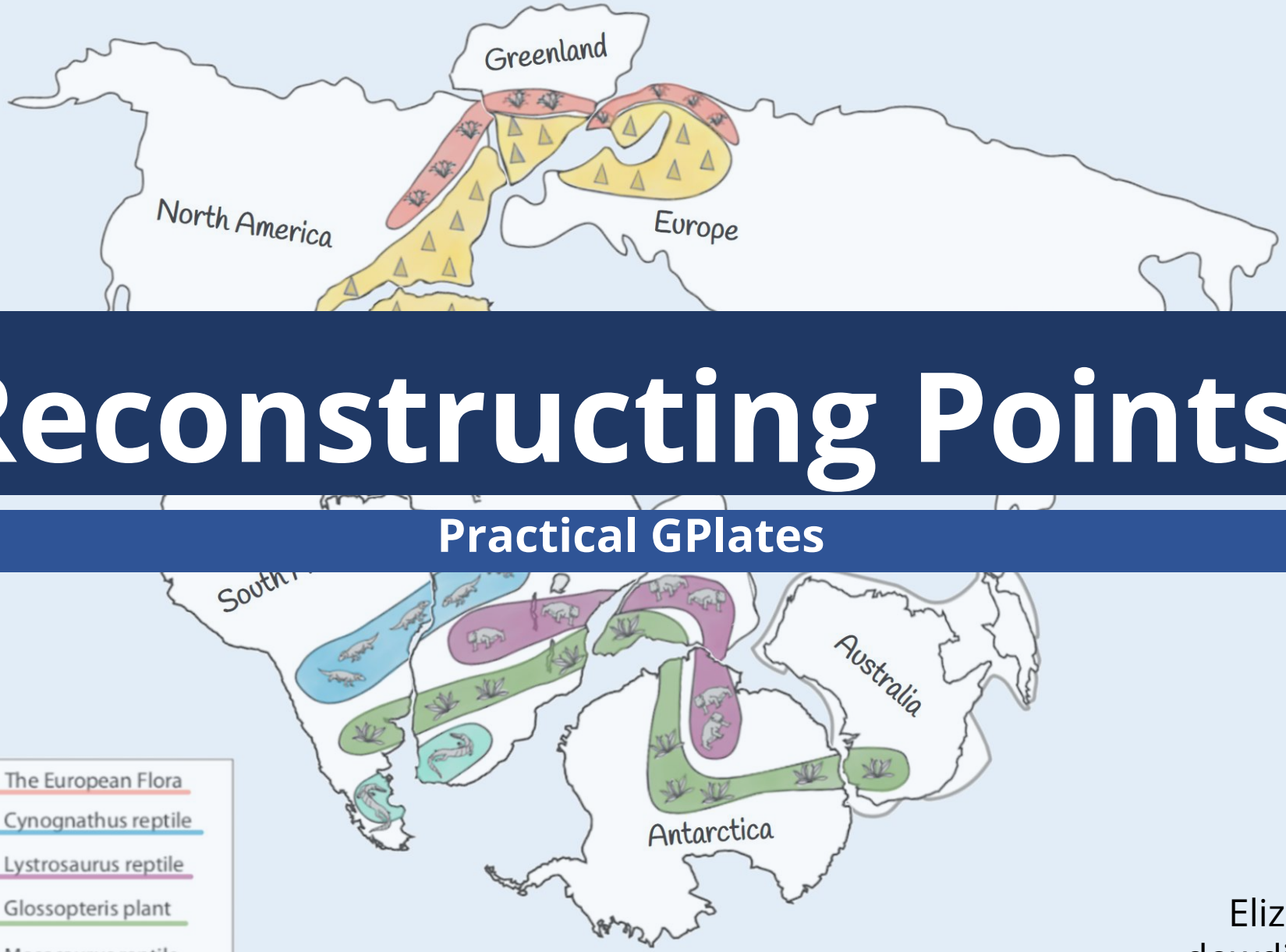
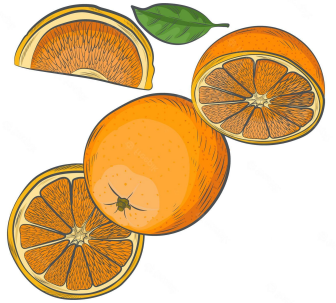


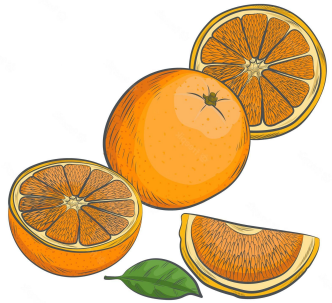
Reconstructing Points

Practical GPlates

Elizabeth M. Dowding
dowdingem@gmail.com
May 2024

Contents





Introduction to learning outcomes

- Session 1
  - Introduction to theory
- Session 2
  - Introduction to using GPlates
  - Practical guide to picking a plate reconstruction
- **Session 3**
  - **Mantle Reference Frame**
  - **Using a plate reconstruction**
- Assignment
  - Group task

https://adamtkocsis.com/se3-gplates/

Assignment

- Practical exercise with GPlates
- Short report (max. 3 A4 pages)
- Assignment can be written in German
- Due until the end of the lecture period (July 19) - necessary to pass the course

The Assignment | GPlates for System Erde III. (adamtkocsis.com)

Revision

- Plate tectonics is the theory that underpins plate reconstructions
- Palaeomagentic data helps us to create euler poles and our plate rotations
- A collection of euler poles leads to the development of Apparent Polar wander
- There are many plate models and some are better for some purposes than others

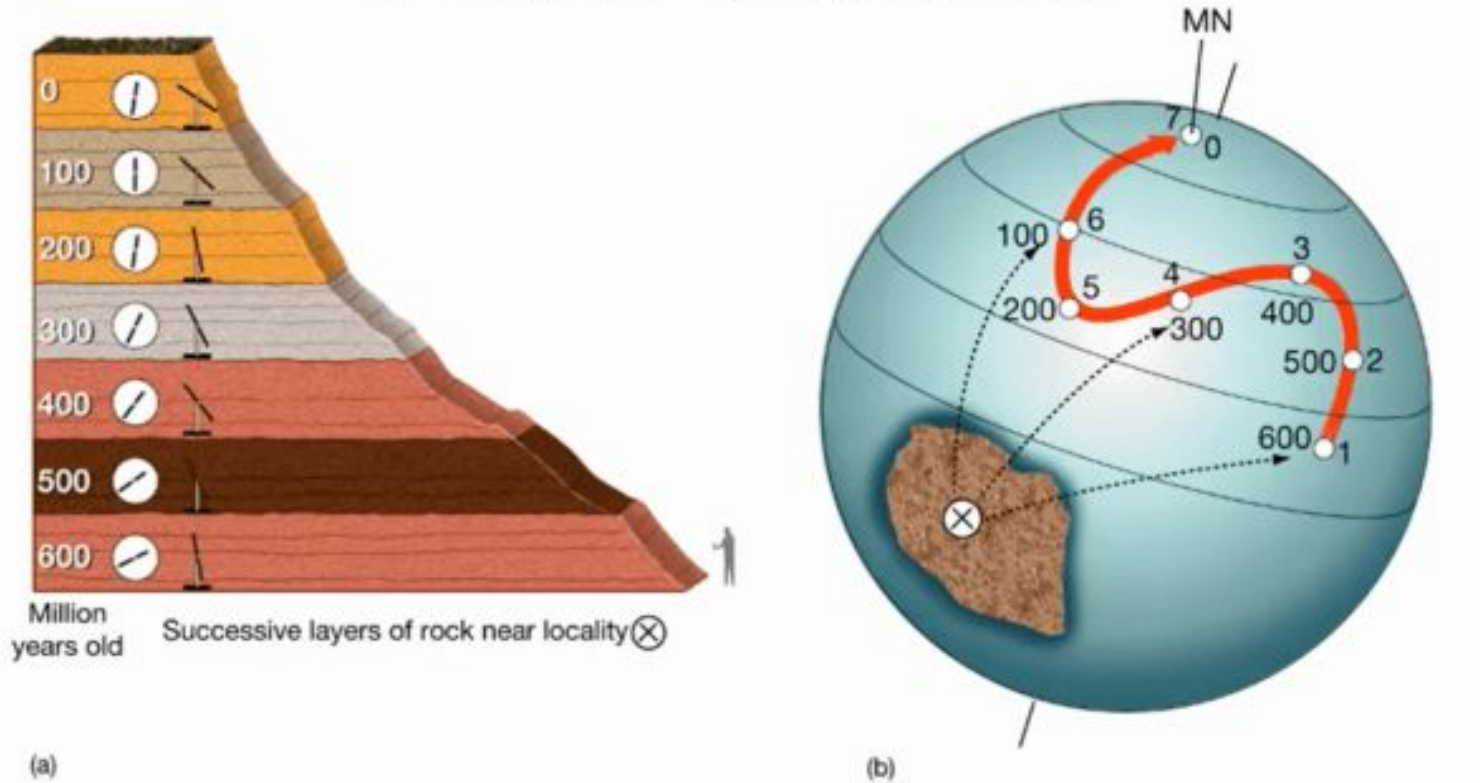
Mantle RF and Palaeomag RF

Apparent Polar Wander?

True Polar Wander?

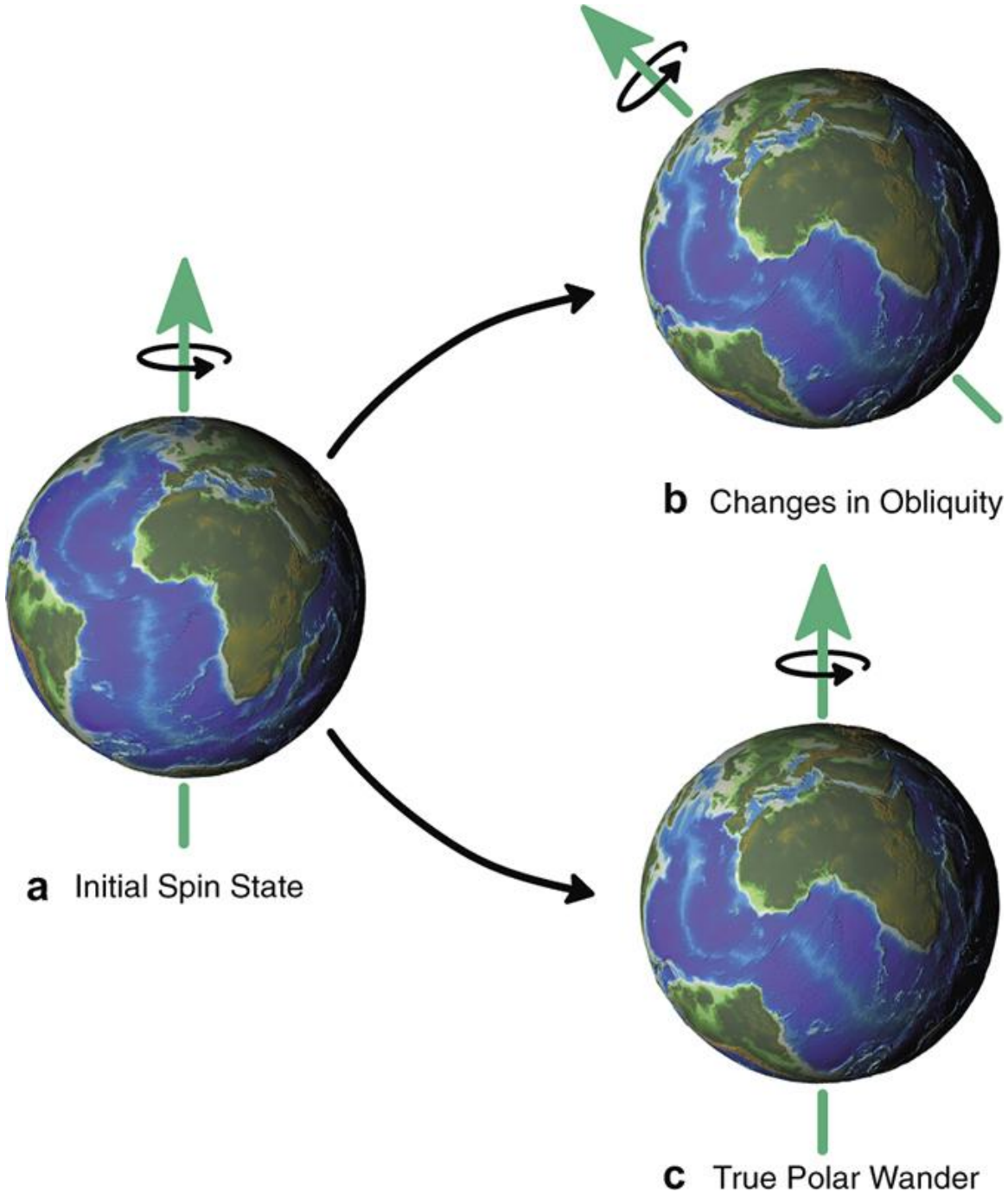
Apparent Polar Wander?

True Polar Wander?



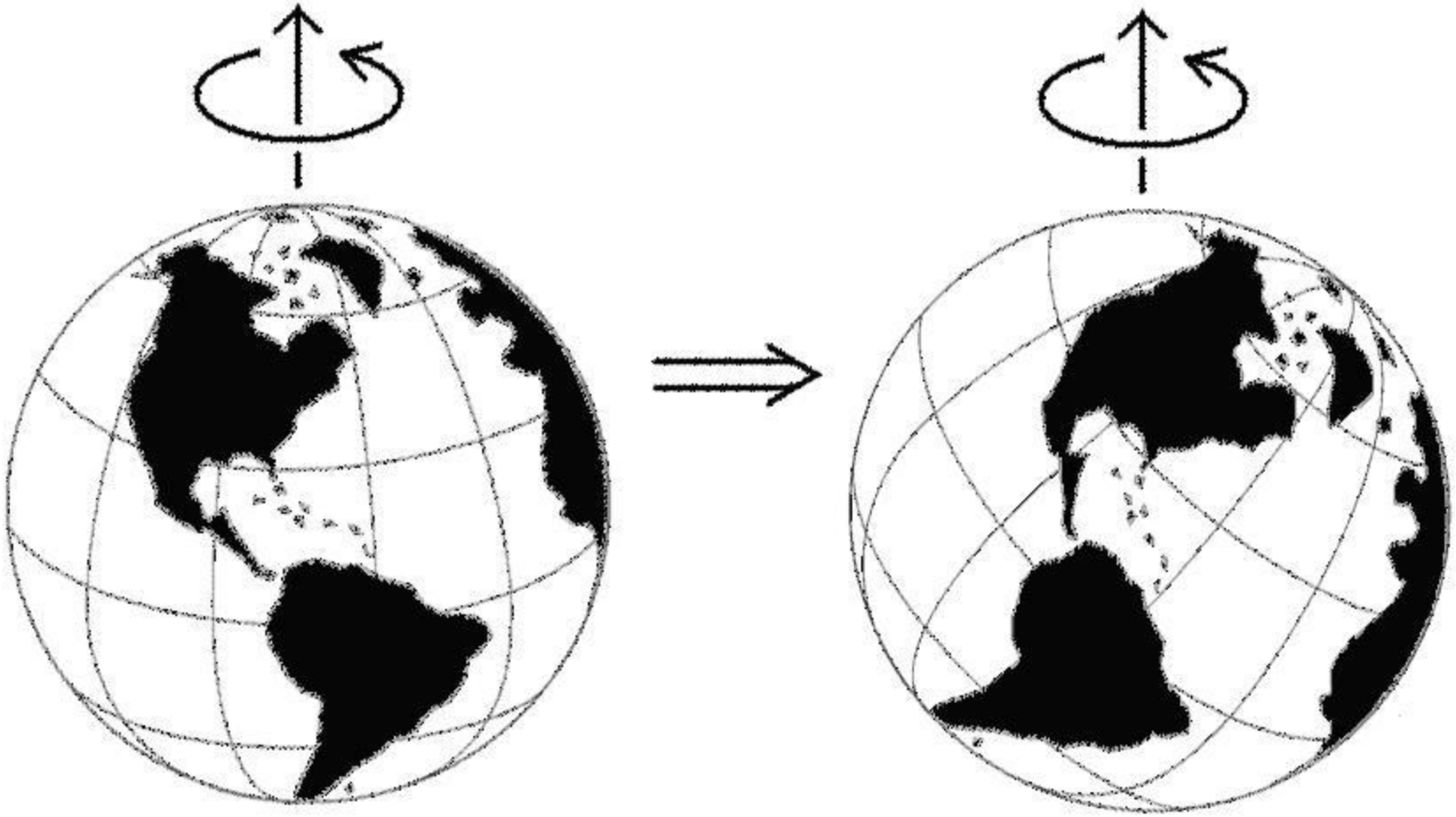
Apparent Polar Wander?

True Polar Wander?



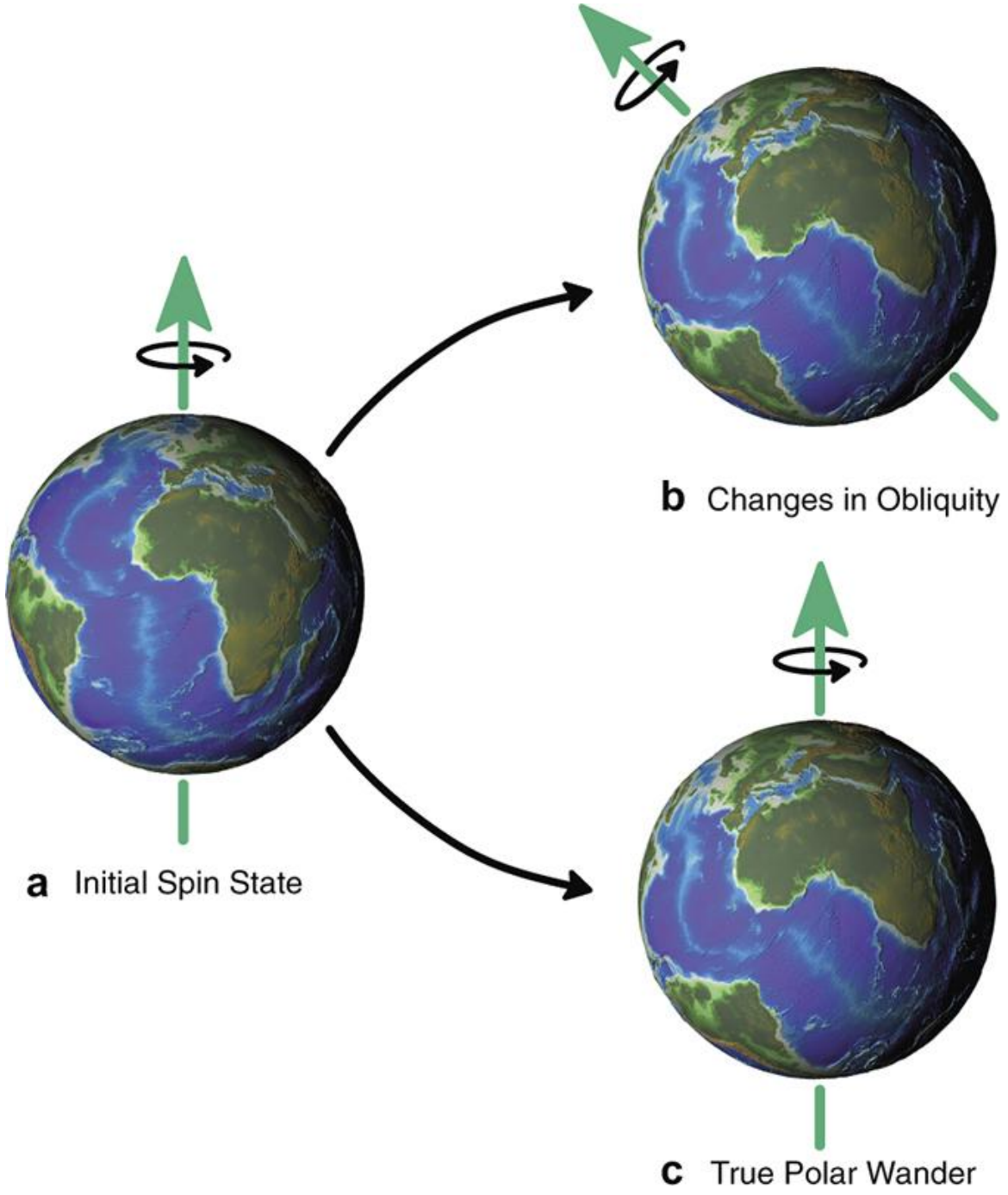
Earth is a spinning ball in space

True Polar Wander: consider reconstruction



True Polar Wander

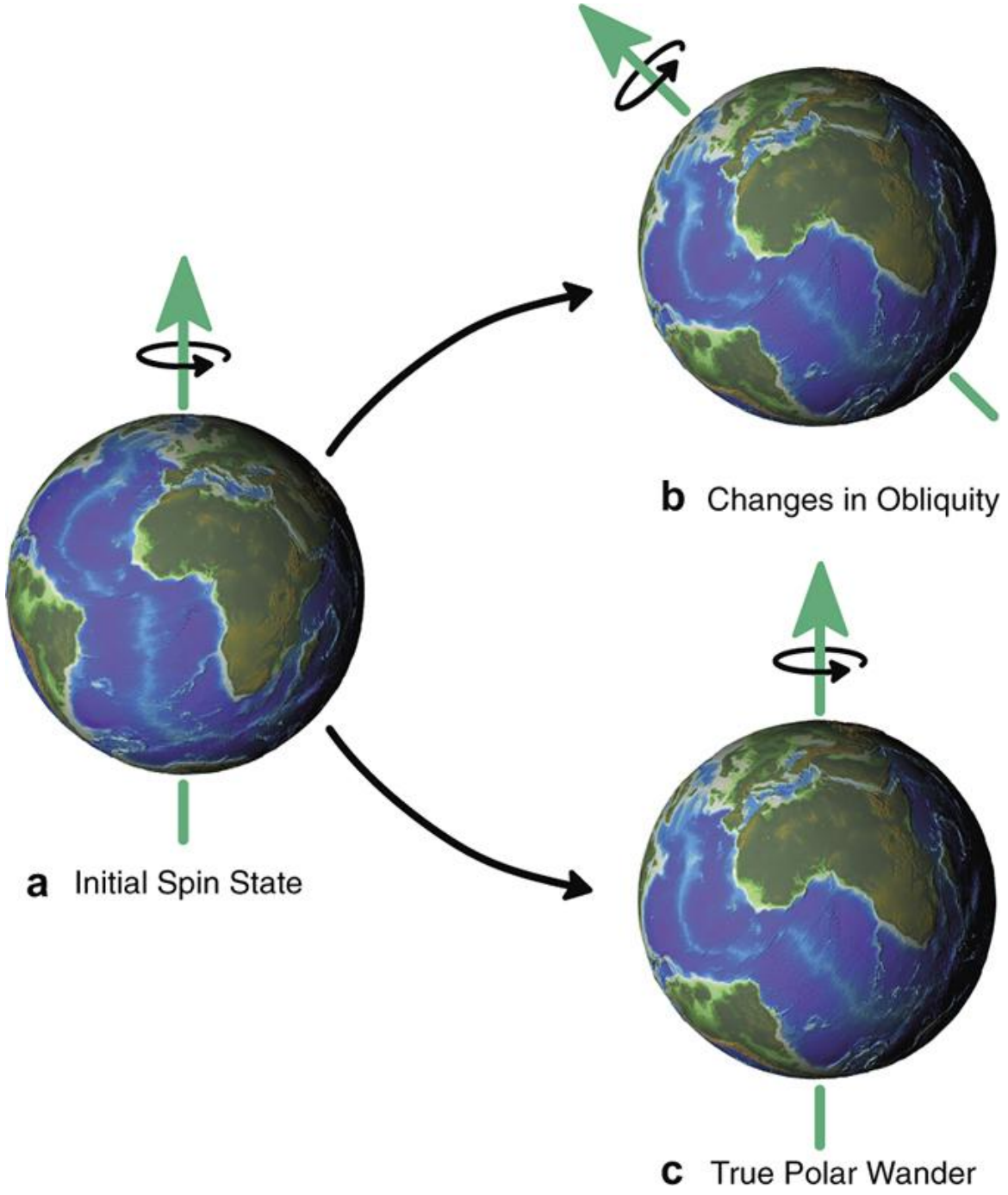
TPW results from changes in the magnetic pole position caused by global slip at the core-mantle boundary, at least in part in response to changes in mass redistribution at the surface caused by the formation and breakup of supercontinents. **Movement of the entire lithosphere with respect to the mantle or of the mantle relative to the core** can produce the same effect.



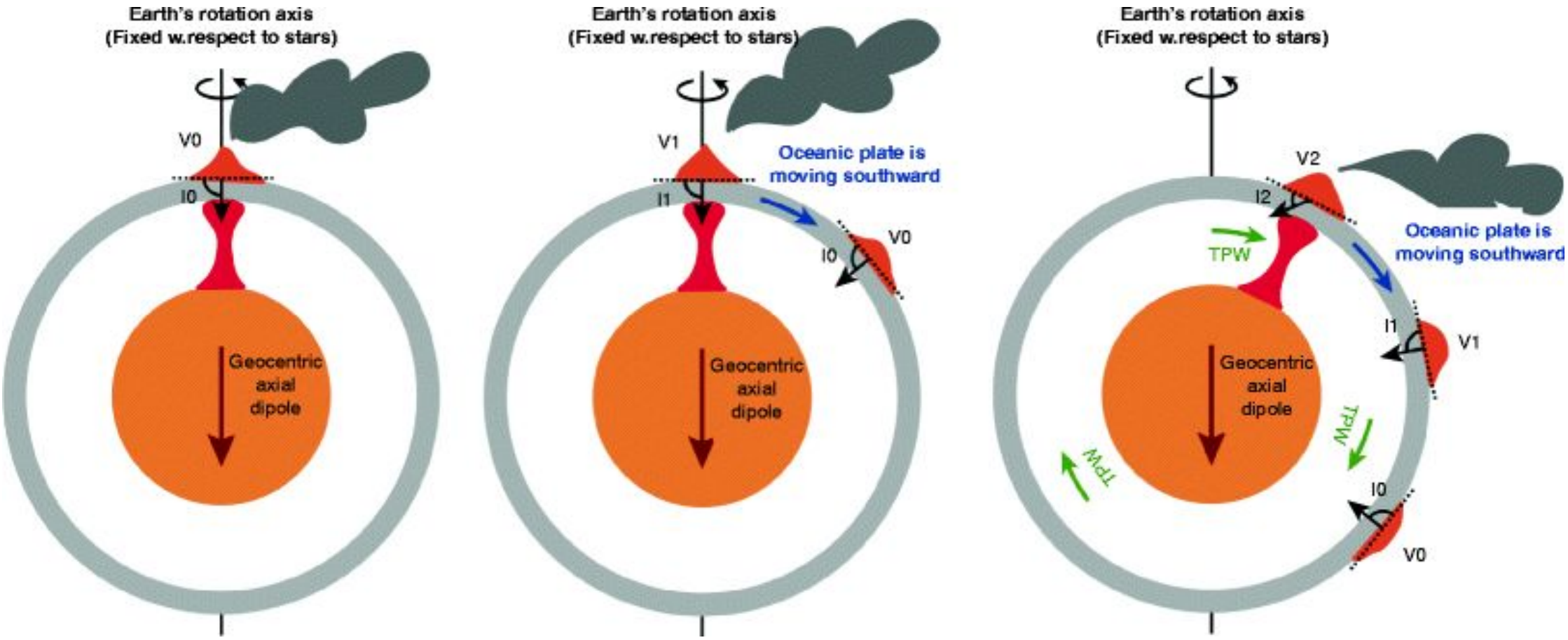
True Polar Wander

Formal definition:

As defined as the migration of the maximum moment of inertia (I_{max}) to. align with Earth's spin axis, TPW occurs as a rotation about an Euler pole controlled by the minimum moment of inertia (I_{min}) that is equatorial and is therefore predicted to circumscribe a great-circle APW path



In GAD we trust



Q: Does TPW influence APW?

Q: Does TPW influence APW?

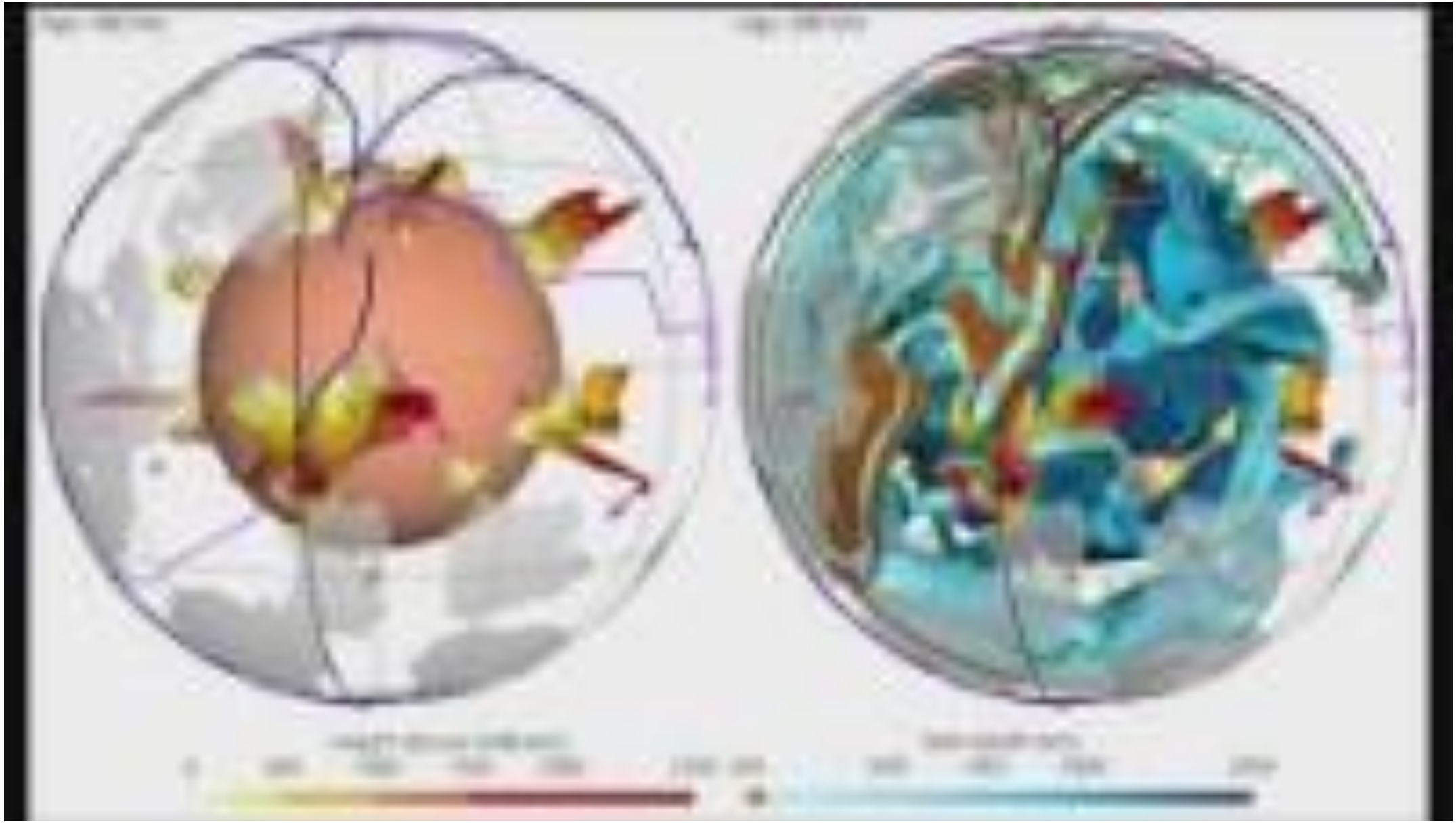
Q. What happens if we don’t account for TPW in our APW?

Q. Does TPW influence APW?

Q. What happens if we don’t account for TPW in our APW?

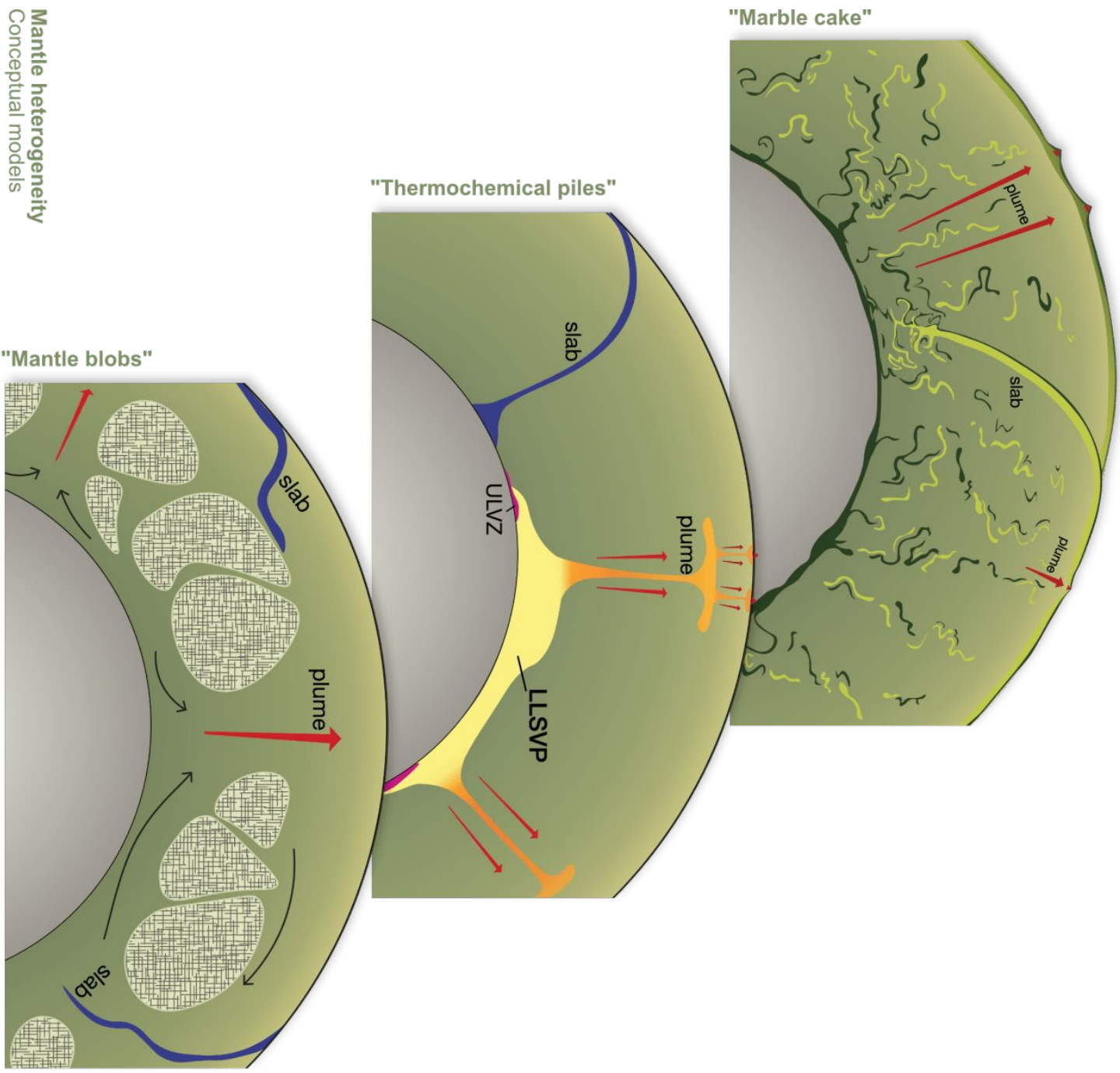
Q. What happens to our tectonic reconstructions?

Mantle Reference Frame

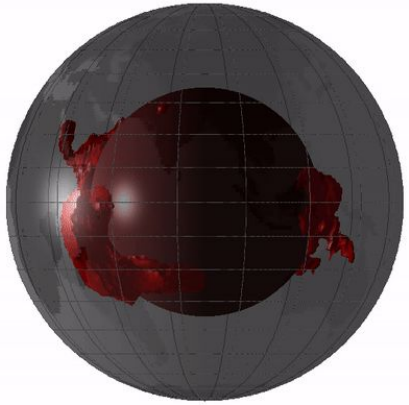


https://youtu.be/swGDLBOCqBg

Earth's mantle heterogeneity theories

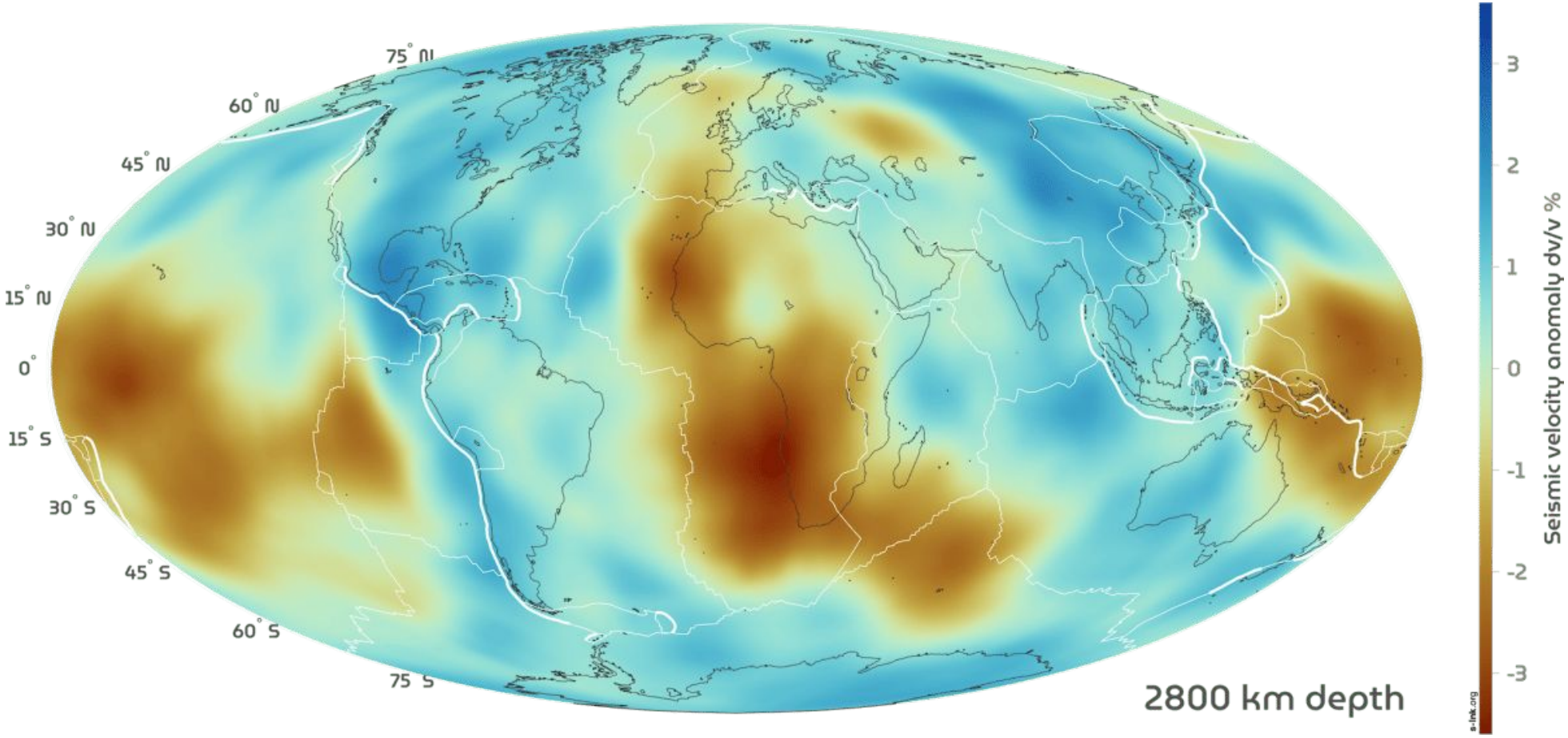


Large Low-Shear-Velocity Province



- 3% slower than the rest of the mantle
- Thermochemical piles: near antipodal and equatorial.
- Their edges are ‘plume generation zones’ and can impact the Wilson cycle.
- LLSVPs are thermal insulator, making core heating effective at their edges for mantle plumes.

Seismic mantle tomography maps



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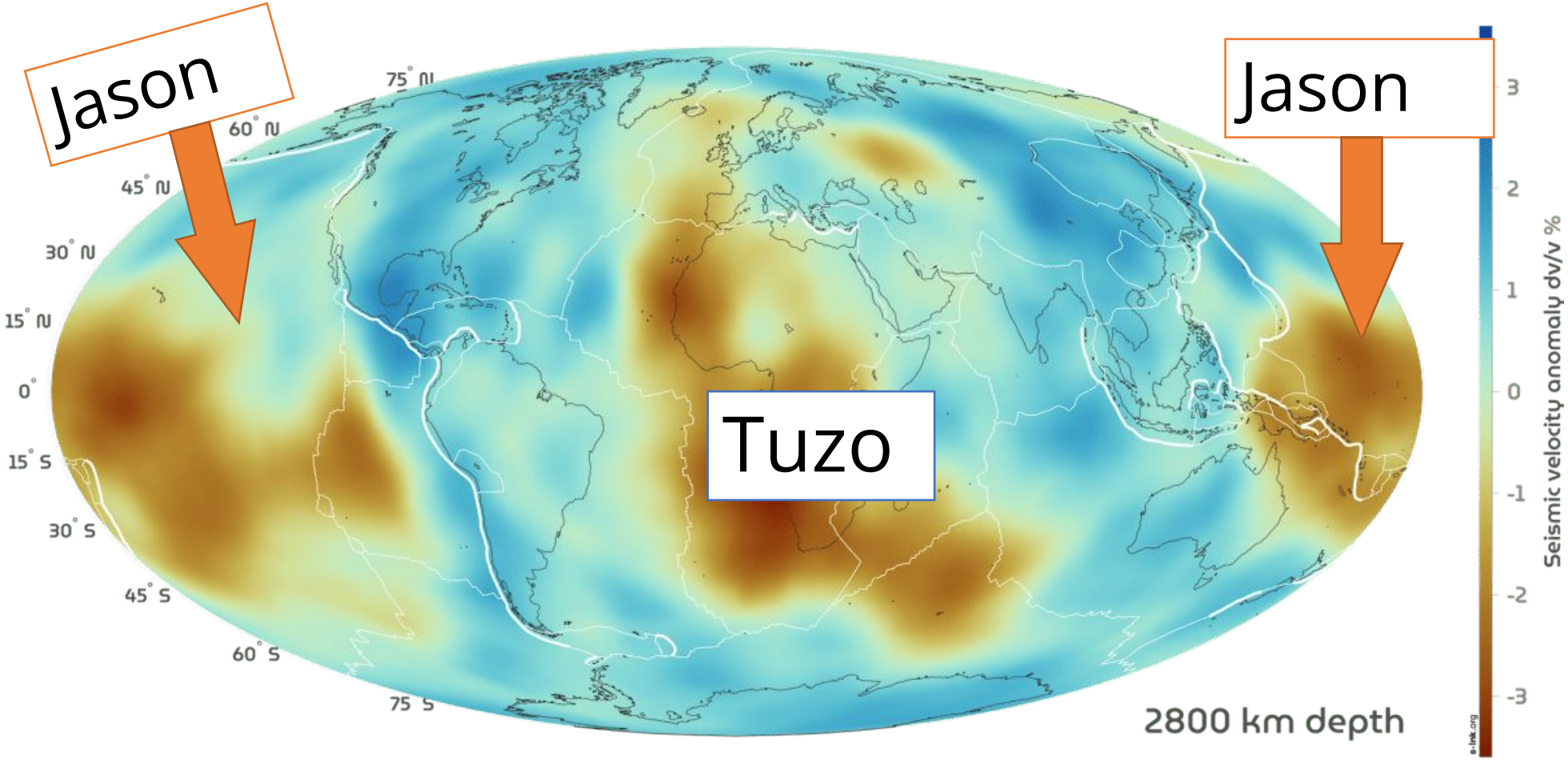
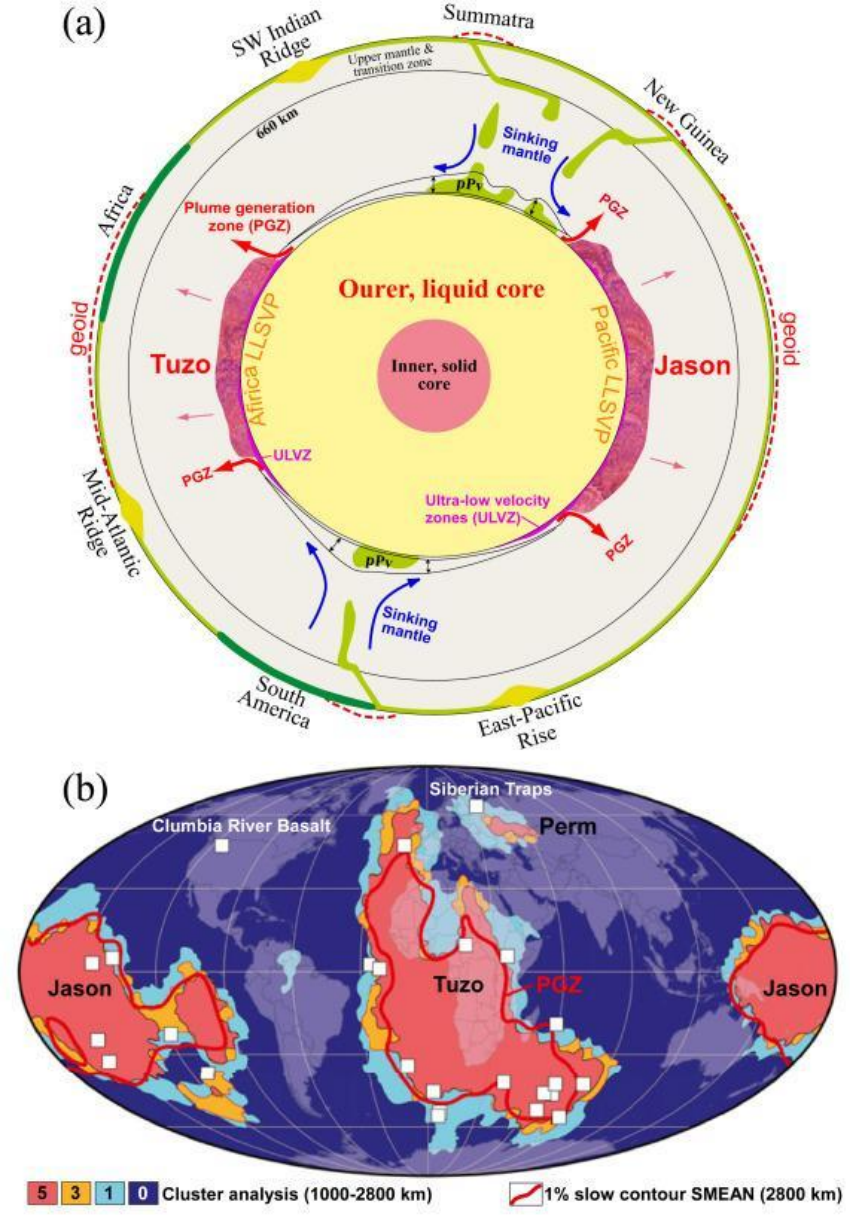


Where, what, and why?

(1) subduction of the ocean crust of basaltic composition (SOC)to the lower mantle is irreversible because SOC is denser than the ambience of peridotitic composition under lower mantle conditions in both solid state and liquid form



Jason and Tuzo are antipodal. Predictions:
[1] their centers of mass are antipodal (also equatorial?);
[2] the mass center of Jason+Tuzo aligns with the axis of the spinning Earth;
[3] such configuration represents the optimal momentum of inertia of the spinning Earth;
[4] hence, the LLSVPs have been and will continue to be stable.

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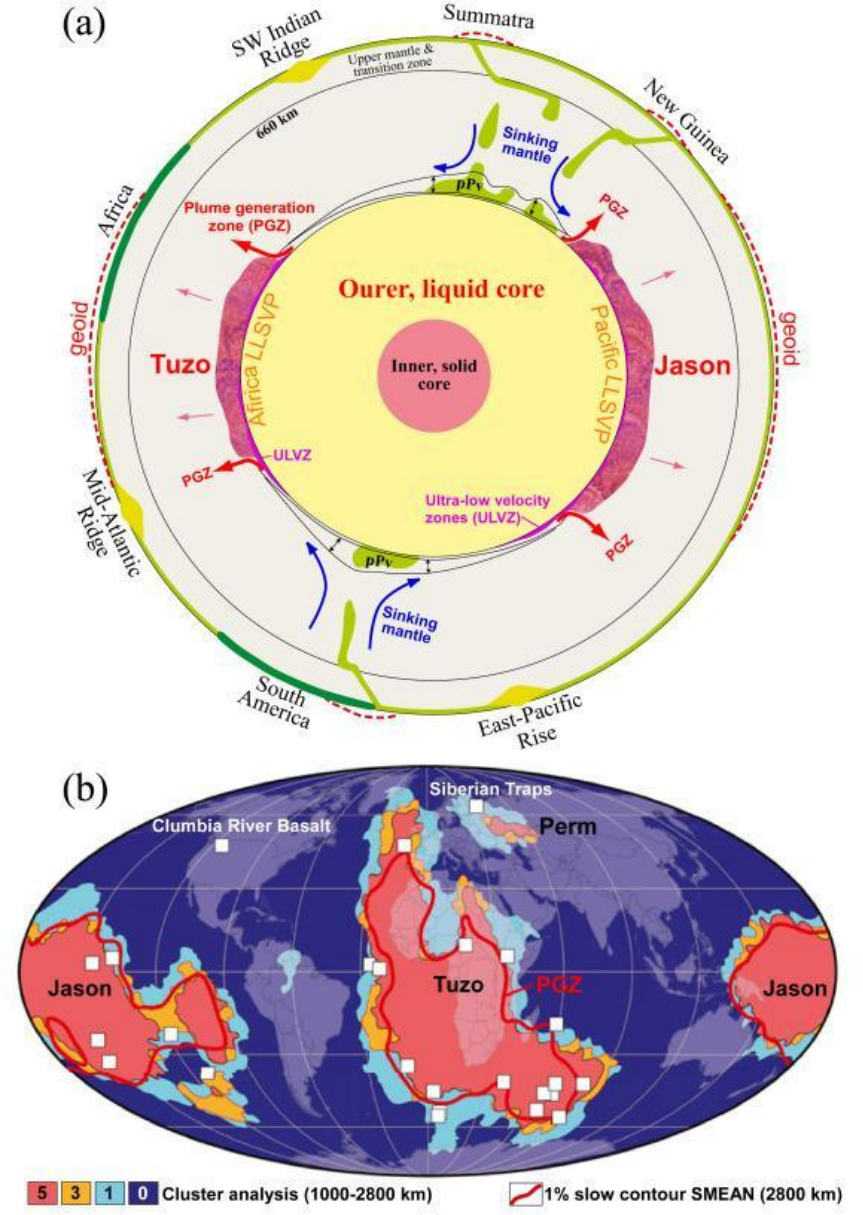

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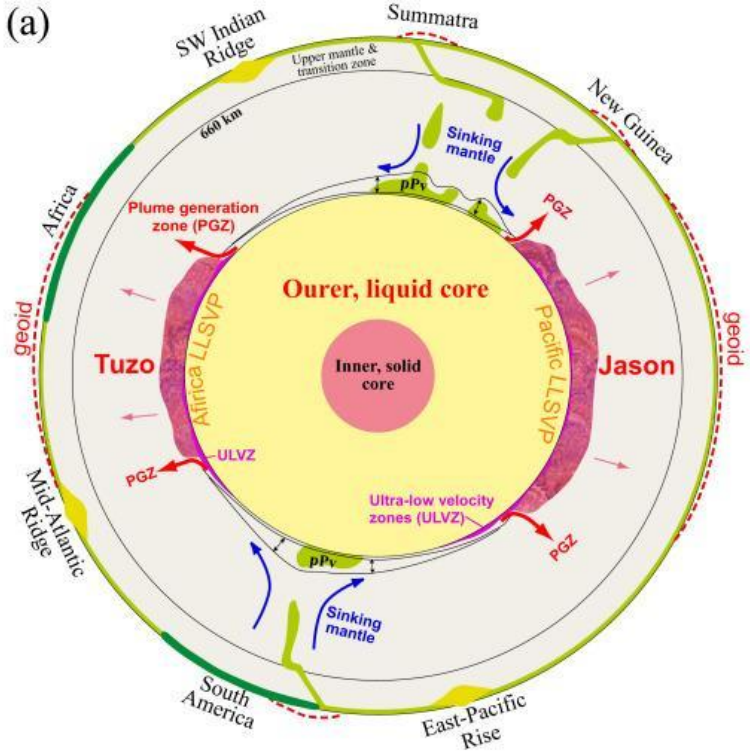

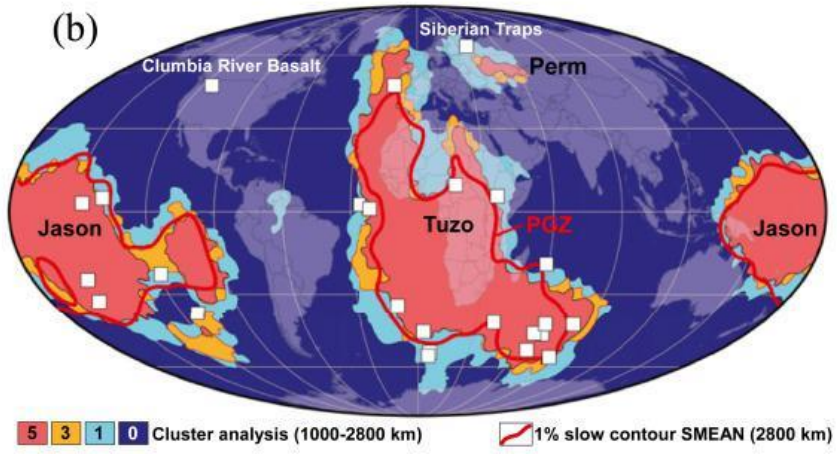

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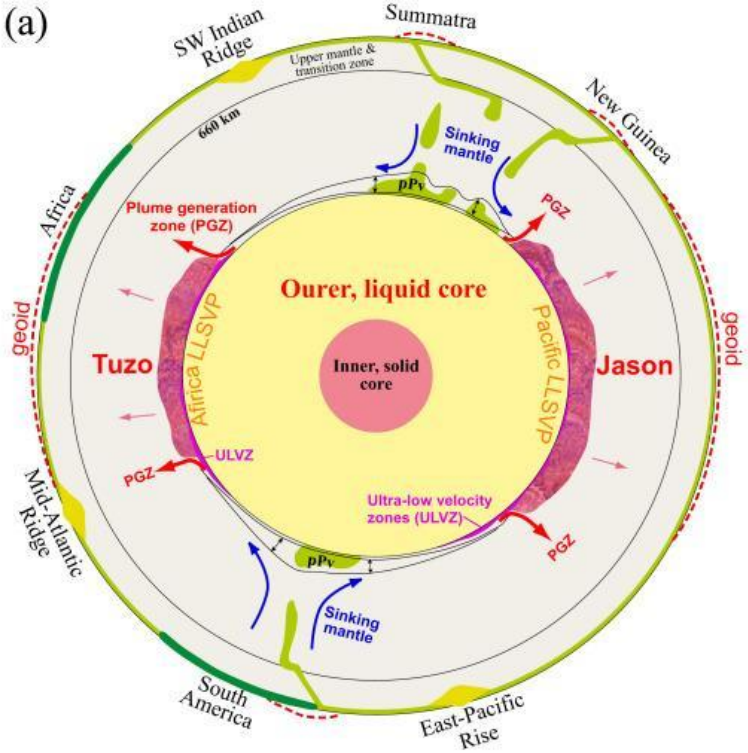
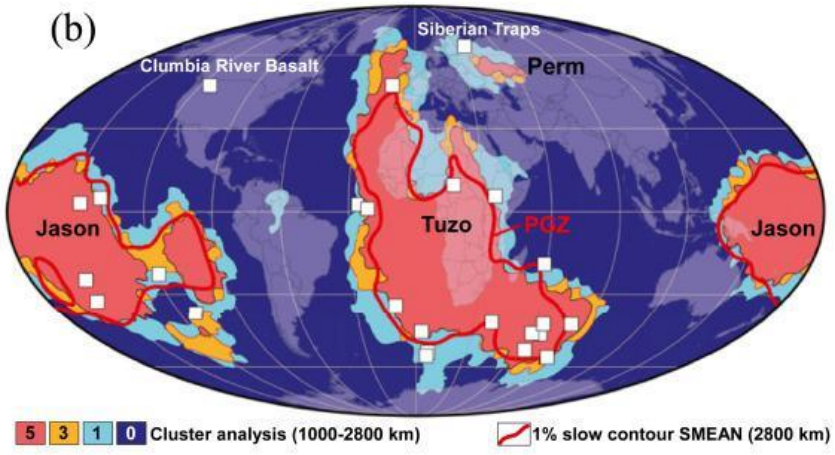
(3) the LLSVPs act as thermal insulators, making core-heating induced mantle diapirs or plumes initiated at their edges, which explains why the large igneous provinces (LIPs) are associated with the edges of the LLSVPs





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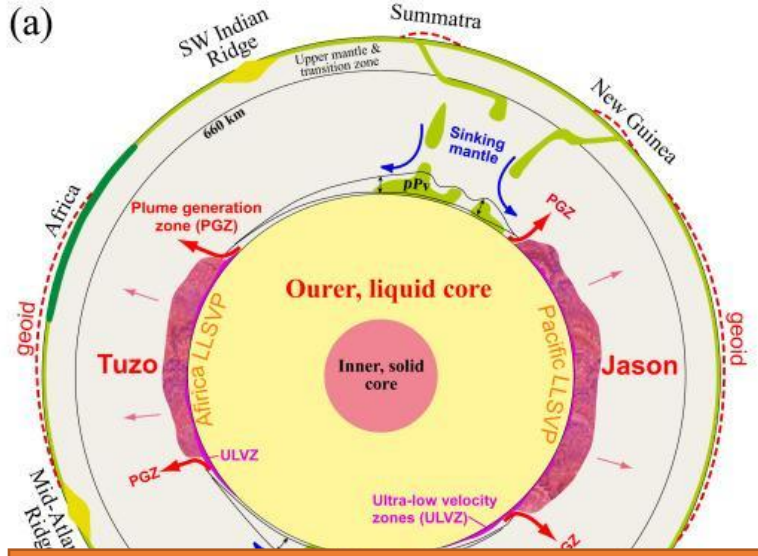

EXTREMELY CONTENTIOUS

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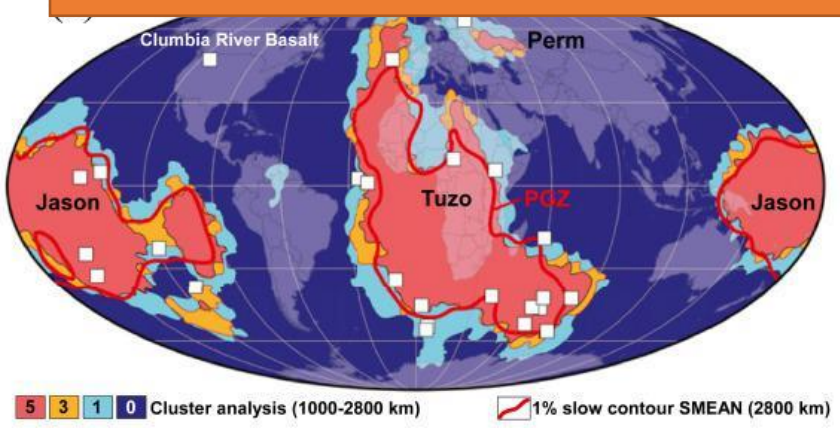

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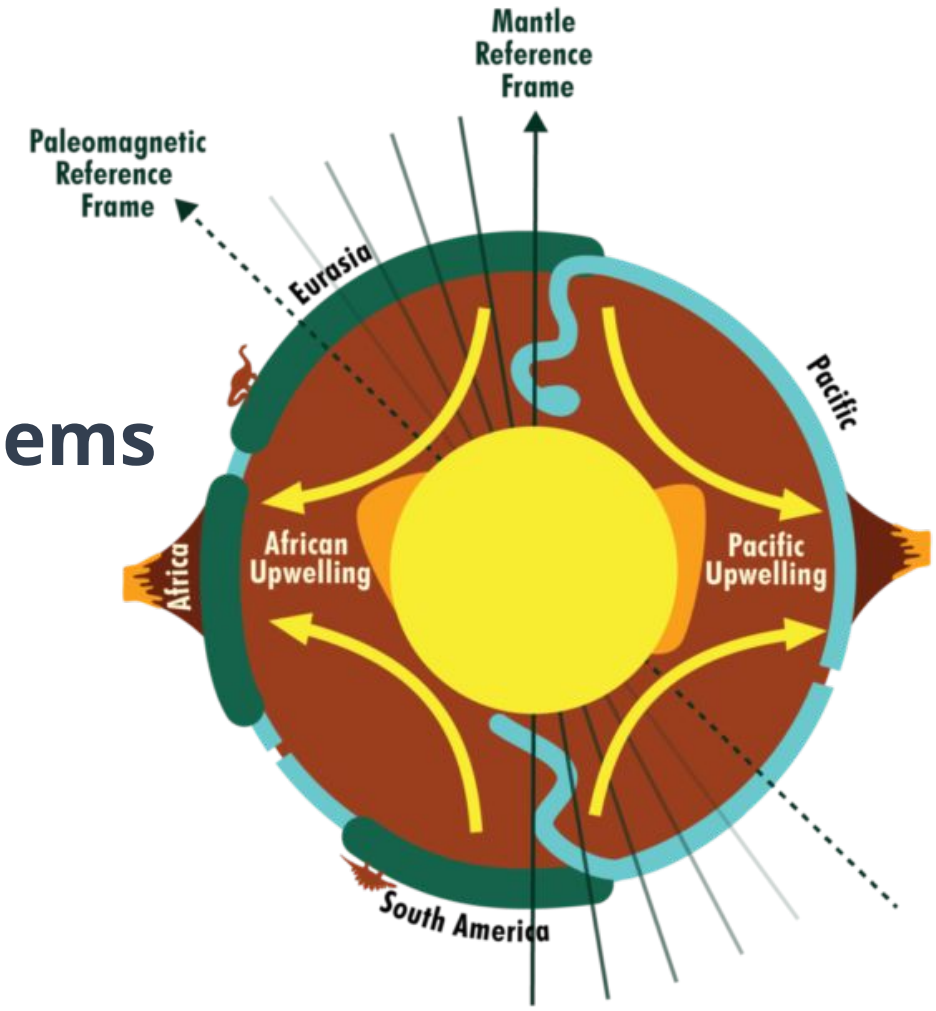
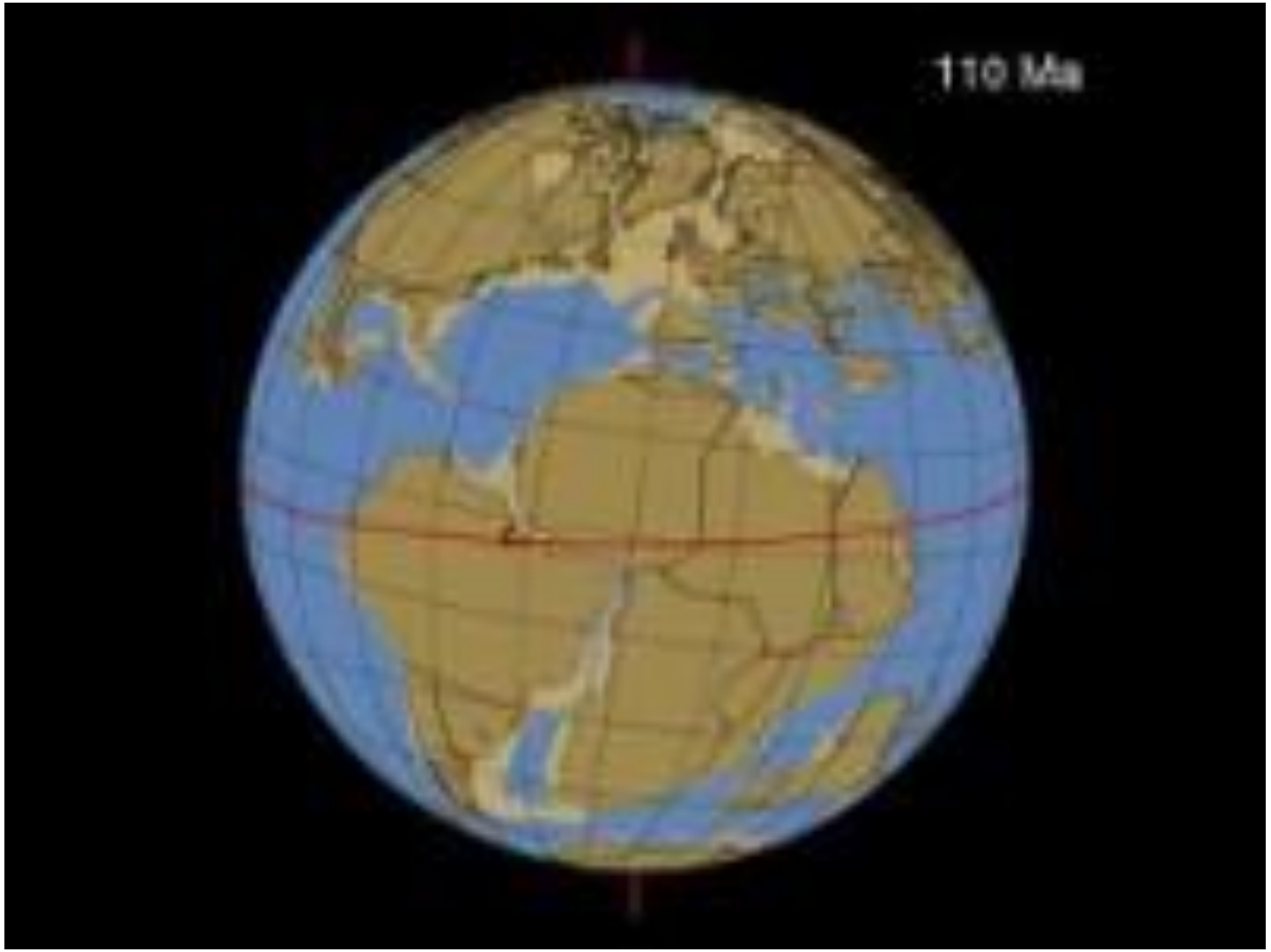
The way you think about a problem will ALWAYS impact the product.

The PMRF has problems



The MRF has problems

True Polar Wander: a reminder



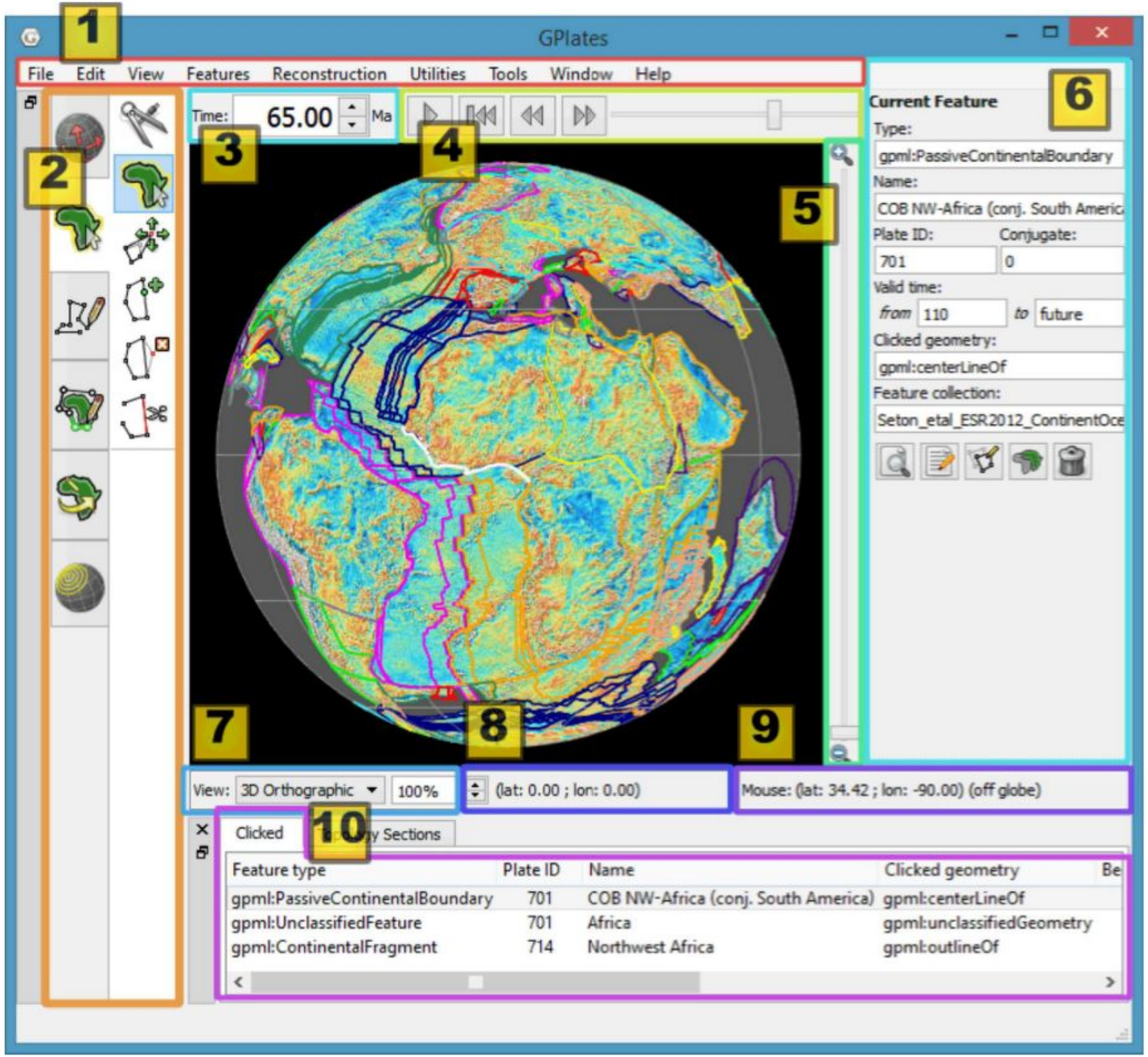
https://youtu.be/UEEFlmxVh94

For Windows

- C:\Program Files\Gplates\GPlates2.5.0\GeoData\

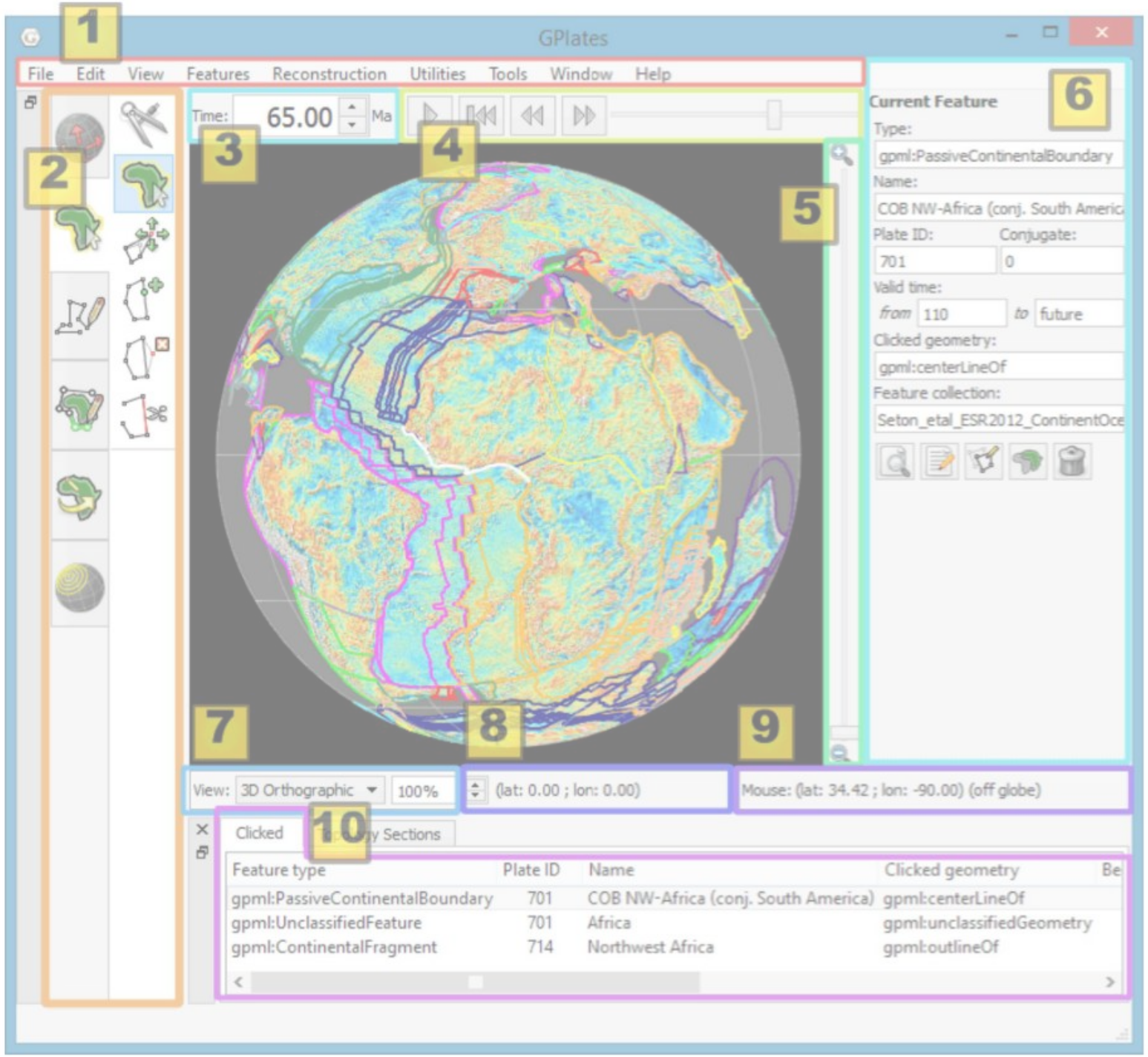
For Macs

- GPlates installed into applications



2	Tool Palette	**A collection of tools which are used to interact with the globe and geological features via the mouse pointer.**

https://www.gplates.org/docs/user-manual/Introducing_The_Main_Window/



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Drag Globe

~Will deselect Feature

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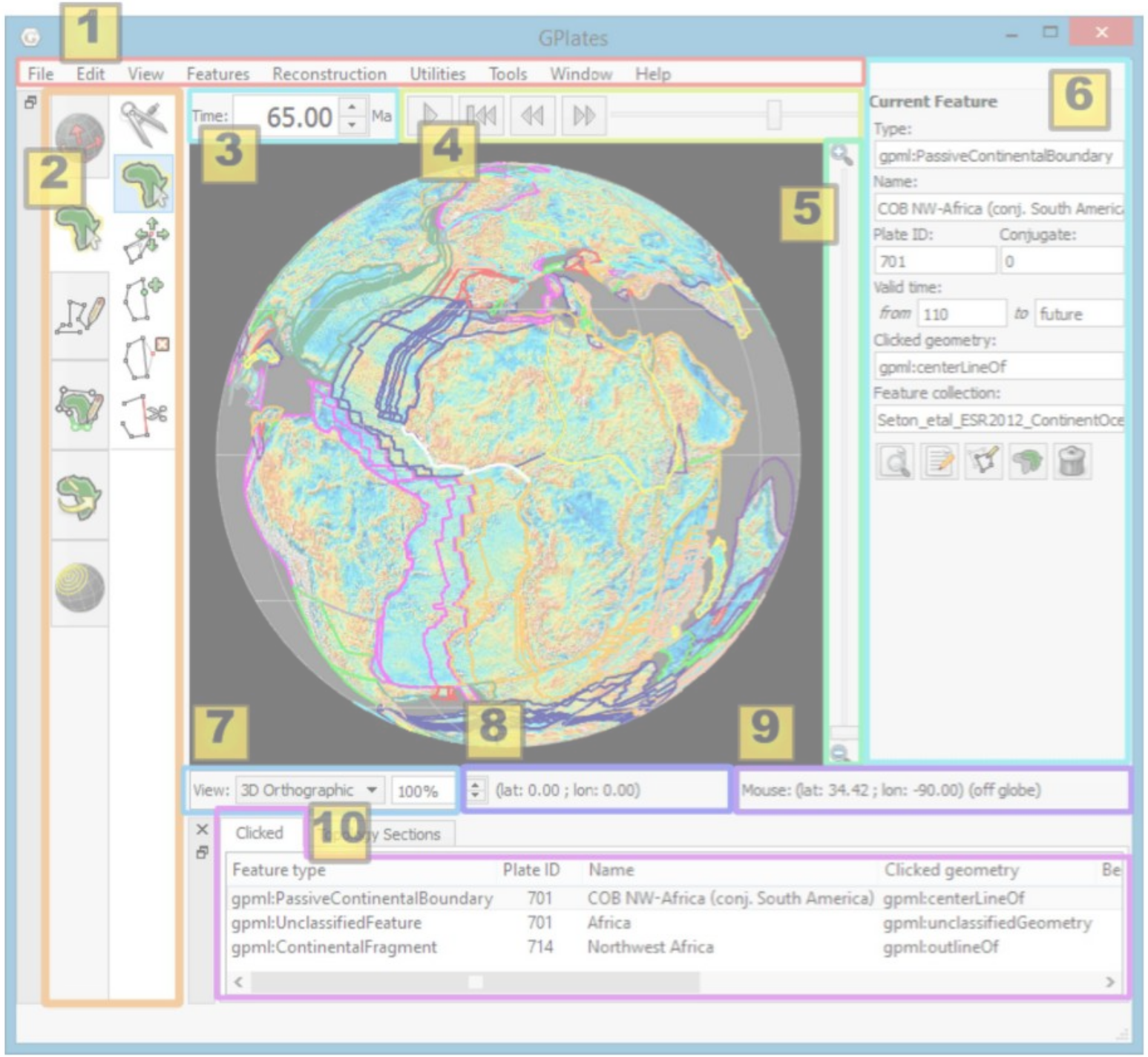

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Choose Feature
~ Used for selecting
If selected will appear in **10**

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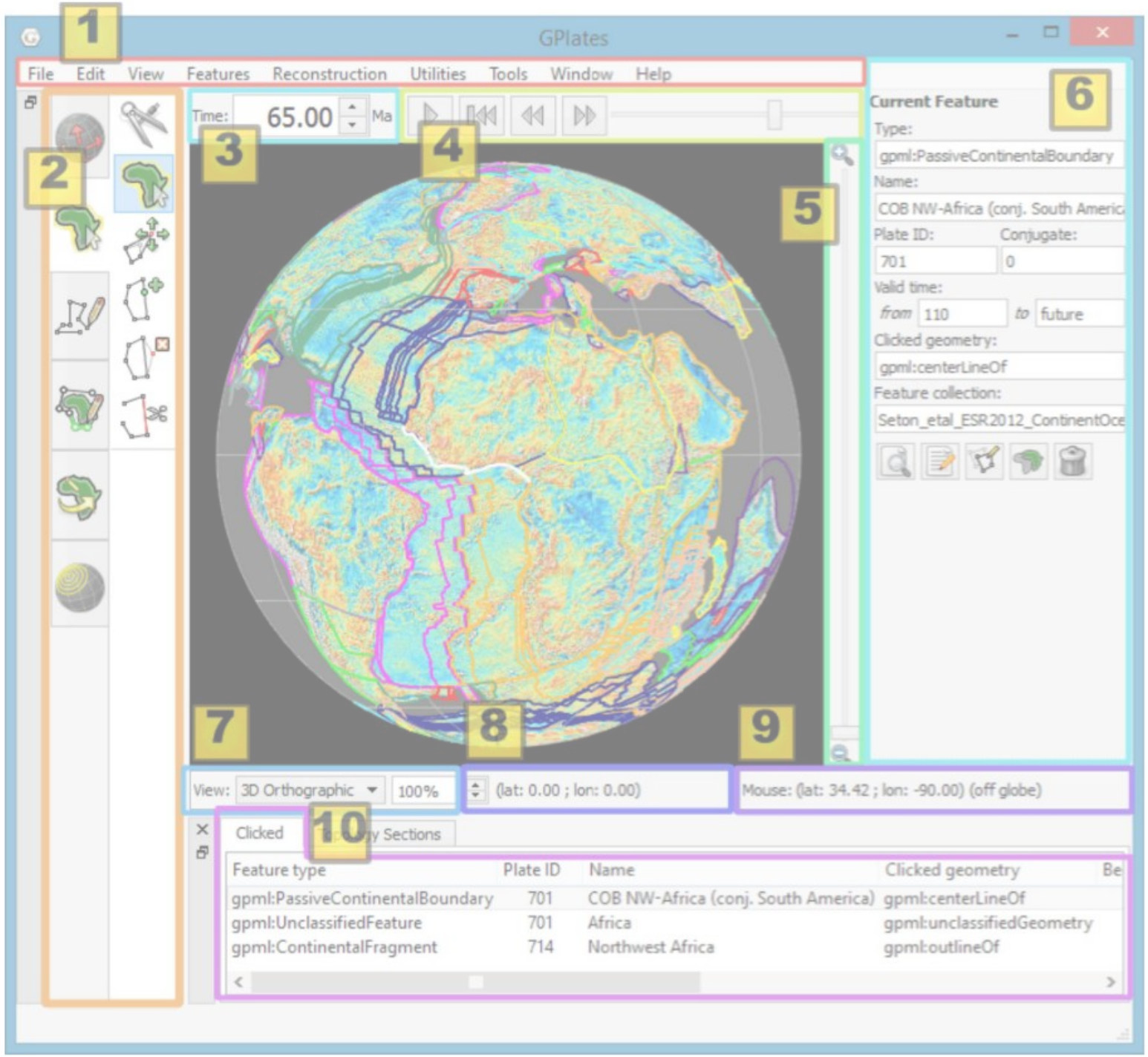

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Choose Feature
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If selected will appear in **10**

Digitise Multi-point Geometry
~Used for creating new features

https://www.gplates.org/docs/user-manual/Introducing_The_Main_Window/

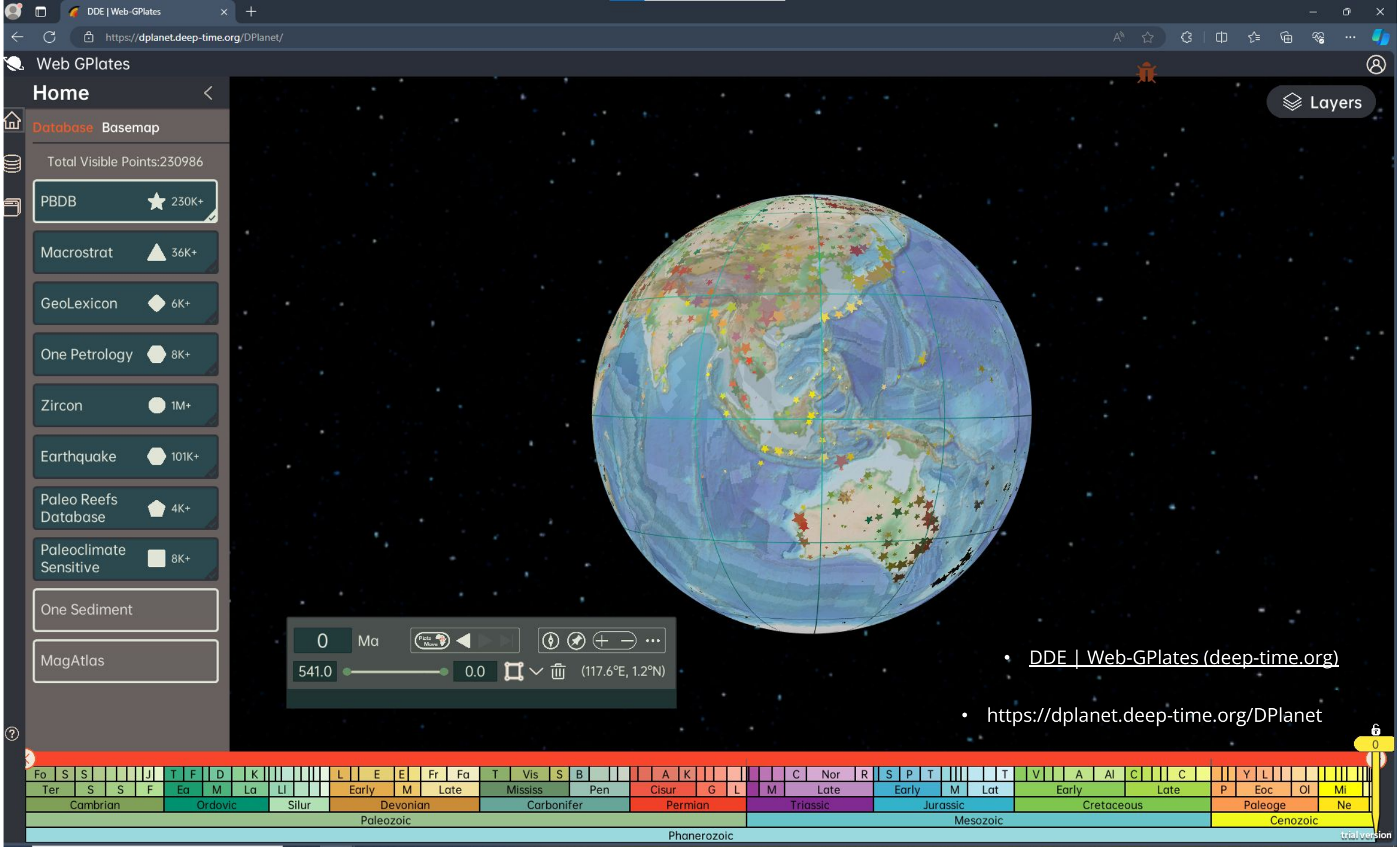
Tutorial Links

- Single point reconstructions | GPlates for System Erde III.

EXTENSION Tutorial Links

- Reconstructing actual data | GPlates for System Erde III.

Necessary tutorial for assignment



- DDE | Web-GPlates (deep-time.org)
- https://dplanet.deep-time.org/DPlanet