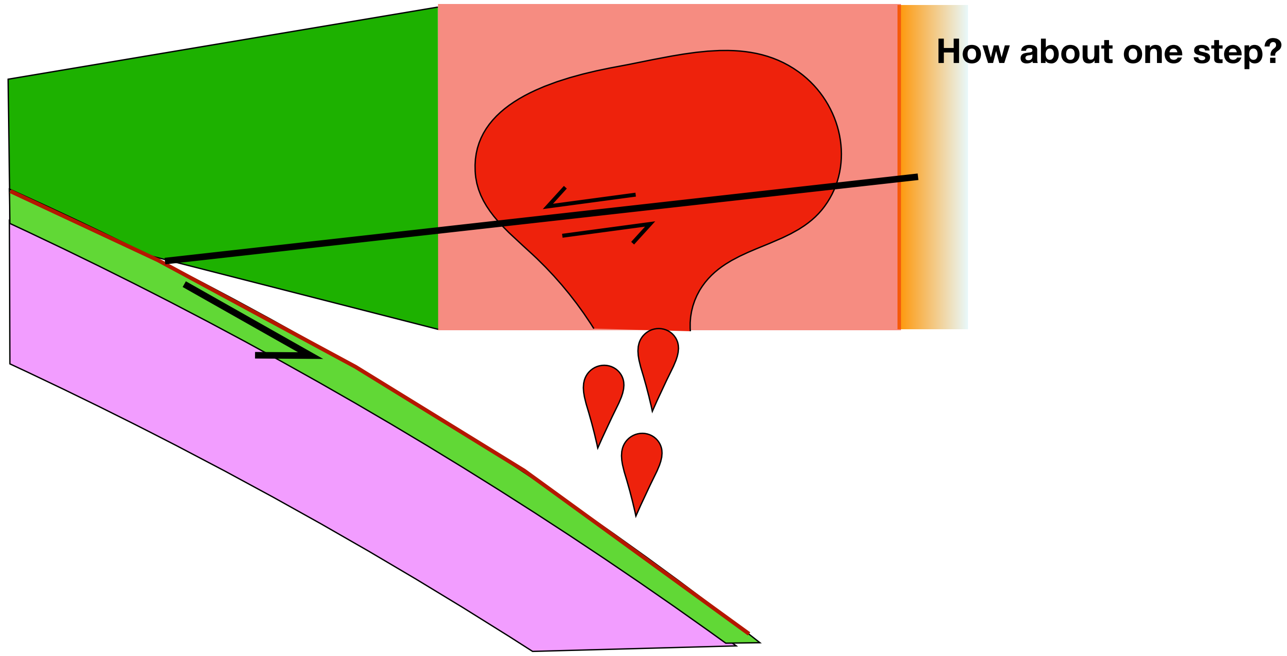


If schist protolith is less than c. 8 m.y. older than cooling pluton, seems like this is very hard to do…and then there is extension right after this to move these rocks higher up (*much* higher up in case of Salinian schists).



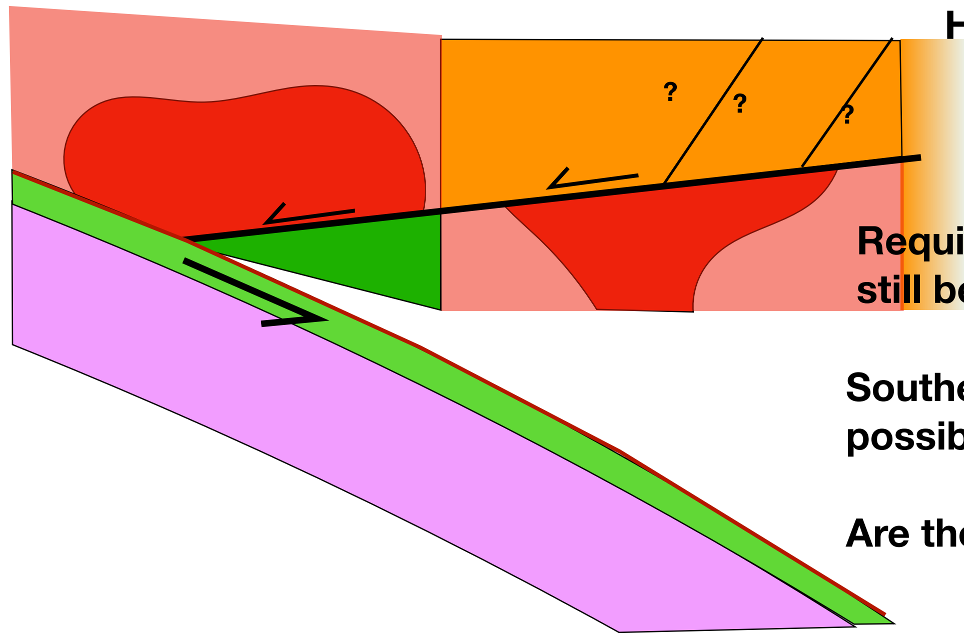
So let’s cut out the middle man…

How to Emplace a Schist?



All these schists have normal faults at the top, it seems, so maybe start there?

How to Emplace a Schist?



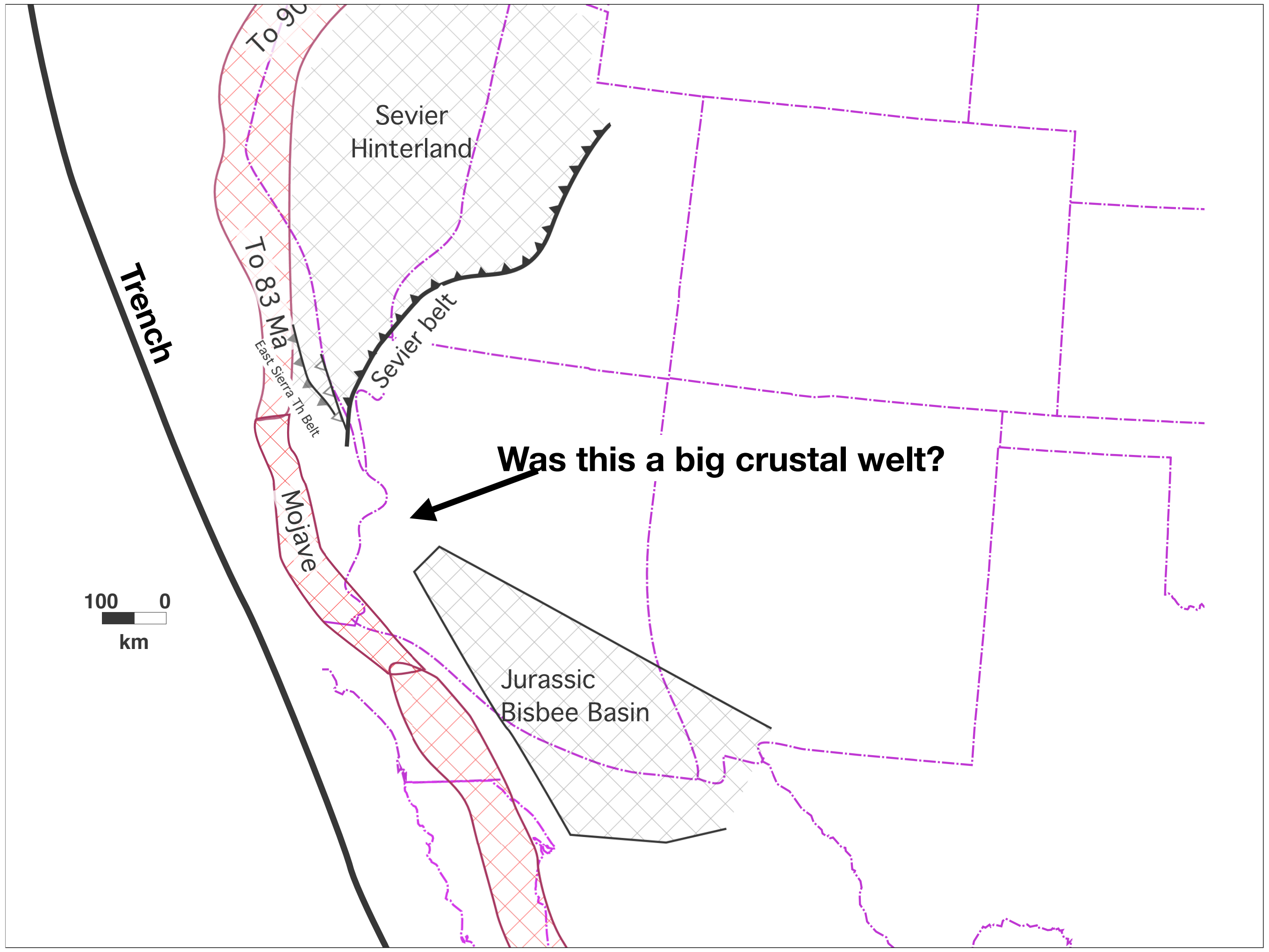
How about one step?

Requires lower crust to still be somewhere…

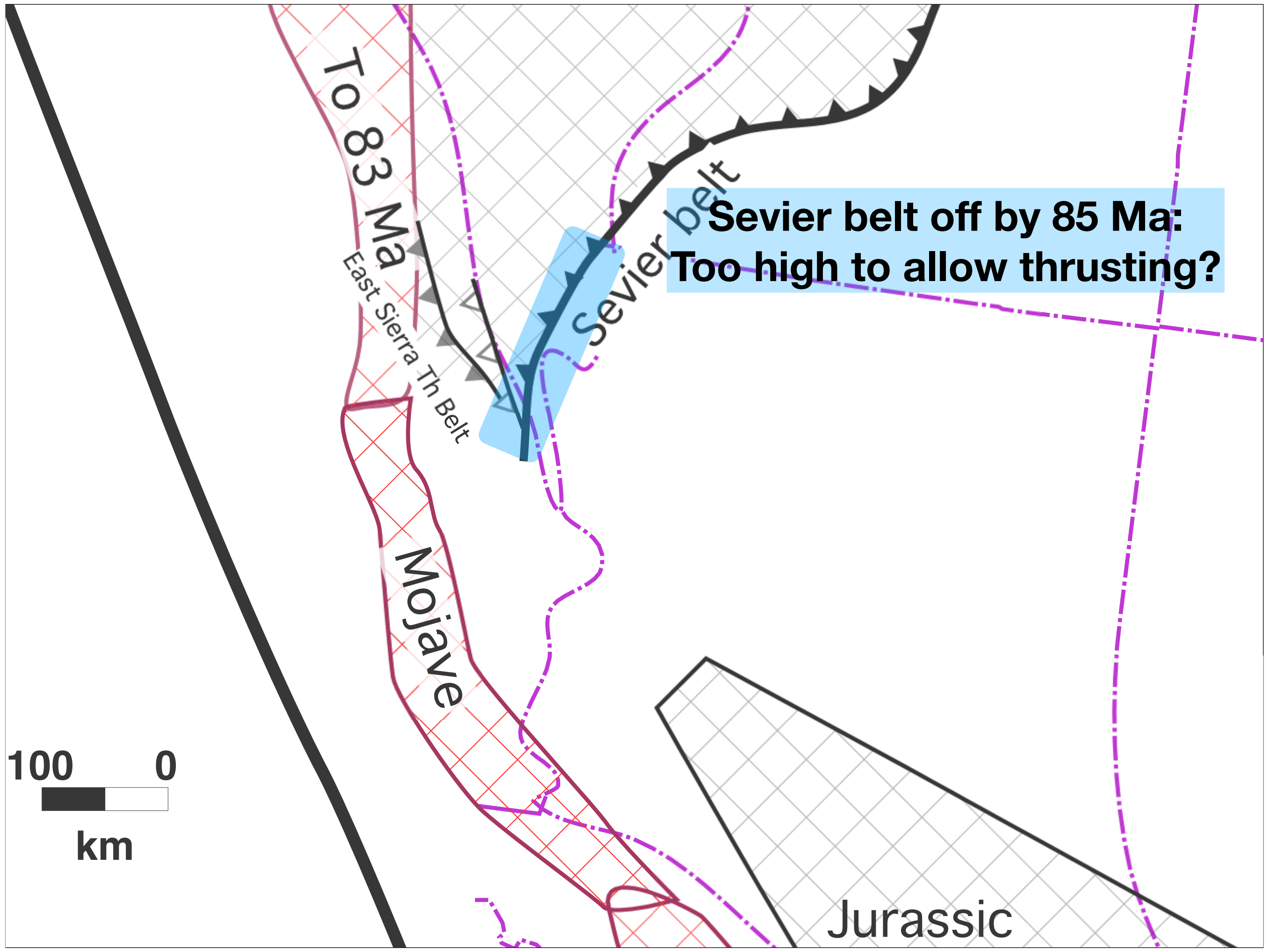
Southernmost Sierra one possibility…

Are there others?

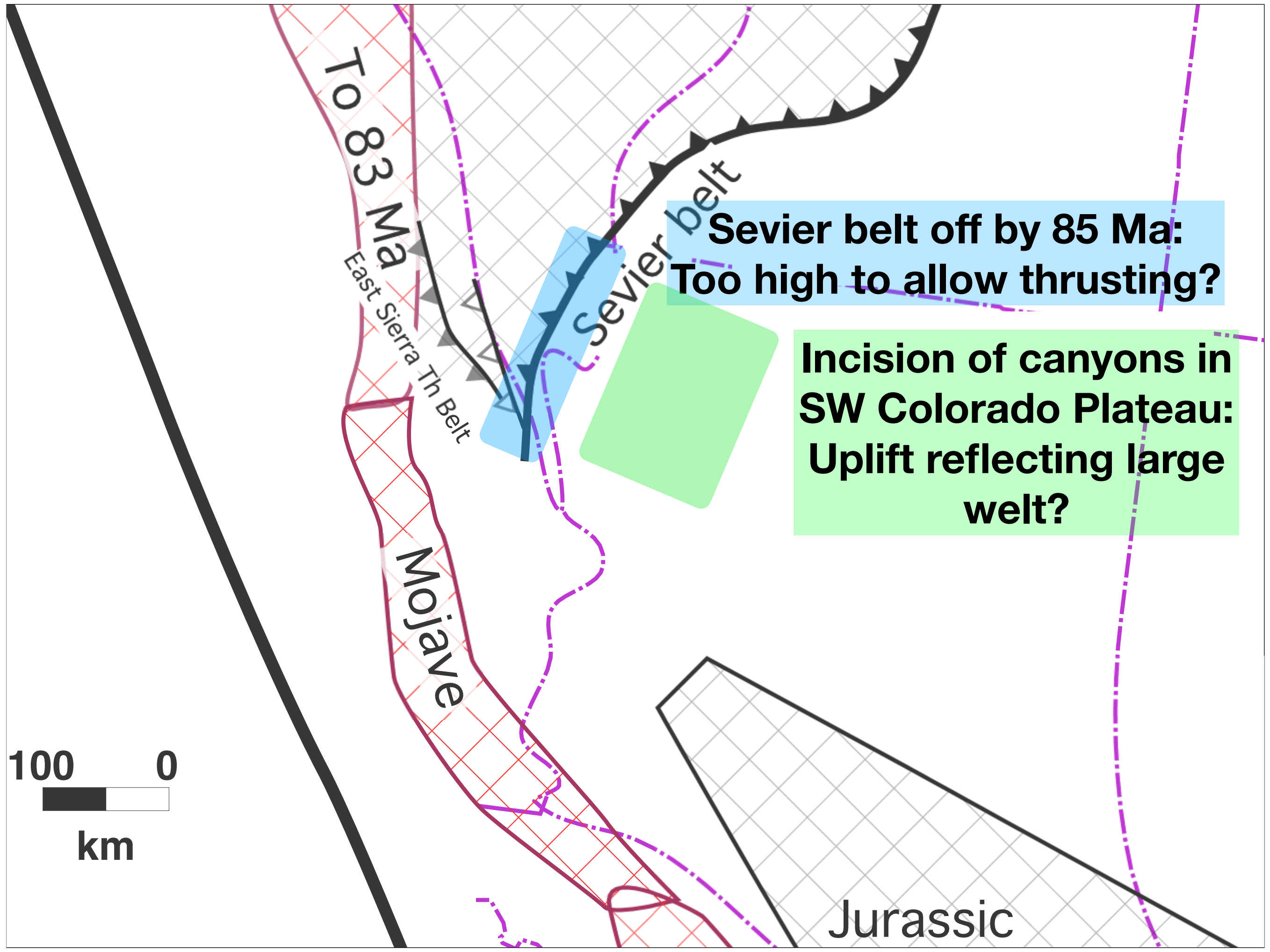
Also requires a big breakaway somewhere…that we don't seem to see. But note that small tilt would make these look like a thrust in some sense. Obviously this proposes that there are a bunch of structures not well recognized out there—but there are some things in favor of this goofy idea…



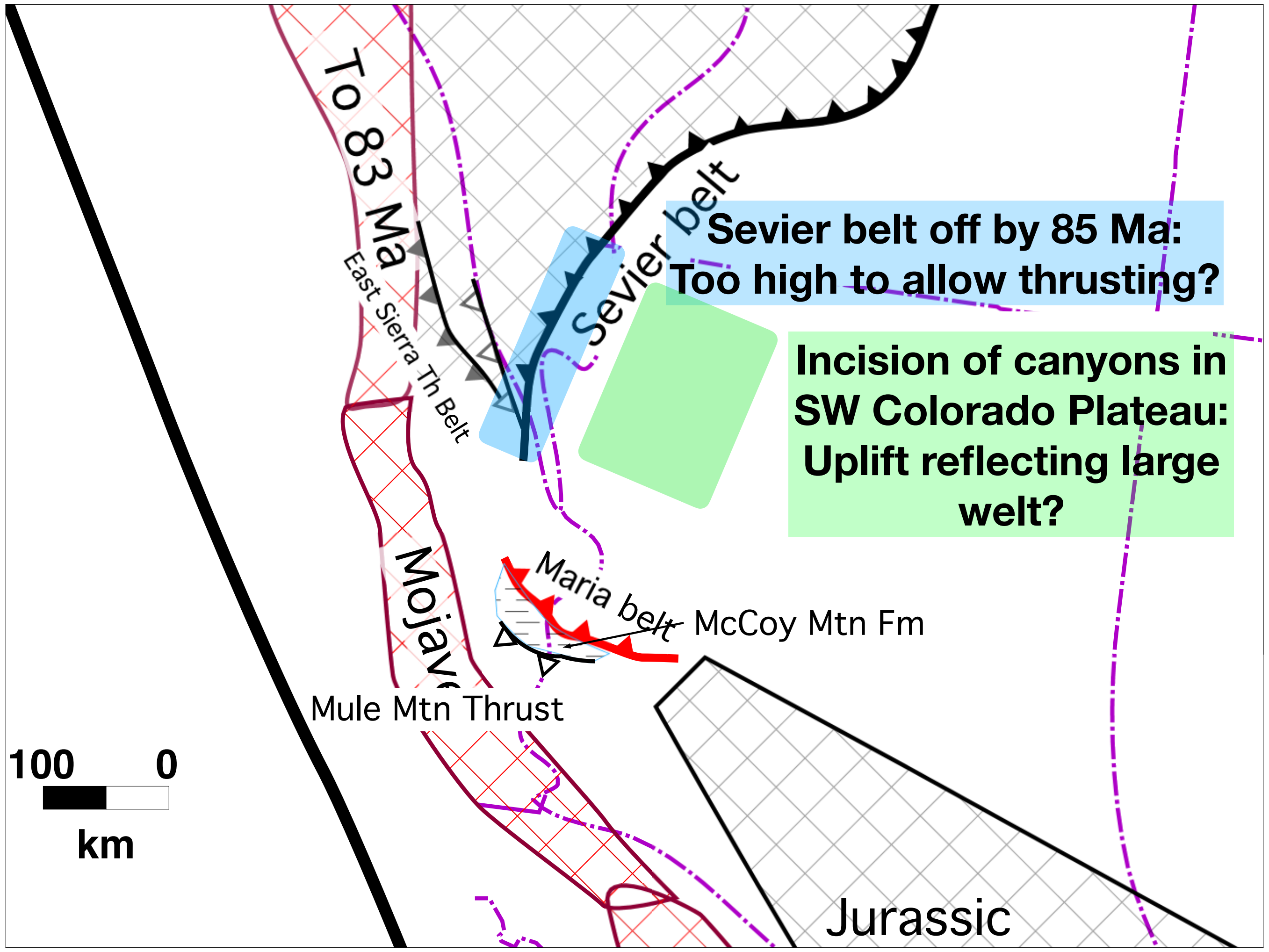
Big normal faults probably require a big pile of crust—or at least crust rising up really high…



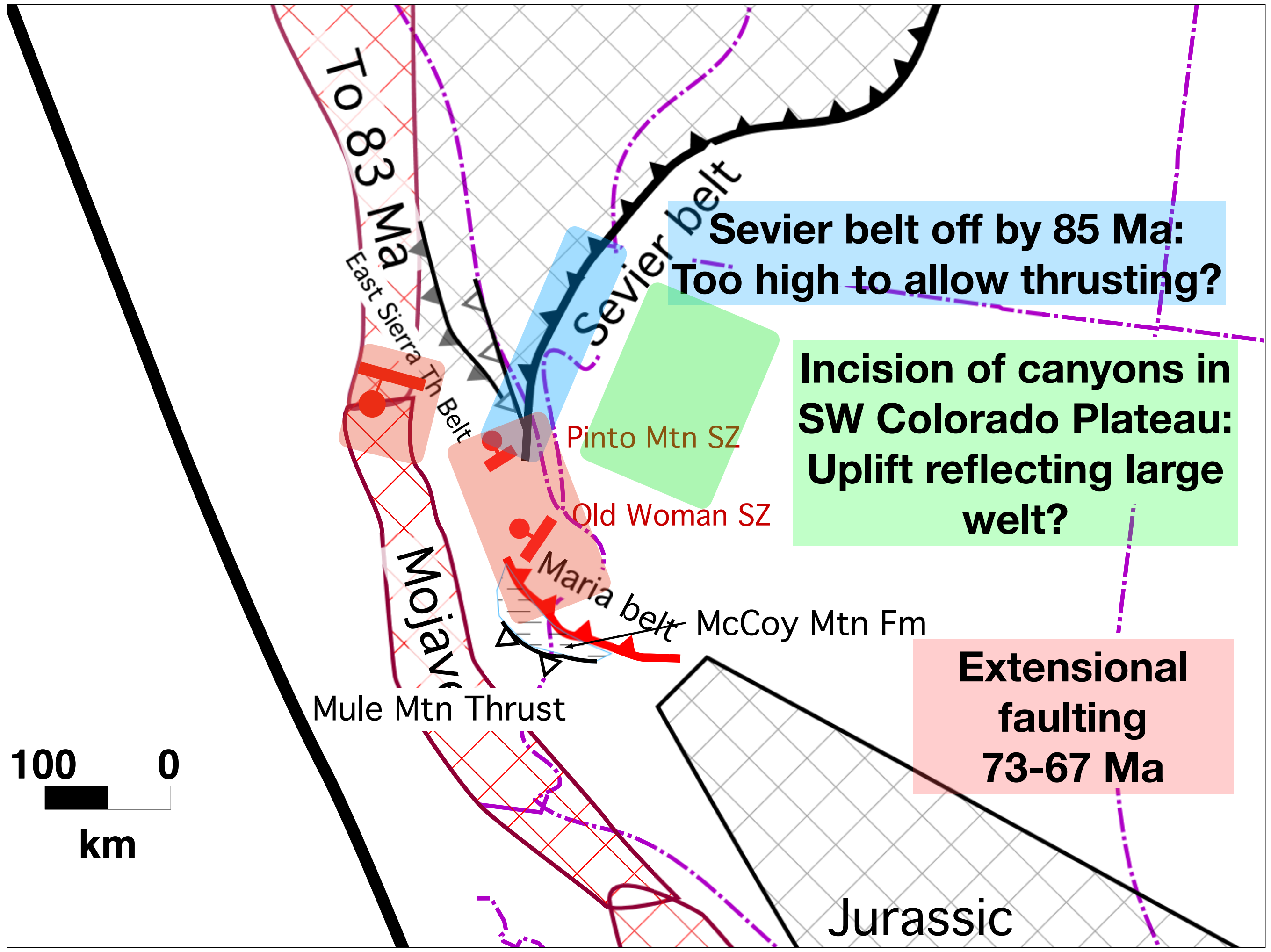
Would explain the shutdown of southern Sevier—just got too high (GPE acts to balance end loads much as Tibet is in extension at the surface). Also makes this as source for rivers to NE more palatable.



CP incision as dated by Flowers et al.; Music Mountain Formation of Richard Young is Paleocene; “California River” deposition of SE CA source into Uinta Basin is late Paleocene.



Also, could thrusts to south be from highland collapsing to the south initially? Faults in Maria belt reverse from compression to extension in this time frame.



Several extensional faults in this area date to immediate post-arc timing.
Funeral Mtns also have 70-74 Ma extensional shear zone

Could this be from a plateau sitting under here? Timing an issue: would need to make young magmatism in Mojave on top of plateau.