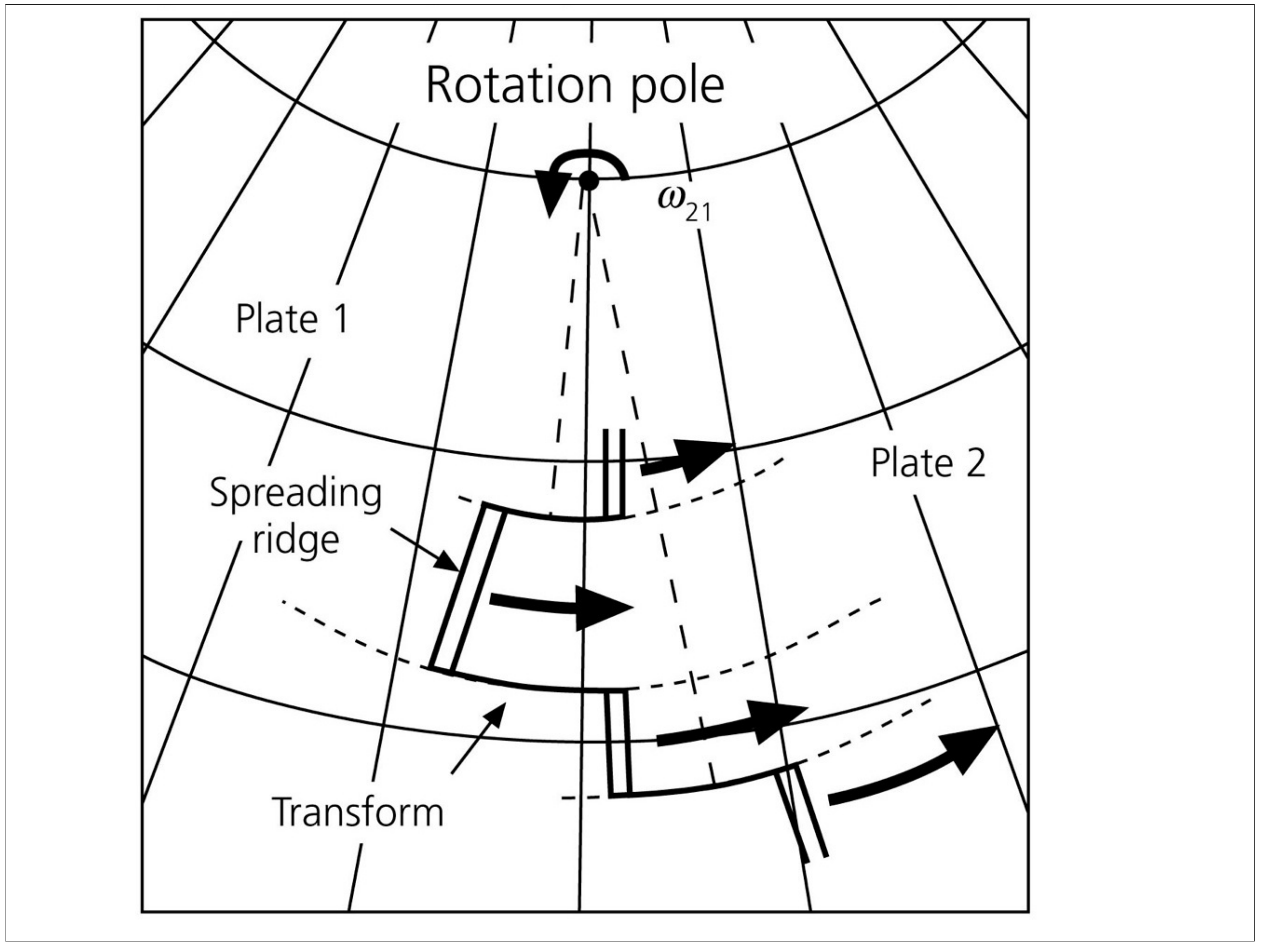
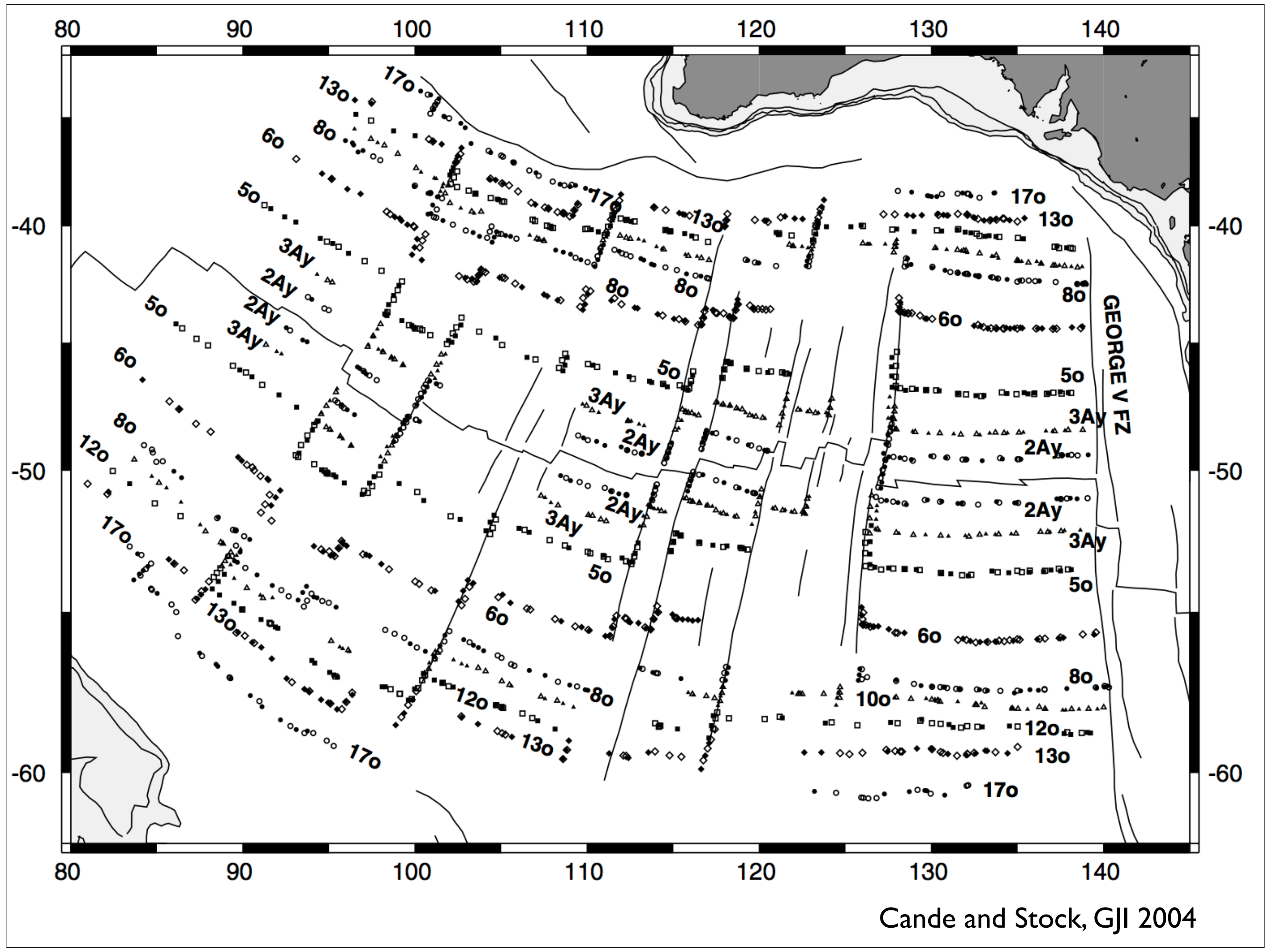
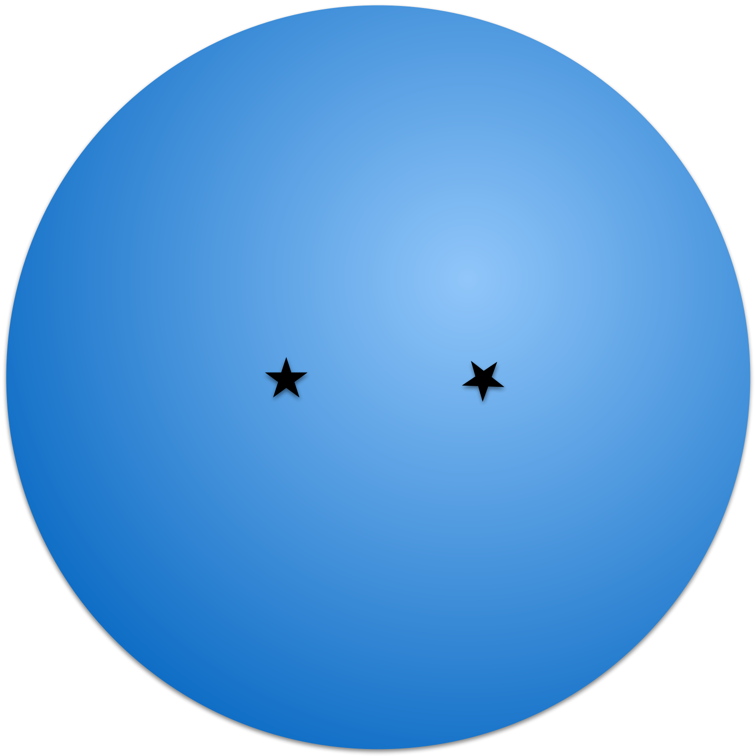


OK, so how do we figure out the relative motion of plates?



This gives an idea of the kinds of data that are needed to determine a stage rotation pole. Each point is an anomaly crossing or a transform crossing. This is south of Australia.

Where is a rotation pole to be found?



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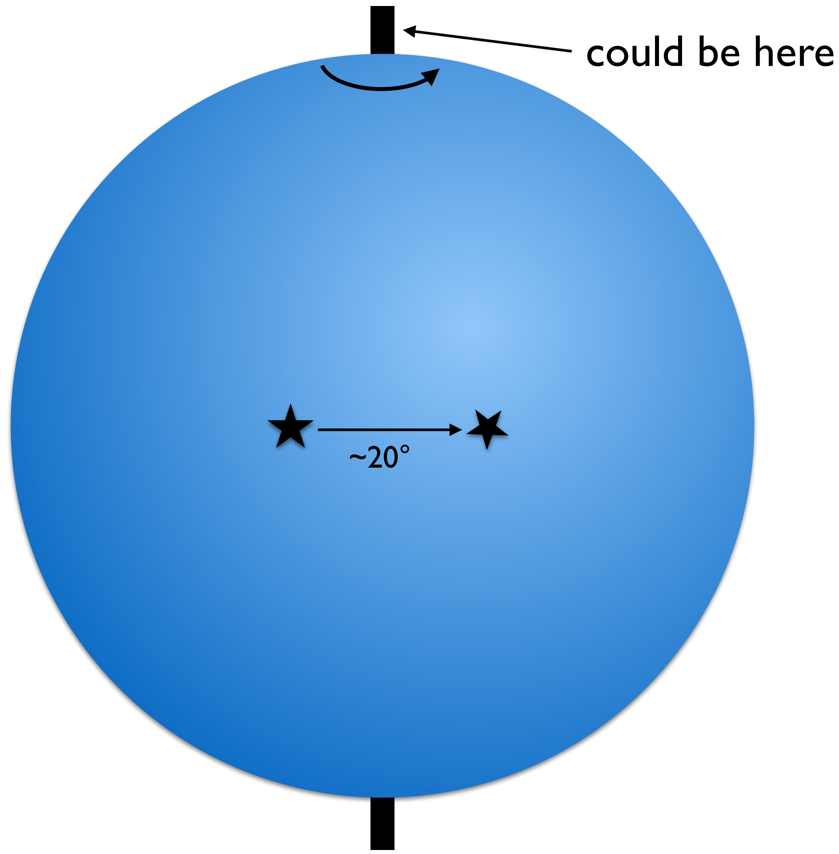

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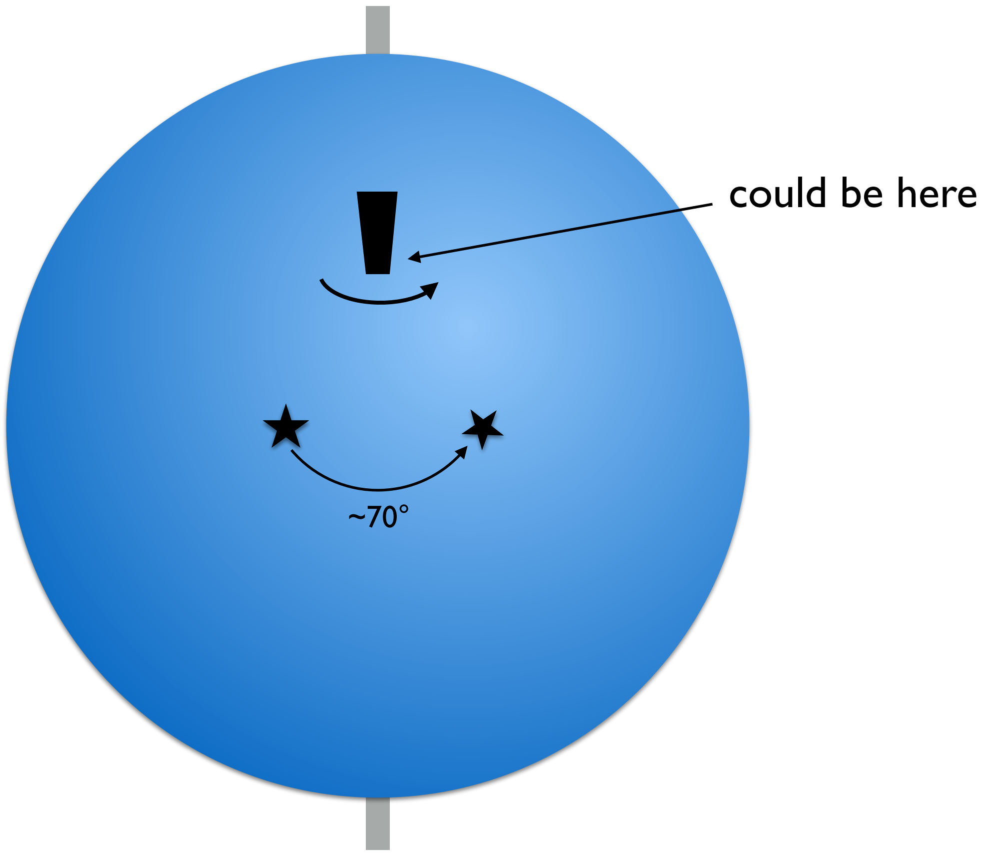
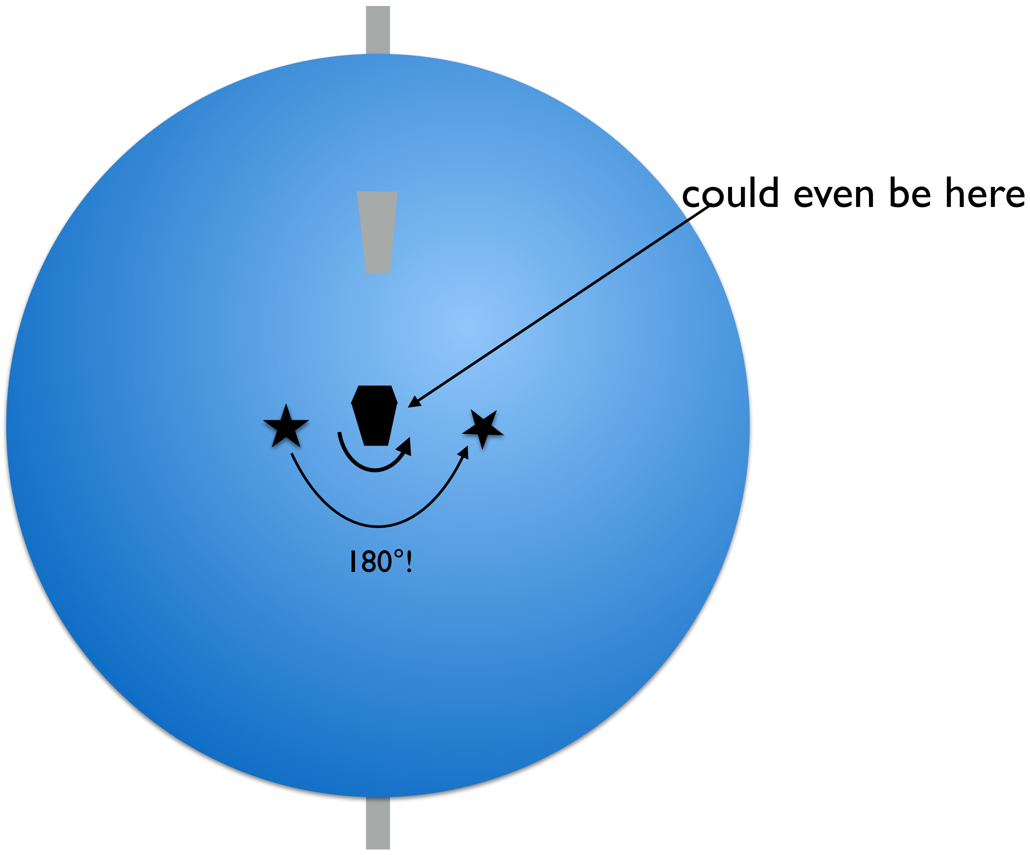
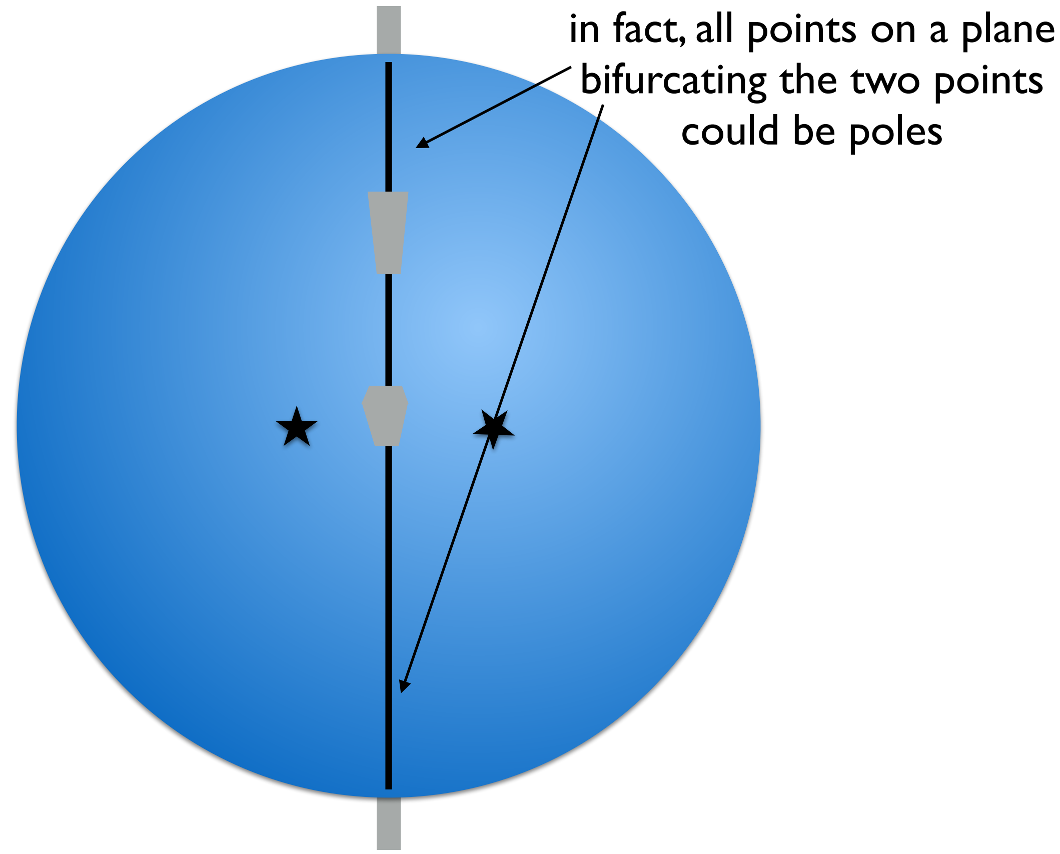


Where is a rotation pole to be found?

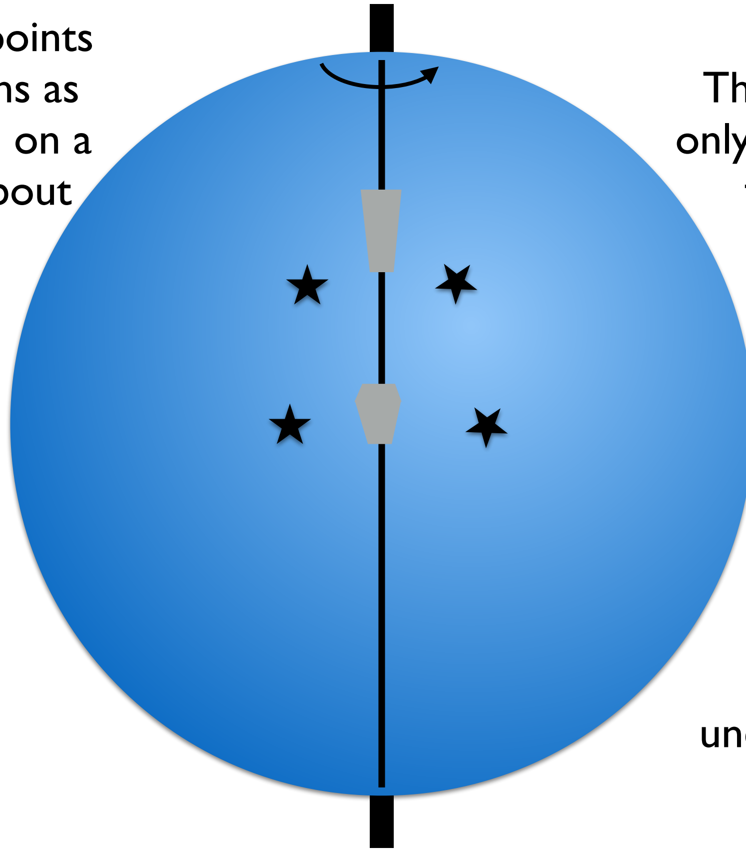


Where is a rotation pole to be found?



Where is a rotation pole to be found?

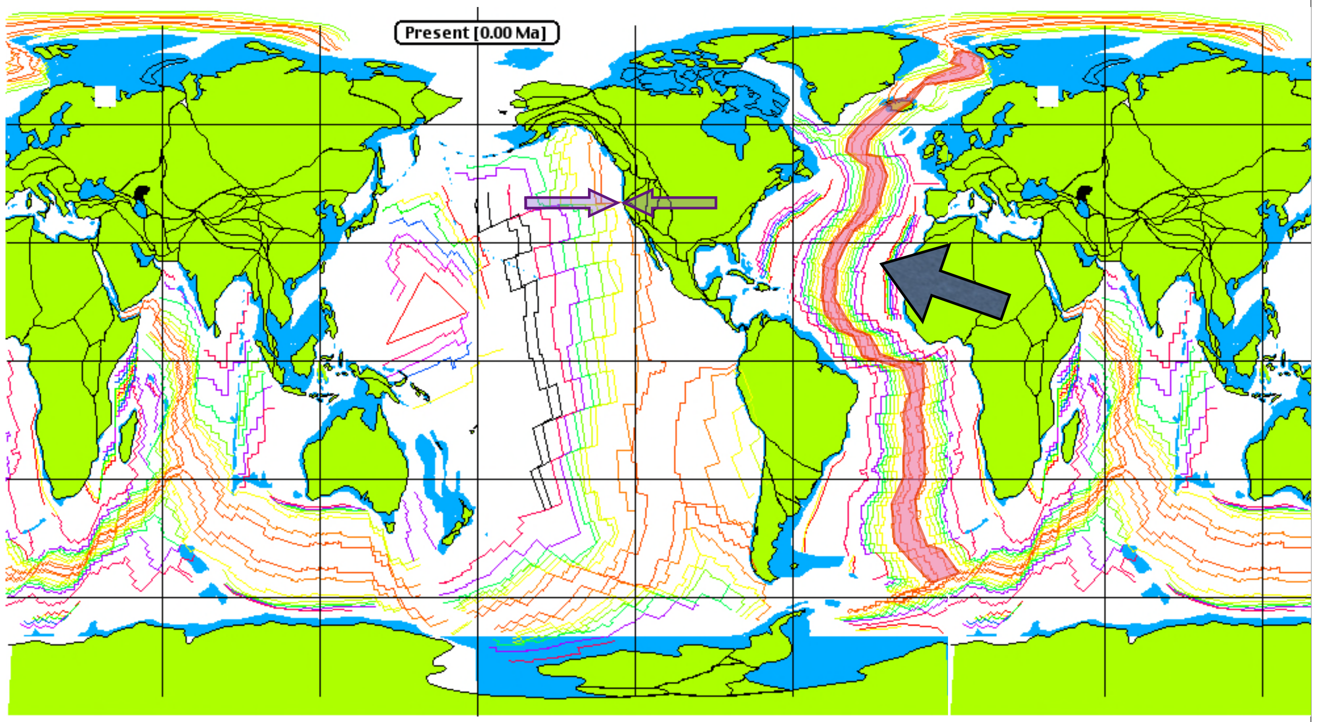
Adding more points limits variations as points must lie on a small circle about the pole

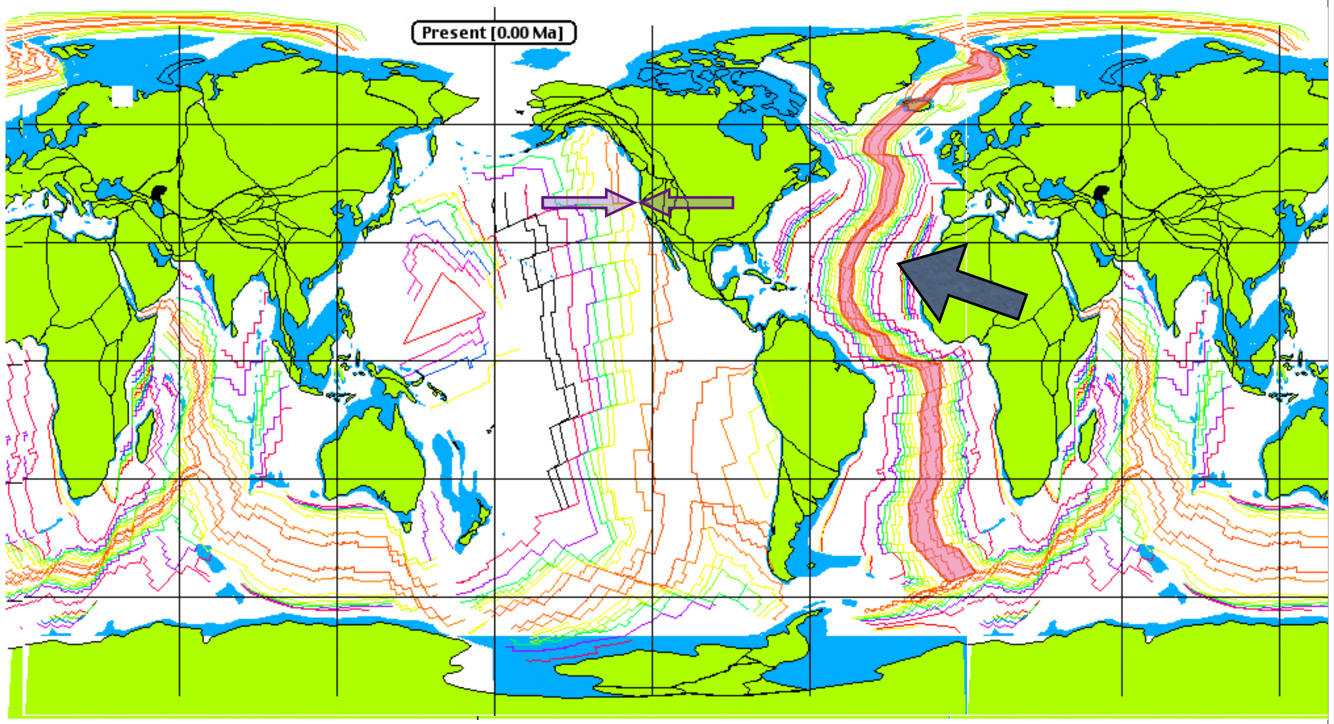


These two pairs only work with the first pole…

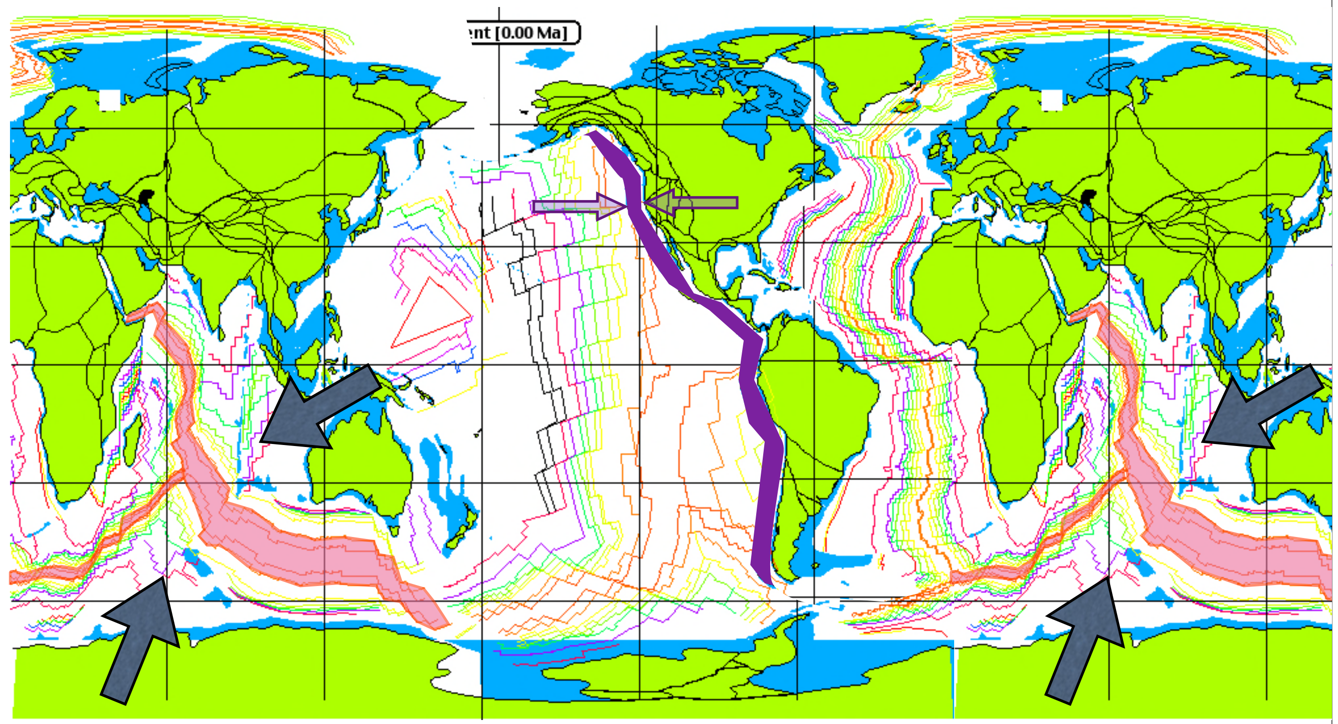
…but the uncertainty is an ellipse.

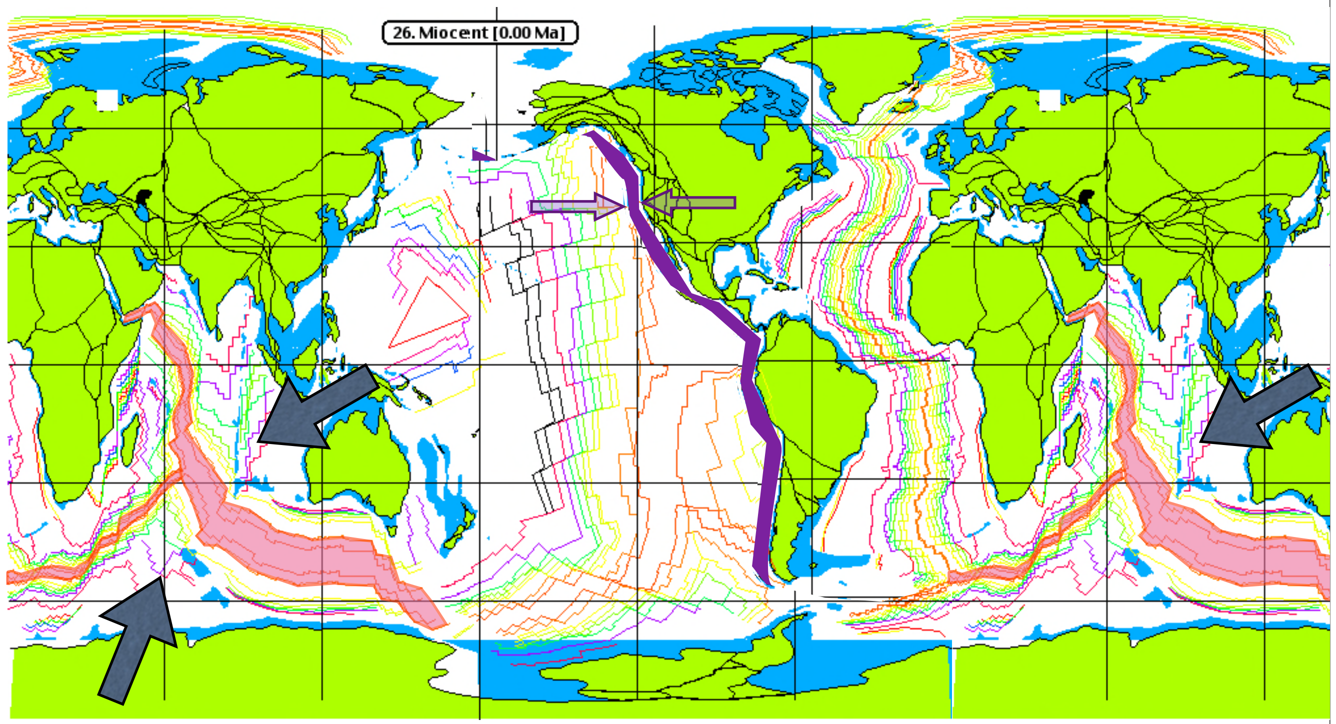
How do we make maps of ancient geography?

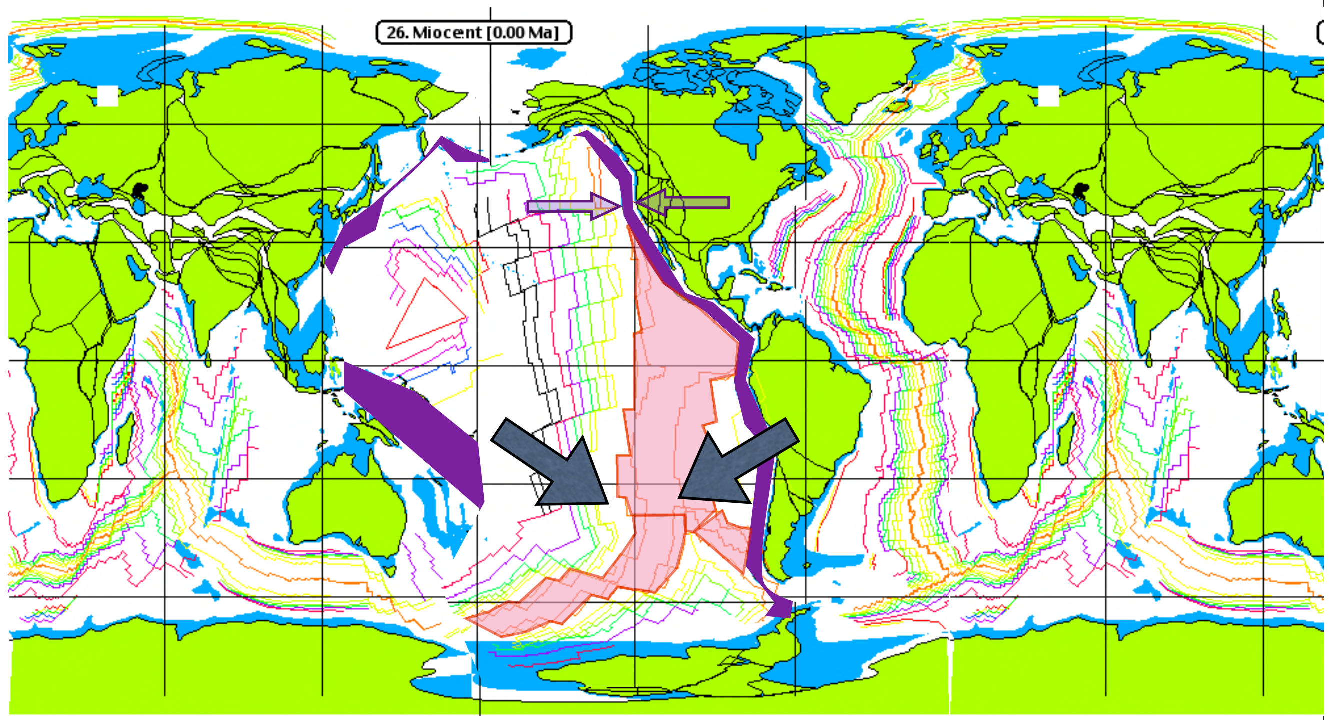


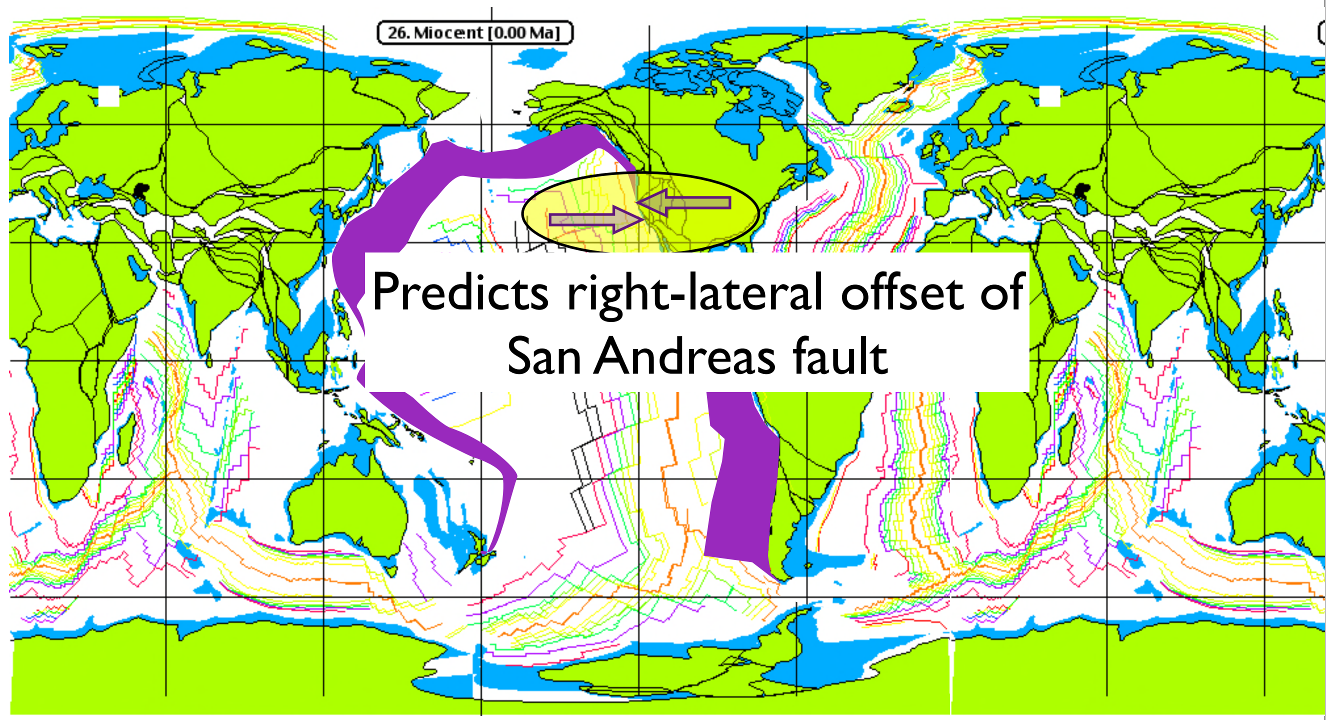


Present [0.00 Ma]

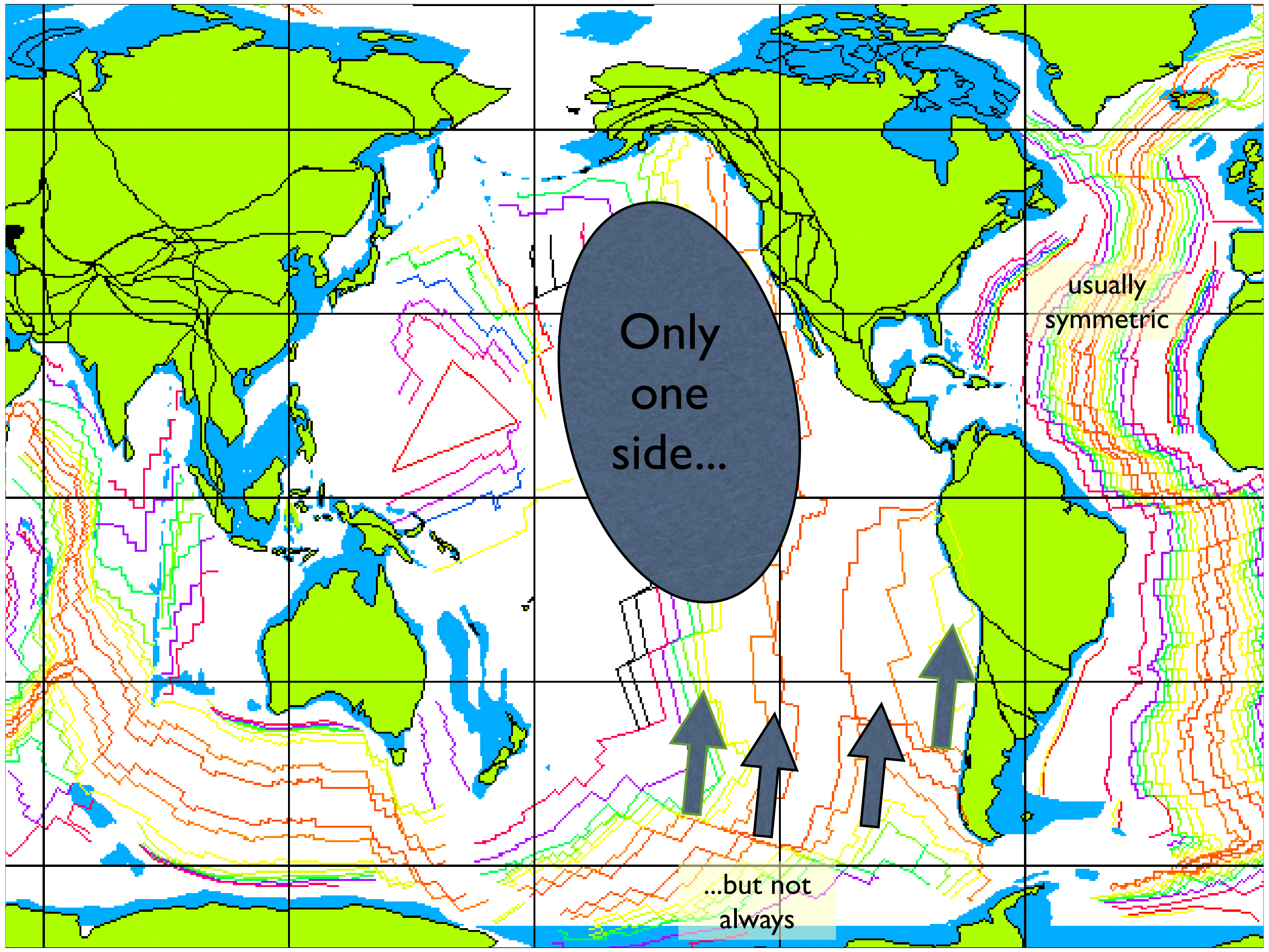

ent [0.00 Ma]


26. Miocent [0.00 Ma]

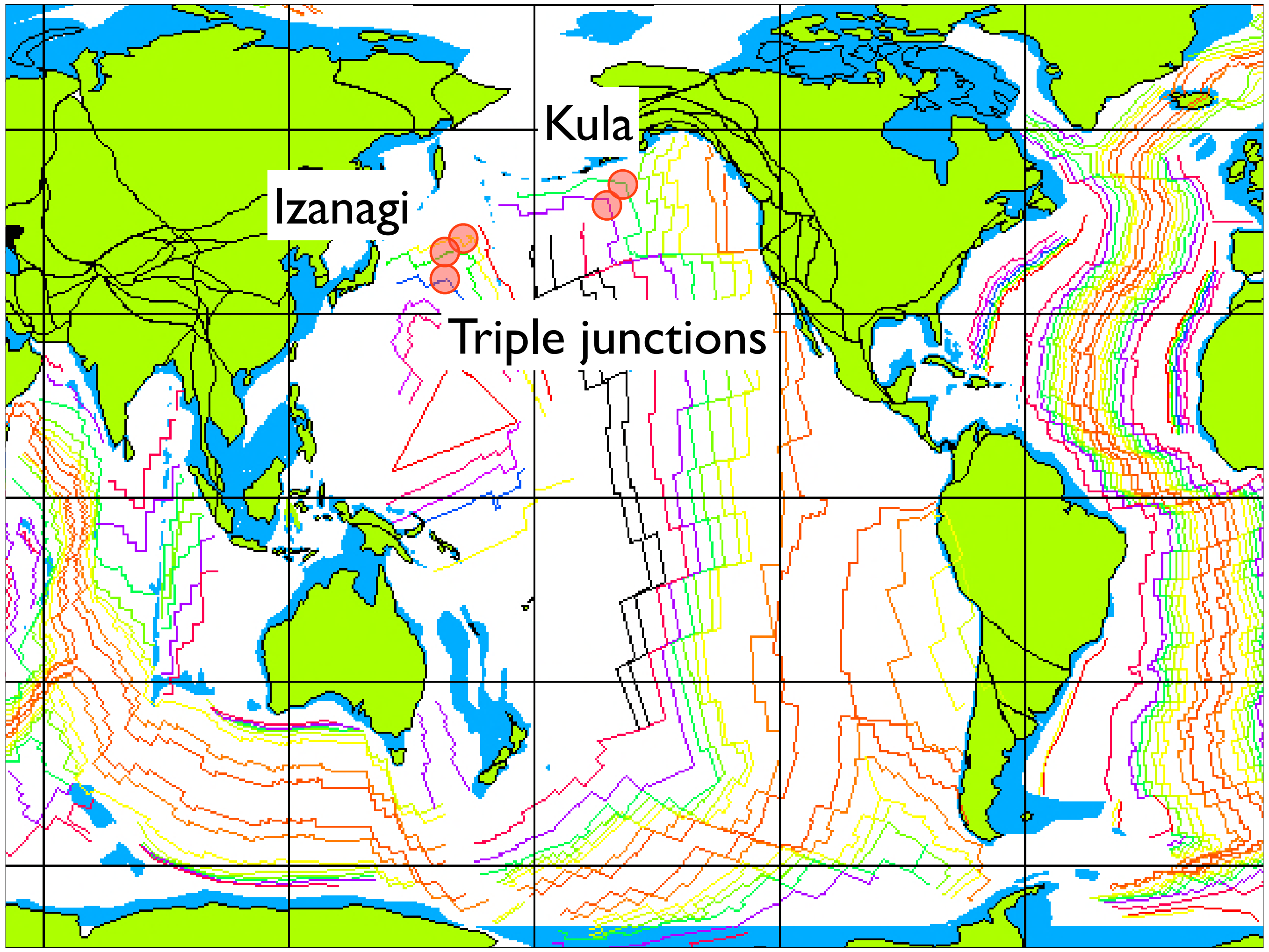

26. Miocent [0.00 Ma]



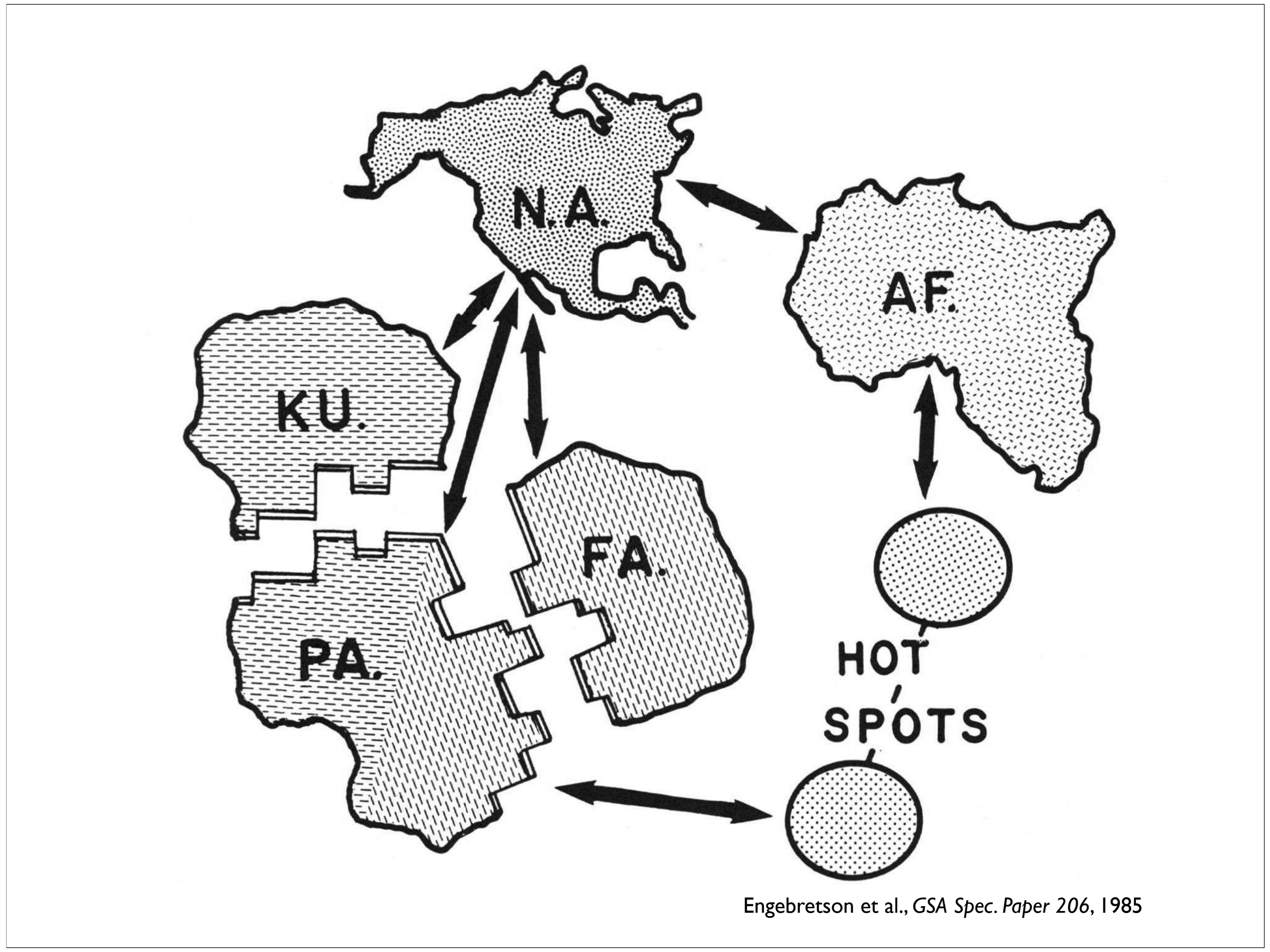
But question arises--what was in the gaps? If we go back prior to 30 Ma, no existing lithosphere in contact with western NAm



Ridges usually symmetric--so can predict one side from the other. but not always....

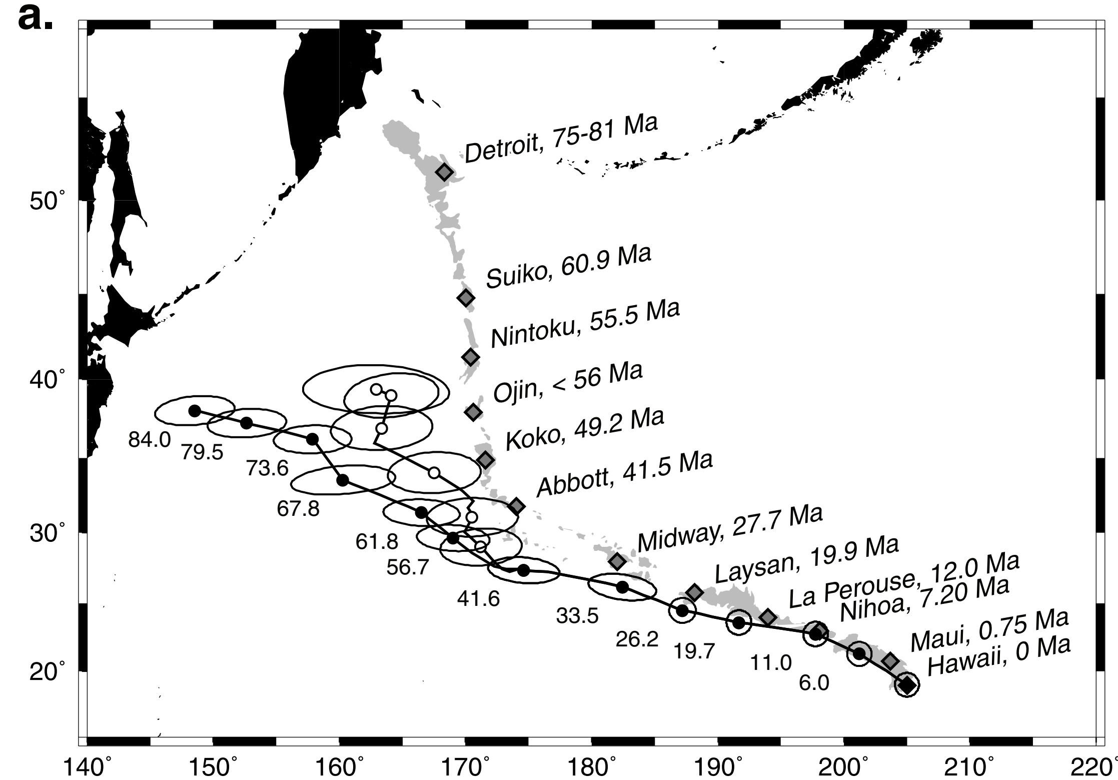


Fossil triple junctions tell us about some other plates now gone: Kula and Izanagi (another one to south)



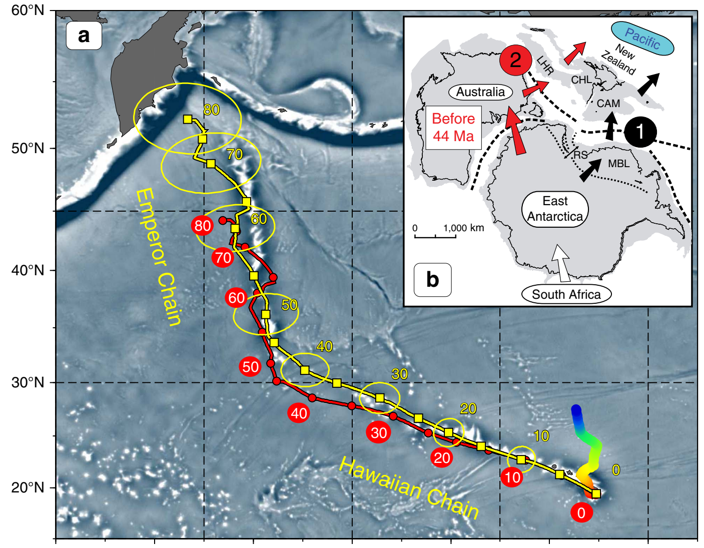
How about farther back in time? Two points here: one is that a popular model relies on fixed hotspots, the other that Farallon/Kula–Pacific spreading was symmetric (and no other plates).

Hotspots fixed? Comparison with plate reconstruction



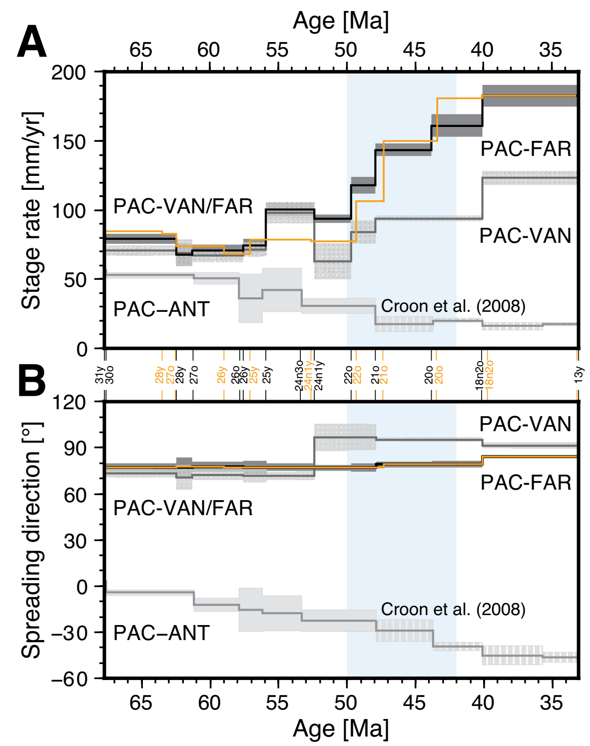
Doubrovine & Tarduno, JGR 2008

47 Ma bend requires change in plate motion



Torsvik et al., Nature Comm. 2017

47 Ma Bend not from change in plate motion



Wright et al., Geol 2015

This argument rages on. Right figure argues lack of notable change in spreading rate means no change in plate motion. On left is preferred model Torsvik et al, which has some southward drift of hotspot (rainbow swath) and a change in plate motion (red line is if Hawaii was fixed)—argue it is death of Izanagi plate in NW Pacific that led to change—dragged whole rest of the system with it. So not like there is no drift of hot spot.

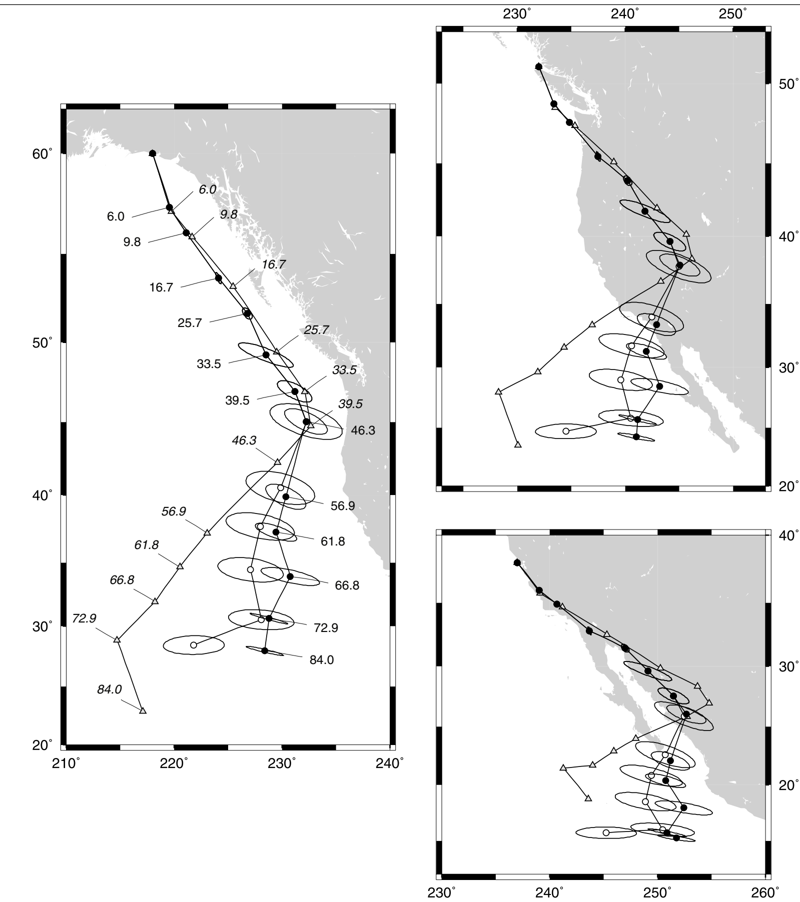
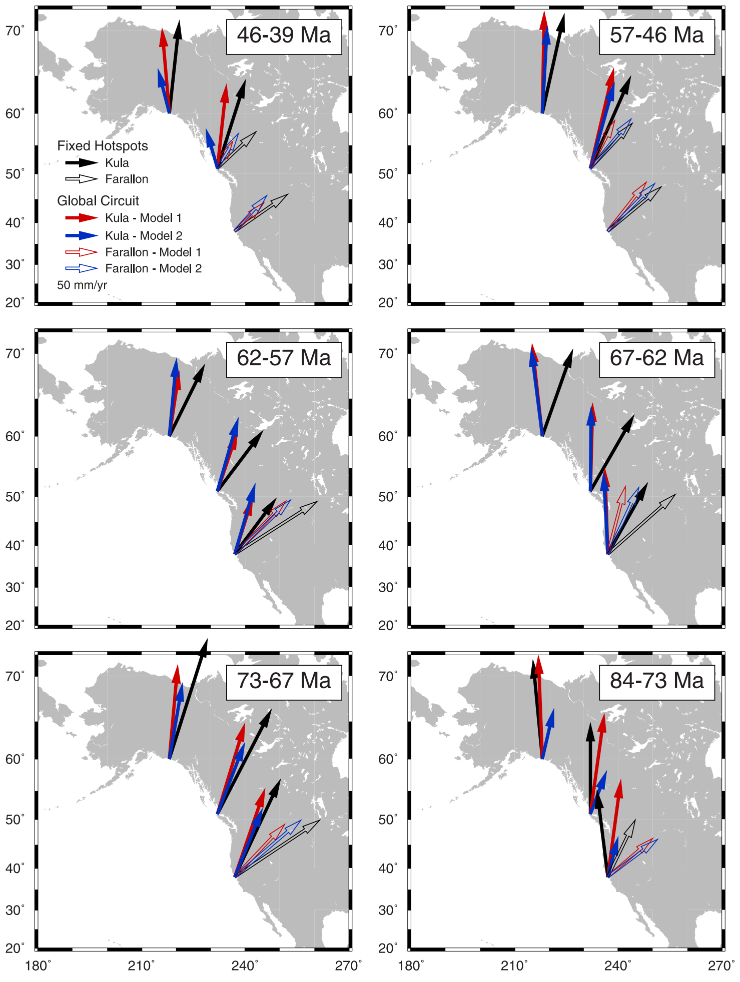


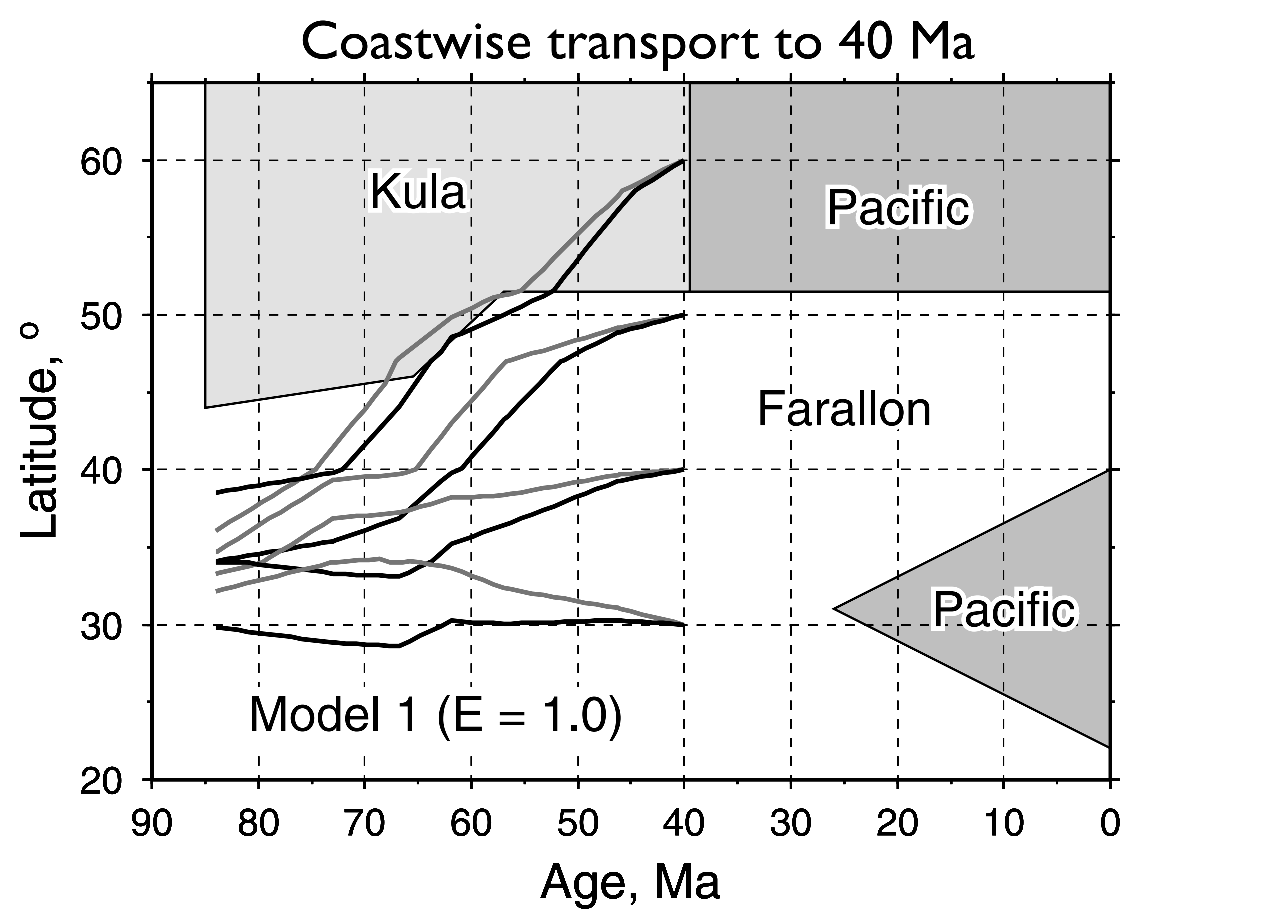
Figure 2. Tracks of three test locations moving with the Pacific plate relative to the fixed North American plate. Tracks were calculated using the fixed hot spot reconstructions of *Engebretson et al.* [1985] (gray triangles, italicized age labels), and the East-West Antarctica (black circles) and Australia-Lord Howe Rise (white circles) plate circuit models. Ellipses around reconstructed points are 95% confidence regions.

Doubrovine & Tarduno, JGR 2008

Shows the difference between a modern plate circuit model and the fixed hotspot model--general patterns the same but big differences in details.

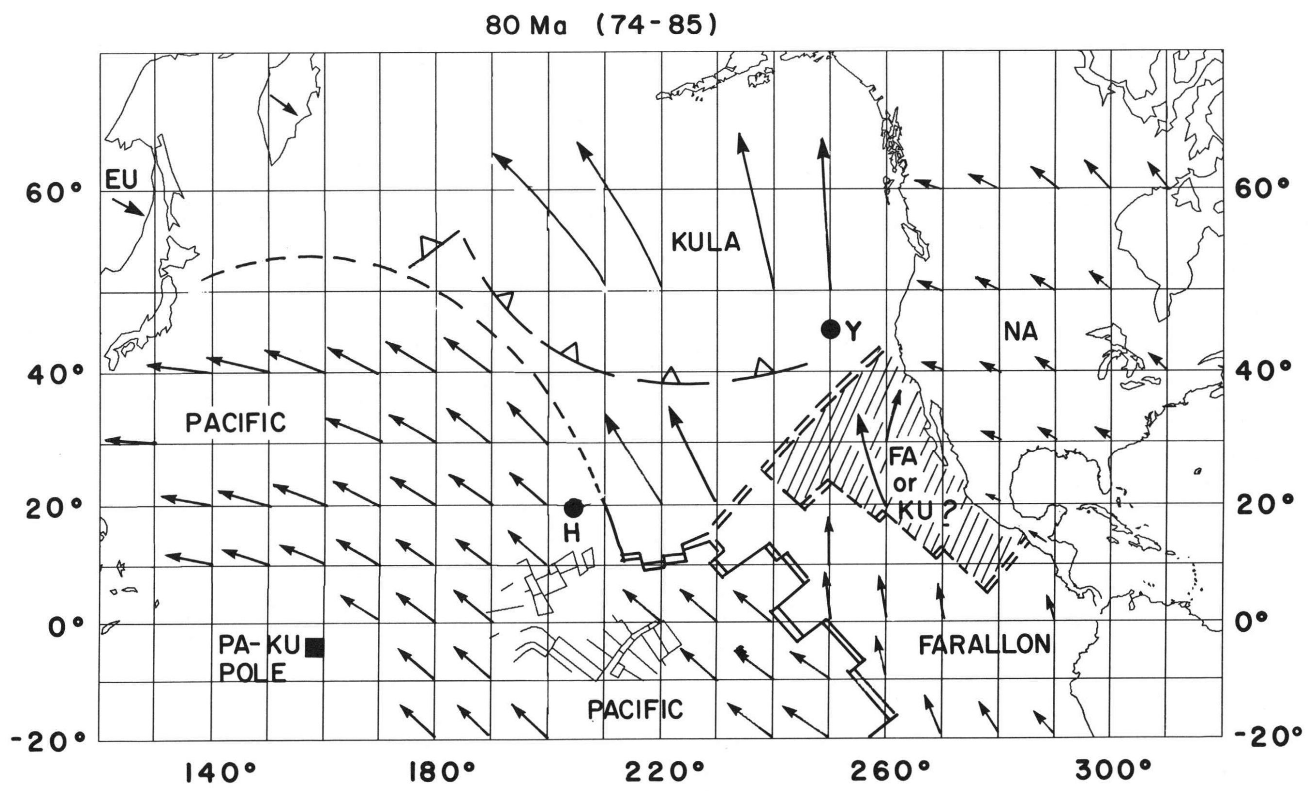


So where in this is there room for the yo-yo model?



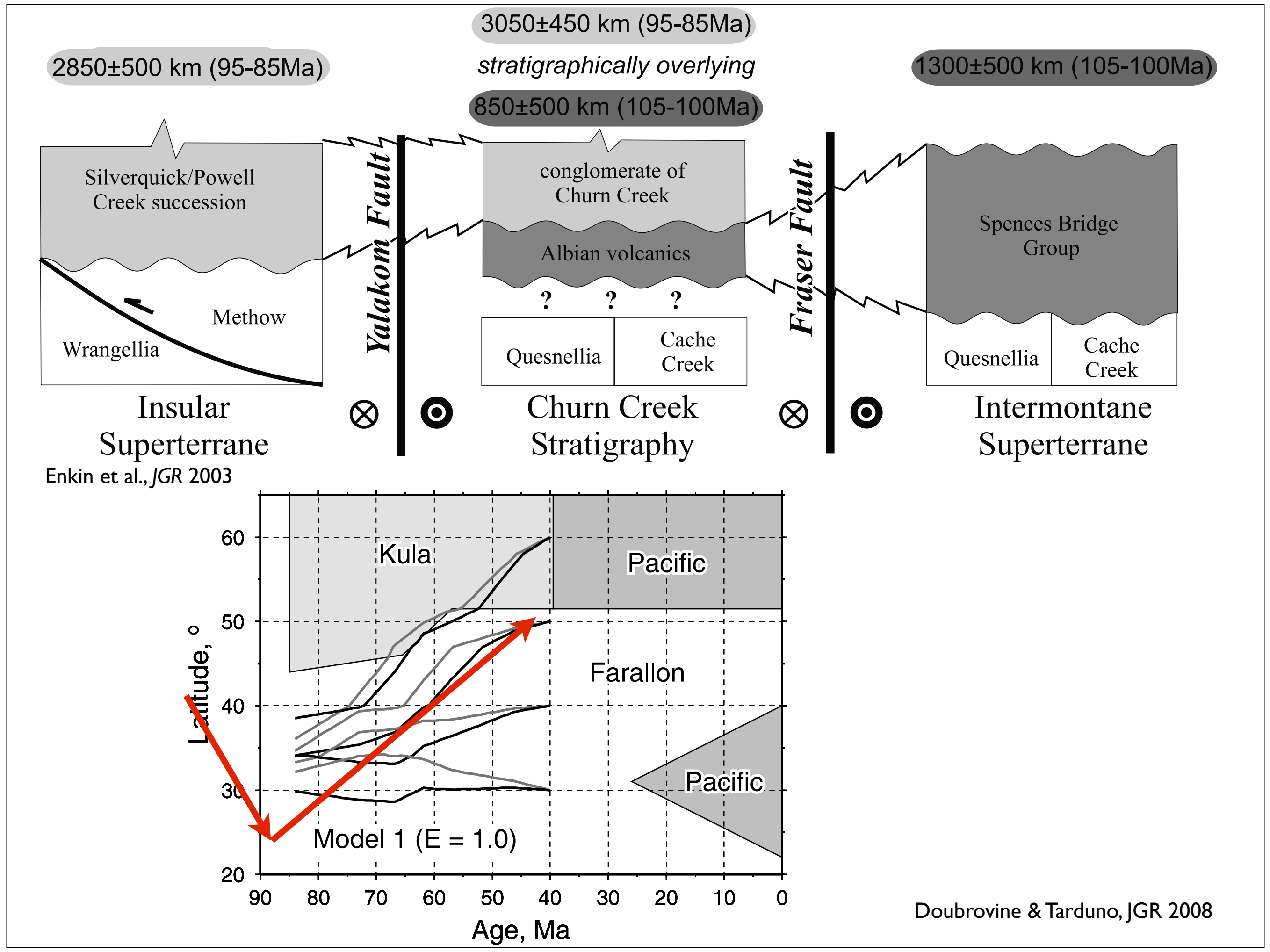
Doubrovine & Tarduno, JGR 2008

Gray are fixed hotspot, black plate circuit. This is motion along the coast assuming movement entirely with the oceanic plate.

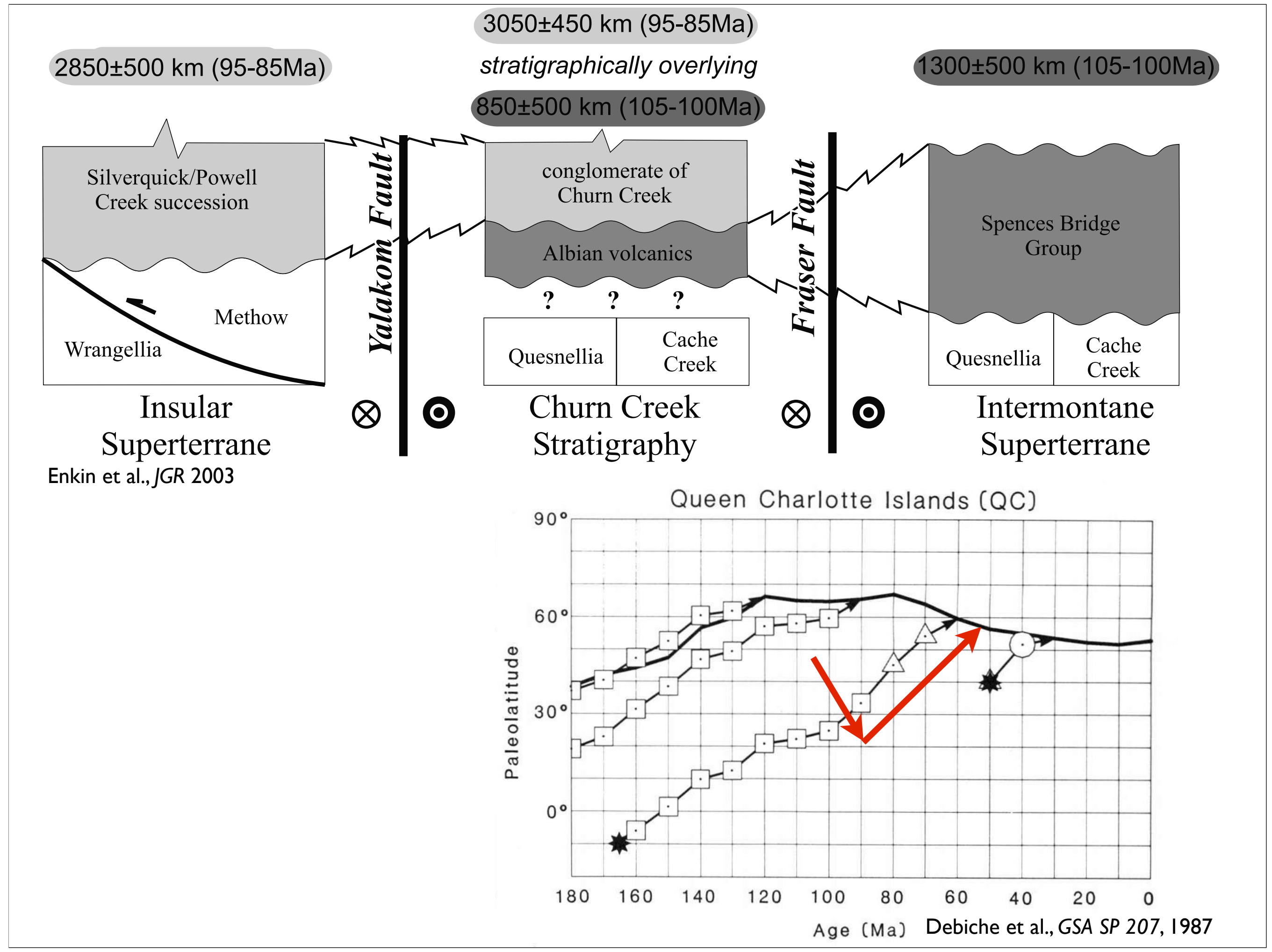


Engebretson et al., *GSA Spec. Paper 206*, 1985

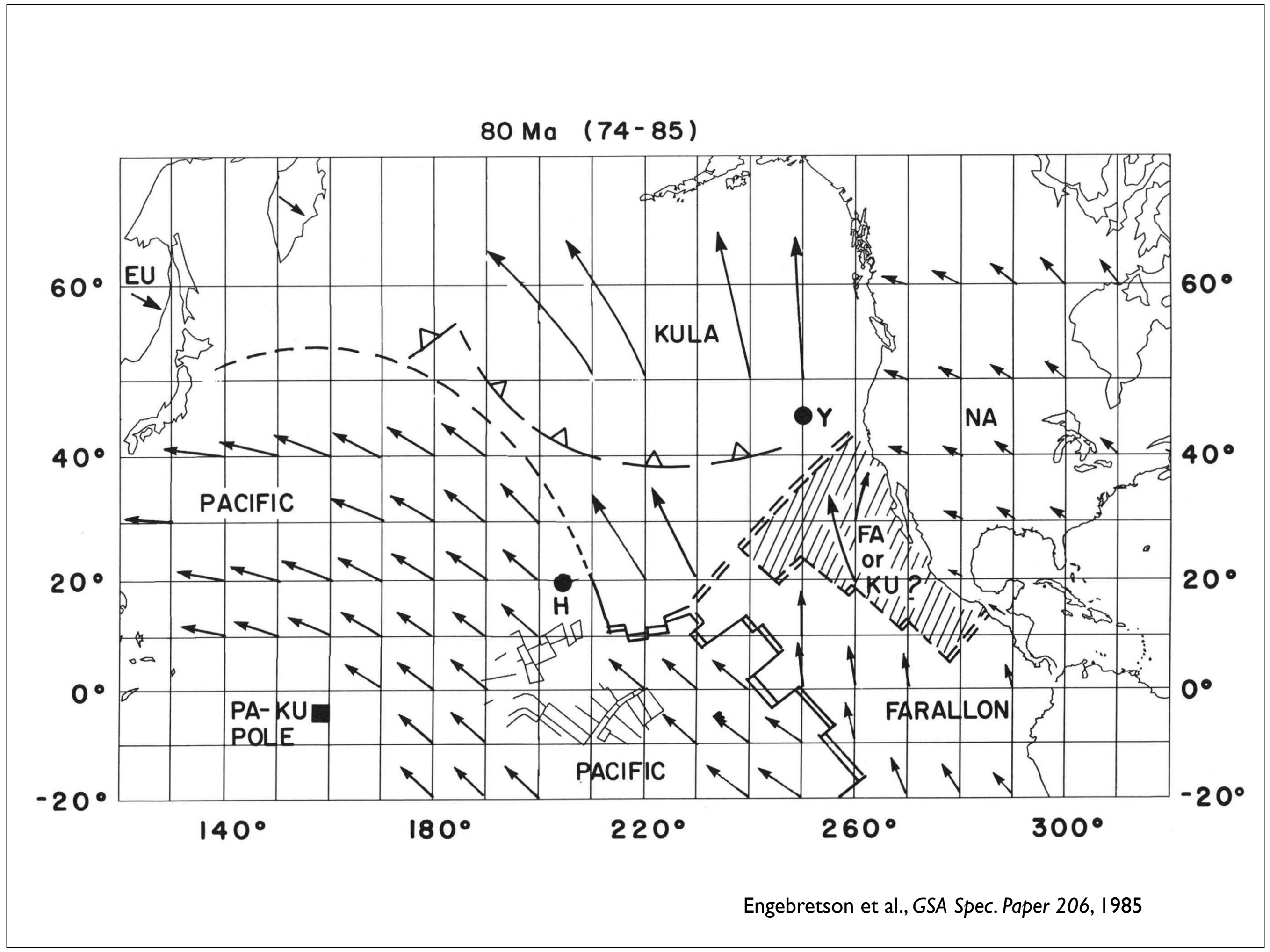
but when you restore all this, there is a lot of stuff now gone where we have to guess. How strange could things be?



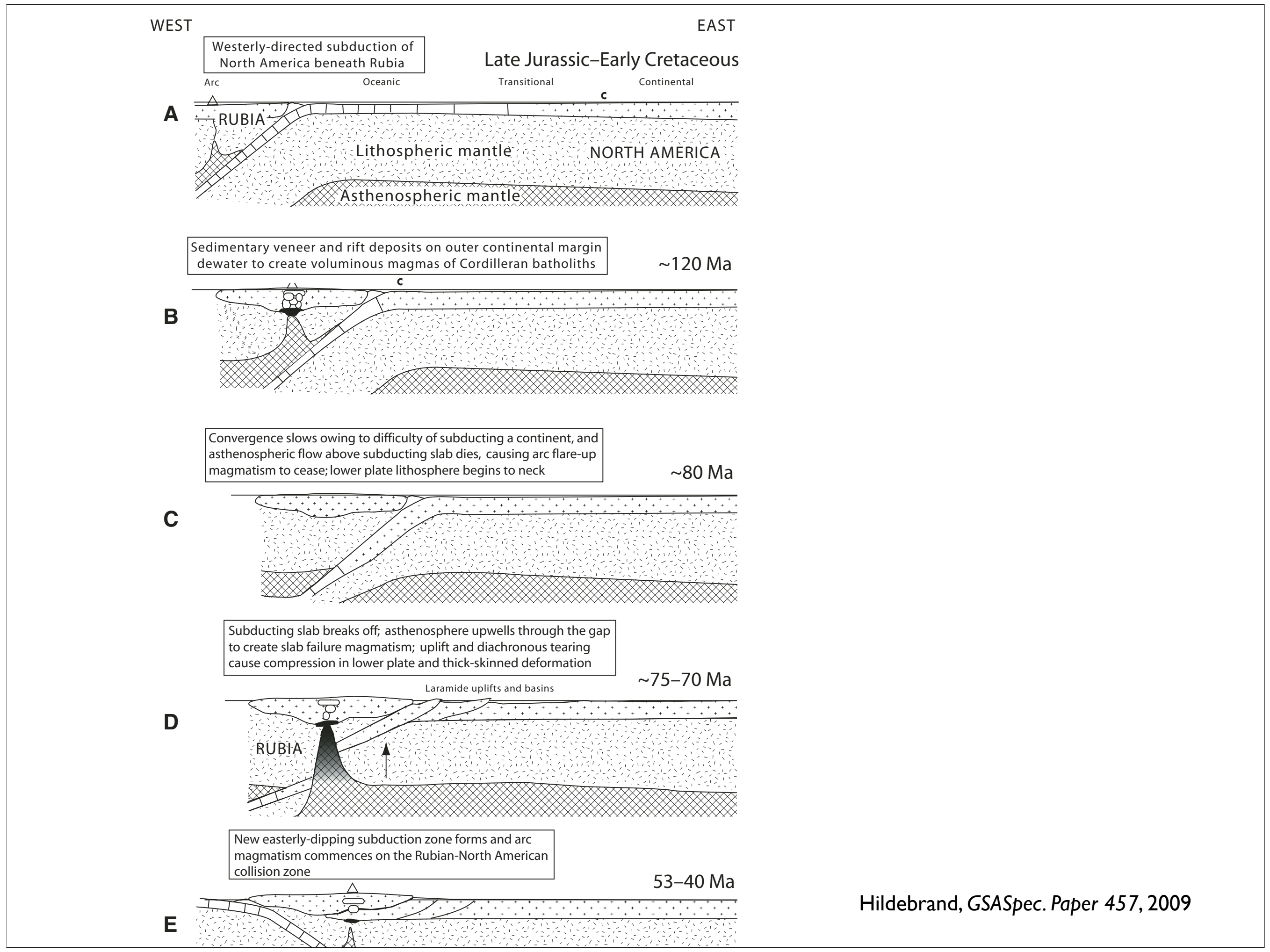
So how would yo-yo work?



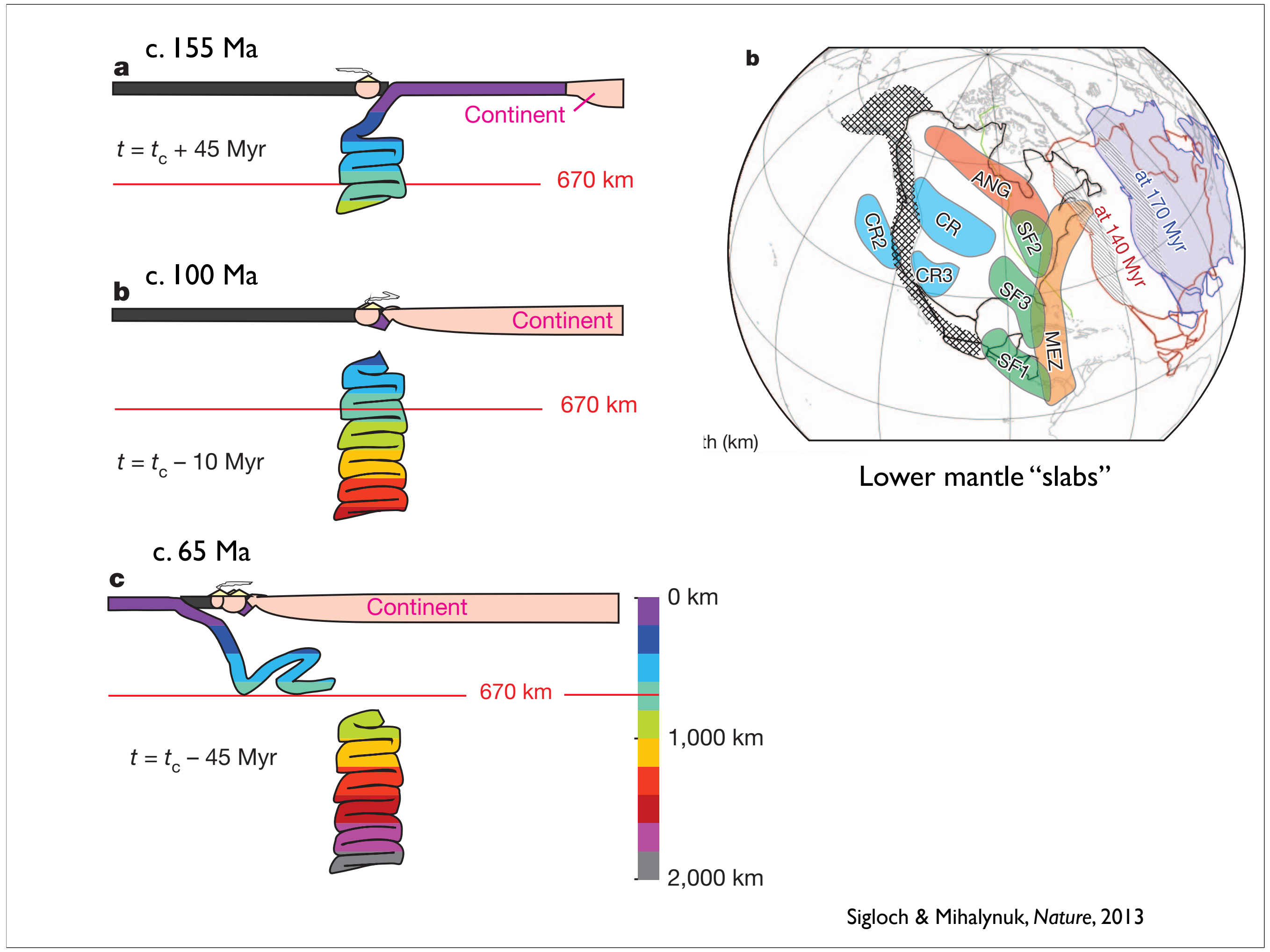
So how would yo-yo work?--note that this plot, points are *on* Farallon plate (so you then have the problem of how they get onto this).



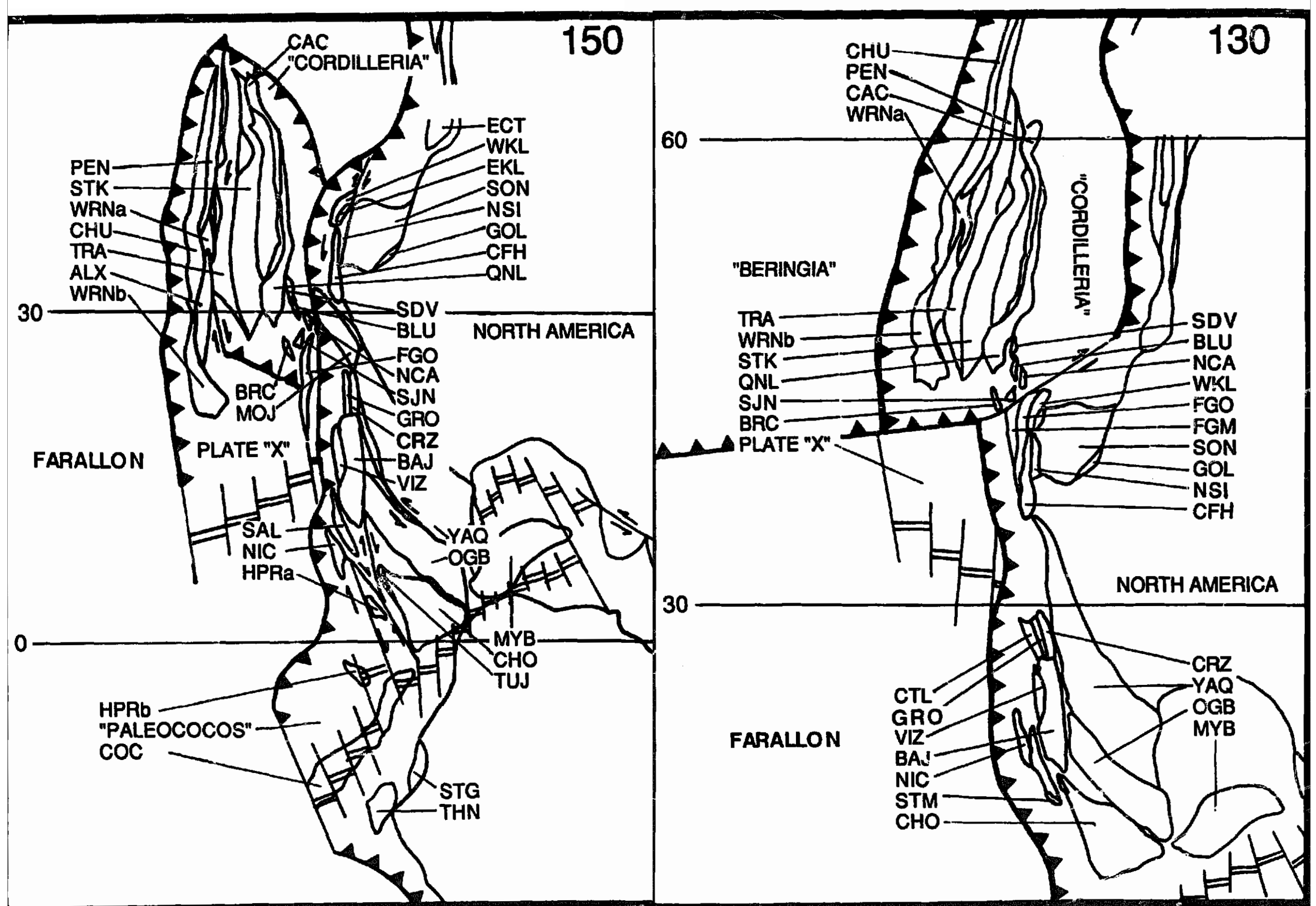
Again, lots of eastern Pacific is simply not available for examination.



One suggestion is west-facing subduction--all allochthonous stuff comes in in K. But that includes things like the Sierra Nevada…(recall some of the links in some of the papers on the Sierra *Paleozoic* terranes).

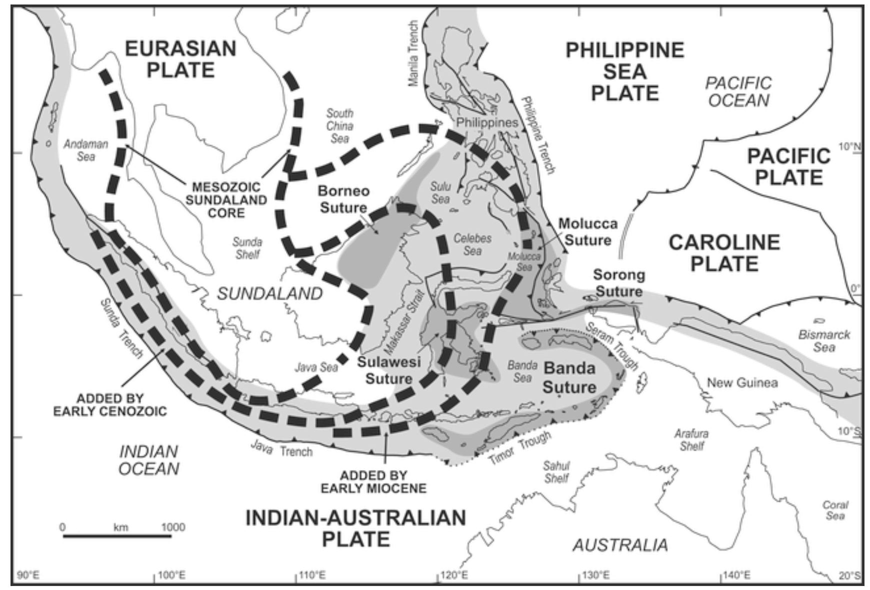


A very different approach is to work back from seismic tomography, though this also likes east-facing subduction. There are some big issues generally swept under the rug: rates of vertical fall of slabs can vary with depth and possibly with age/composition of the subducted material (though this does allow for issues getting through the 660/670 discontinuity).



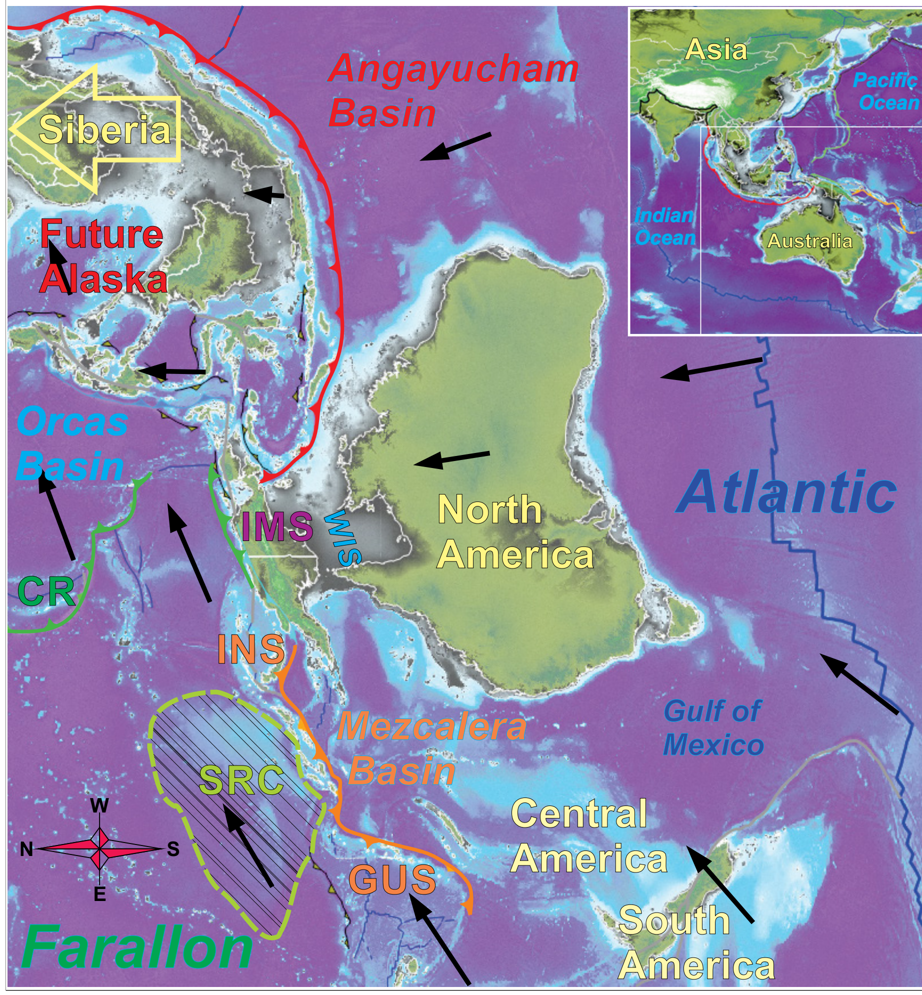
Wilson et al., *Marine Geol.*, 1991

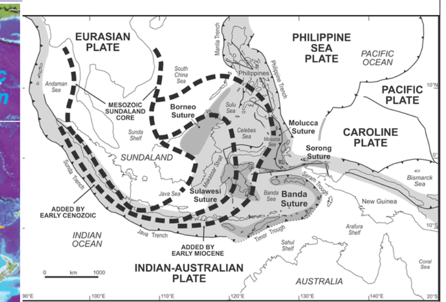
In point of fact, we know little about the eastern Pacific in the late Jurassic and early K, as this paper proposed.



Hall and Smyth, *GSA Spec. Paper*, *436*, 2008

So a possible analog is in SE Asia.





Hall and Smyth, *GSA Spec. Paper*, *436*, 2008

Sigloch & Mihalynuk, *GSA Bull*, 2017

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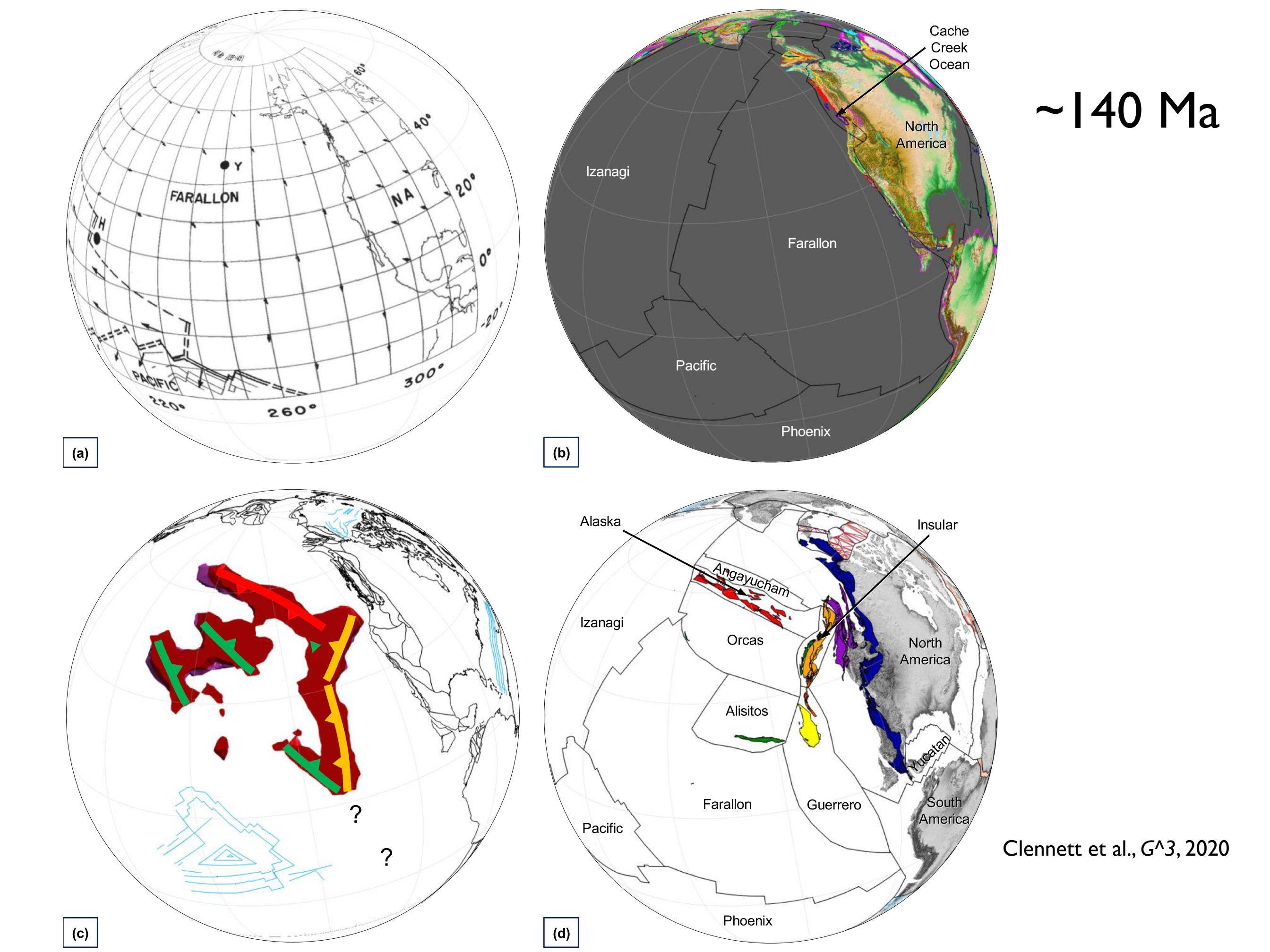
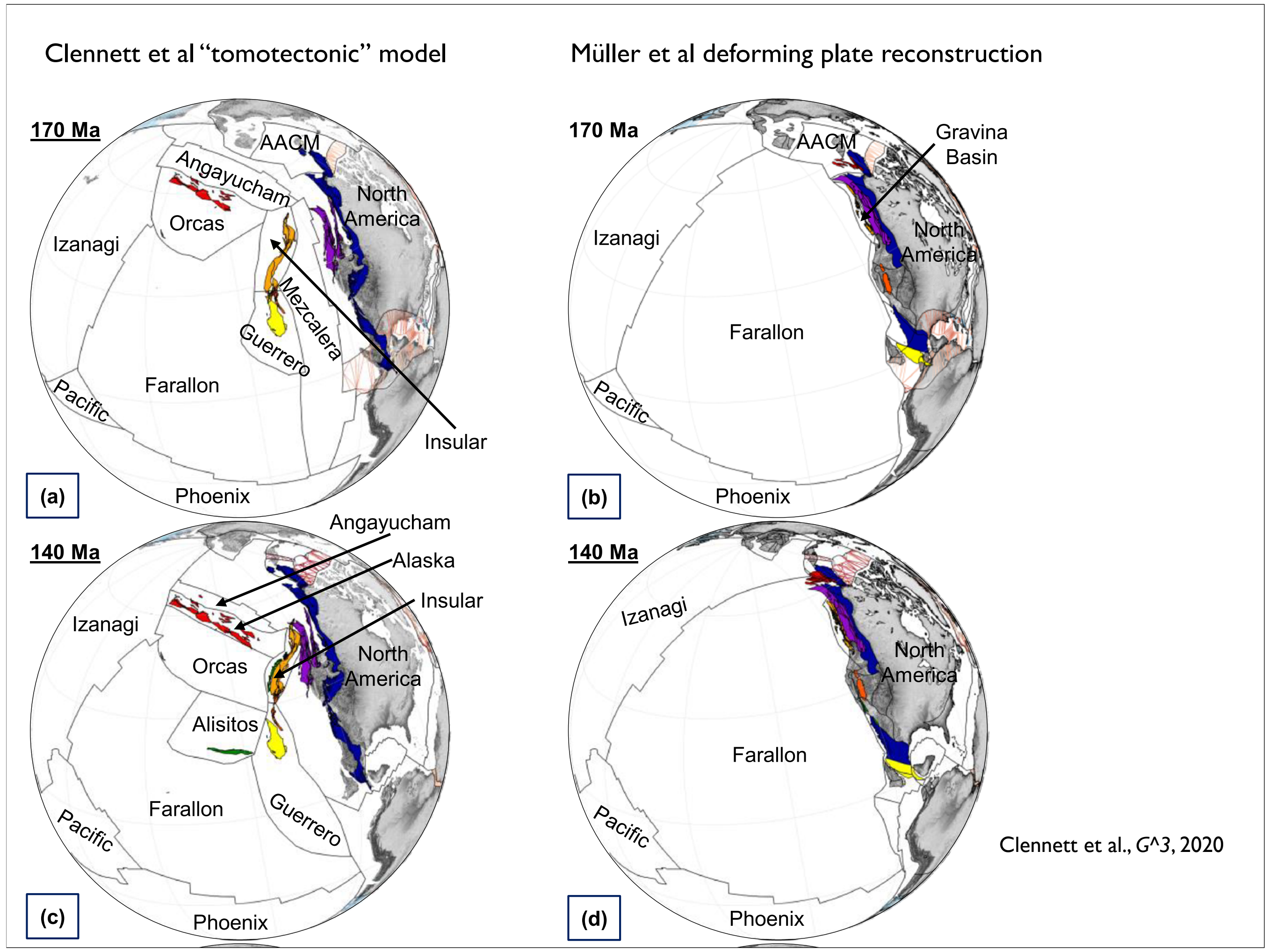


~140 Ma

Clennett et al., *G^3*, 2020

So contrast the complexity of the huge Farallon plate vs. a much more complex collection of island arcs in the Pacific.



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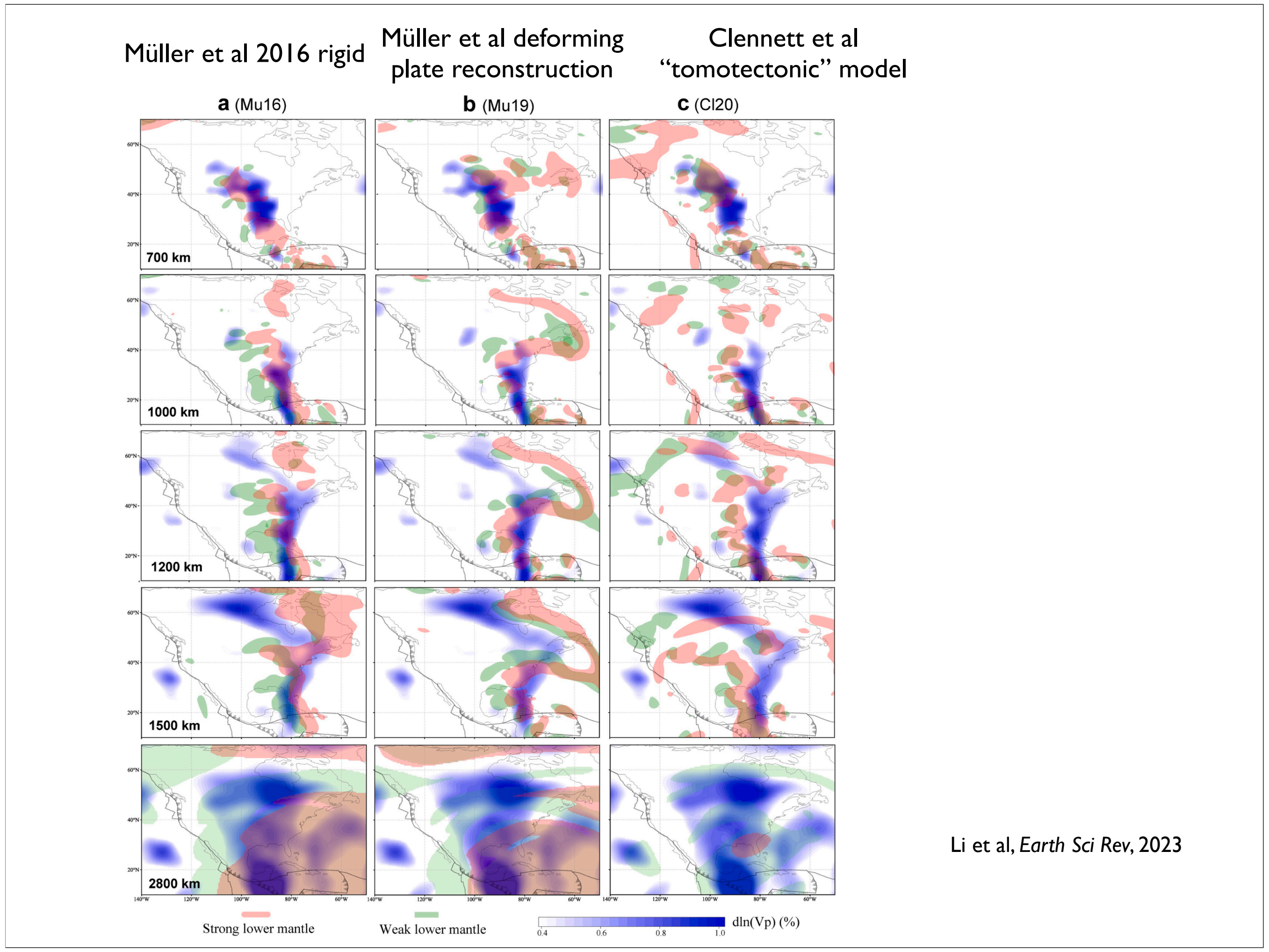
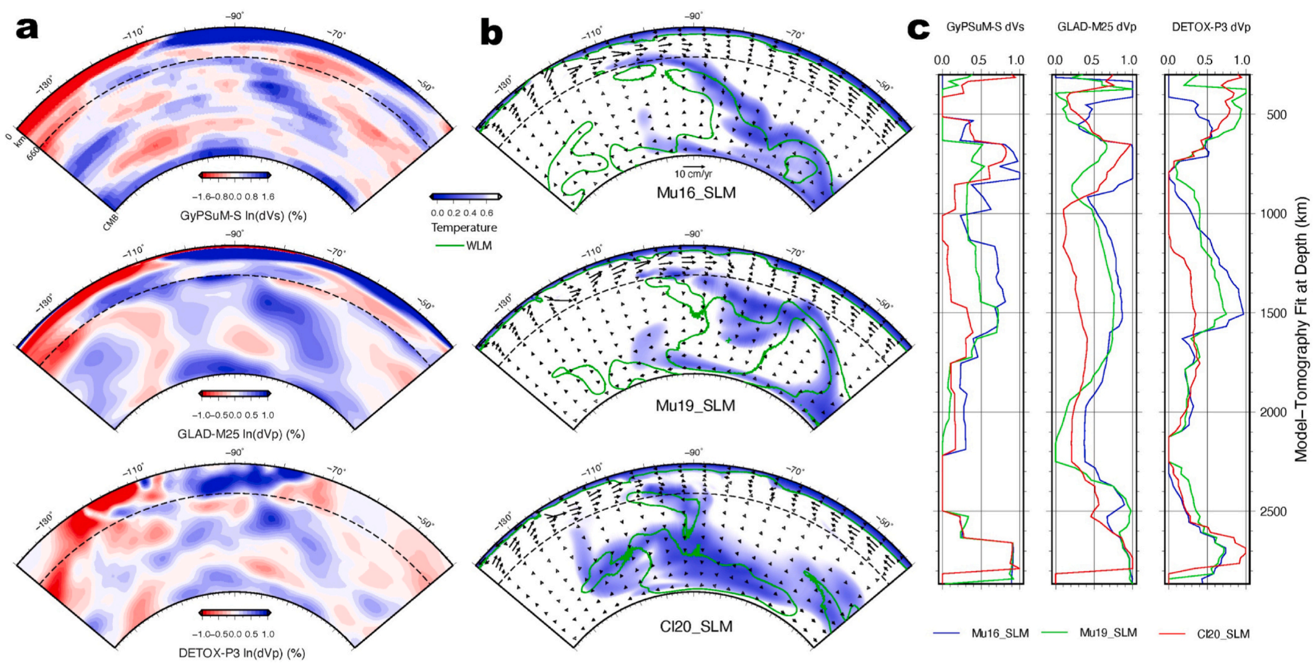


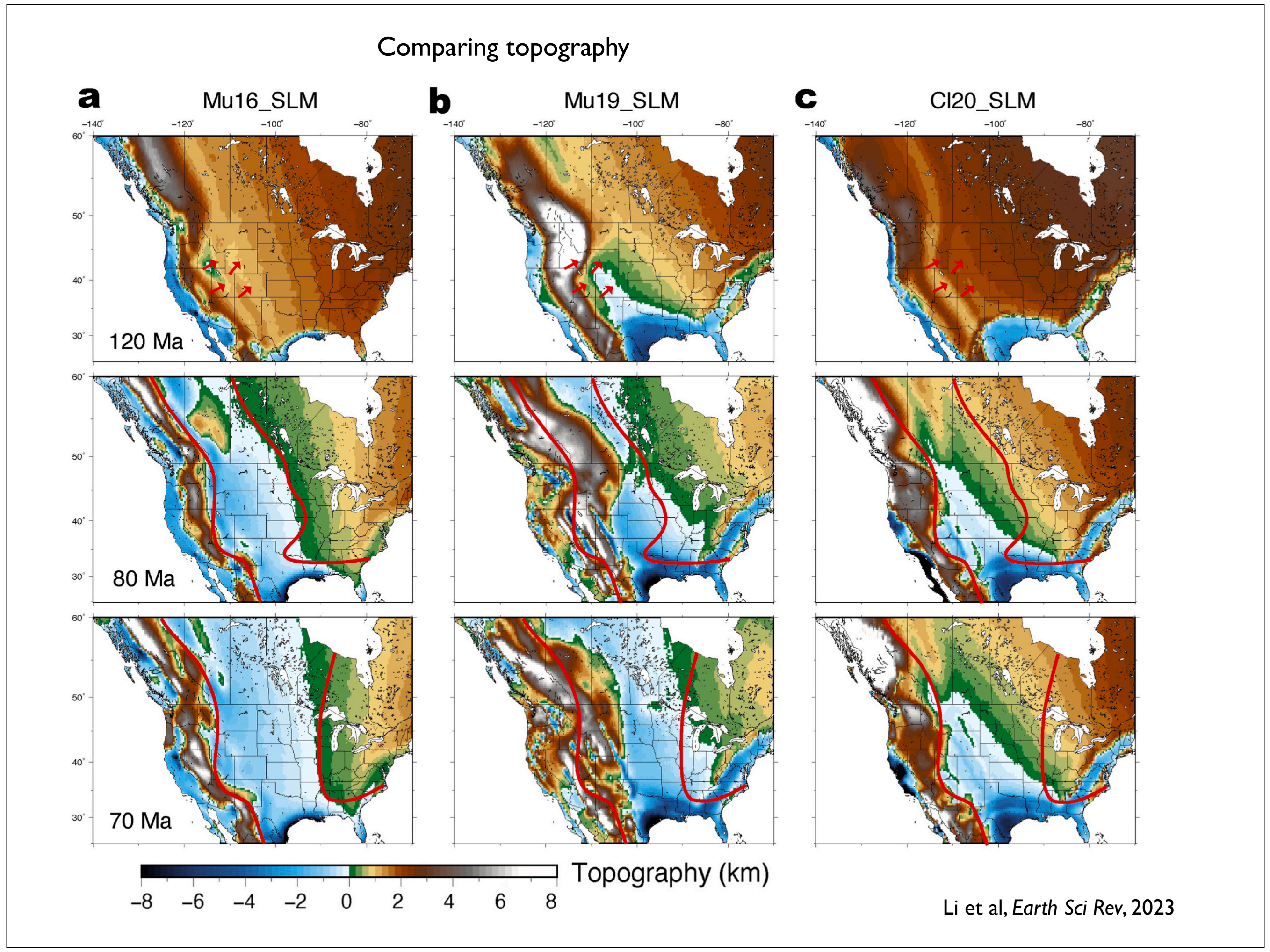
Comparing strong (tan) and weak (green) lower mantle convection models based on the different plate reconstructions with one of the seismic models (GLAD_M25)

Comparing predictions at 40°N



Li et al, *Earth Sci Rev*, 2023

OK, green lines are the weak lower mantle models; blue stuff are slabs from the strong lower mantle models. Rightmost line graph shows for the three tomo models how well each reconstruction fits. [Frankly, none of the models are that impressive].



Li et al. go so far as to predict topography from both dynamic effects and changes in lithosphere. Red arrows are sediment transport directions (Burro Mtn and equivalents); red lines edges of WIS.