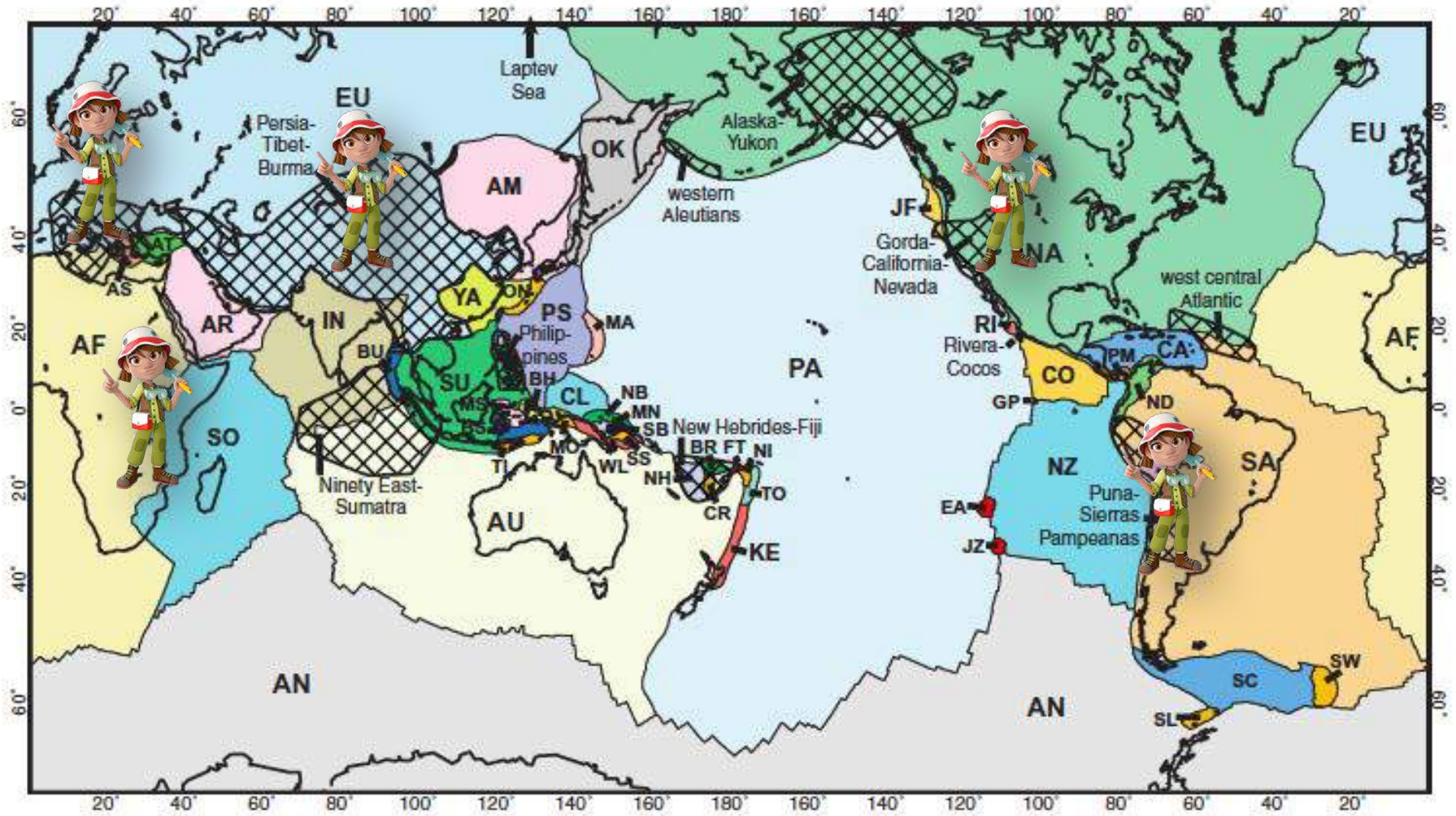


Bird (2003)



Bird (2003)

Will Plate Tectonics still Be our Paradigm in 50 Years?



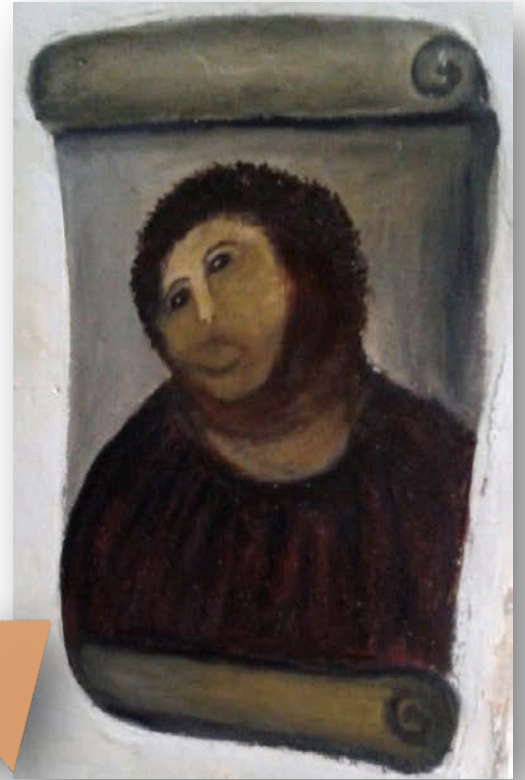


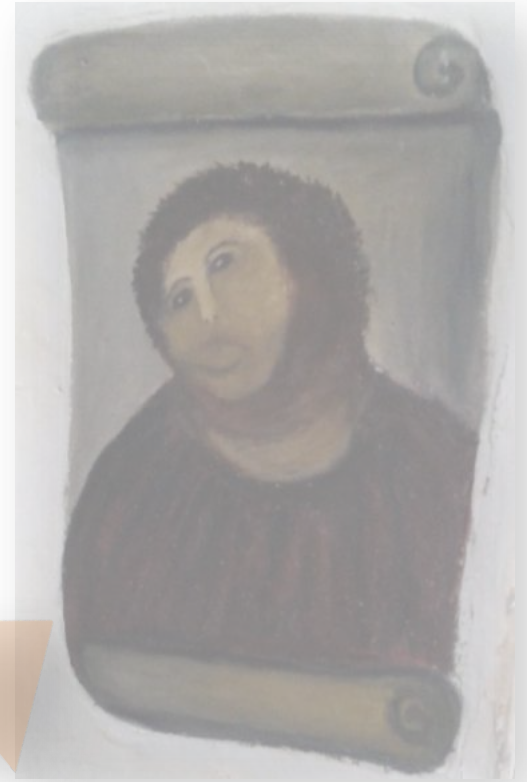
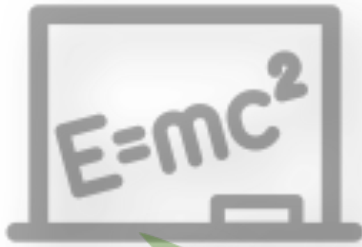


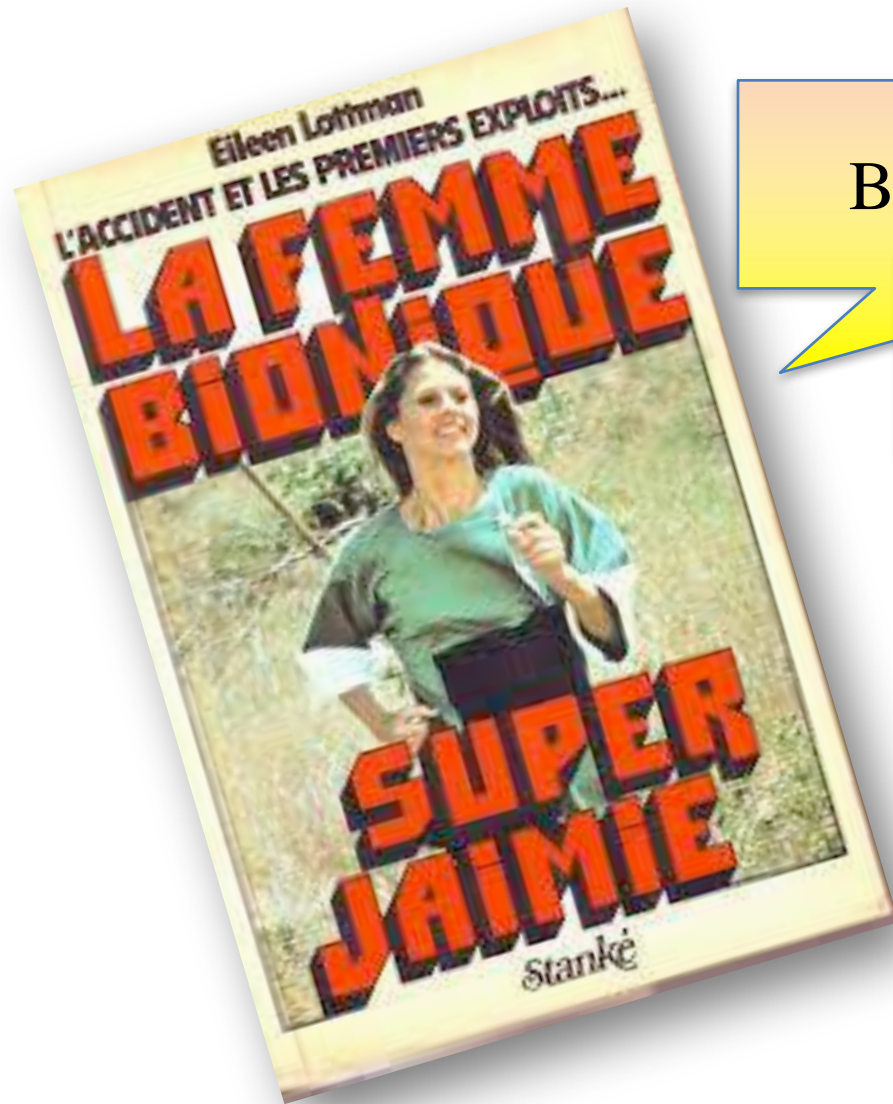
Plate tectonics



$$E=mc^2$$

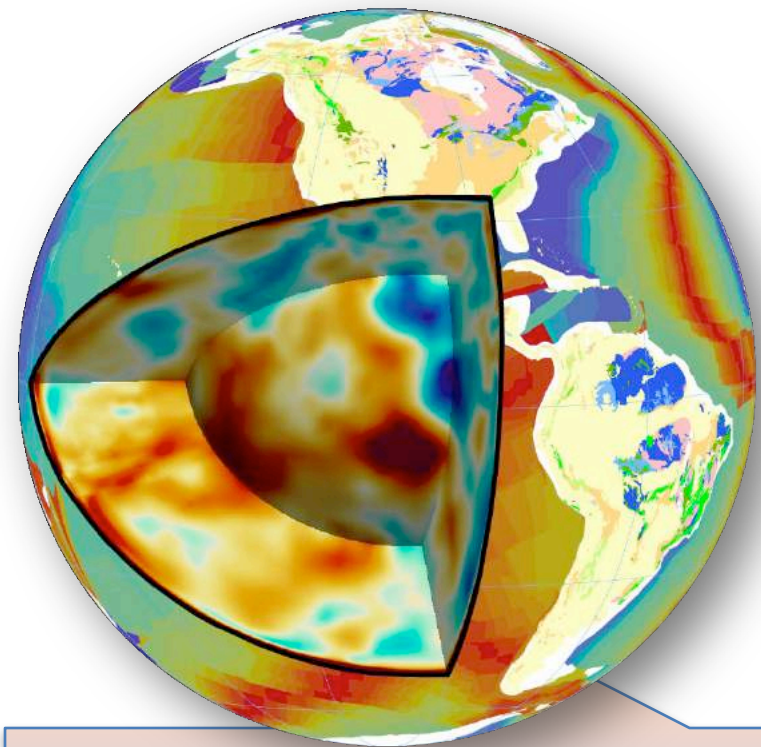
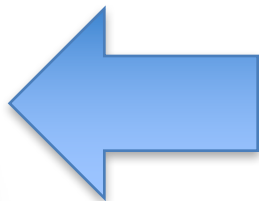
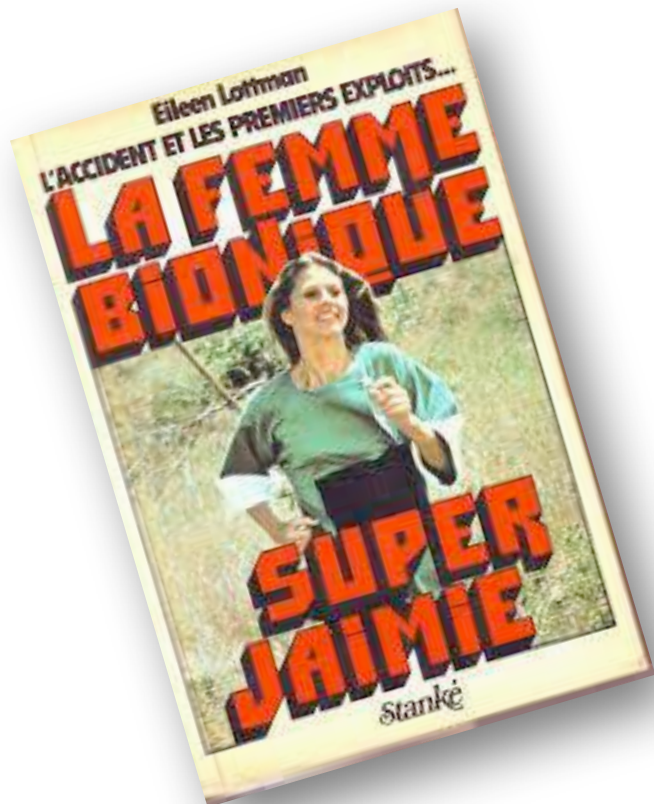




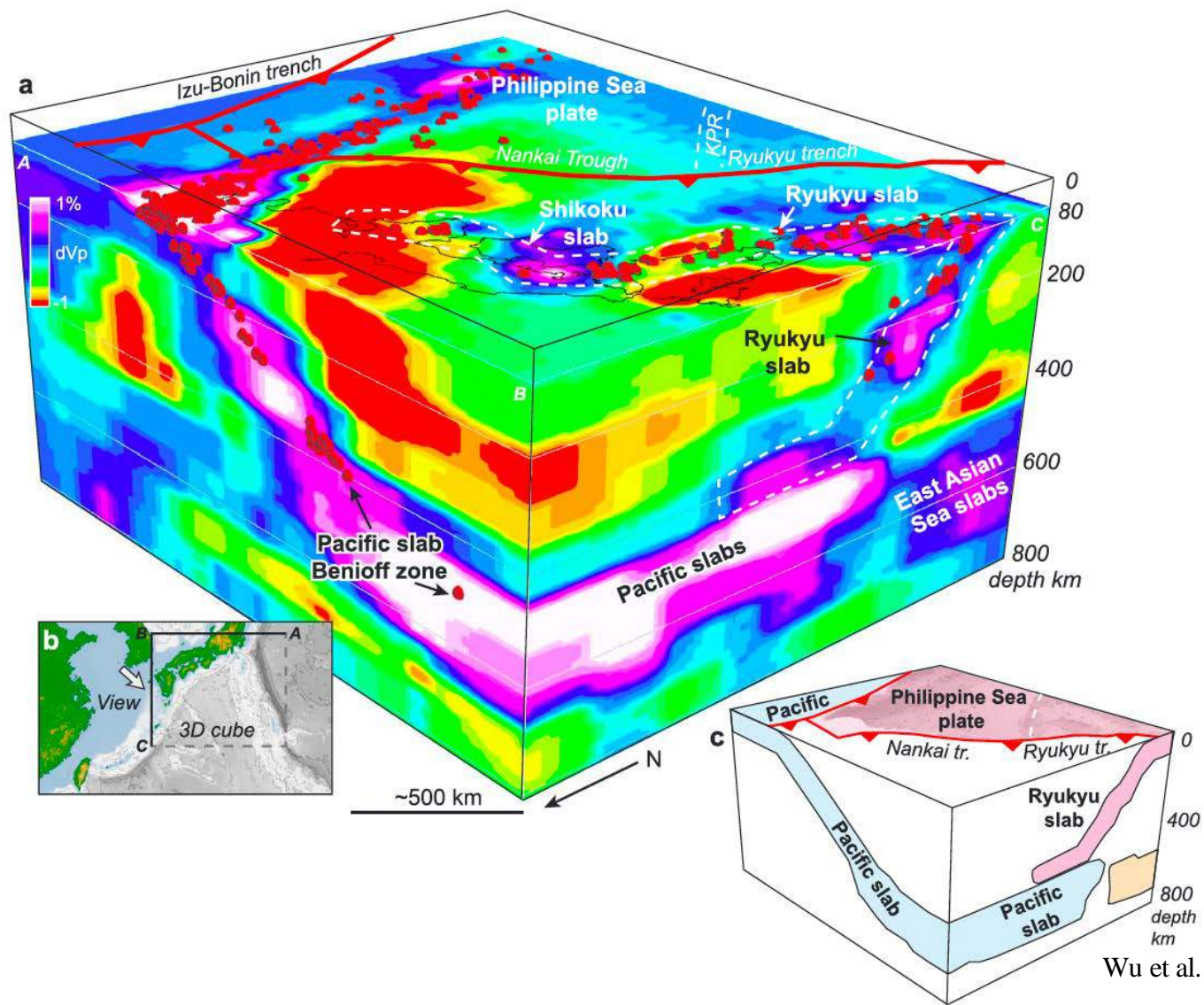


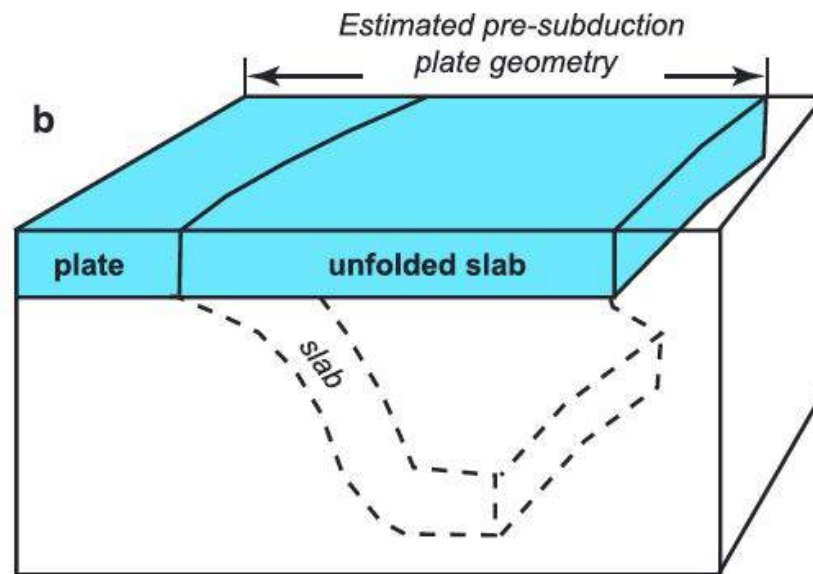
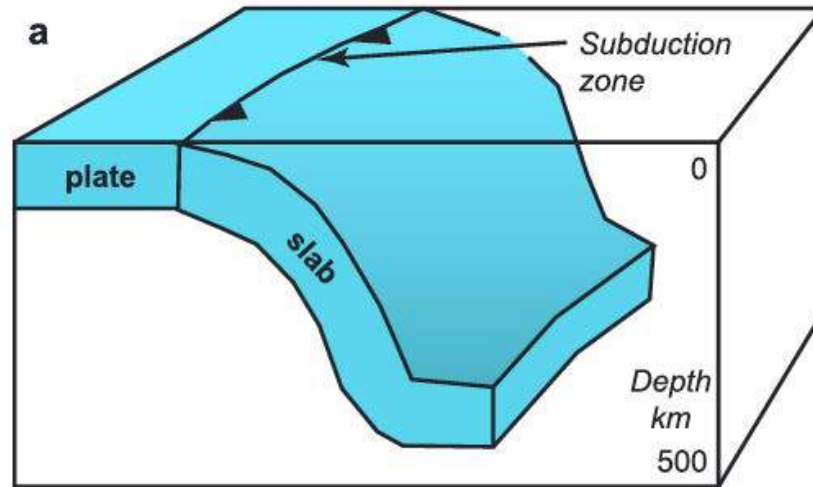
Bionic plate tectonics

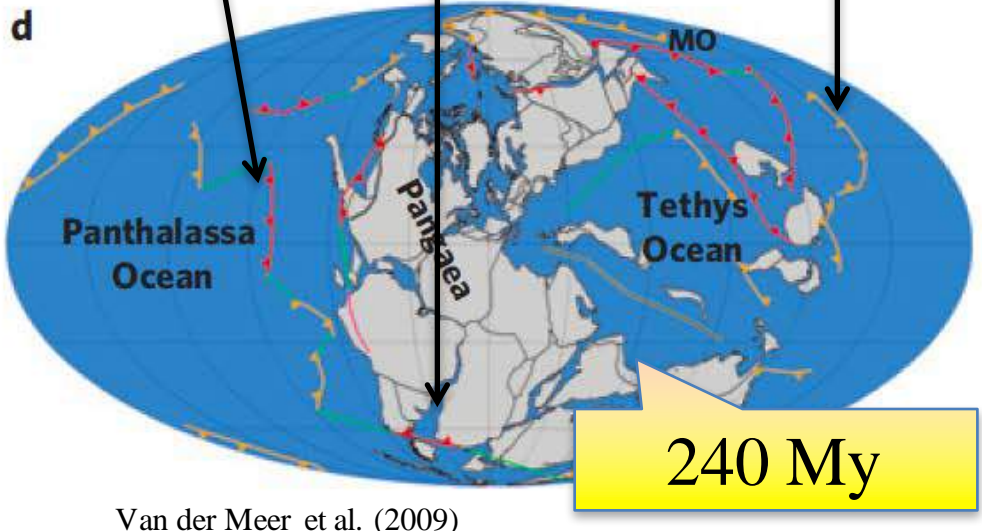
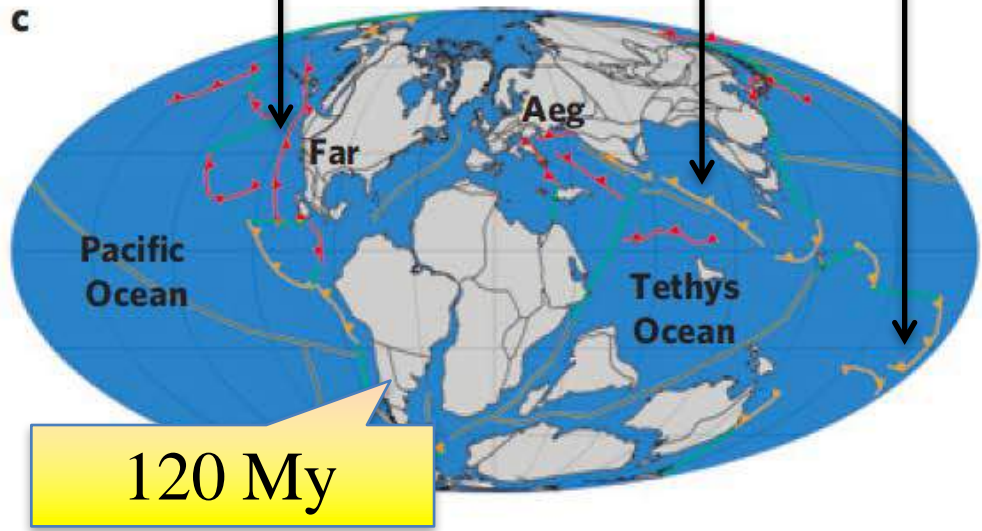
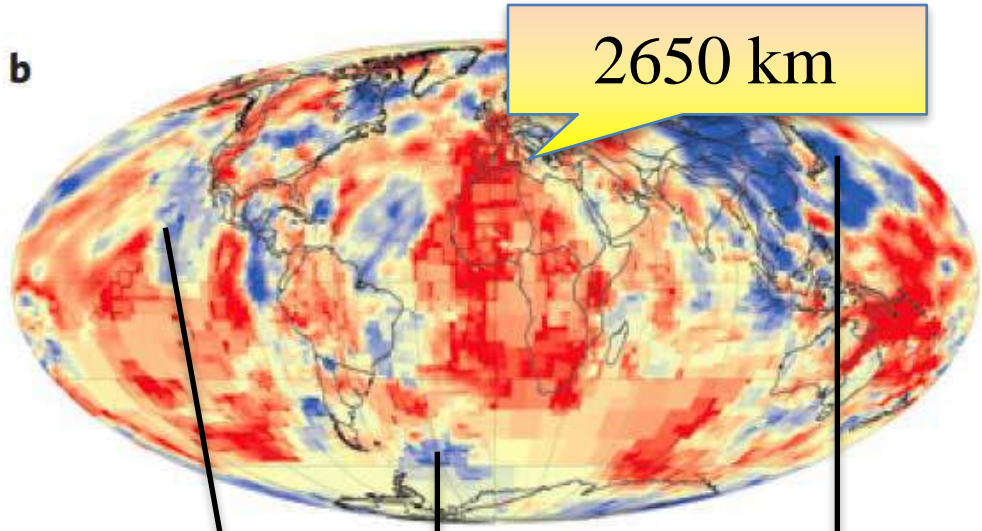
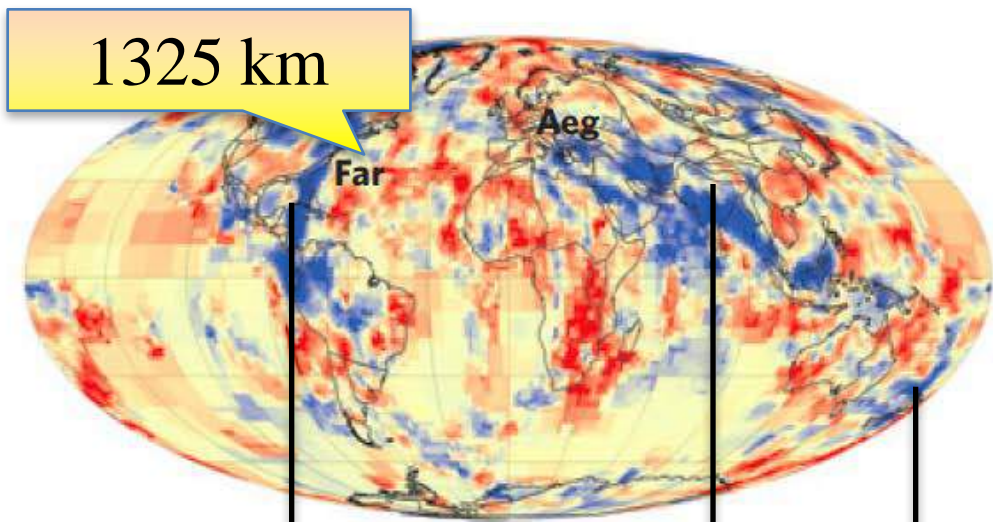
Augmented plate tectonics



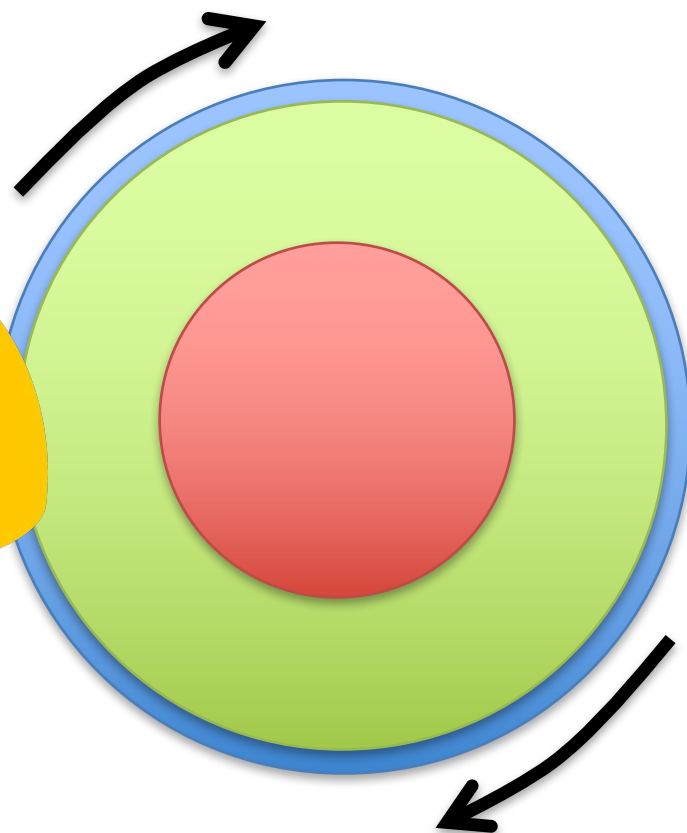
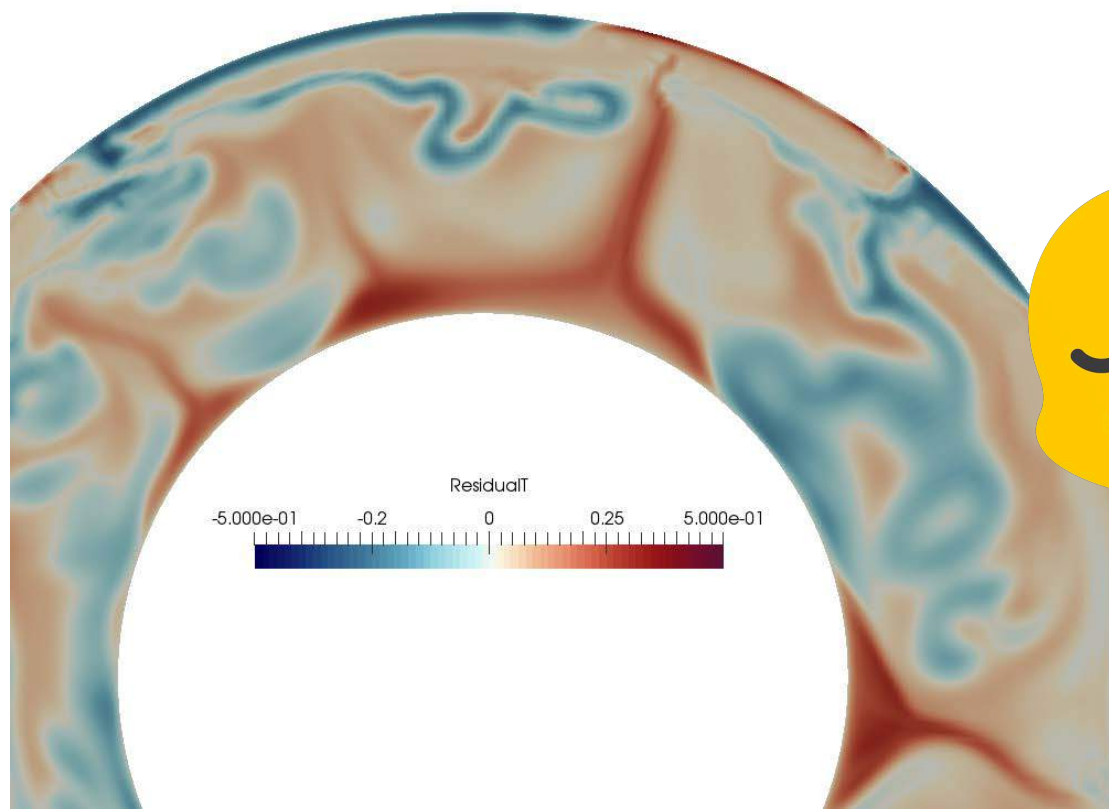
Seismic slabology

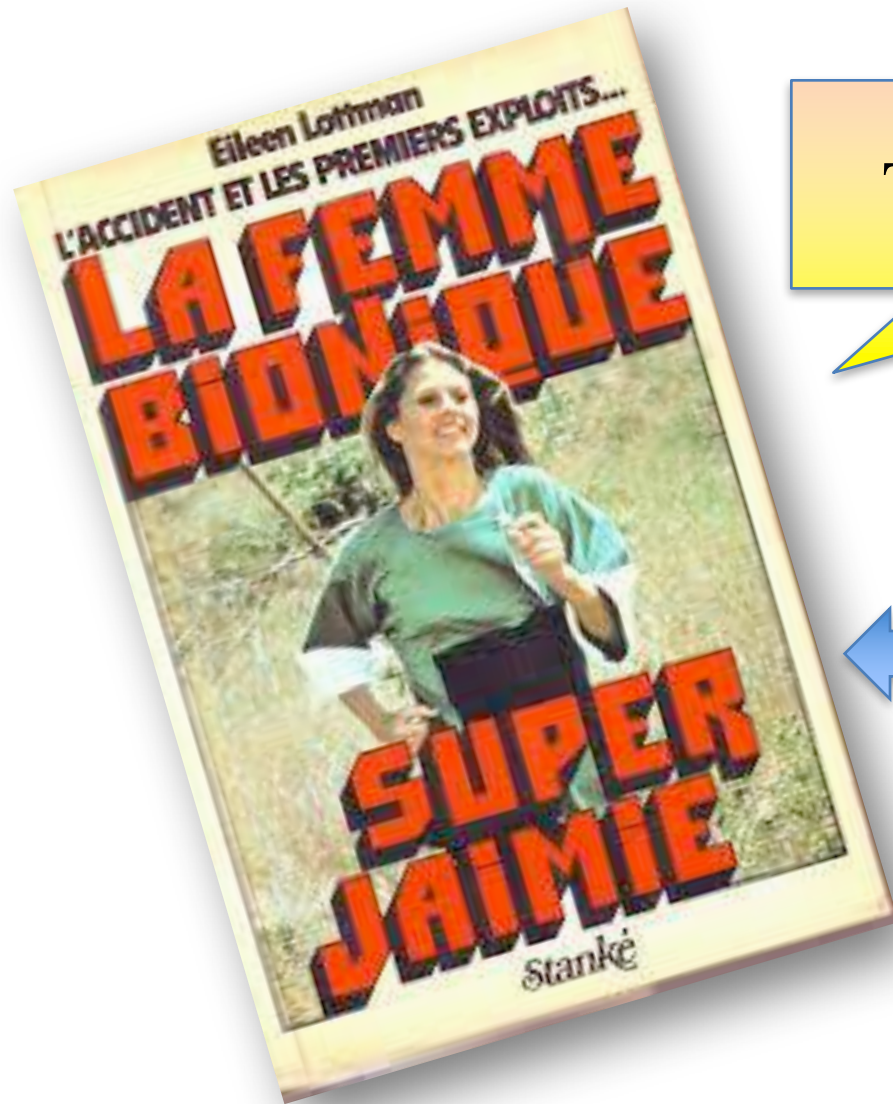






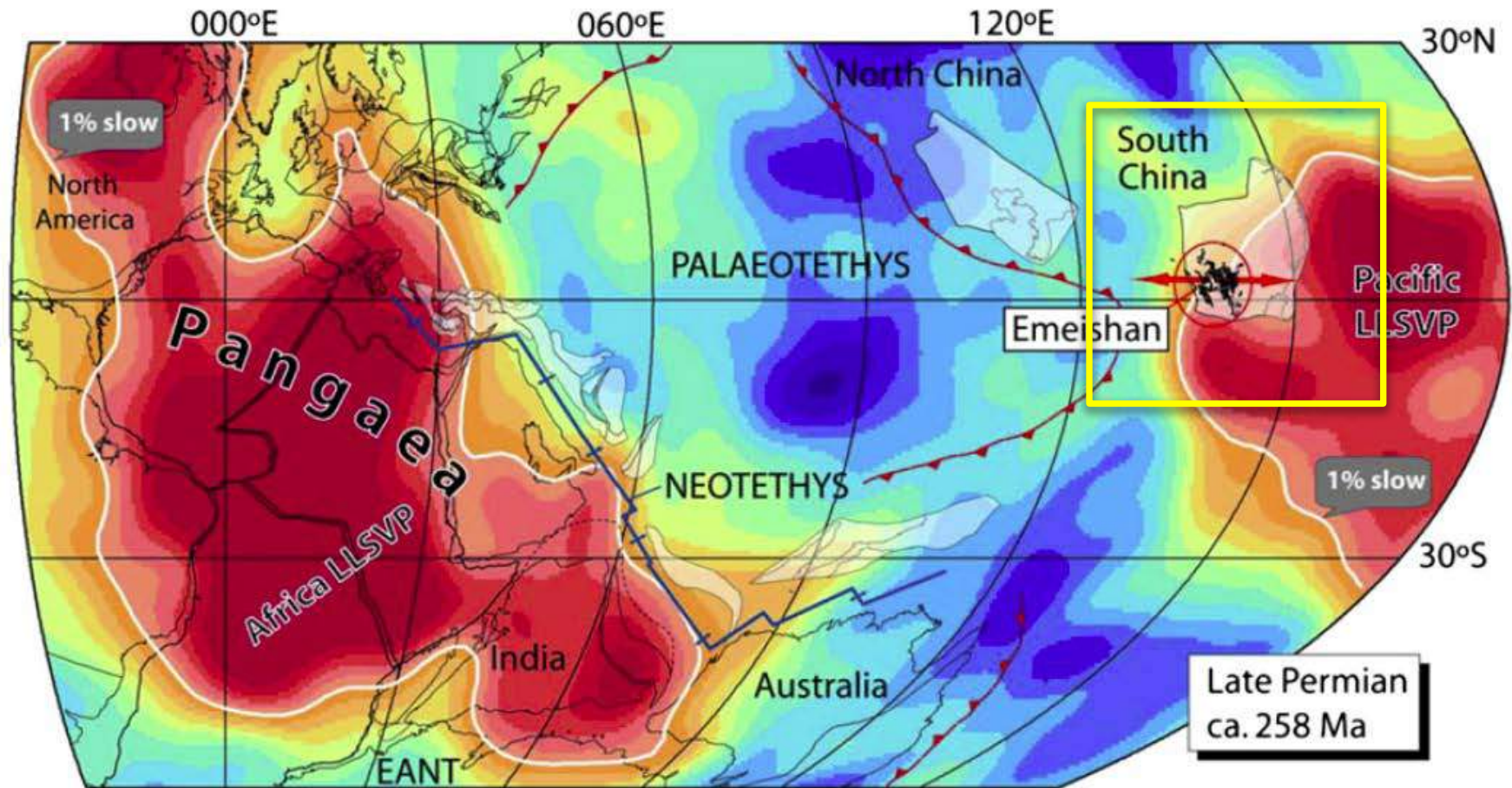
Van der Meer et al. (2009)



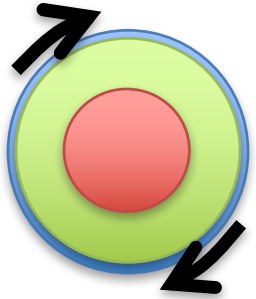


Thinking geodynamics

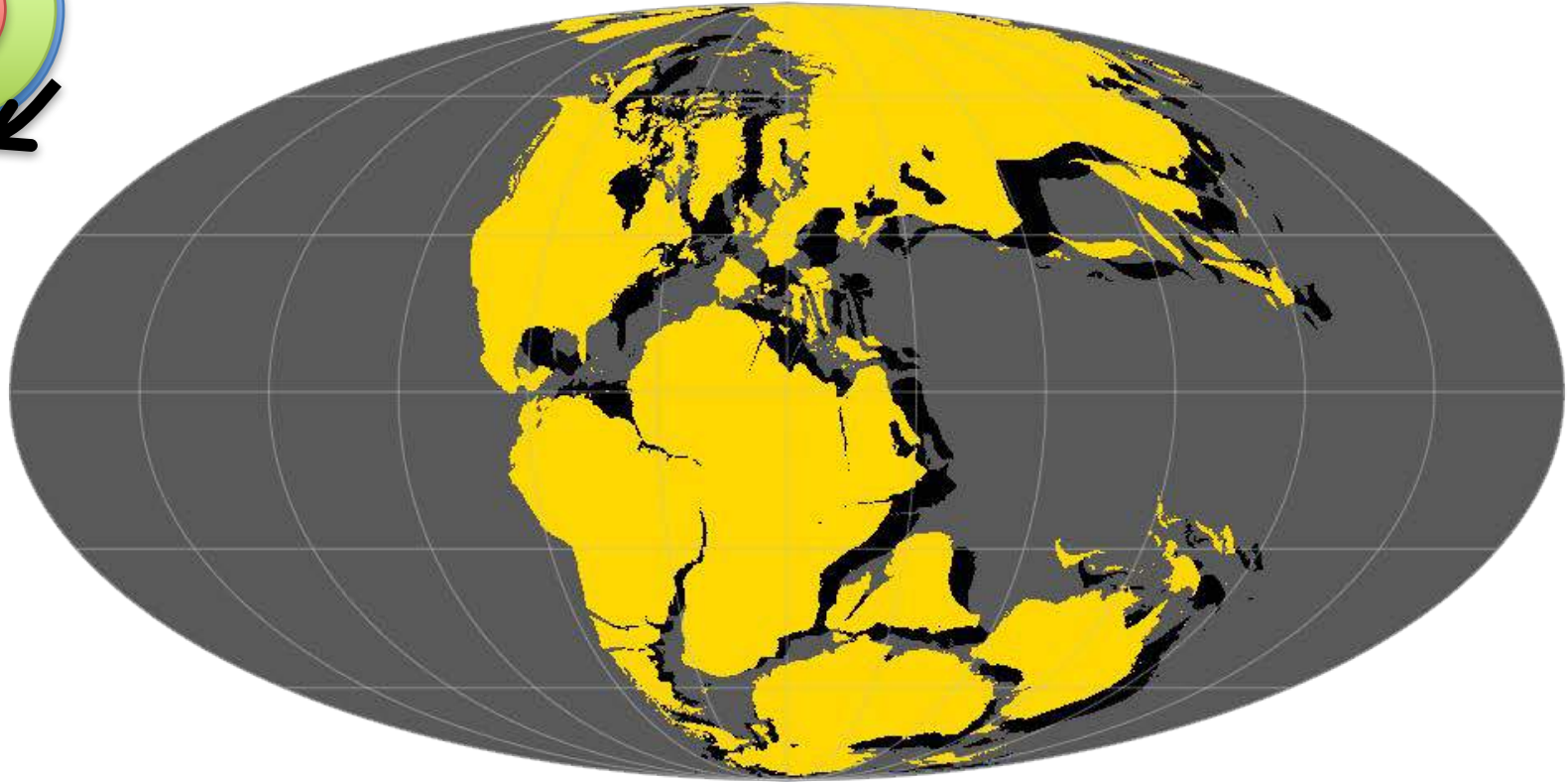




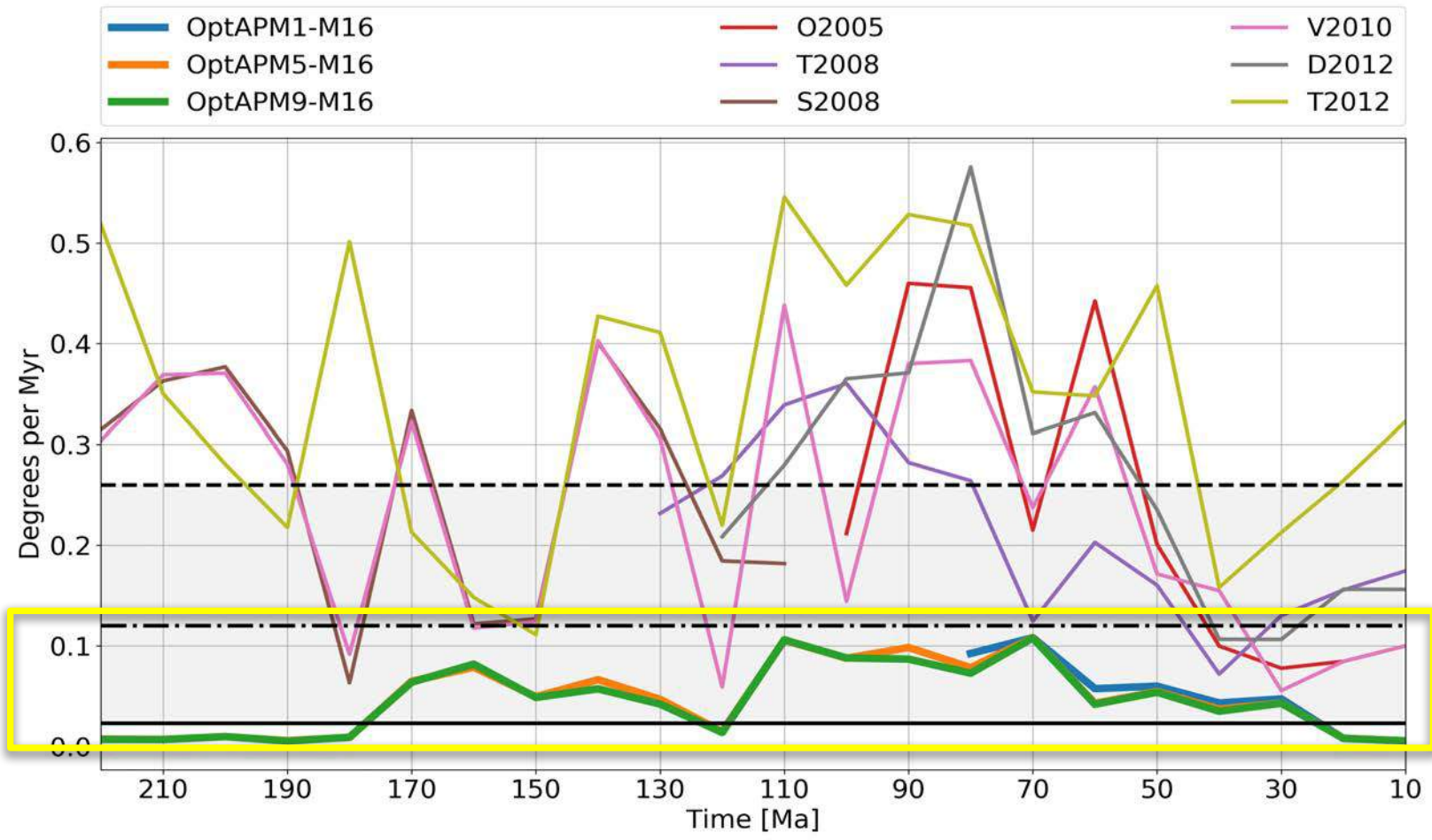
Torsvik et al. (2008)



150 Ma



Tetley et al. (soon)

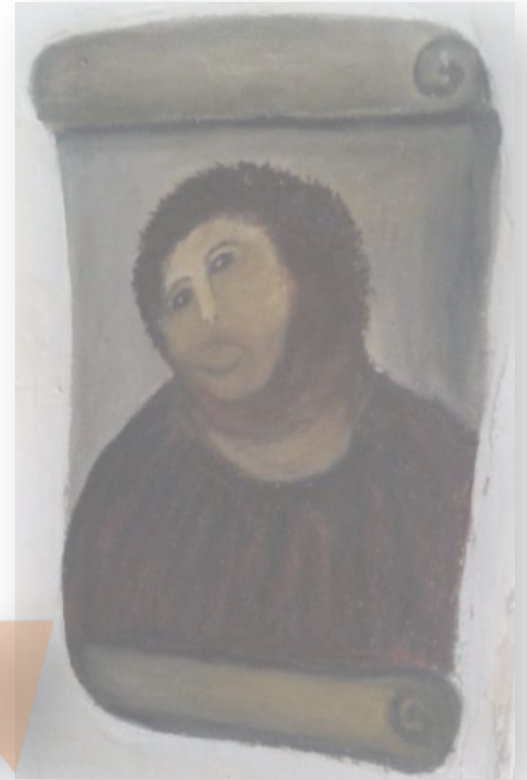


Tetley et al. (soon)



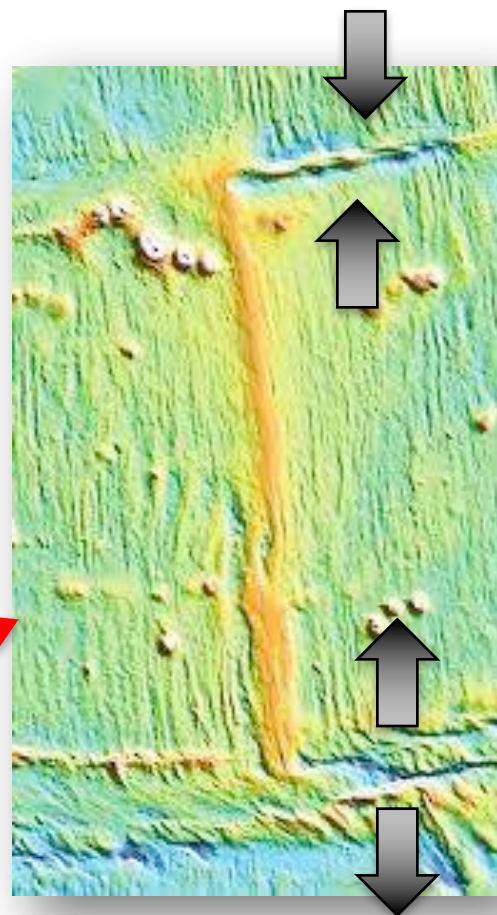
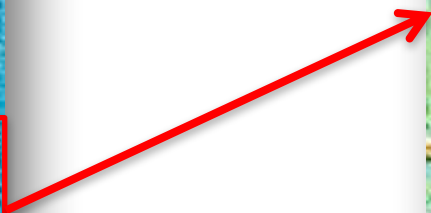
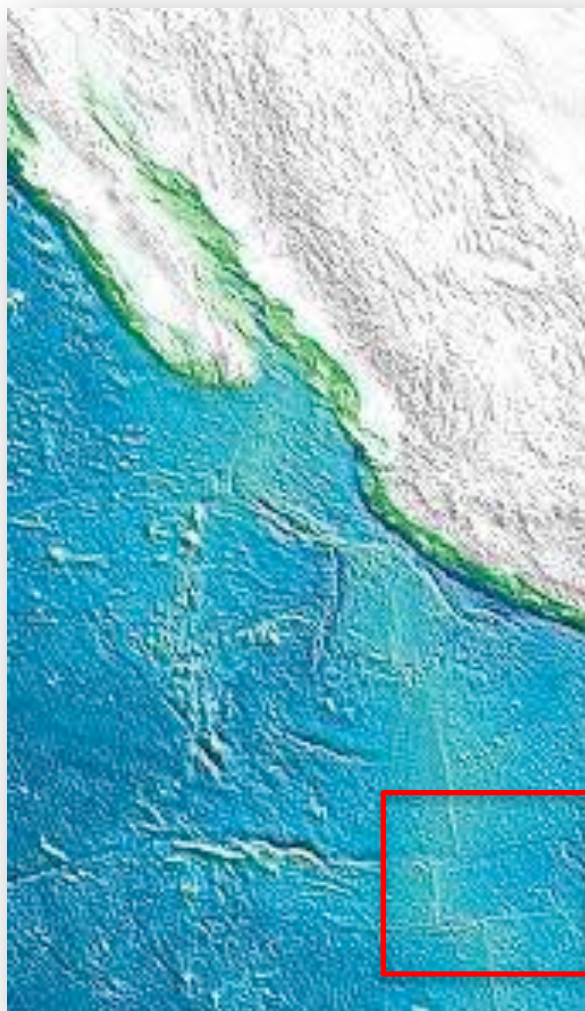


$$E=mc^2$$



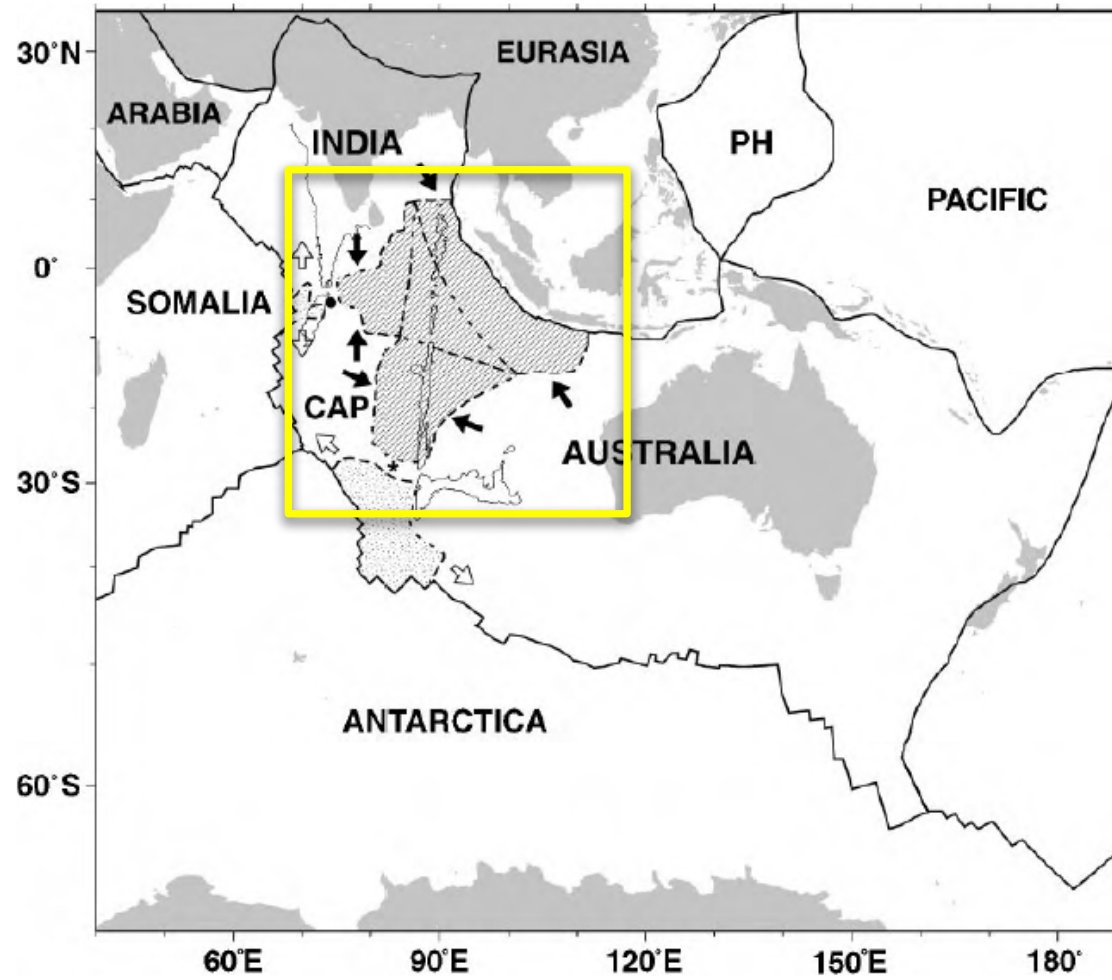
More types of plate boundaries



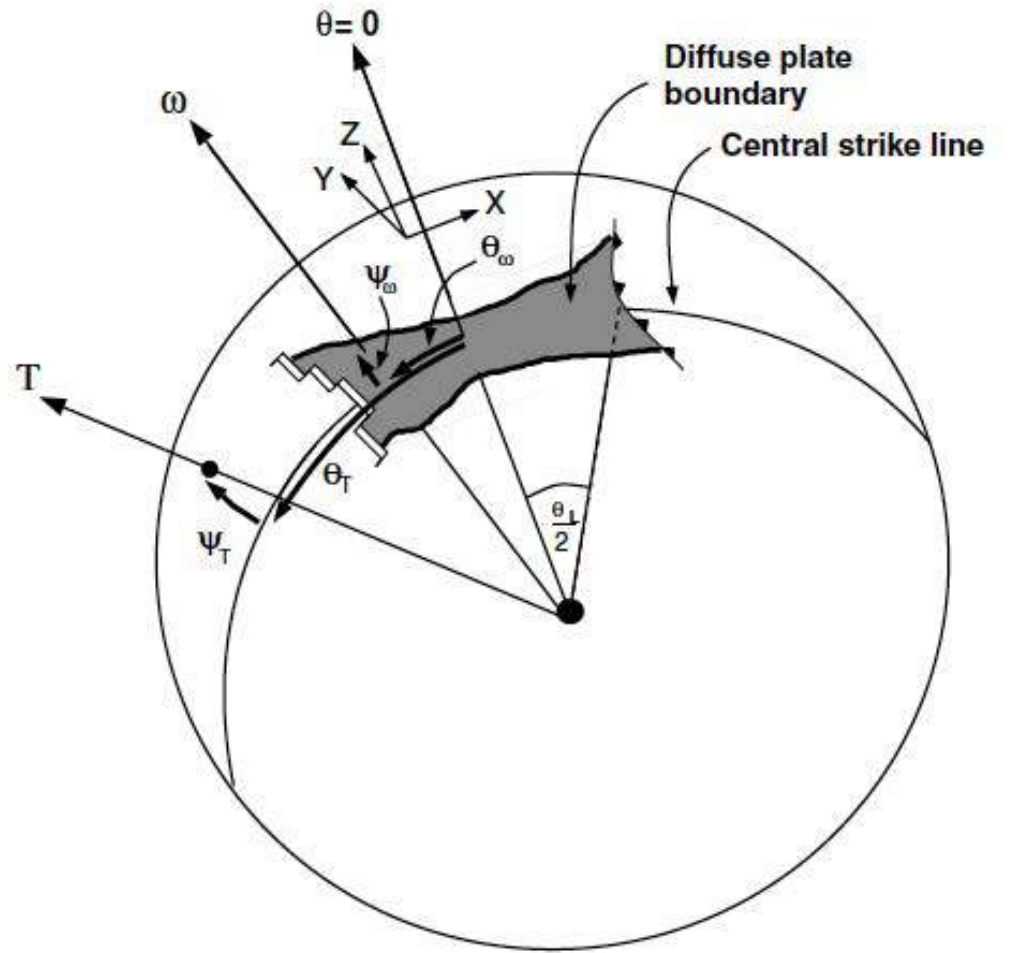
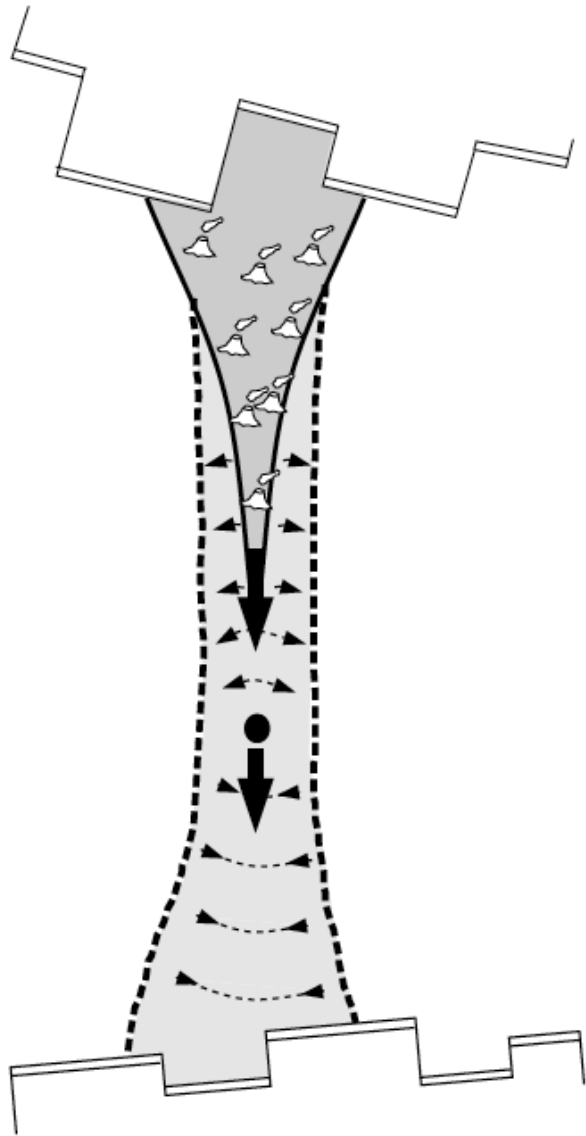


Clipperton

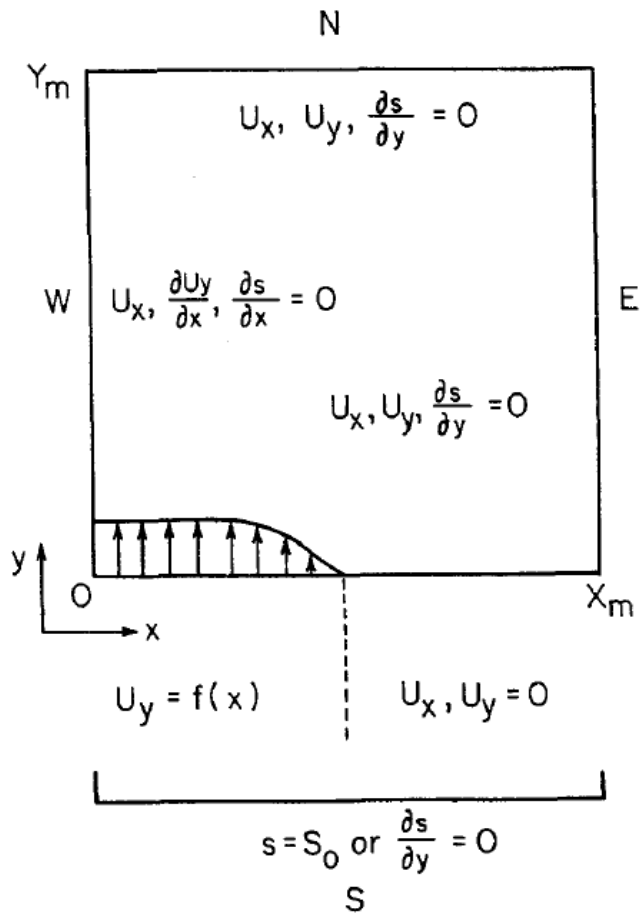
Siqueiros



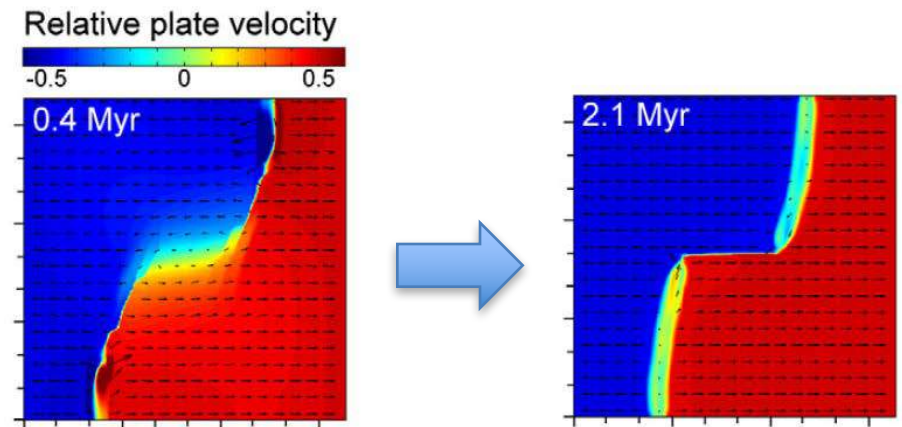
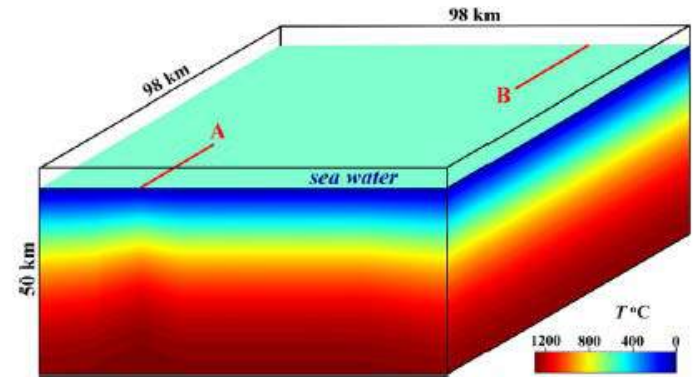
Royet & Gordon (1997)



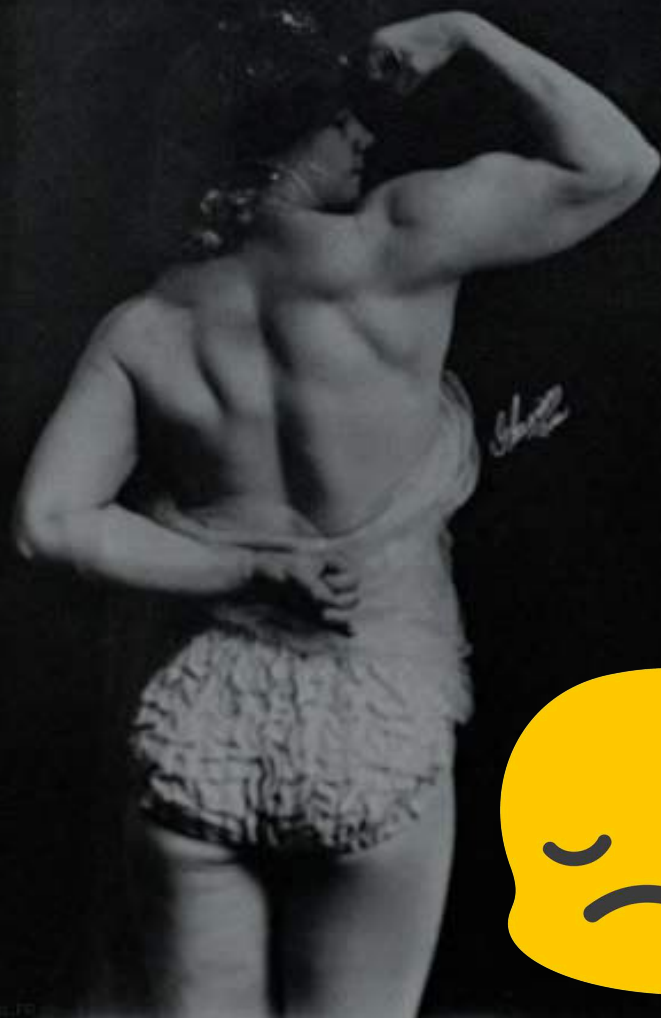
Zatman et al. (2001)



England & McKenzie (1982)

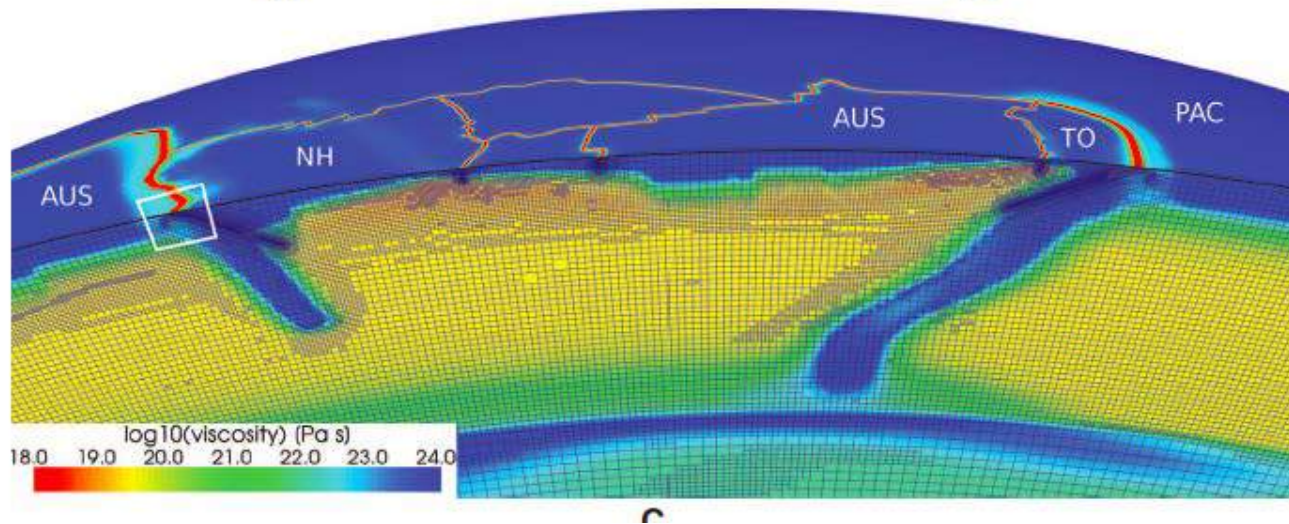
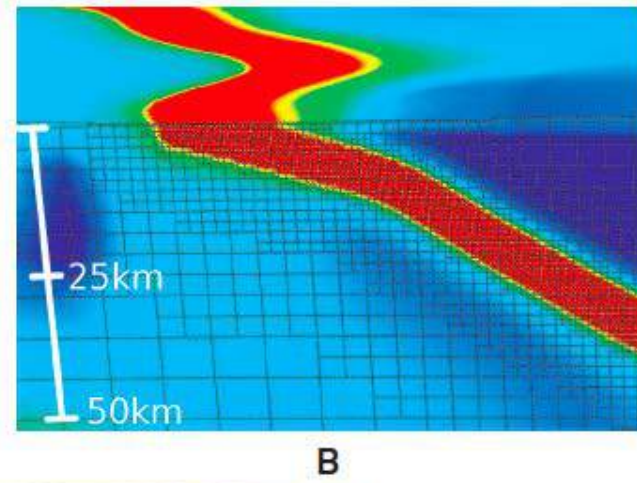
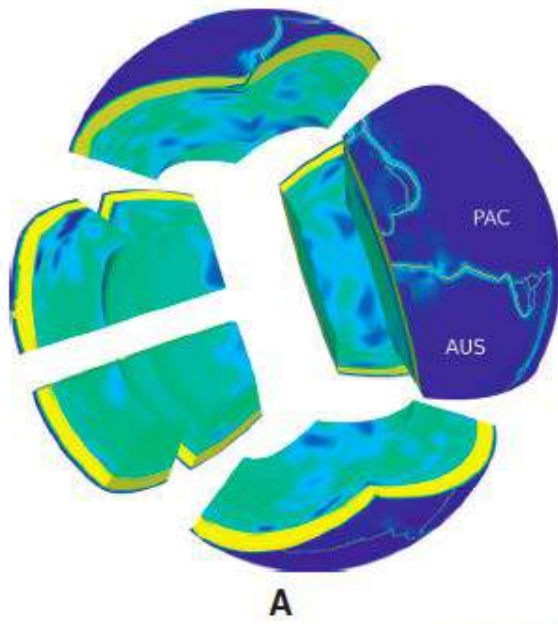


Gerya (2013)

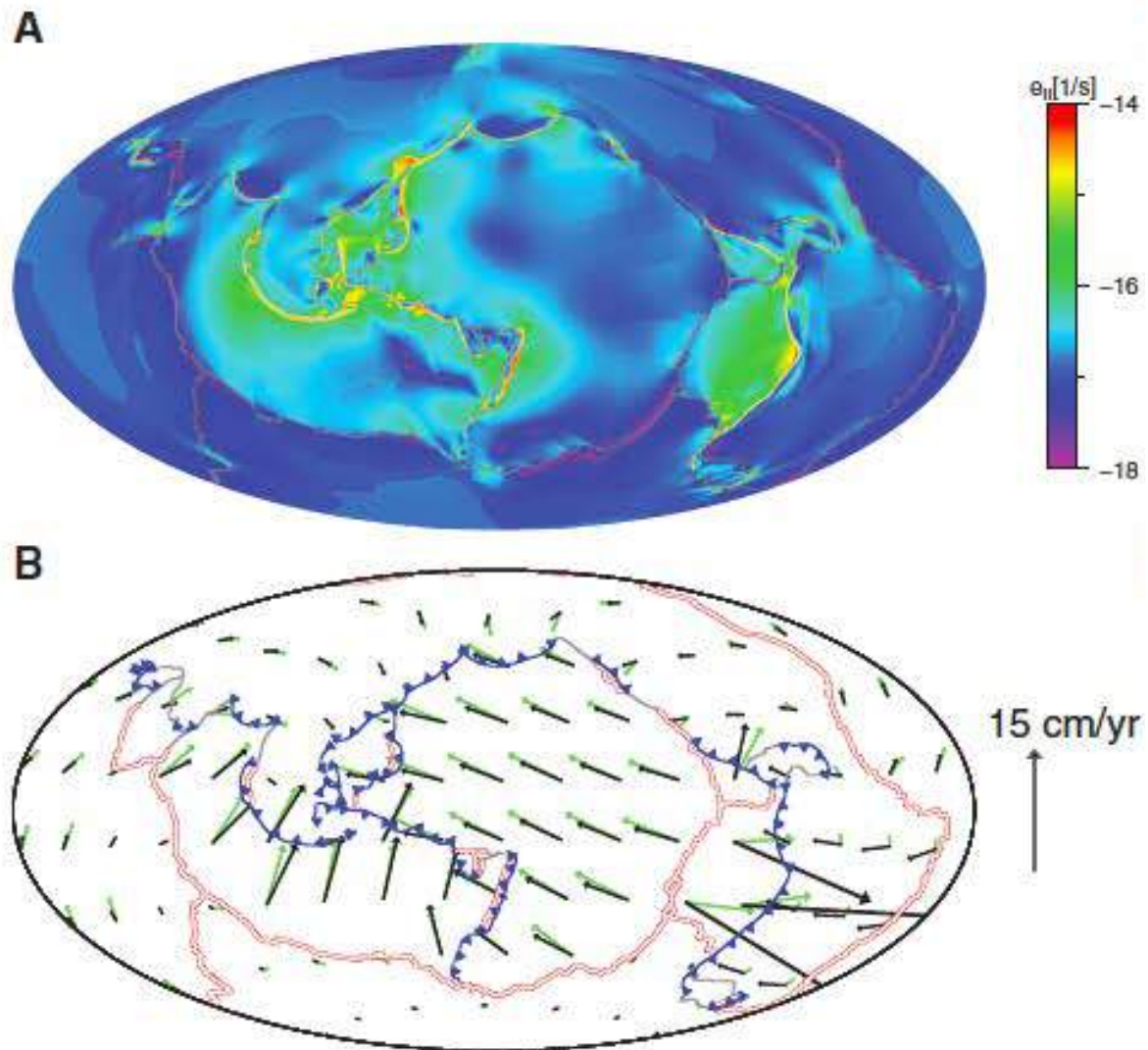




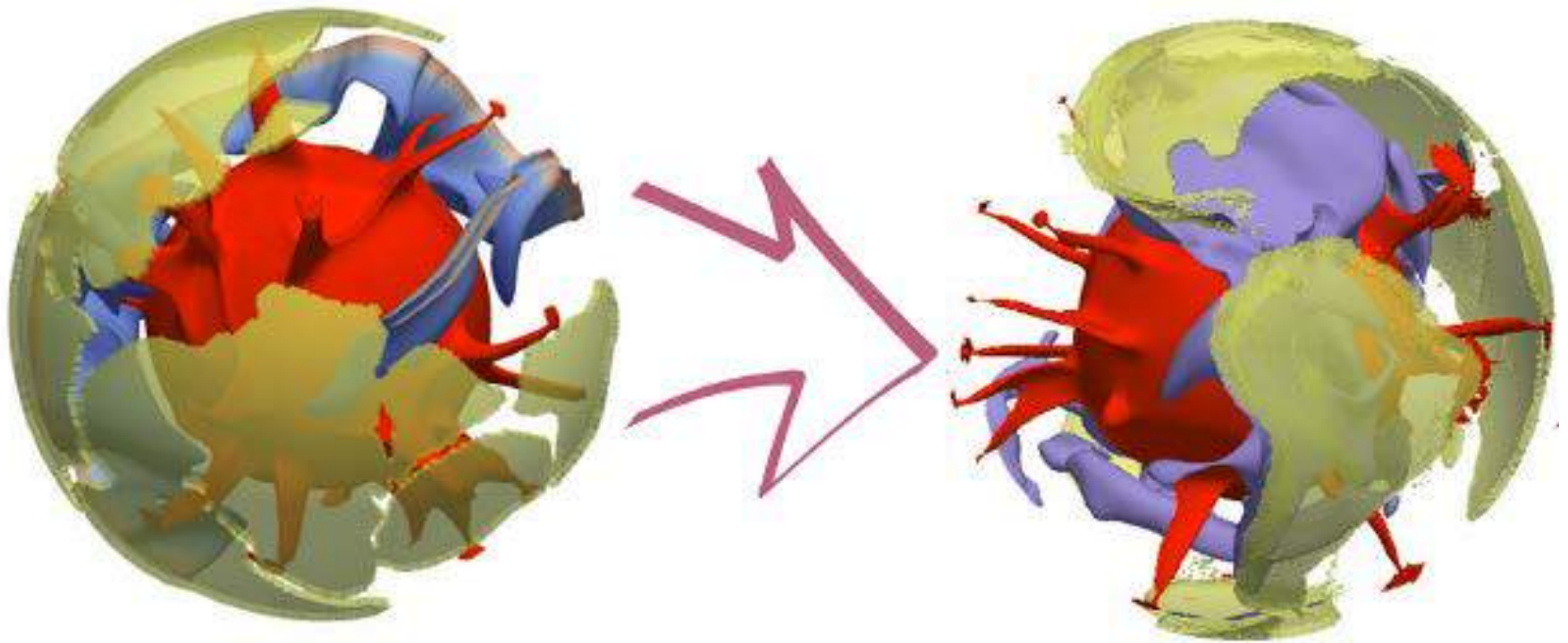
Non-rigid plates driven by mantle flow



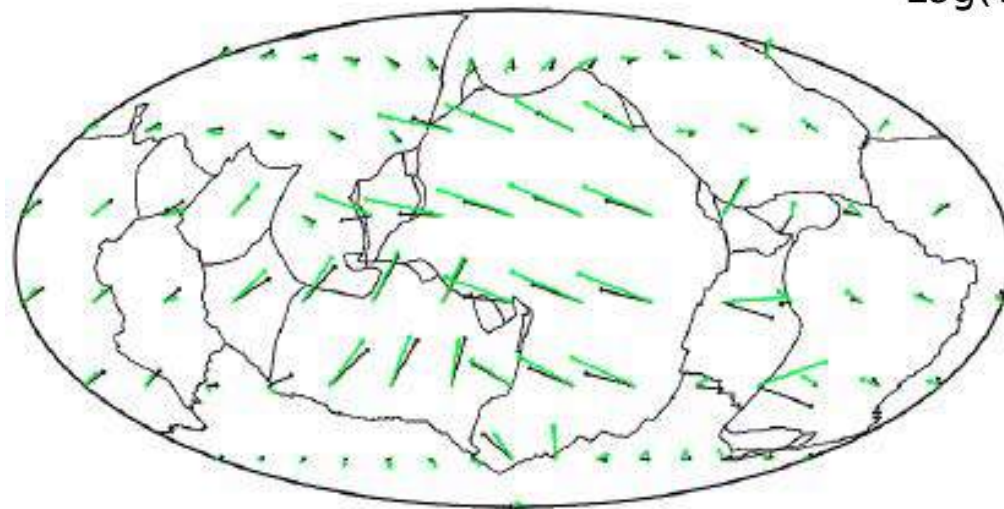
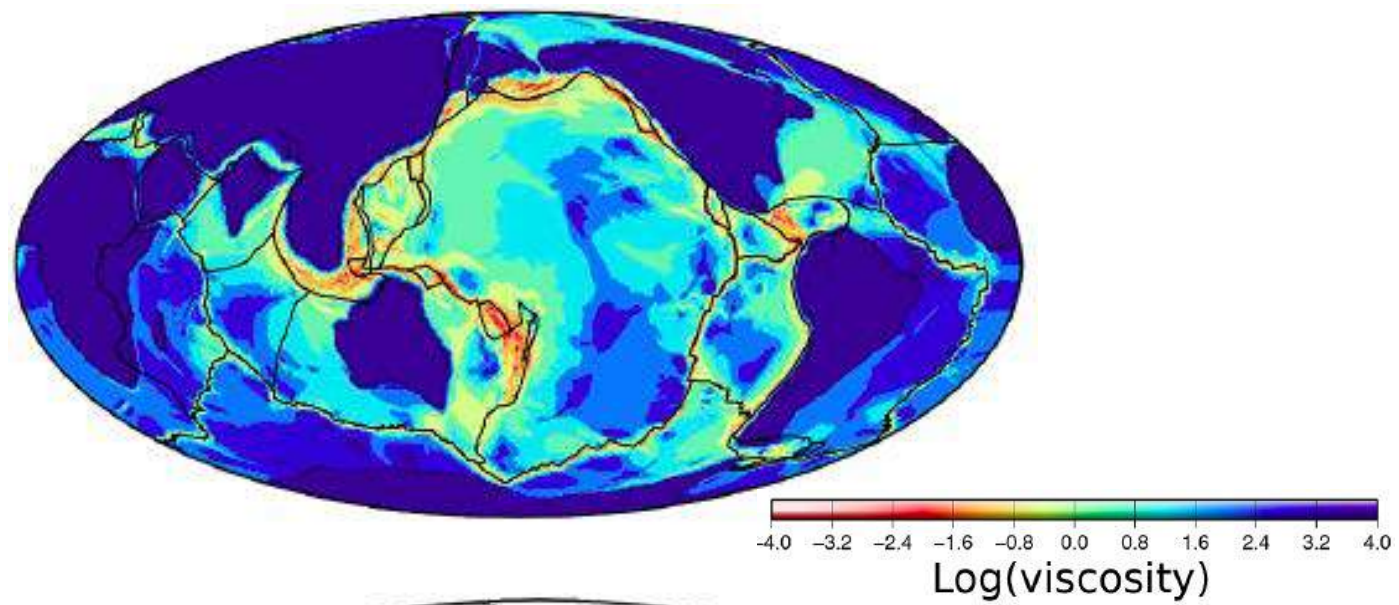
Stadler et al. (2010)



Stadler et al. (2010)



Coltice & Shephard. (2018)



Coltice & Shephard. (2018)



Lateral motion



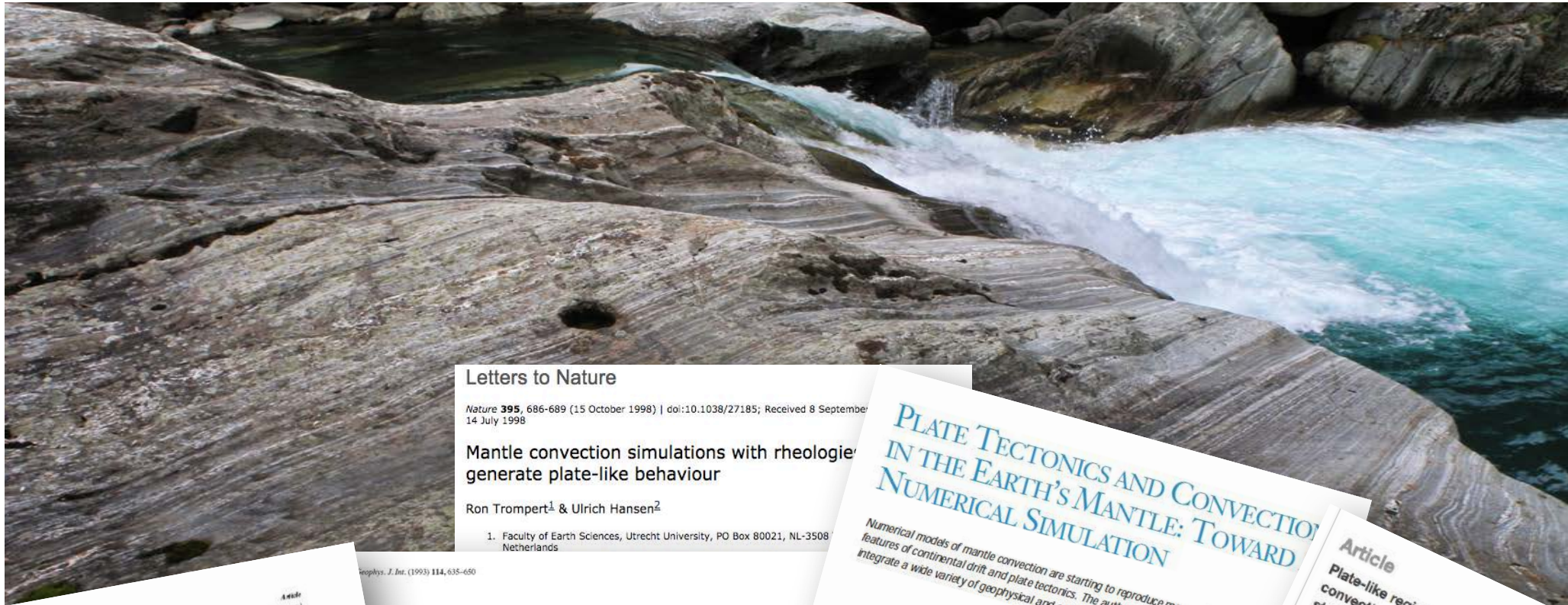
Lateral+vertical motion

LOOT



Dynamic feedback between
lithosphere and mantle





Letters to Nature

Nature 395, 686-689 (15 October 1998) | doi:10.1038/27185; Received 8 September 1998

Mantle convection simulations with rheologies that generate plate-like behaviour

Ron Trompert¹ & Ulrich Hansen²

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PLATE TECTONICS AND CONVECTION IN THE EARTH'S MANTLE: TOWARD NUMERICAL SIMULATION

Numerical models of mantle convection are starting to reproduce many of the essential features of continental drift and plate tectonics. The authors show how such methods can integrate a wide variety of geophysical and geological observations.

Article
 Plate-like regime of a numerically modeled mantle convection in a fluid with temperature- and stress-history-dependent viscosity
 Masaru Ogawa
 Journal of Geophysical Research: Atmospheres (Impact Factor: 3.43), 02/2000, DOI: 10.1029/2000JB000068

Geochemistry Geophysics Geosystems
 AN ELECTRONIC JOURNAL OF THE EARTH SCIENCES
 Published by AGU and the Geochemical Society
 ISSN: 1525-2027
 Published August 23, 2000
 Prior number 2000G00034

Consistent generation of tectonic plates in independent, three-dimensional mantle convection simulations with endoplastic yielding

Jackley
 Department of Earth and Space Sciences, University of California, Los Angeles, 405 Hilgard Avenue, Los Angeles, California 90095 (jackley@zapher.ucla.edu)

Presented here are self-consistent, three-dimensional simulations of mantle convection, which demonstrate plate tectonic behavior that is continuous in space and time. The material description of mantle rheology, however, the required yield strength of the mantle is not modeled. Tectonic plates are formed by the consistent generation of

Simple Model of Plate Generation from Mantle Flow

David Bercovici*
 Department of Geology & Geophysics
 School of Ocean & Earth Science & Technology
 University of Hawaii, Honolulu
 *Department of Geology & Geophysics, Yale University

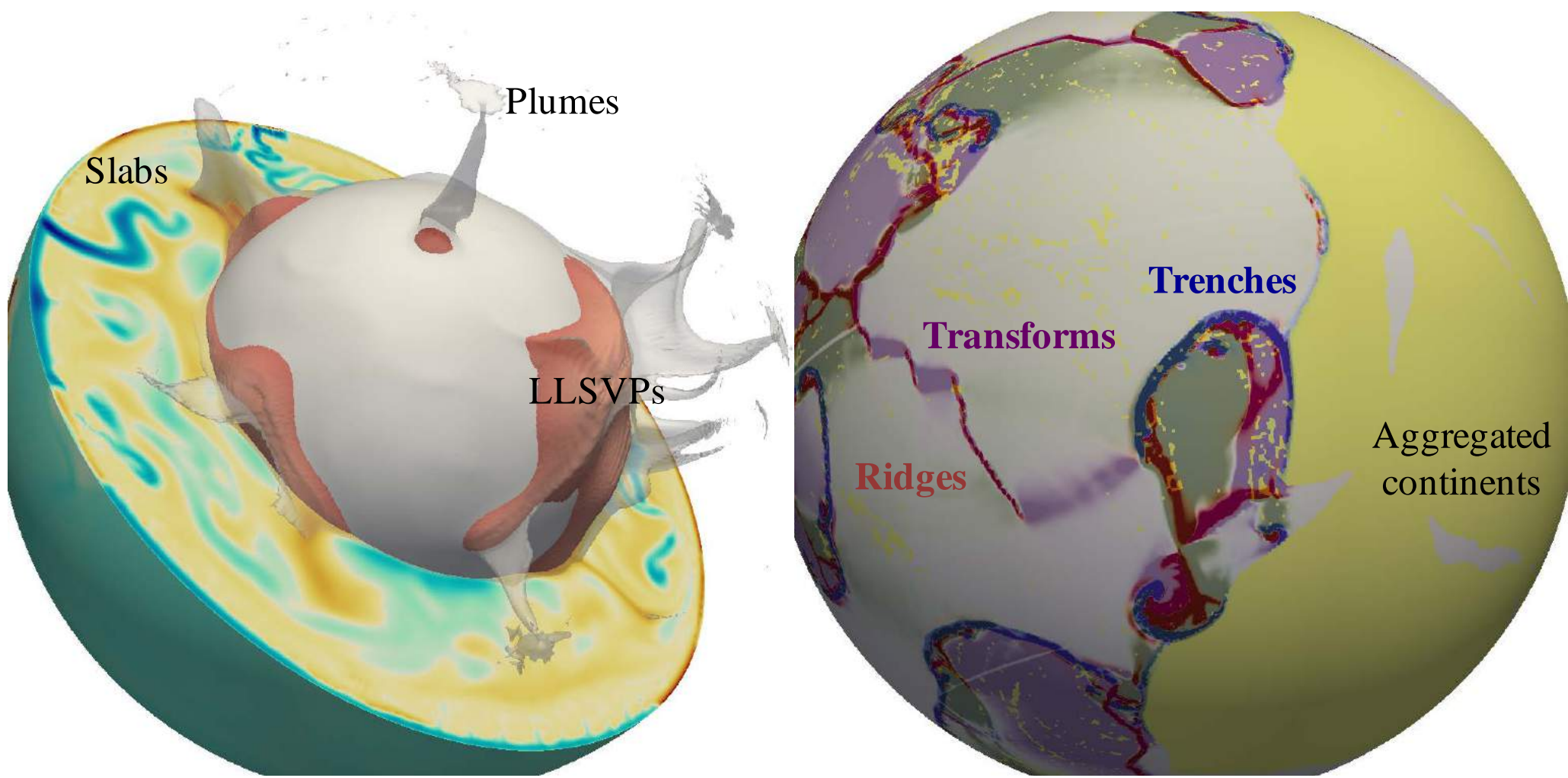
SUMMARY
 A simple model of non-Newtonian creeping flow is used to evaluate whether or not viscous mantle flow can become plate-like. The model describes motion driven by sources and sinks. The sources represent spreading centers and subduction zones; the sources and sinks thus also prescribe the surface flow field. The toroidal (strike-slip) component of the solution of the Stokes equation with non-Newtonian rheology. As the model, the horizontal divergence from the two-dimensional Olson & Bercovici (1991) is used for the source-sink field. The fluid flow reproduces the rectangular plate is used to measure the

Plate tectonics is a kinematic description of Earth that treats the outer shell of its mantle as a number of plates or rigid spherical caps that move with respect to each other (see the "Plate tectonics" sidebar). The mantle is the outer, solid 3,000-km-thick shell that overlies Earth's fluid outer core. An enormous amount of geological and geophysical data has gone into determining the motion of the plates, and within the last few years direct GPS measurements have corroborated the geological constraints on the motions of plates. A fundamental question in geology has been what drives the plates? This question has largely been solved—the plates are part of a system of large-scale thermal convection—and geodynamicians have moved on to more difficult questions, such as what are the details of the coupling between surface motions and deeper mantle flow? and why do we have plate tectonics as opposed to some other mode of tectonic convection?

Answering these more subtle questions is complicated by the fact that the primary motion is to consume the old oceanic crust into the mantle. The primary cycle it into the mantle. The primary history is therefore limited to 200 million years or so (less than the overall history of plate tectonics). The primary history of plate tectonics is therefore limited to 200 million years or so (less than the overall history of plate tectonics). The primary history of plate tectonics is therefore limited to 200 million years or so (less than the overall history of plate tectonics).

Model formulation
 The equations for the mantle convection are solved using a finite-difference method. The mantle is modeled as a fluid with a temperature- and stress-history-dependent viscosity. The equations are solved for a 2D cross-section of the mantle. The results show that a plate-like regime can emerge from a numerically modeled mantle convection in a fluid with temperature- and stress-history-dependent viscosity.

1021-9615/00/2000-0000-0000
 LOUIS M...



Slabs

Plumes

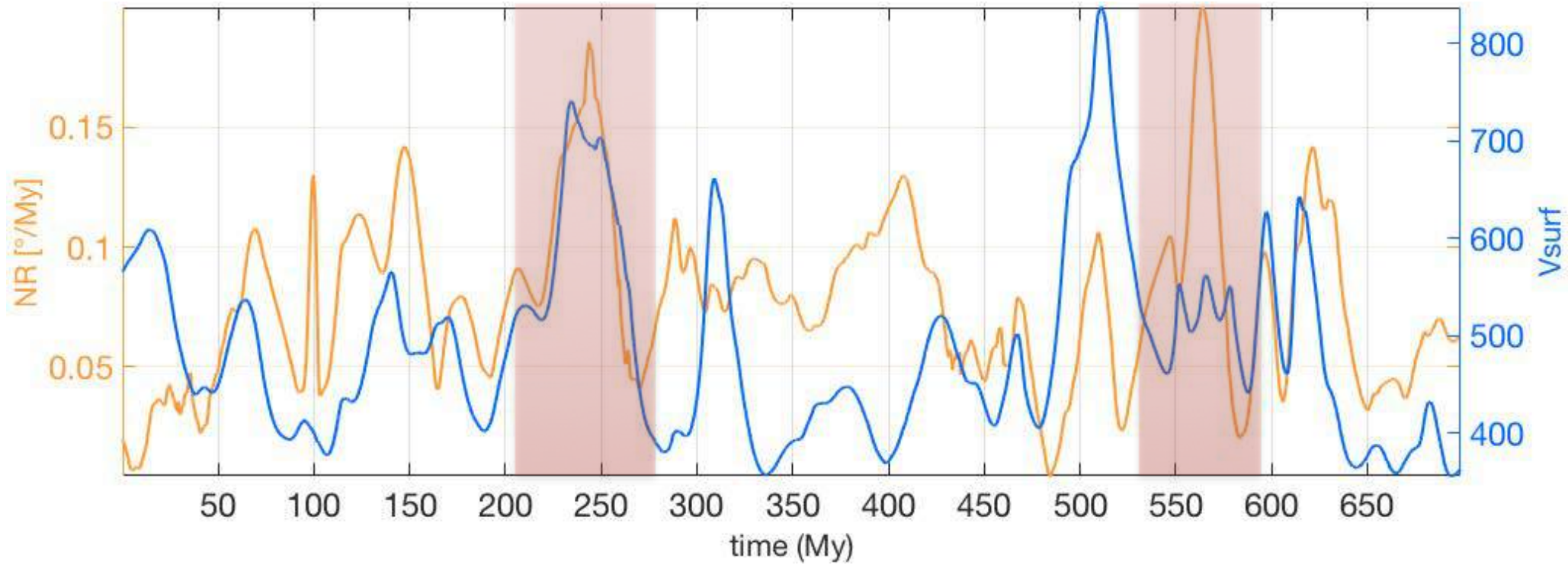
LLSVPs

Ridges

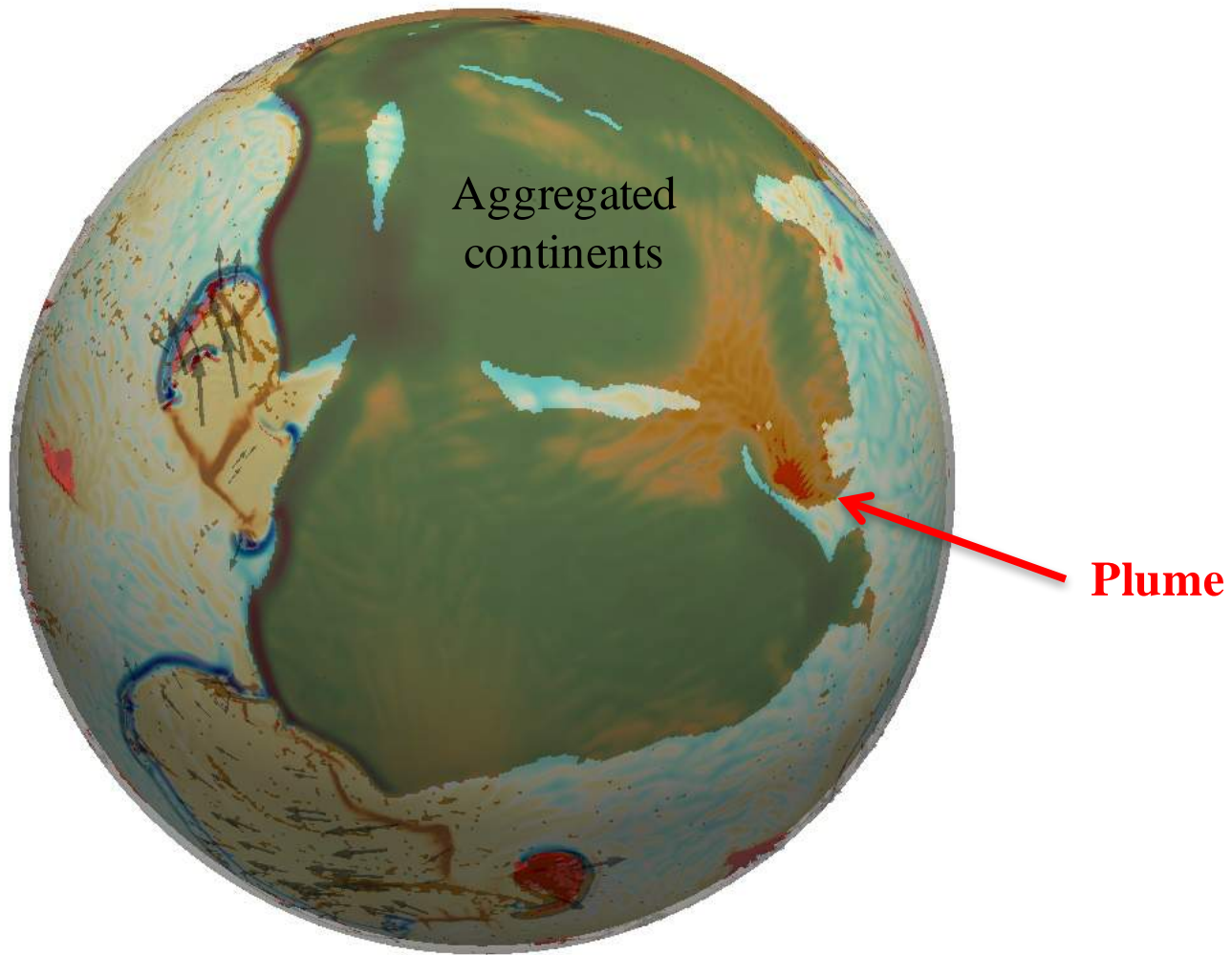
Transforms

Trenches

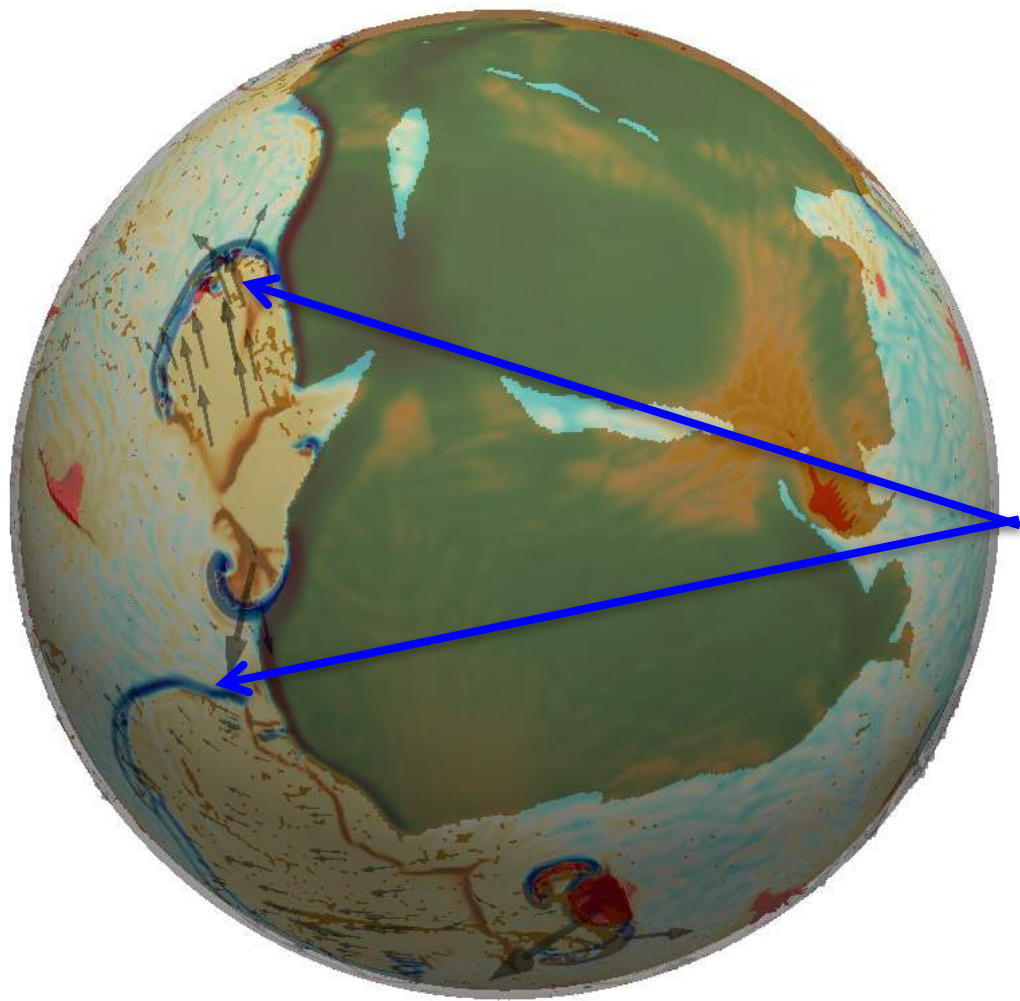
Aggregated continents



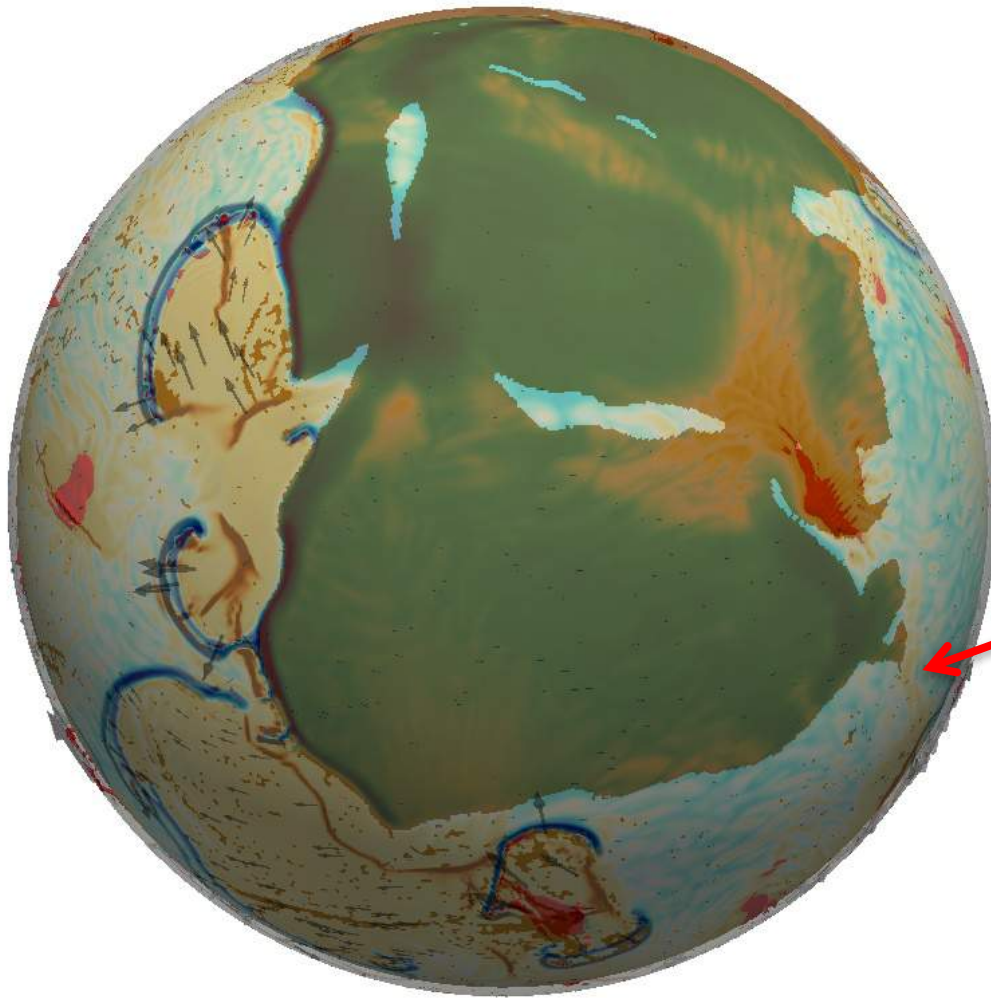
Gérault et al. (soon)



+10 myr



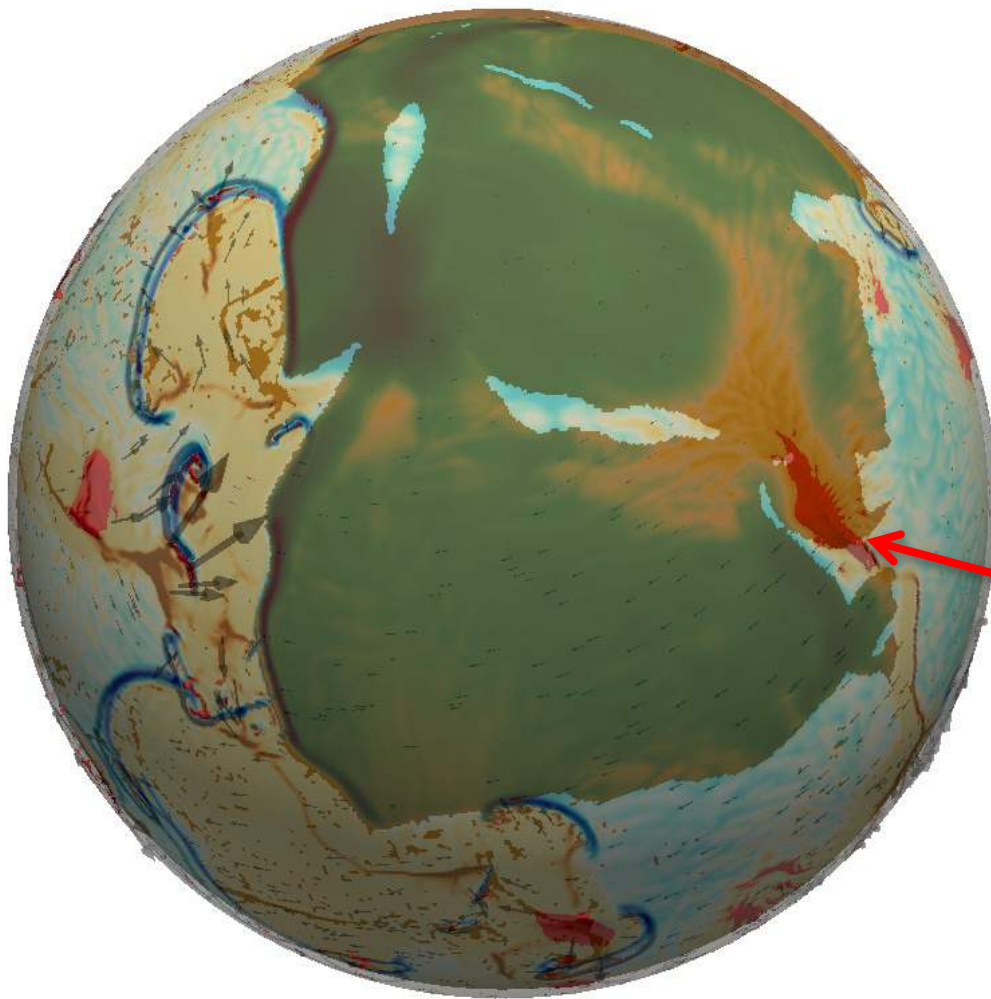
Trench retreat



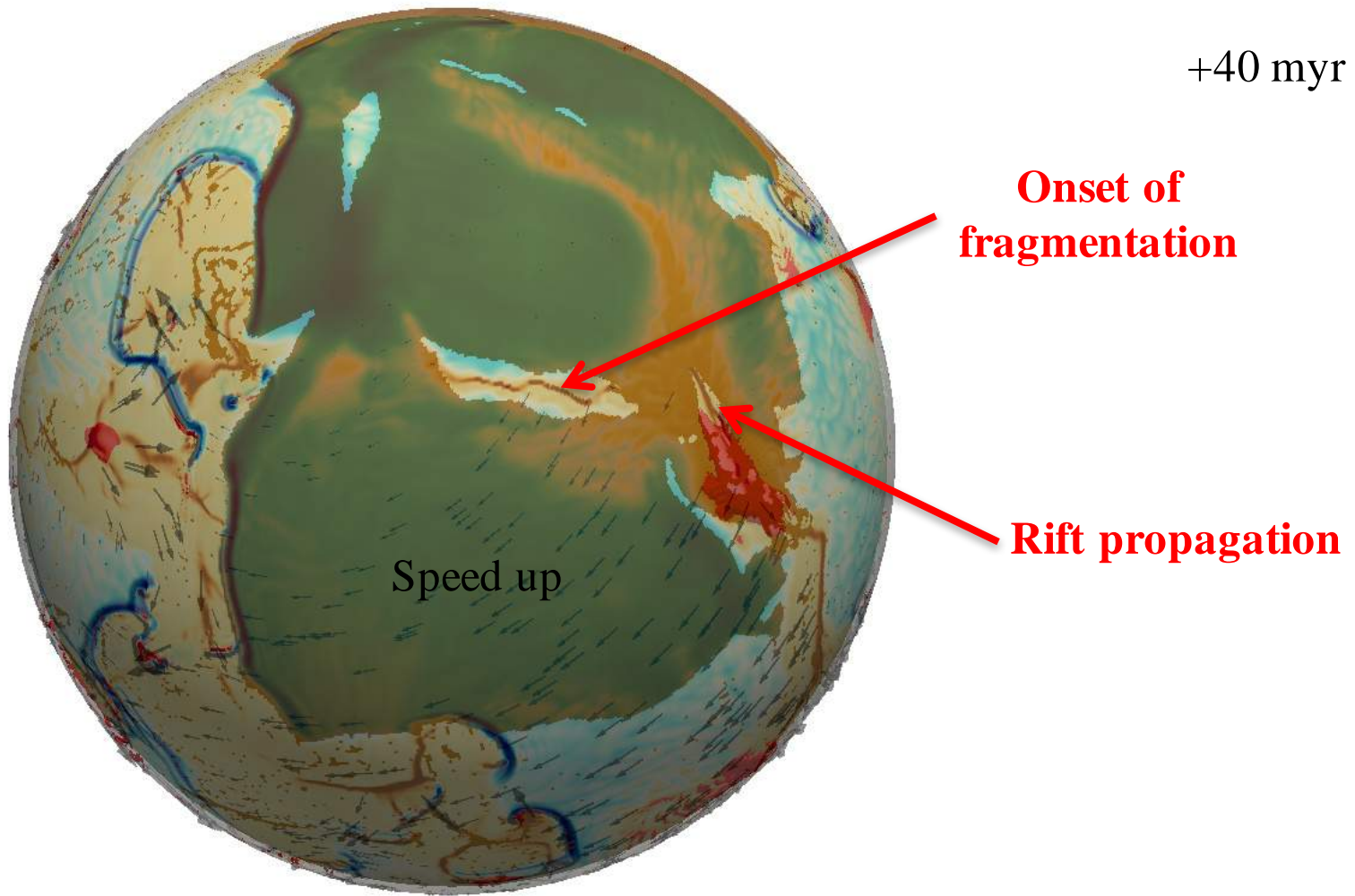
+20 myr

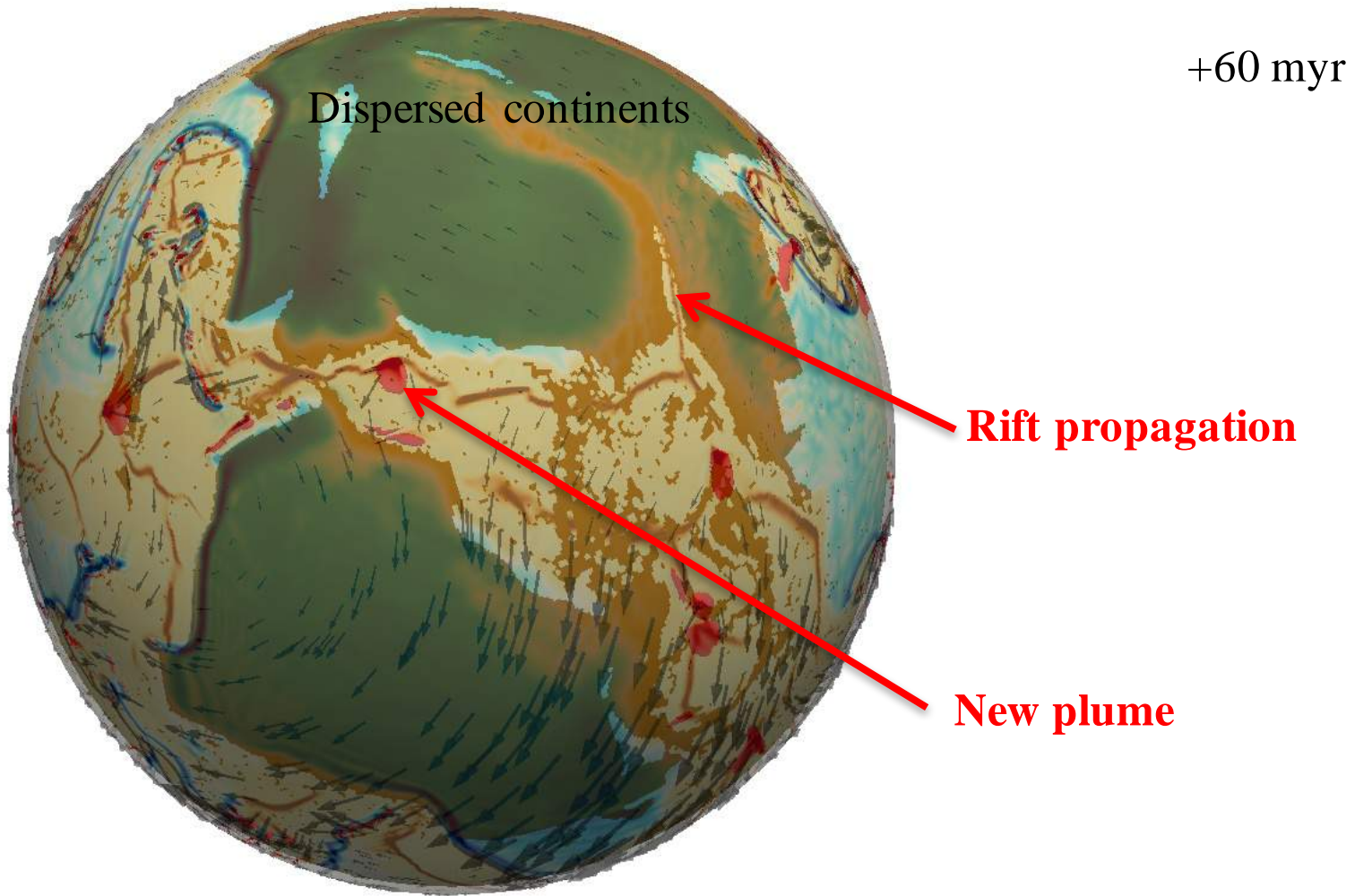
**Onset of fragmentation of the
oceanic plate**

+30 myr



Rift initiation







Slab pull (60%)



Plume weakening



Will Plate Tectonics still Be our Paradigm in 50 Years?



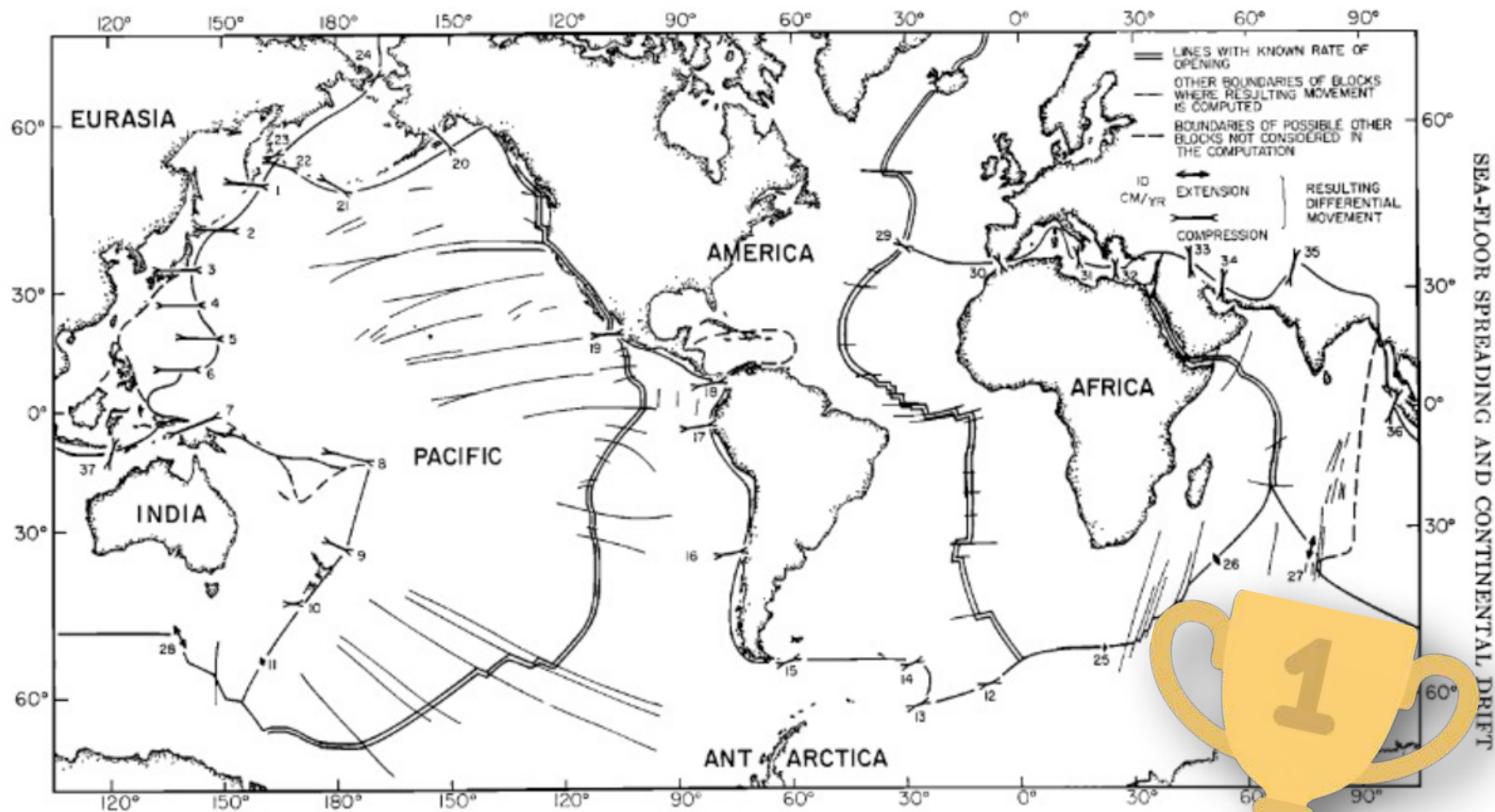


Fig. 6. The locations of the boundaries of the six blocks used in the computations. The numbers next to the vectors of differential movement refer to Table 5. Note that the boundaries where the rate of shortening or slippage exceeds about 2 cm/yr account for about 80% of world earthquake activity.



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CATEGORY: STRIPS

PRETTY FACE

06/04/2018
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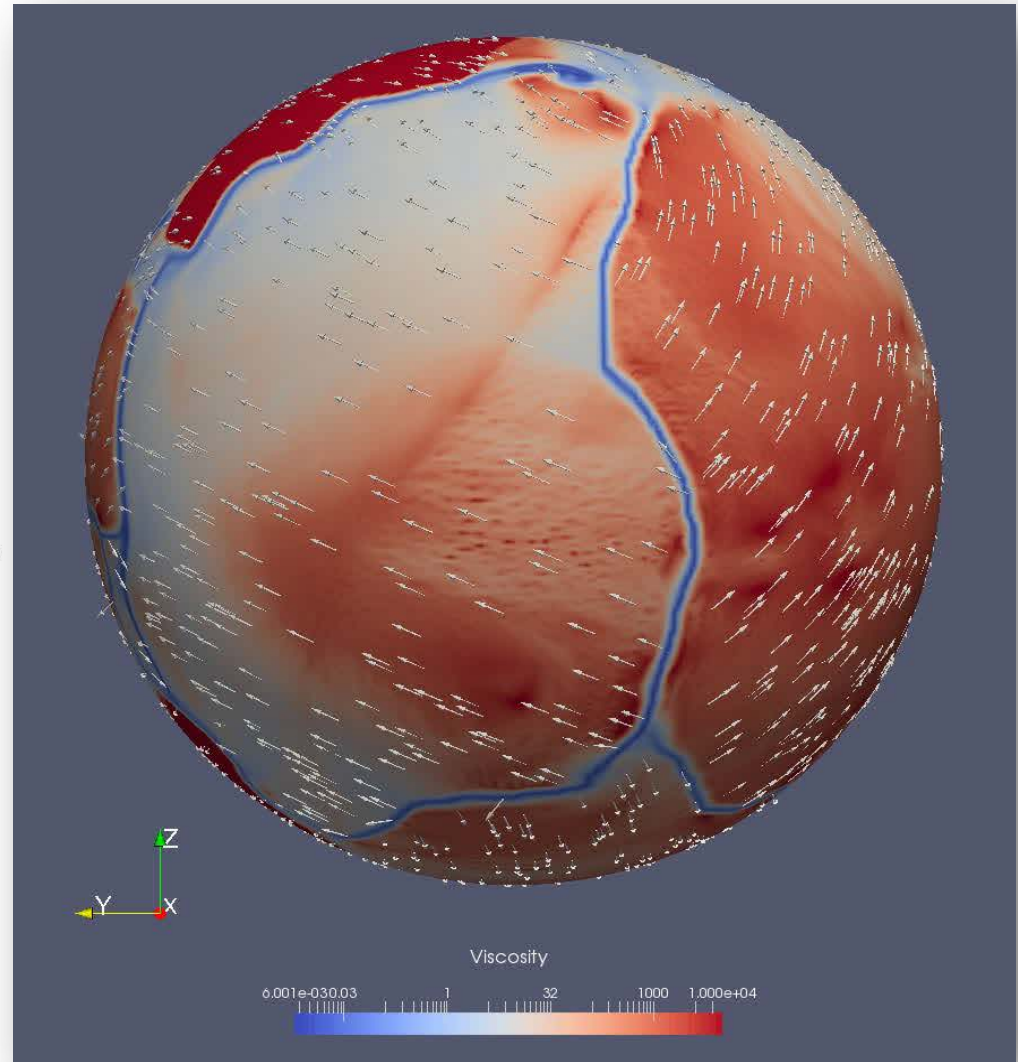
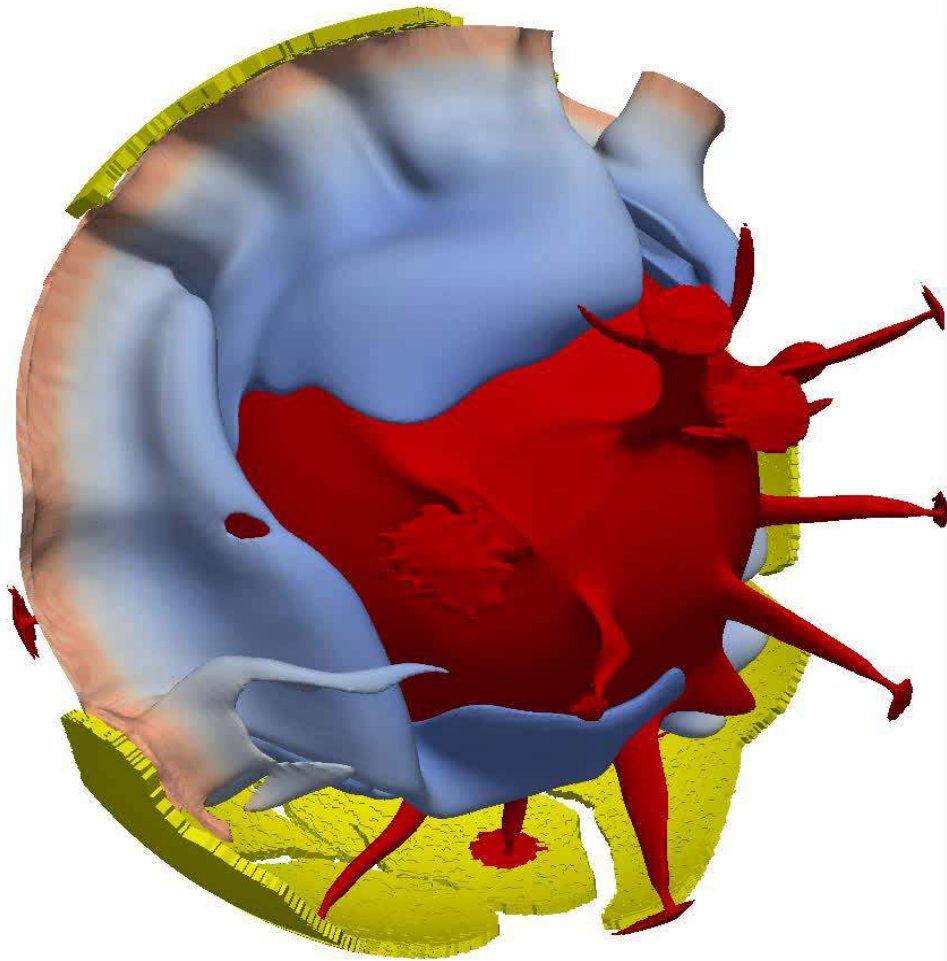
[Team](#)

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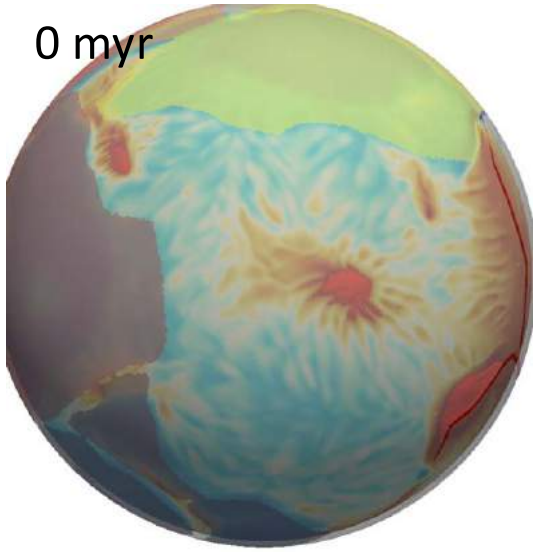
- SUIVEZ-NOUS -



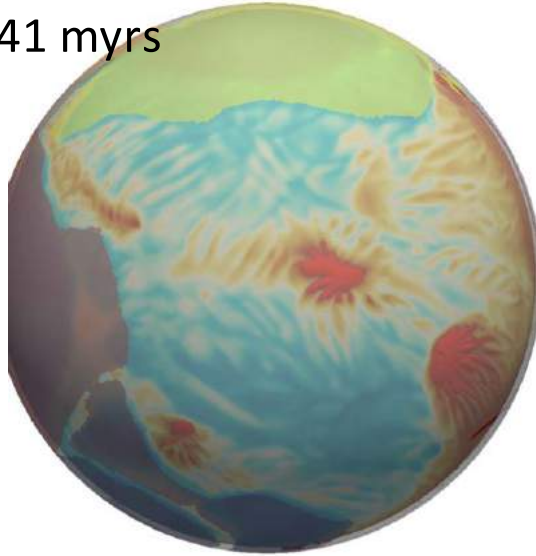
- TAGS -



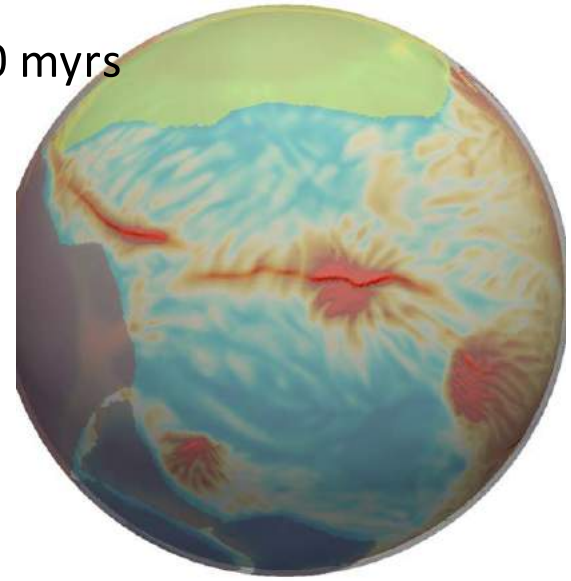
0 myr



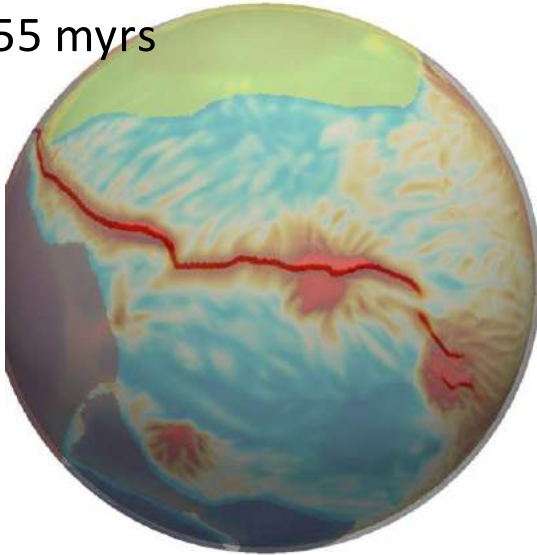
41 myrs



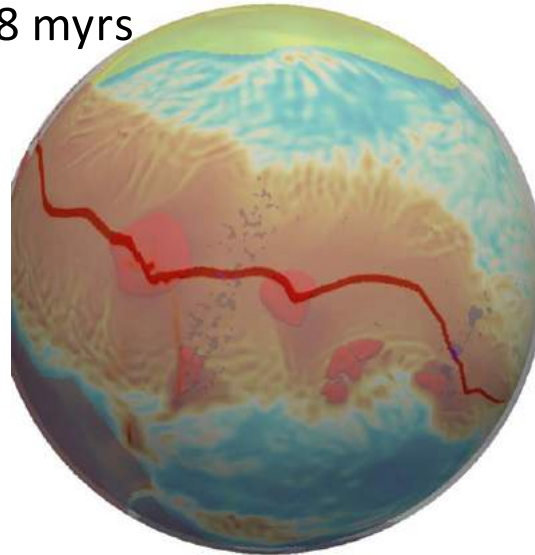
50 myrs



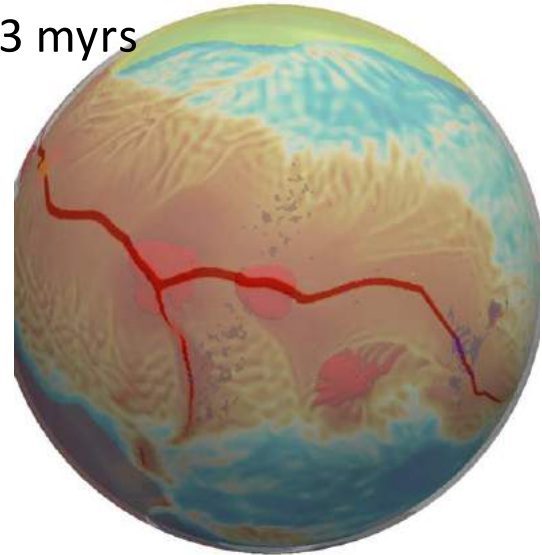
55 myrs



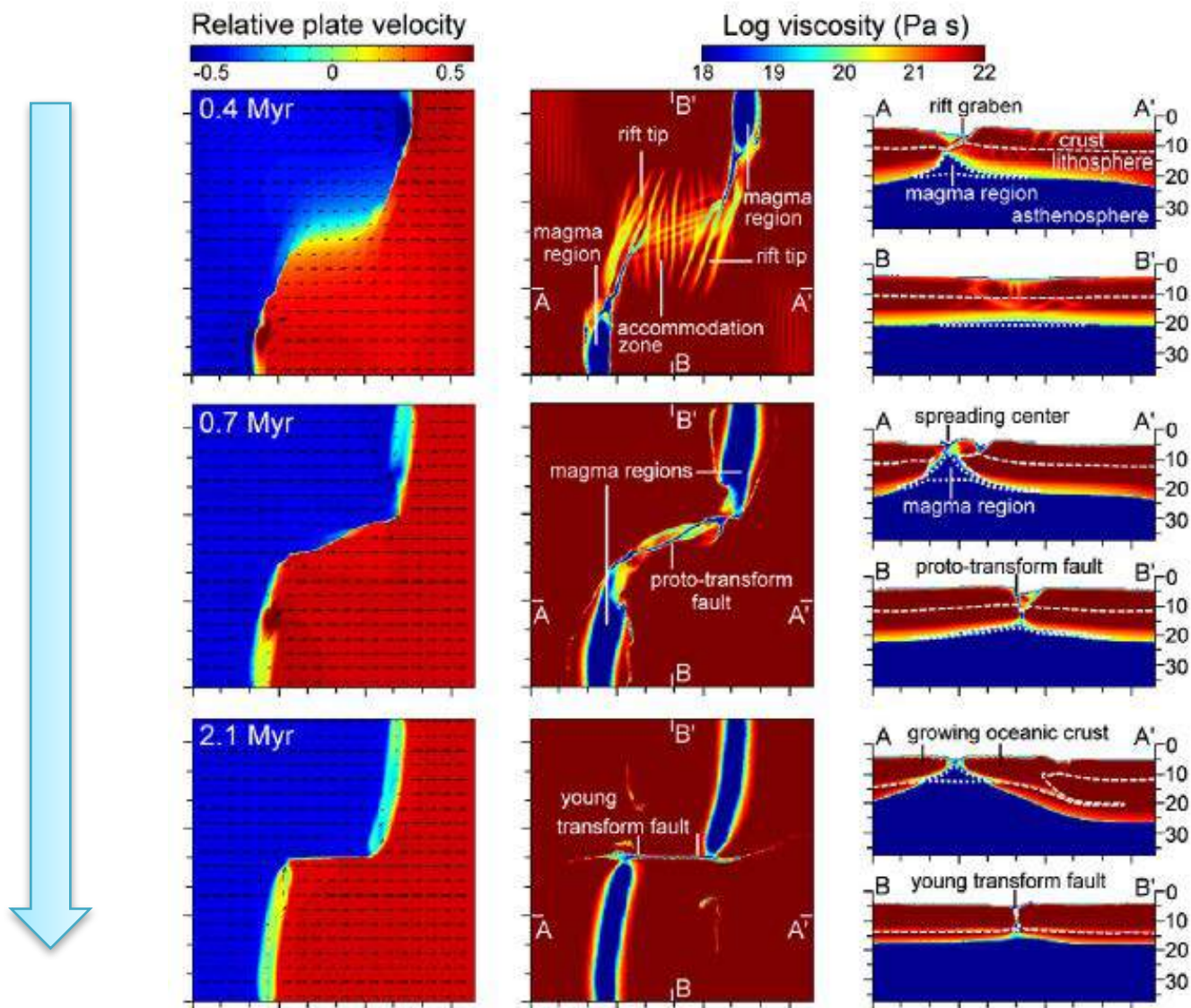
78 myrs



83 myrs

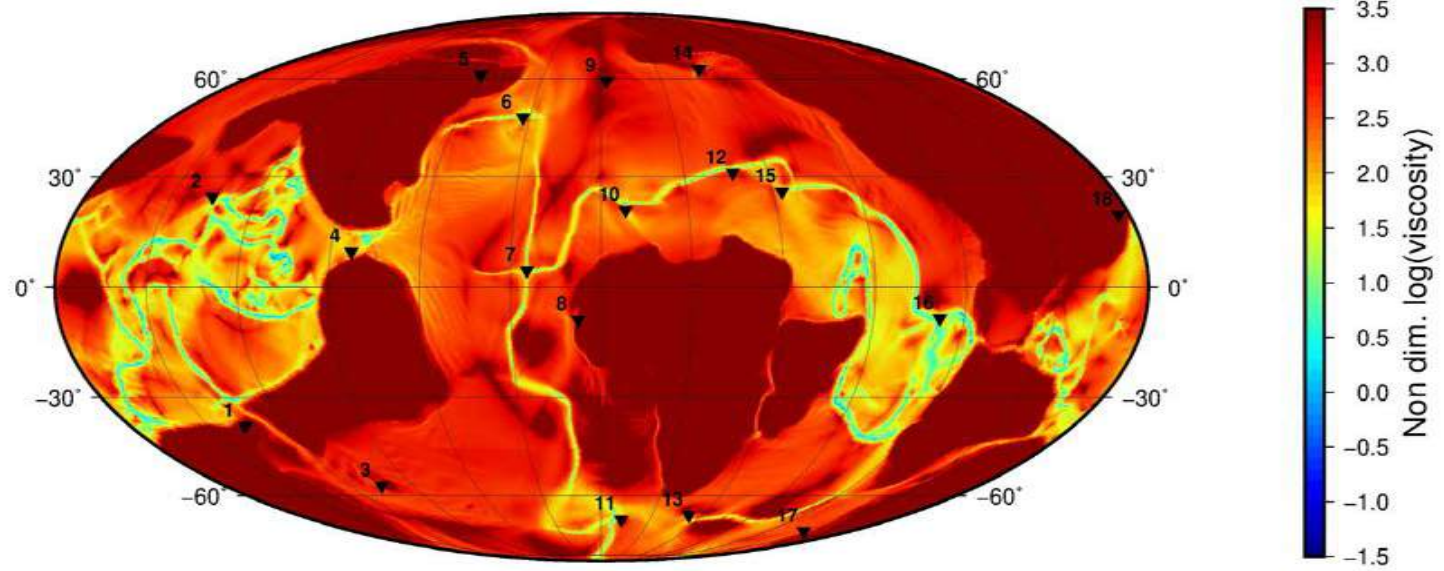


Time



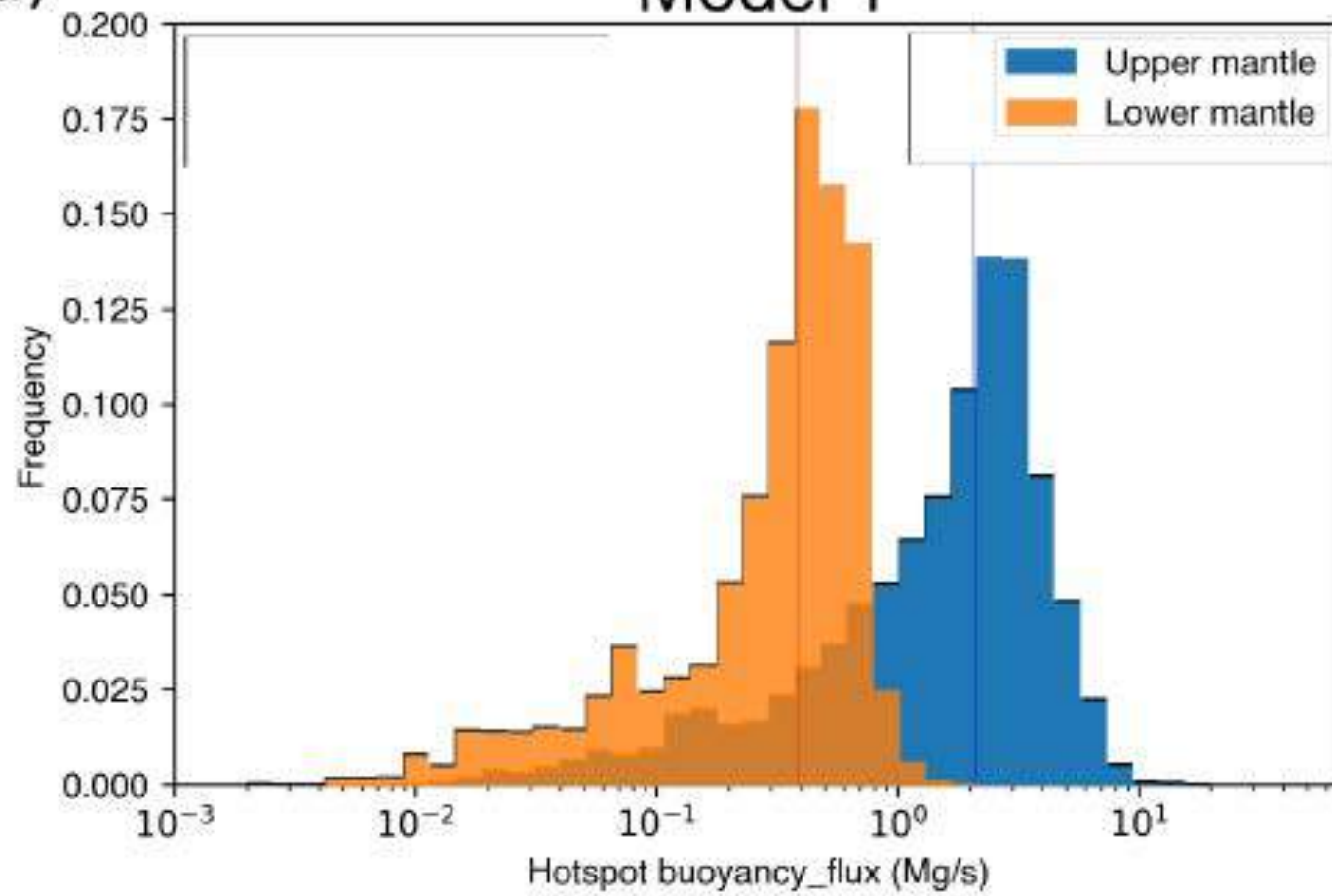
Gerya (2013)

0 Myr

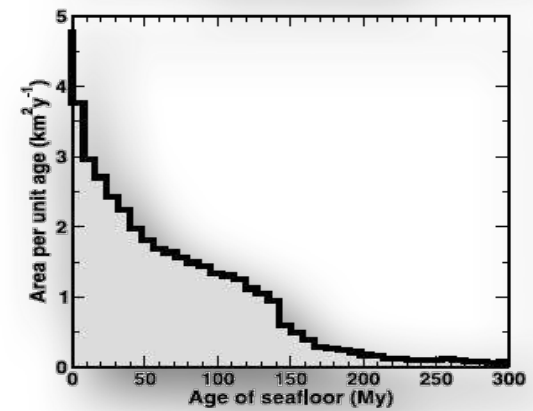
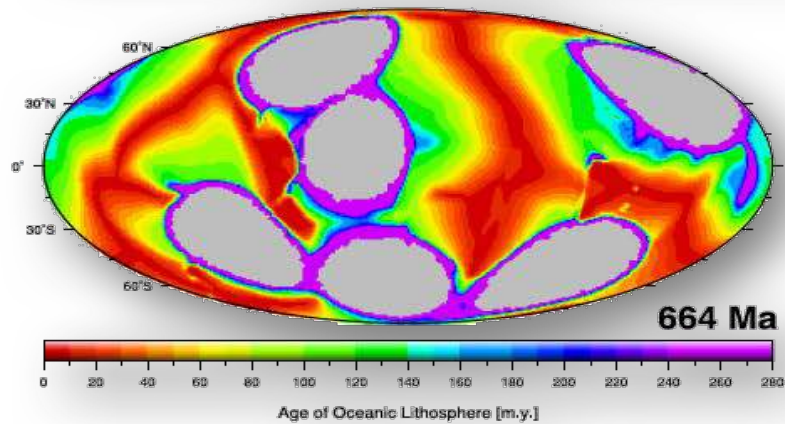
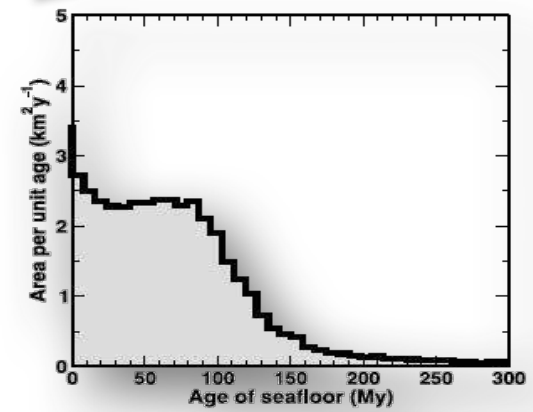
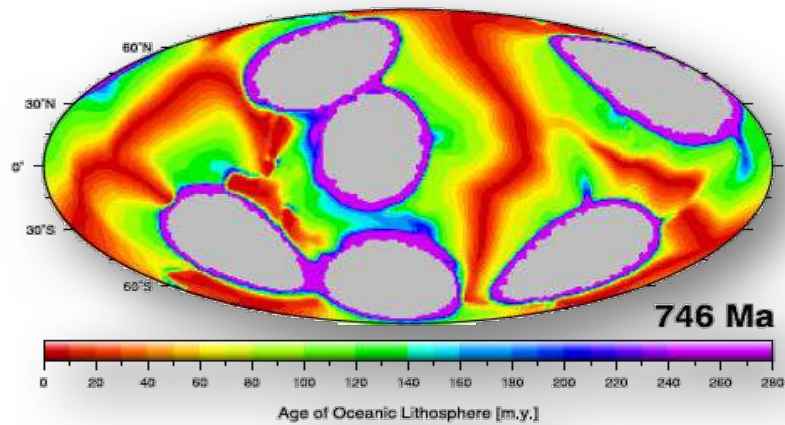


(a)

Model 1

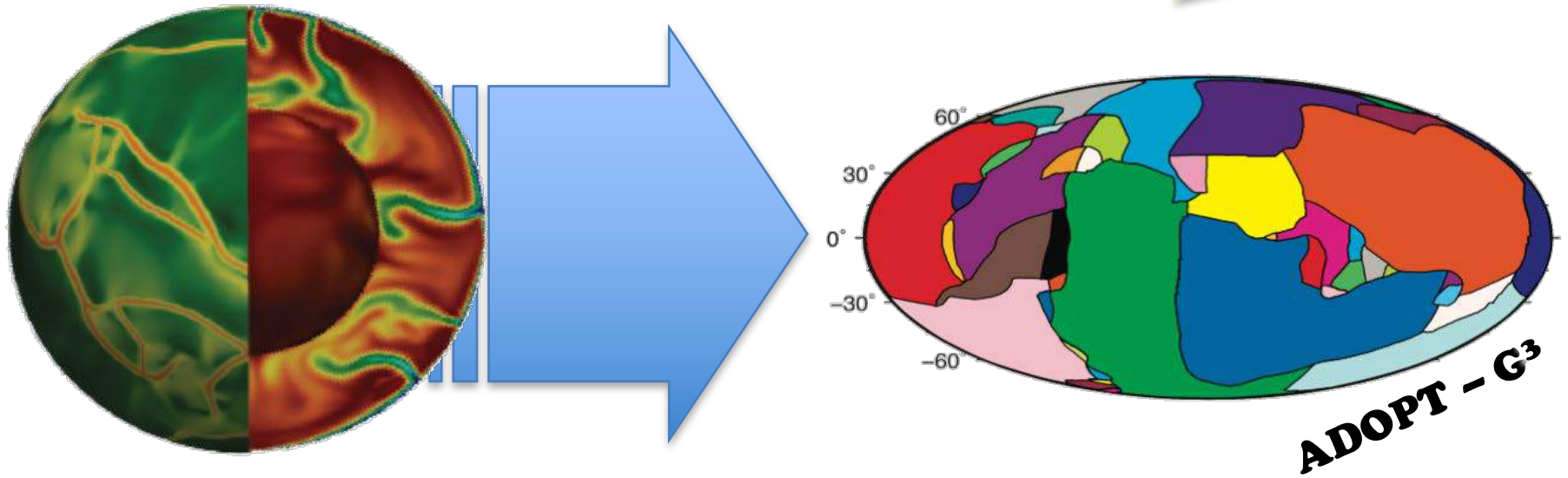


Seafloor age distribution



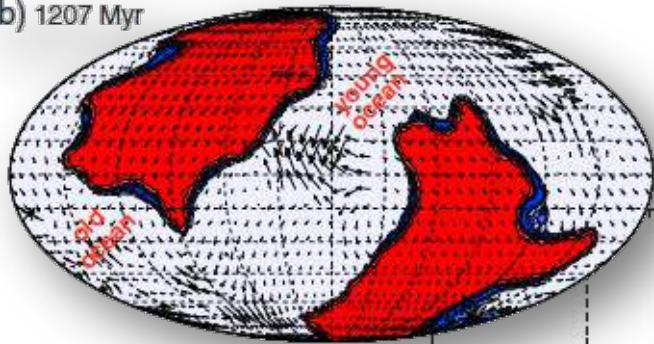
Coltice et al. (2012, 2013)

Plate size distribution

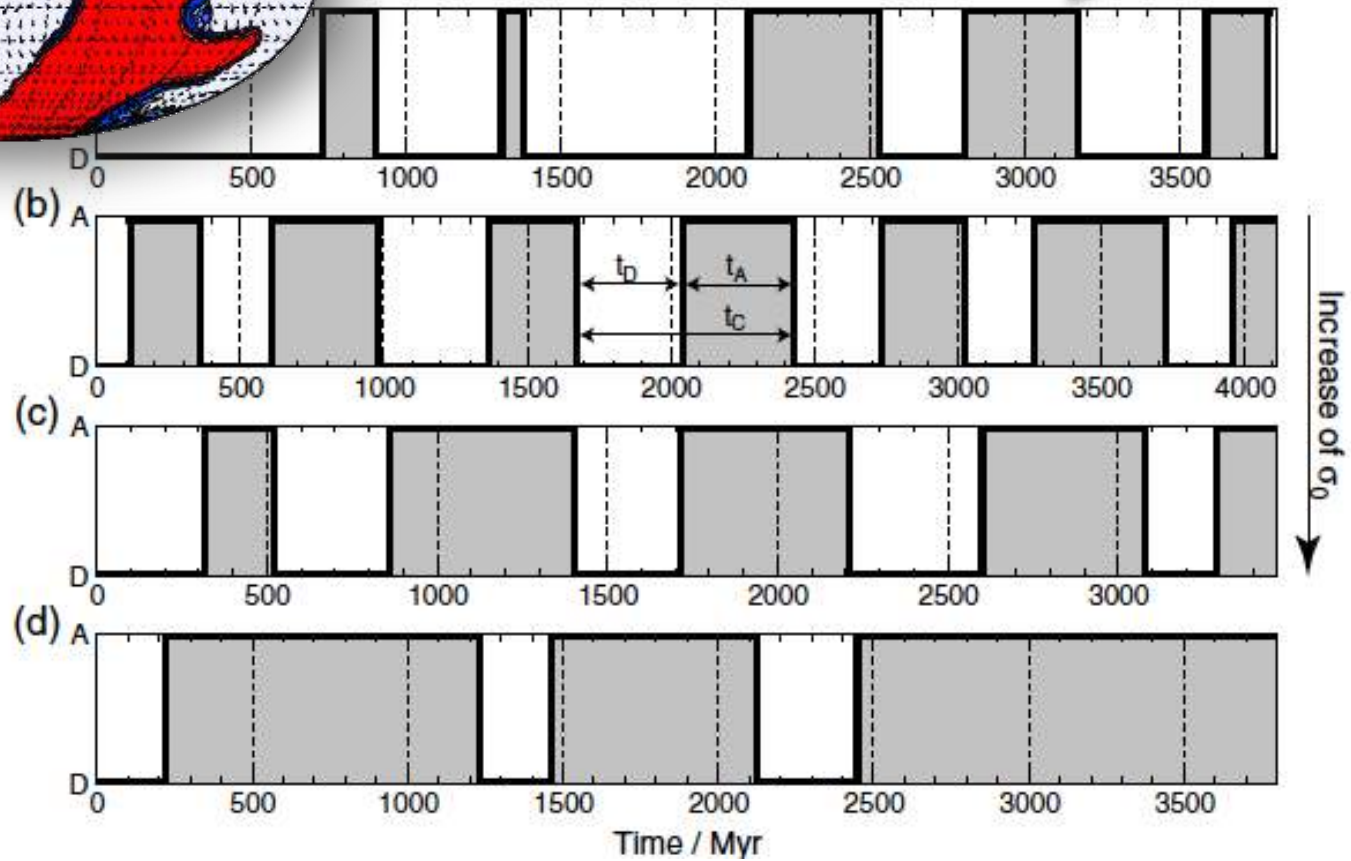


Mallard et al. (2016, 2017)

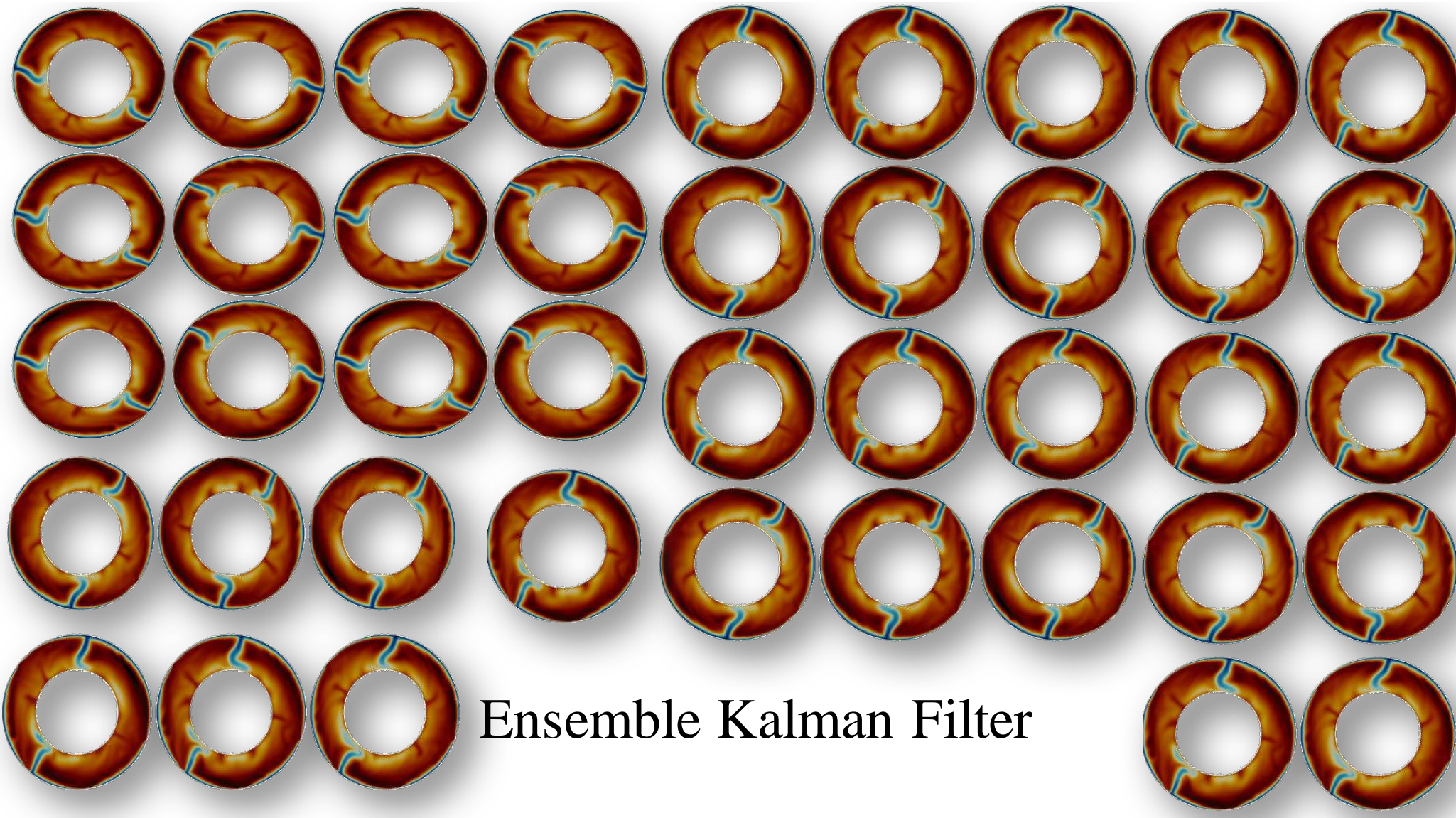
(b) 1207 Myr



Continental drift

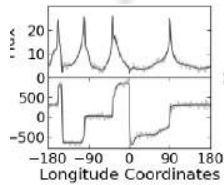


Rolf, Coltice & Tackley (2014)



Ensemble Kalman Filter

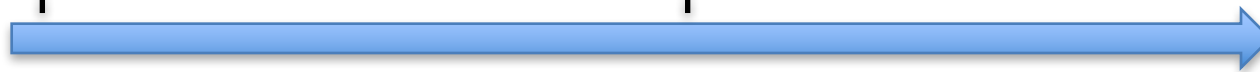
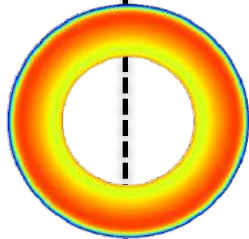
Data available



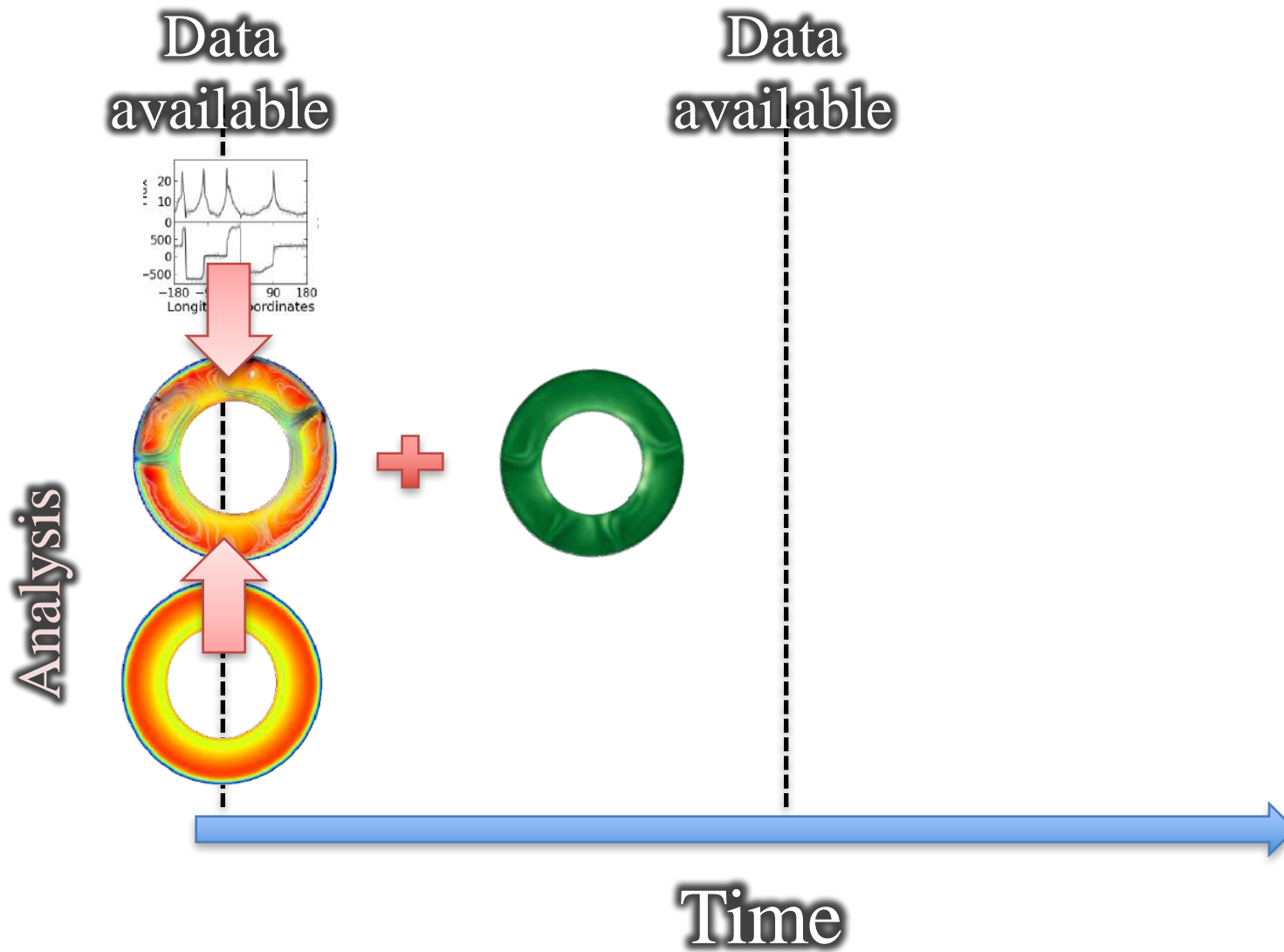
Data available

Kinematics
Seafloor age

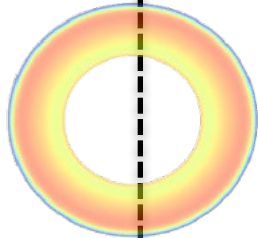
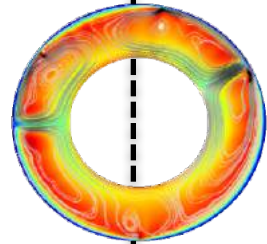
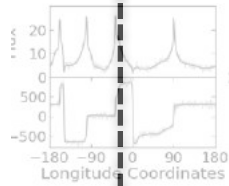
Ensemble of 2D models
with plate-like behavior



Time

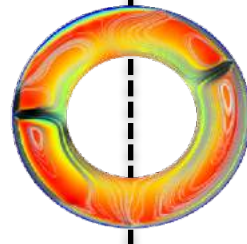


Data available



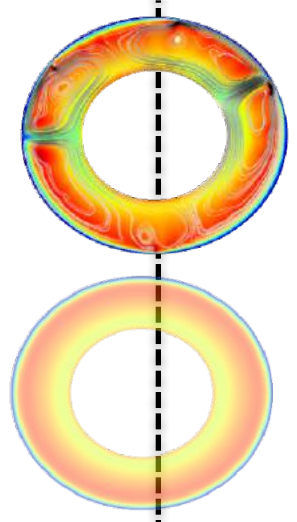
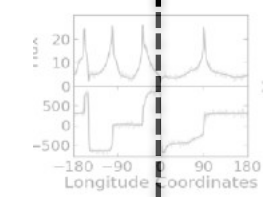
StagYY

Data available



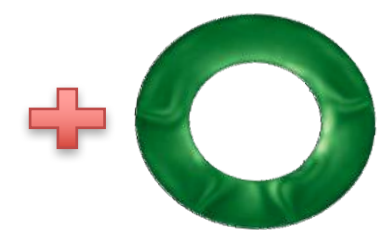
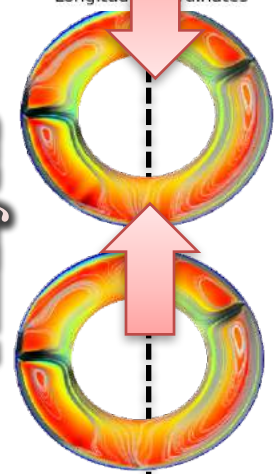
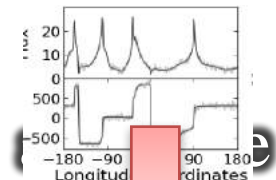
Time

Data available



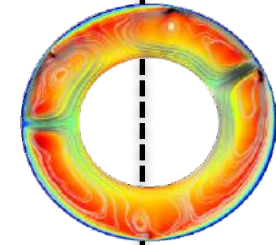
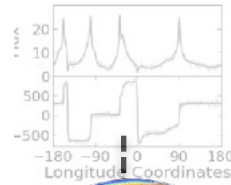
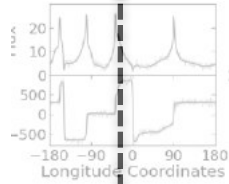
StagYY

Analysis

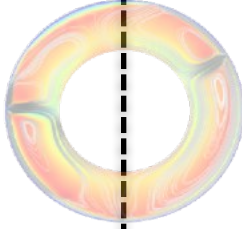


Time

Data available



StagYY

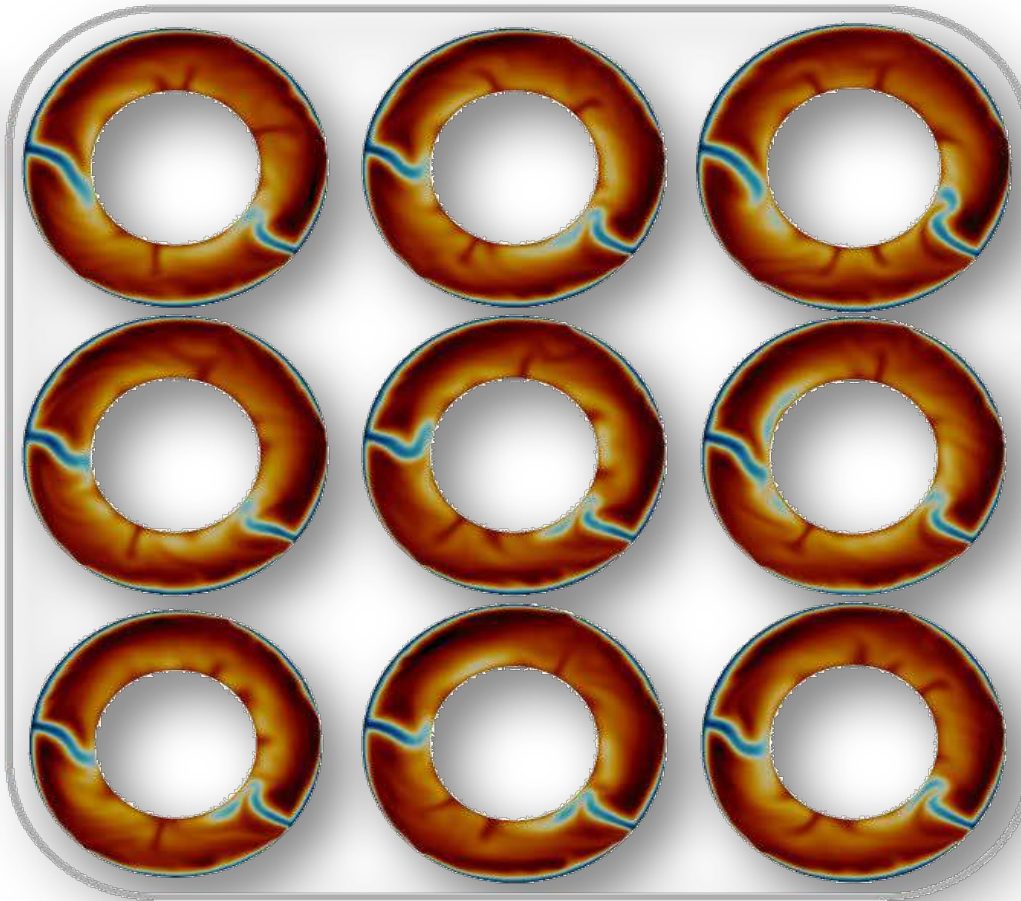


StagYY

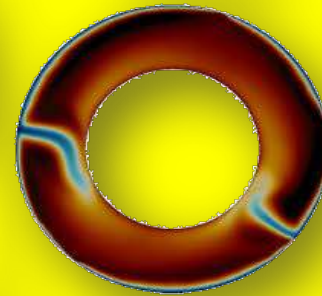


Time

Temperature
Examples
For Different
Members



Average
Temperature
of Ensemble



True
Temperature

