



**Plate Tectonics:
Exploration of Deep Time**

Bright Horizons Cruise #6

David Blackwell

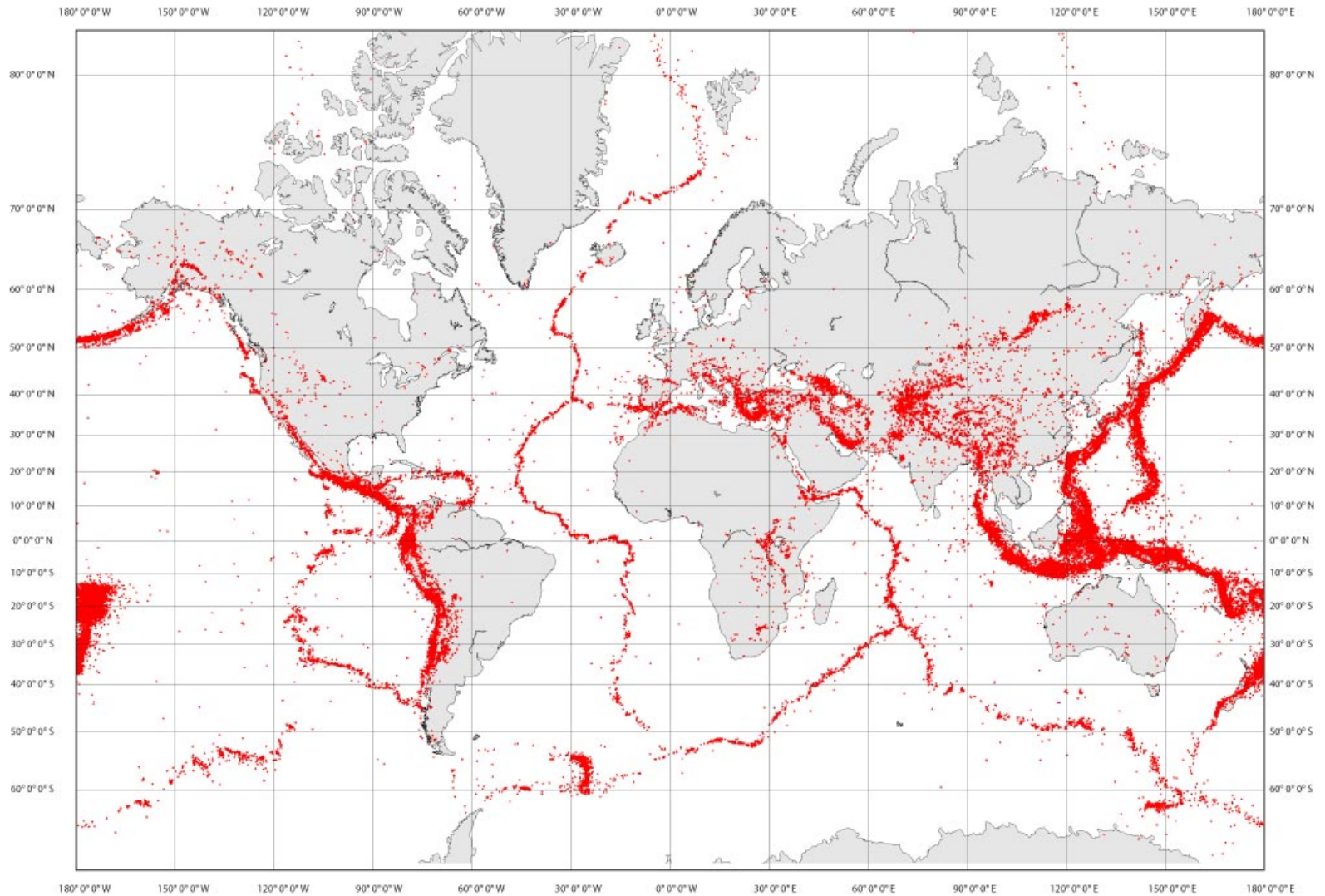
Southern Methodist University

Pilbera Region, NW Australia, 2,500 to 3,00 MY

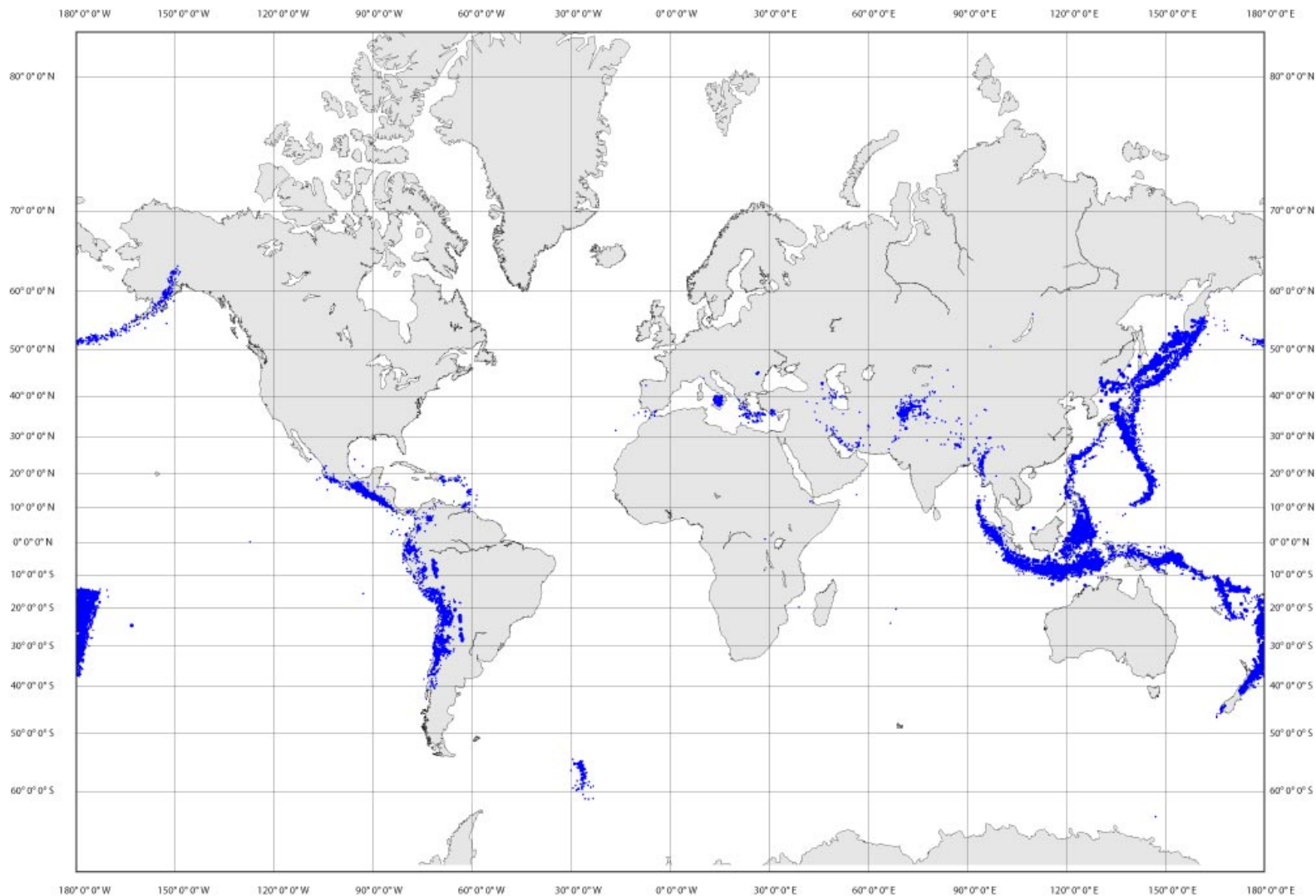


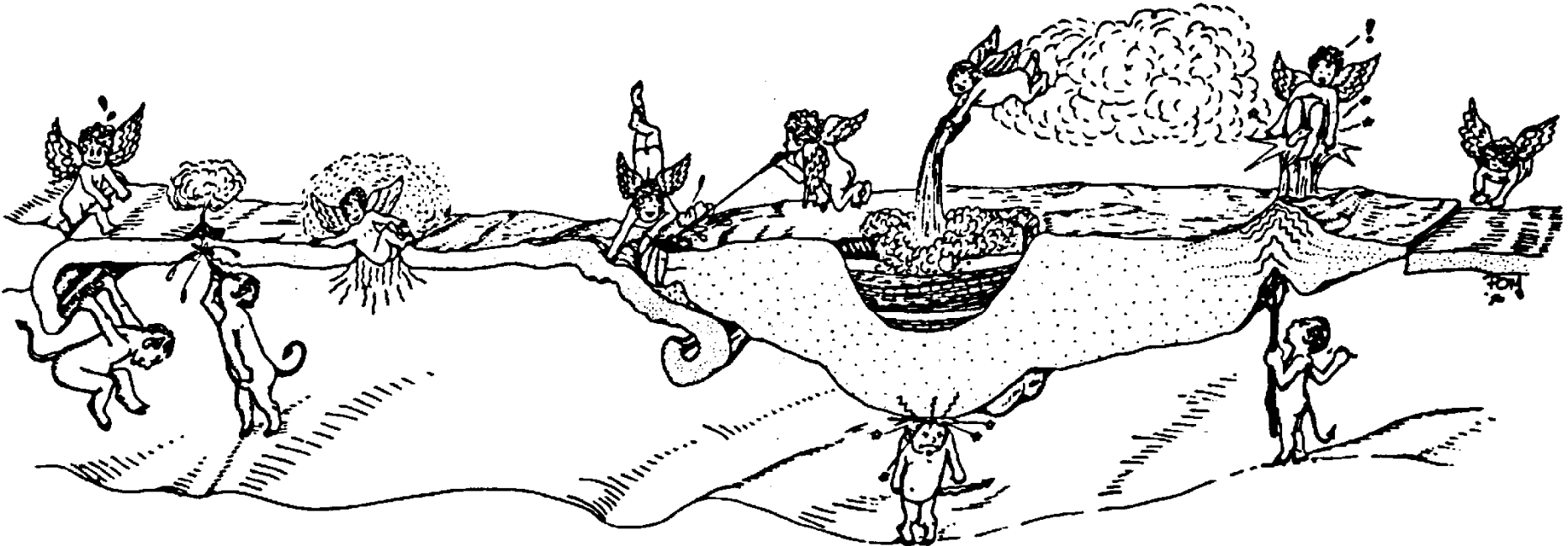
Niaca Mine, Chihuahua, Mexico

Shallow-Focus Earthquakes(0-70 km)

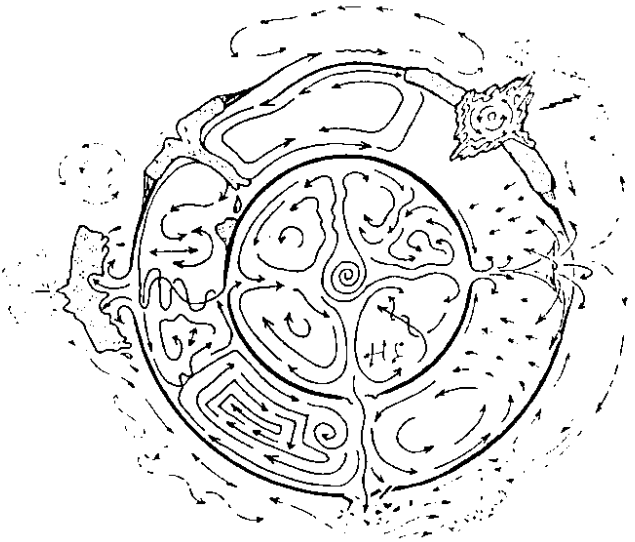


Deep-Focus Earthquakes (greater than 70 km)

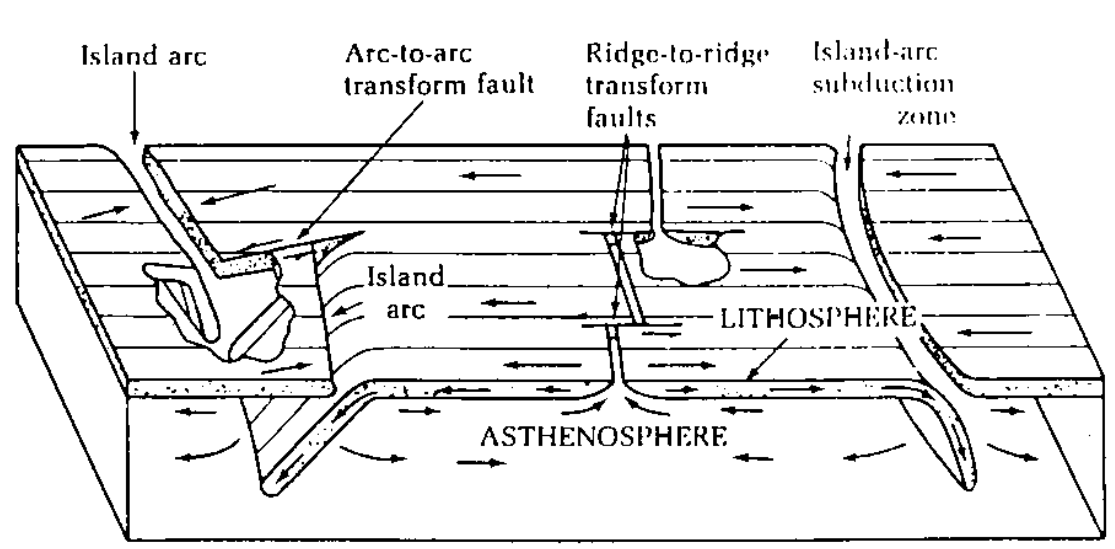




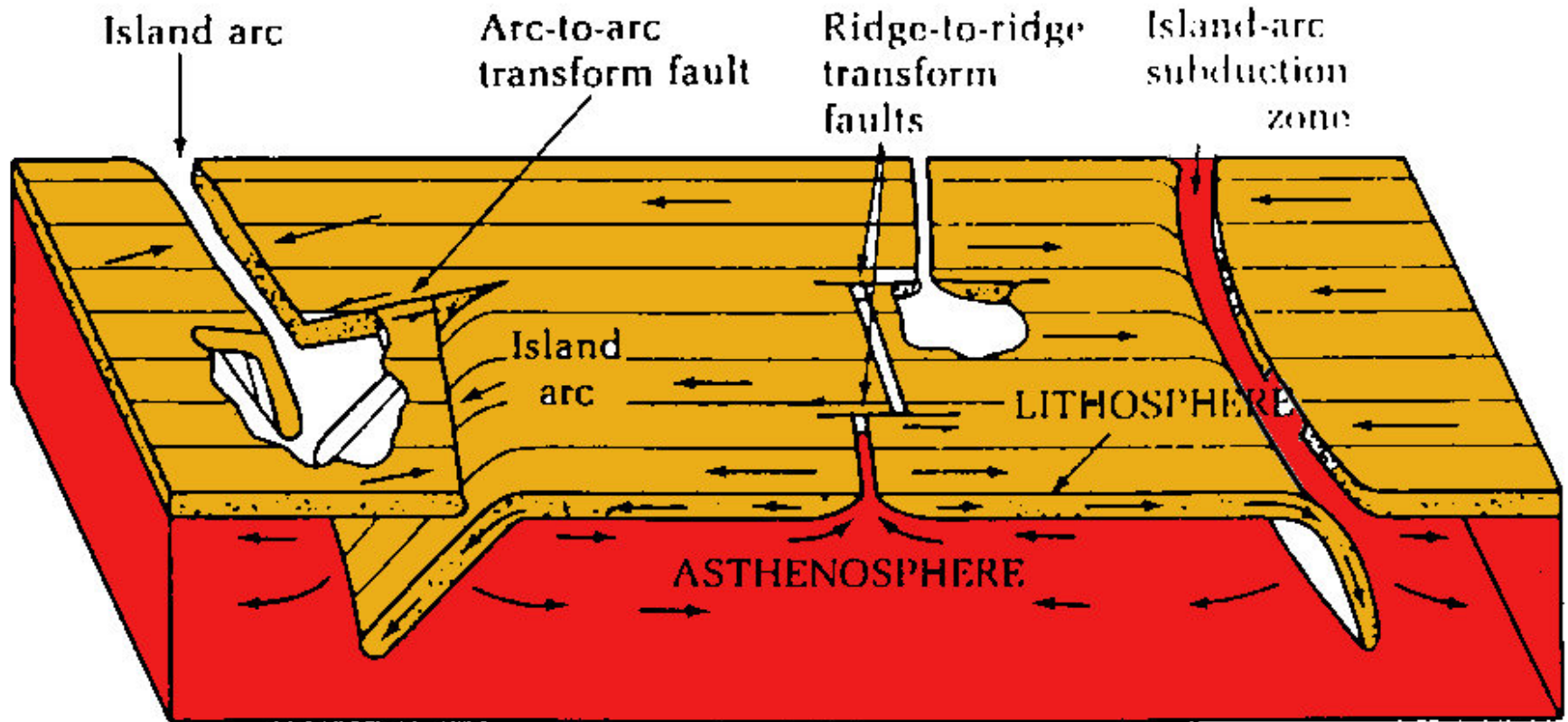
A Model of Plate Tectonics



...wheels within wheels within wheels



And Another

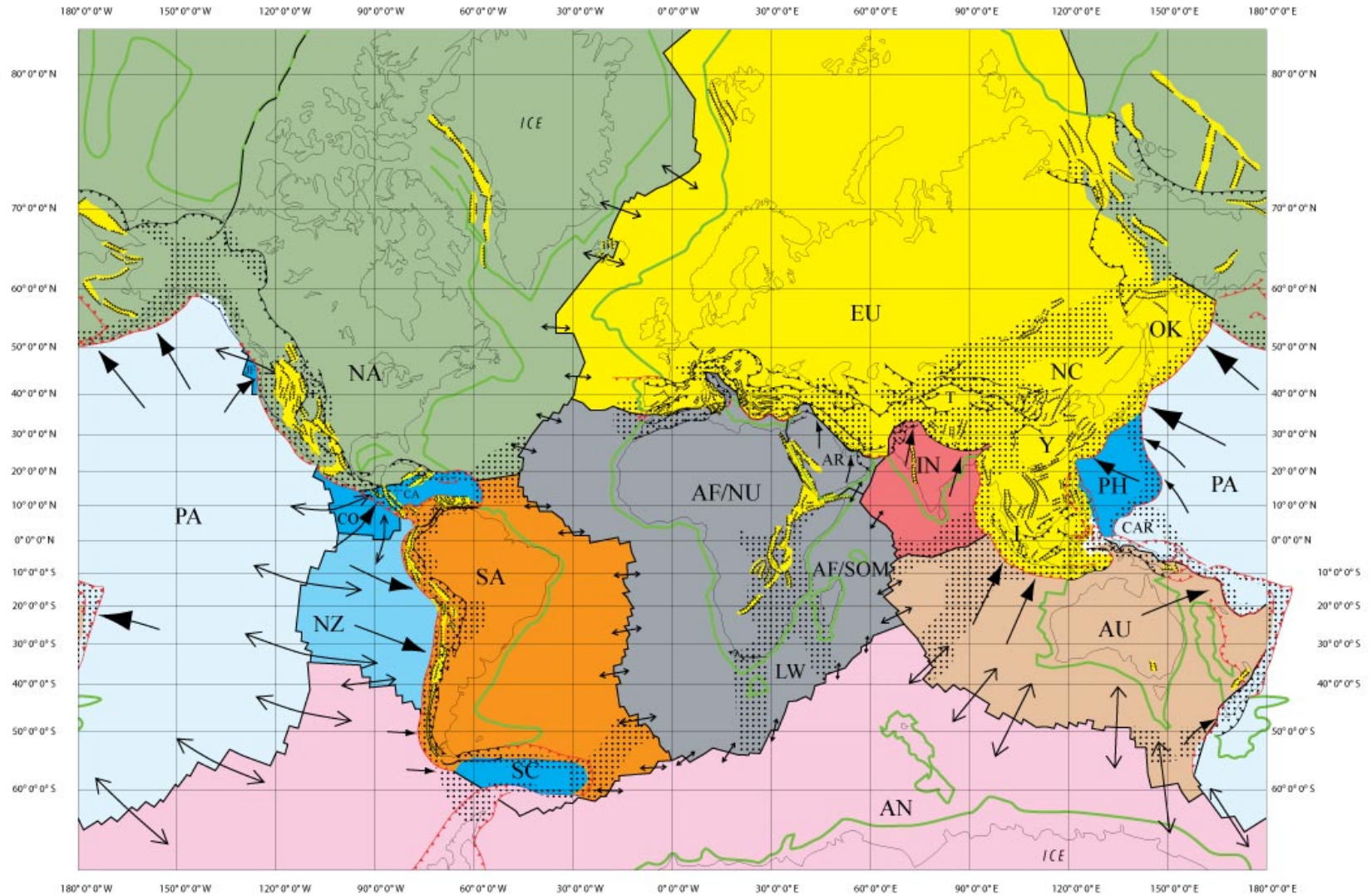


And Another

Isaacs, Oliver and Sykes, 1967 (IOS)

What About Hot Spots?

Diffuse Plate Boundaries / "Conventional" Plates



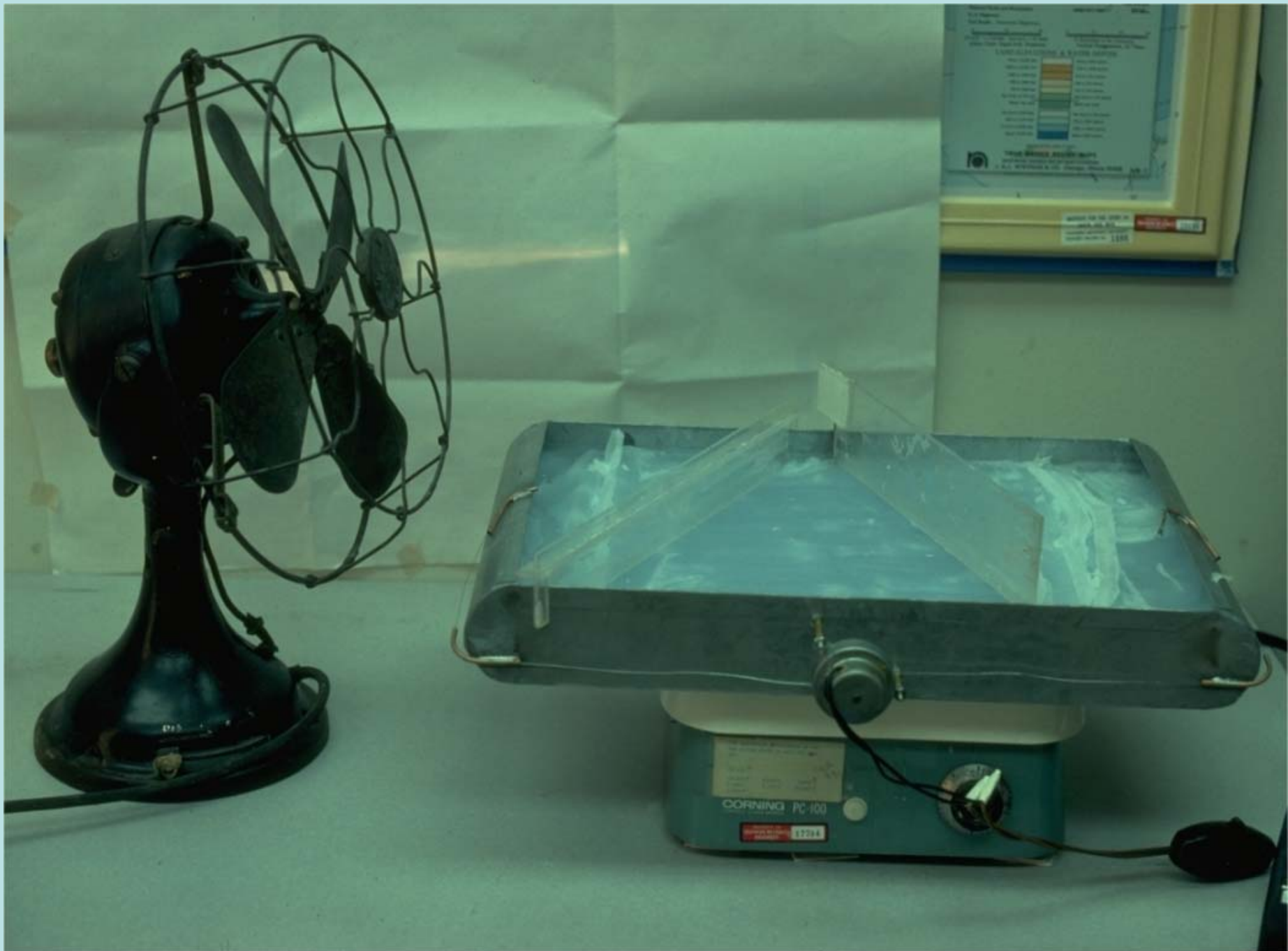
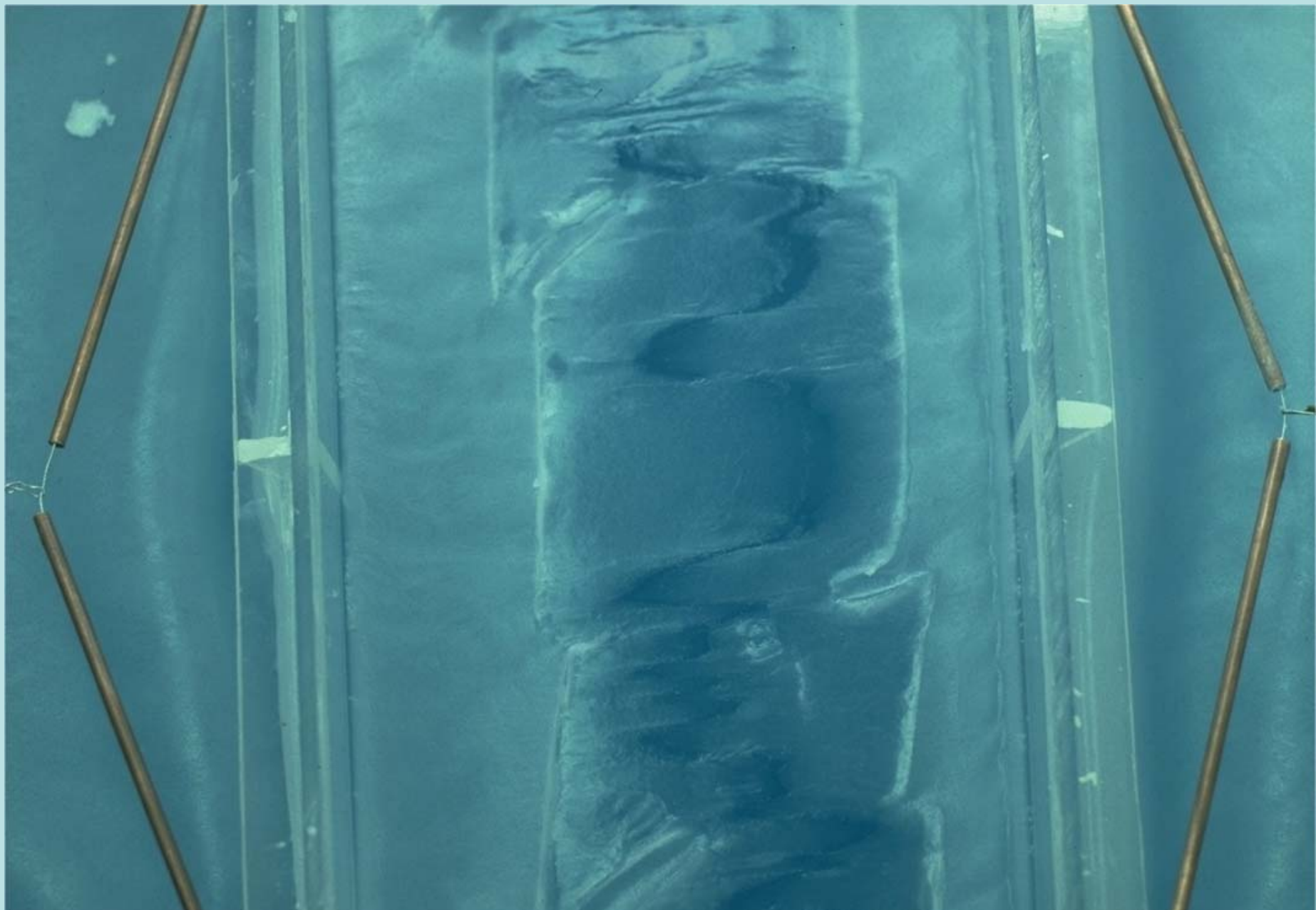


Table with multiple columns and rows of data, likely a calibration or reference chart. The text is small and difficult to read, but it appears to be a technical document.

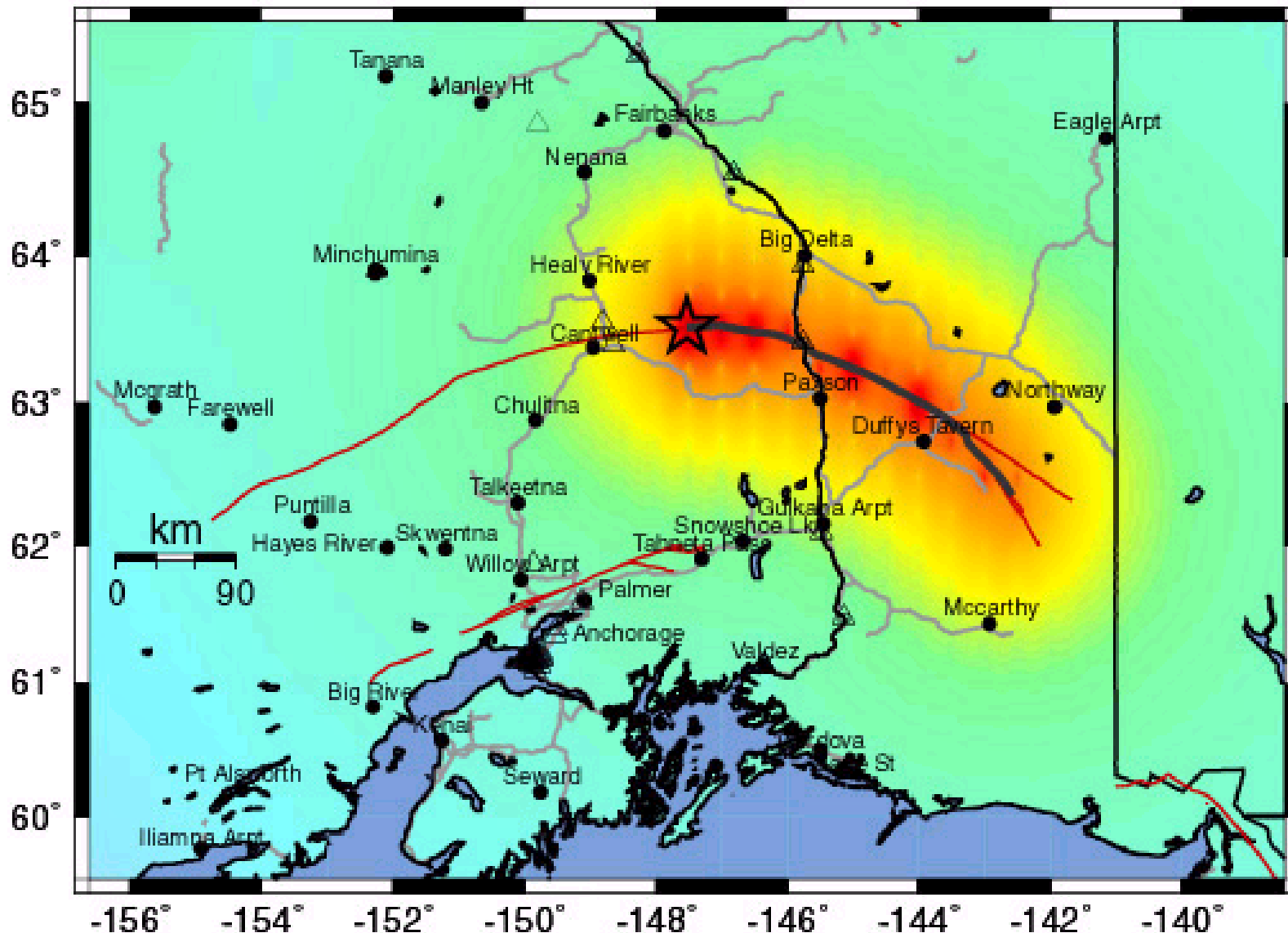
CORNING PC-100
13234





USGS Rapid Instrumental Intensity Map for event: 110302

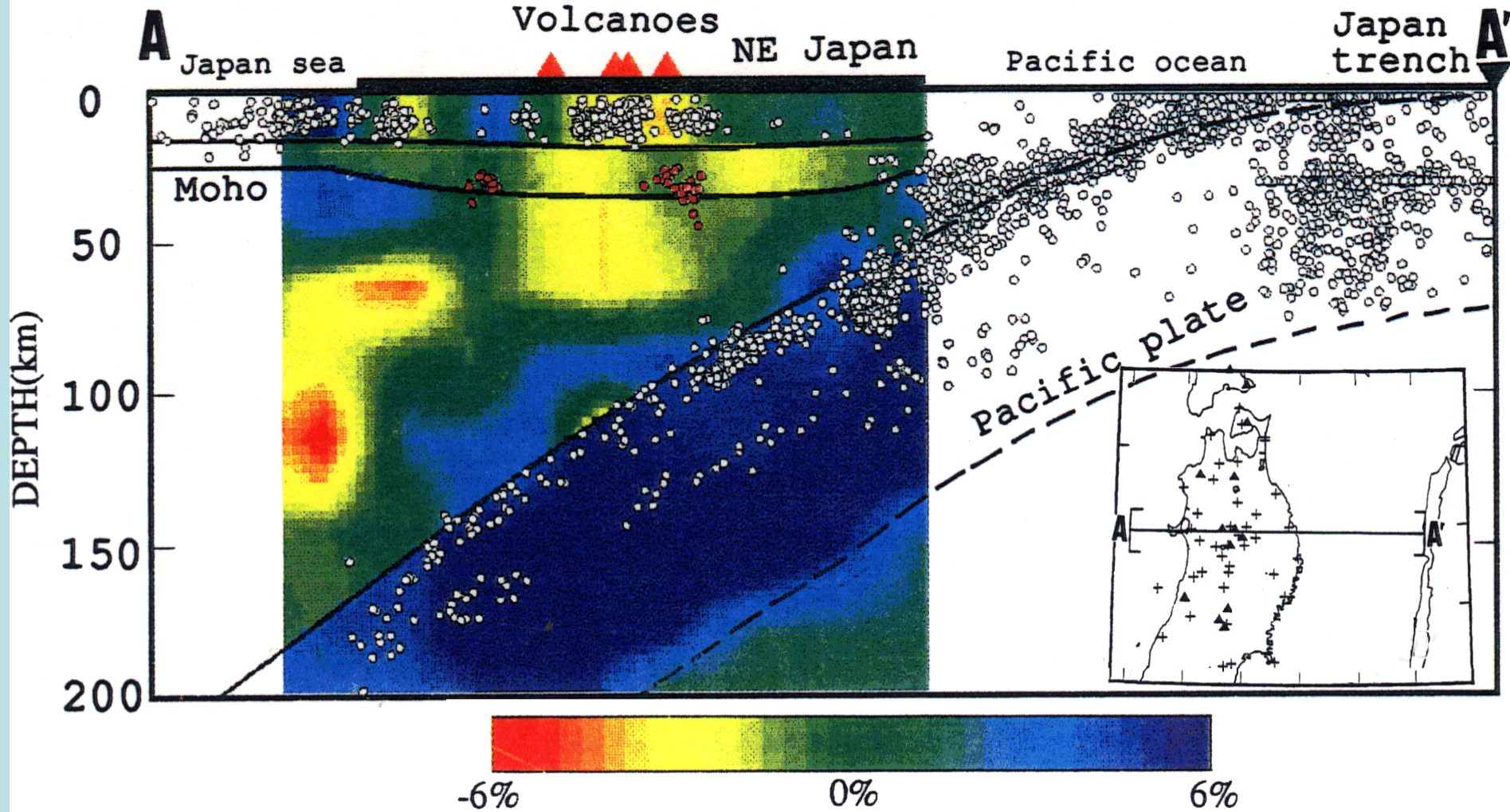
Sun Nov 3, 2002 10:12:41 PM GST M 7.9 N63.52 W147.53 Depth: 5.0km ID:110302



PROCESSED: Tue Nov 12, 2002 06:35:30 PM GST, --

Subduction Zone, Northern Honshu Japan

ZHAO ET AL.: *P* AND *S* WAVE TOMOGRAPHY OF NORTHEASTERN JAPAN 19,926



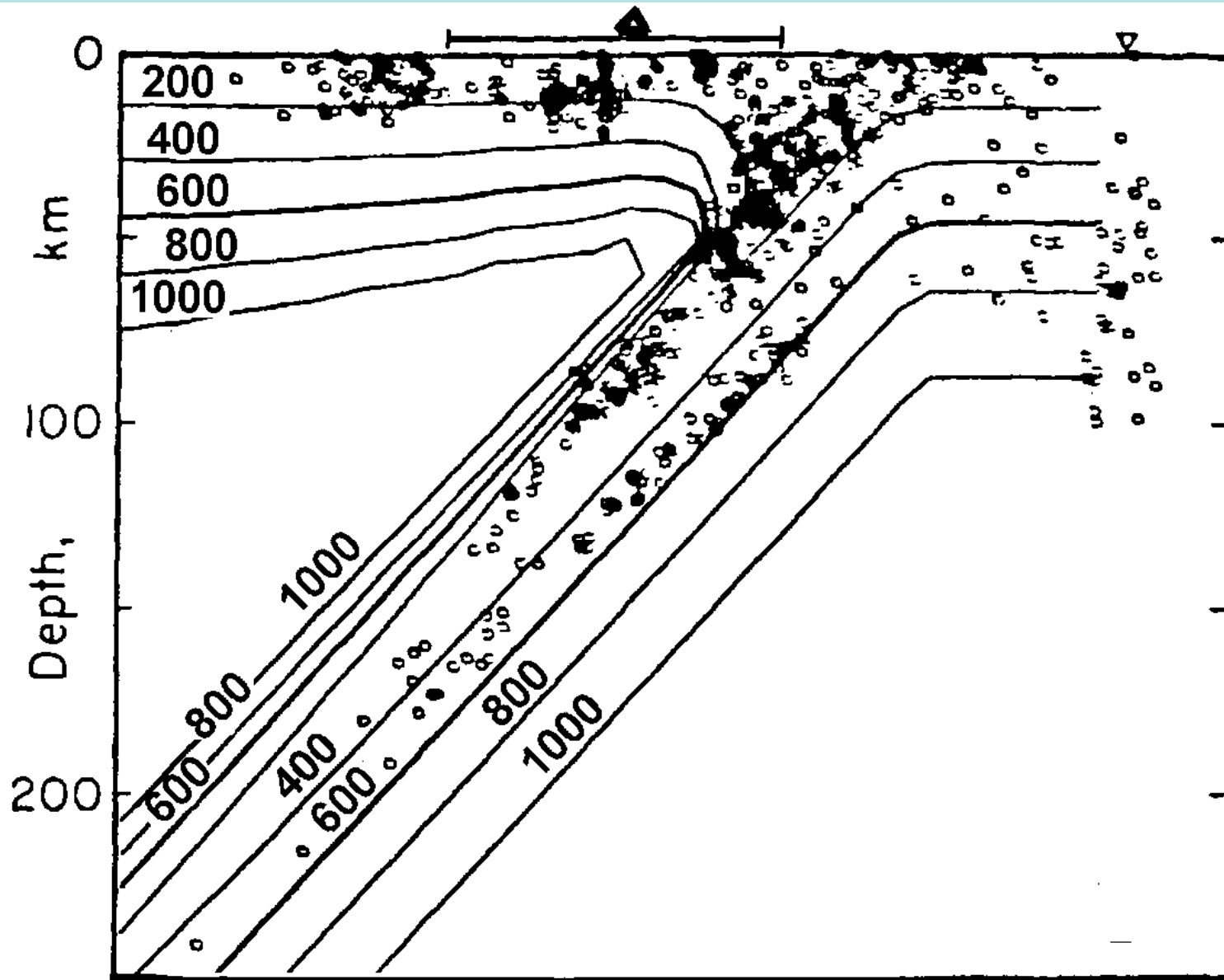
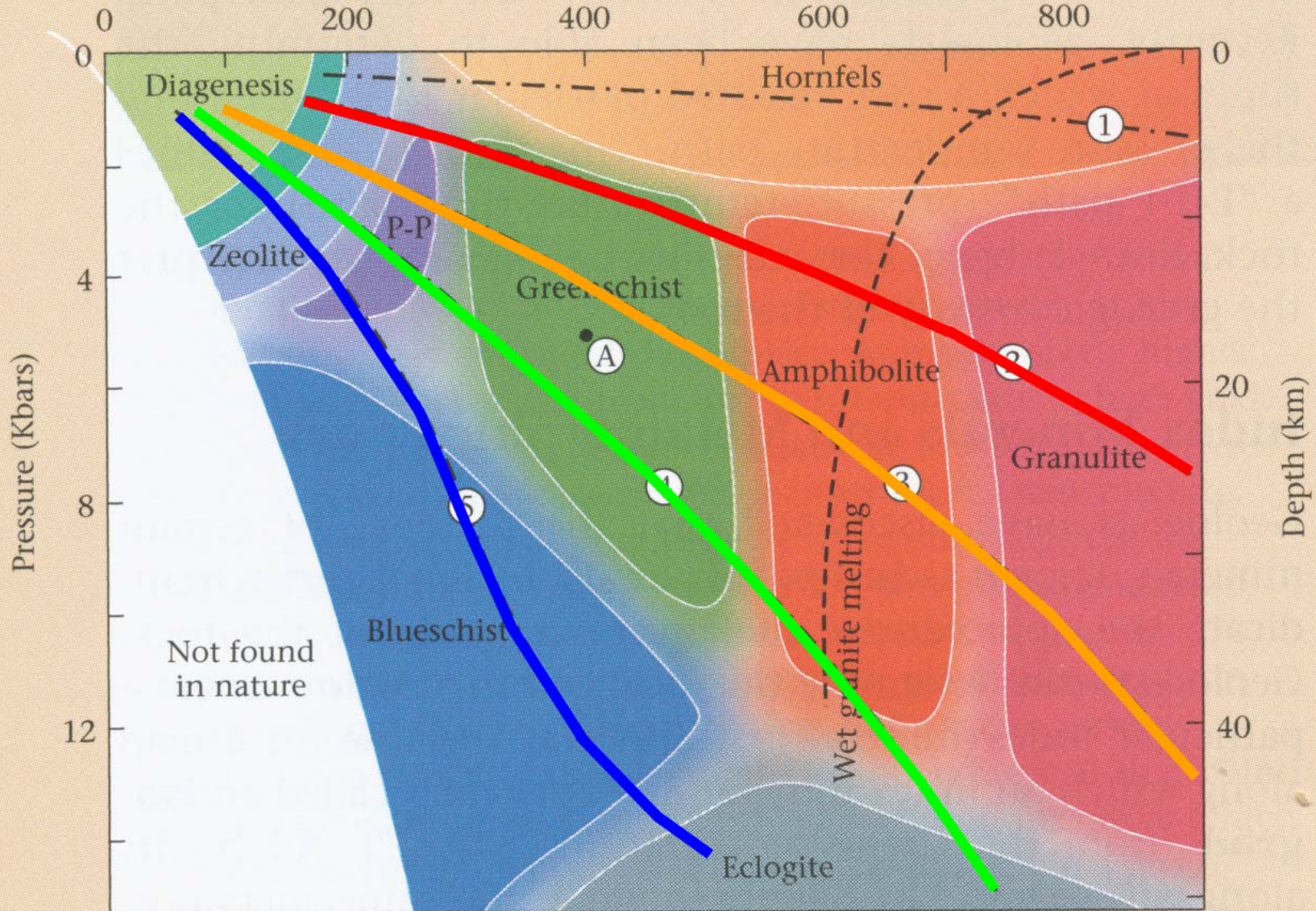


Figure 5.3.6. Double seismic zone beneath Tohoku [after Hasegawa et al., 1978a] is compared with the thermal model. Contours are drawn for every 200 C. The

Temperature, °C



① Contact (thermal) metamorphism

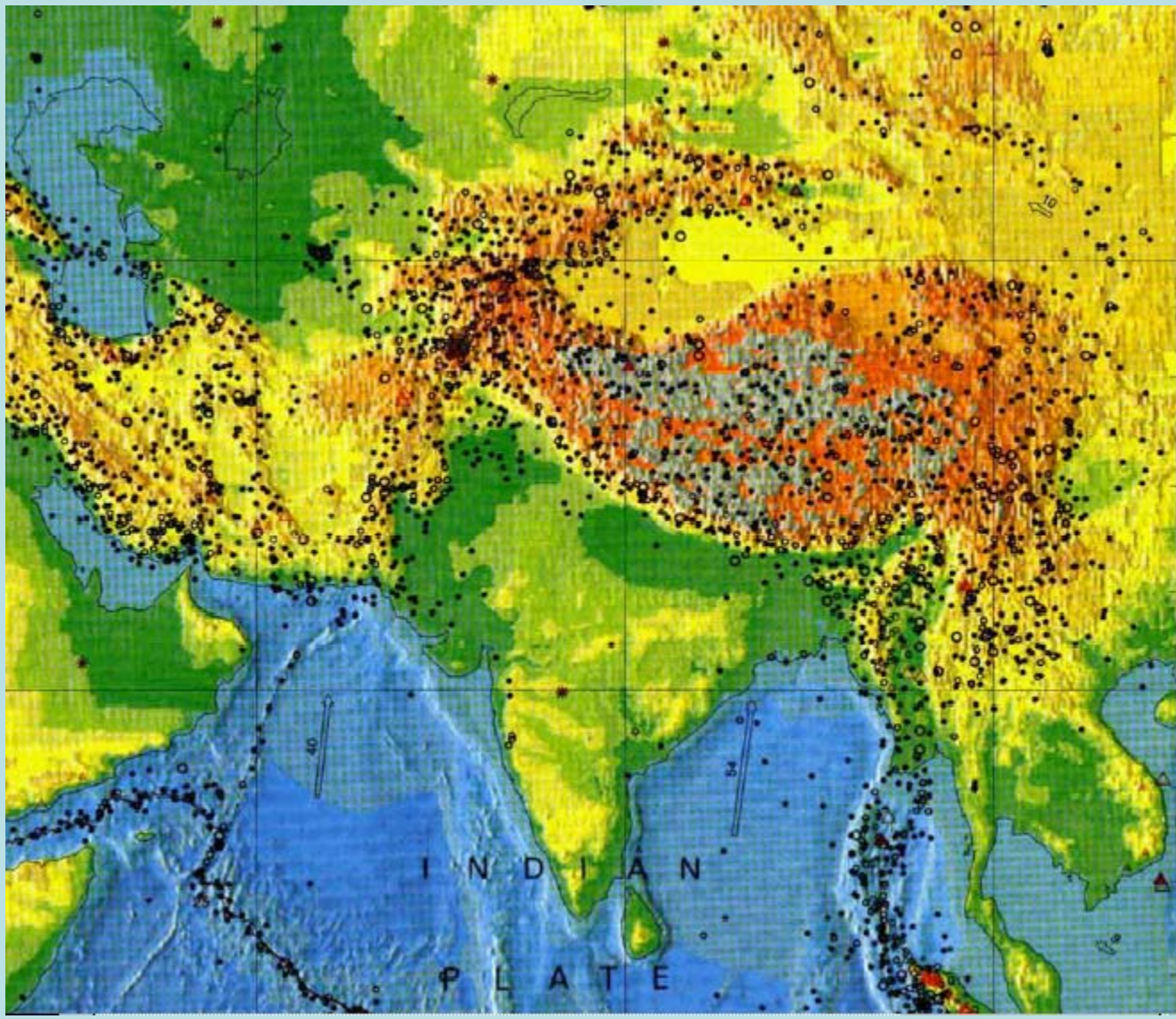
② Volcanic arc

③ Collisional mountain belt

④ Stable continent

⑤ Accretionary prism

Metamorphic Facies



Himalaya Crust and Mantle Section

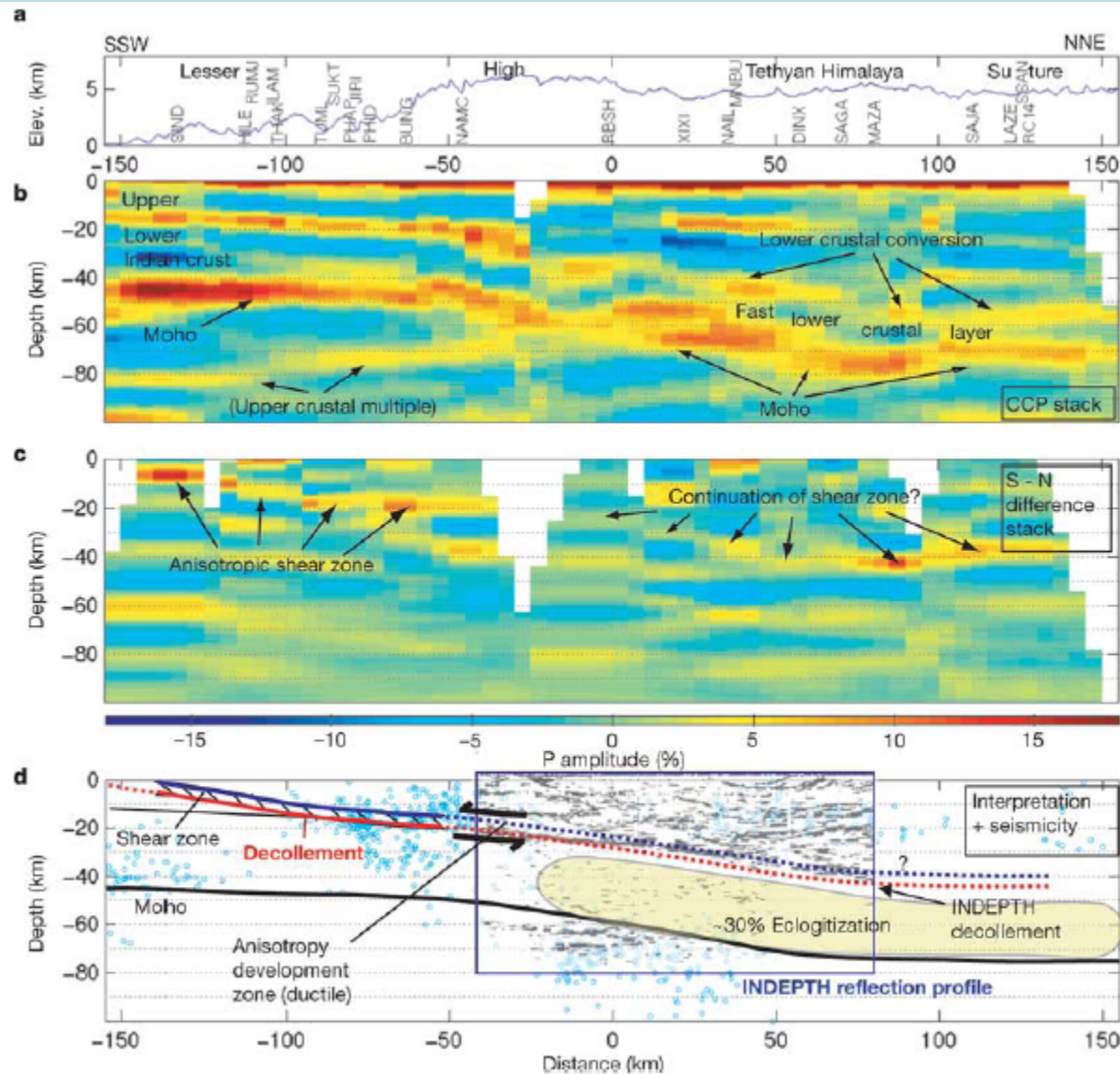


Figure 2 | Receiver function analysis along profile and interpretation.
a, Topography and station locations along the N18E profile indicated in

Supplementary Information for discussion of the upper crustal multiple.)
c, South–north azimuthal difference common conversion point stack: the

3 Types of Volcanoes

- Basaltic, shields, ridges, all volcanic regions
- Intermediate, Andesite StratVolcanoes, Island arcs (Subduction)
- Silicic, Calderas, Continental melting

Mona Loa, Hawaii



Generalized Geologic Time Frames

- **Stage 1: Pregeologic 4.5 to 4.0 BY**
- **Stage 2: Archean 4.0 to 2.5 BY**
 - » Early Plate Tectonics, life
- **Stage 3: Proterozoic 2.5 to 0.6 BY**
 - » Plate Tectonics, life; Polar Wandering
- **Stage 4: Early Phanerozoic 0.6 to .15 BY**
 - » Cambrian, hard shelled fossils
- **Stage 5: Late Phanerozoic .15 to 0 BY**
 - » Ocean Magnetic Anomalies

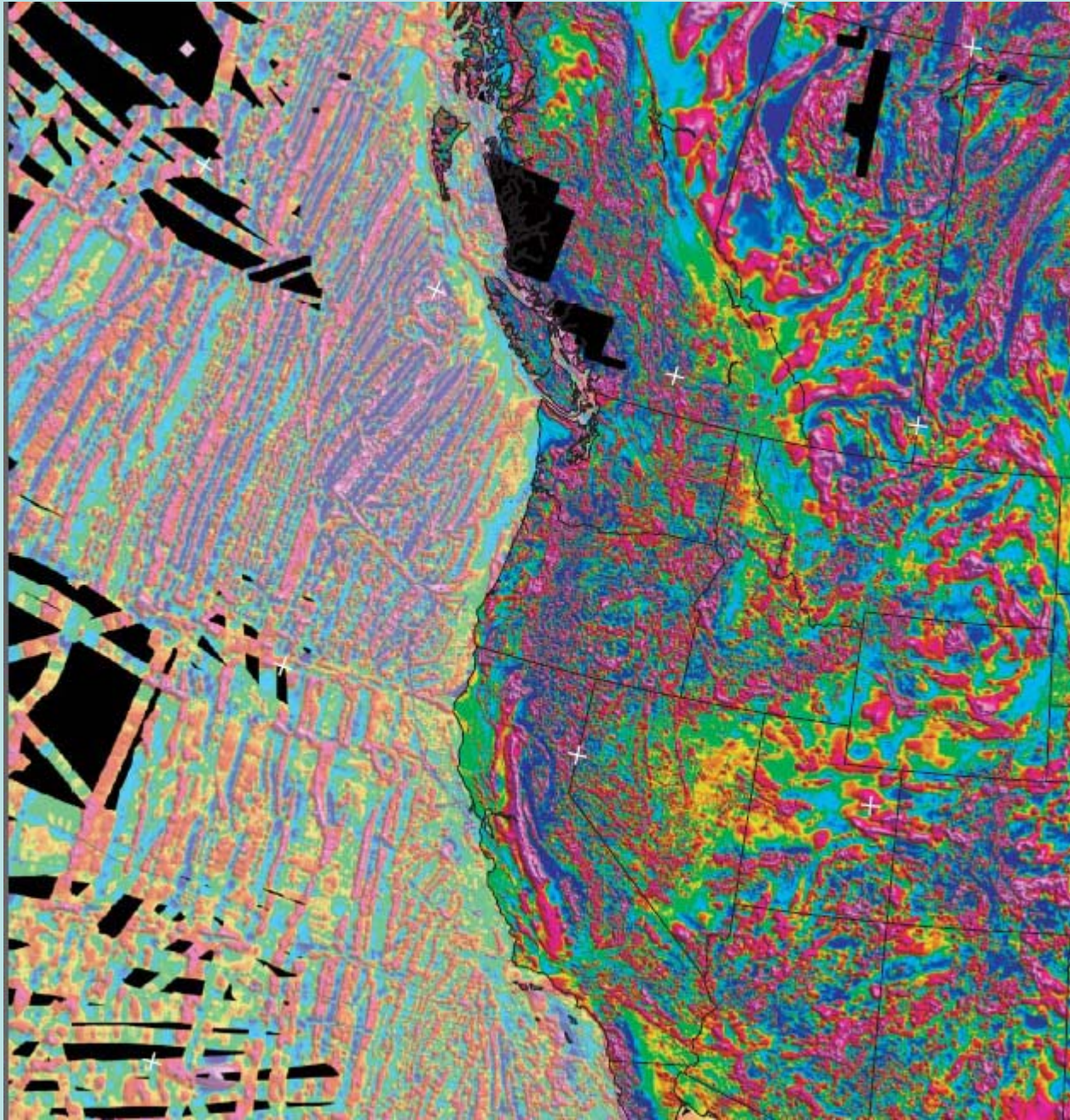
Newberry, Volcano, Bend Oregon



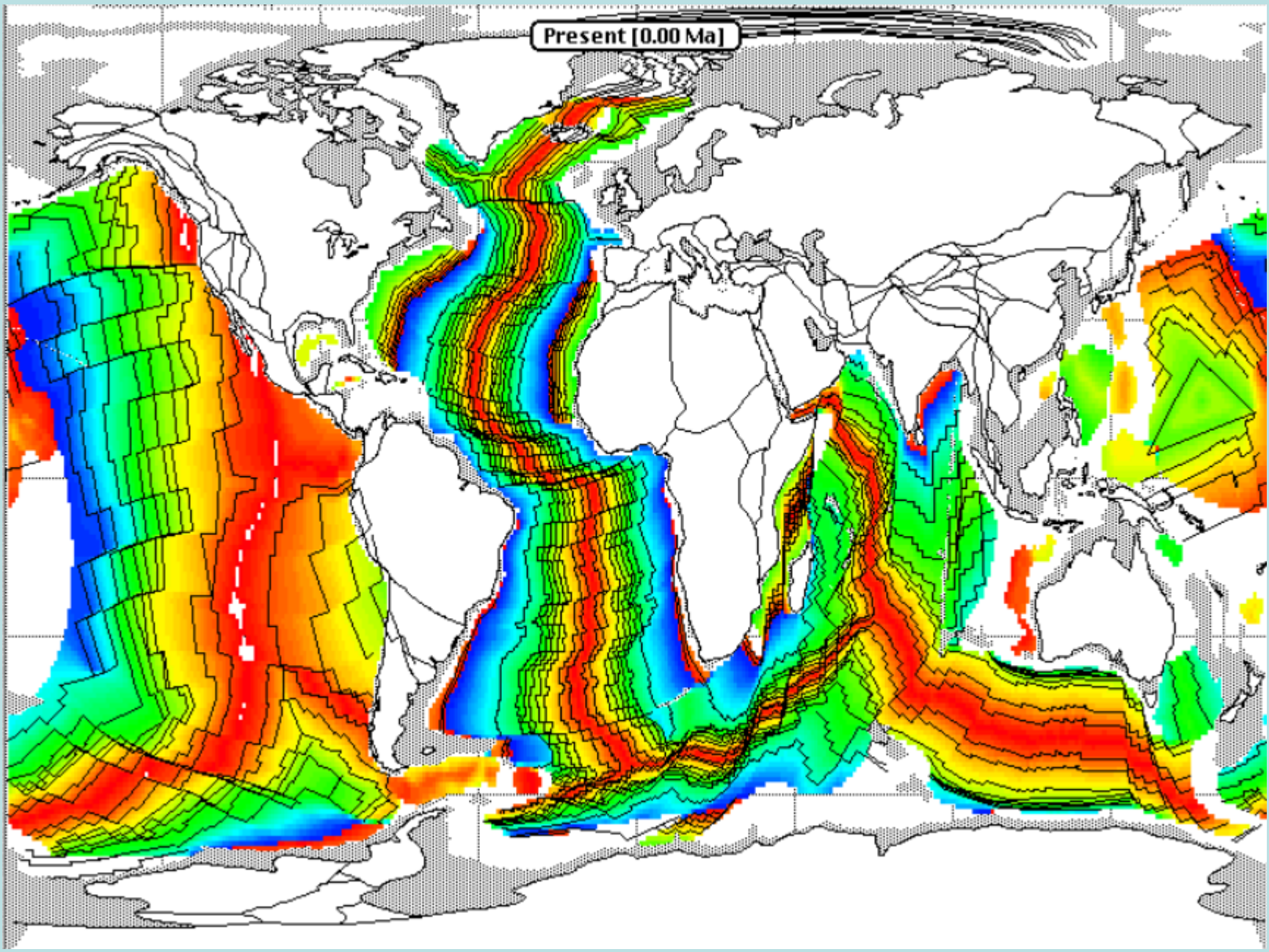
**Mt St Helens (pre 1980) and
Mt Rainier, Washington**



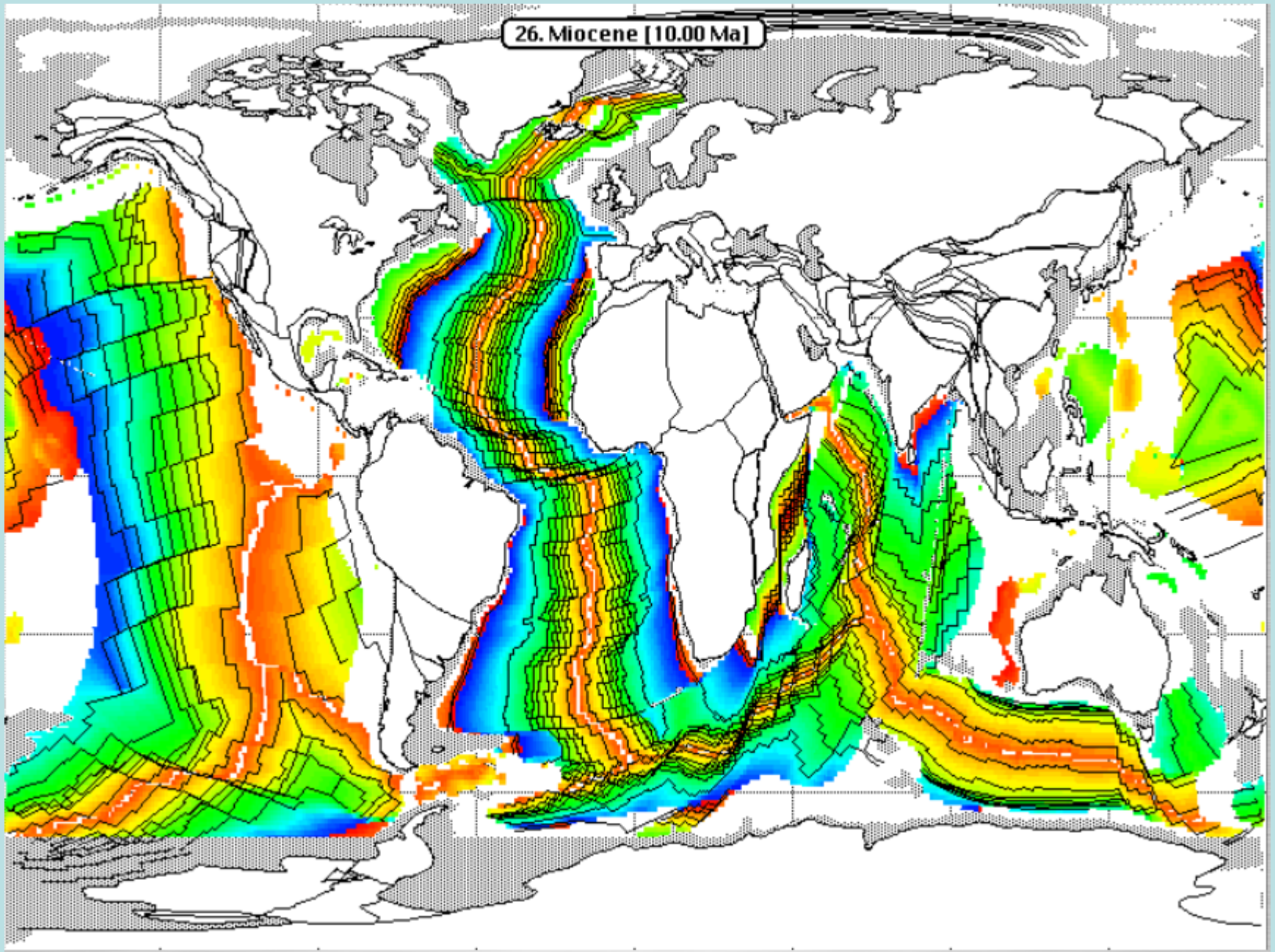
Note Difference in Pattern in Oceans and on Land



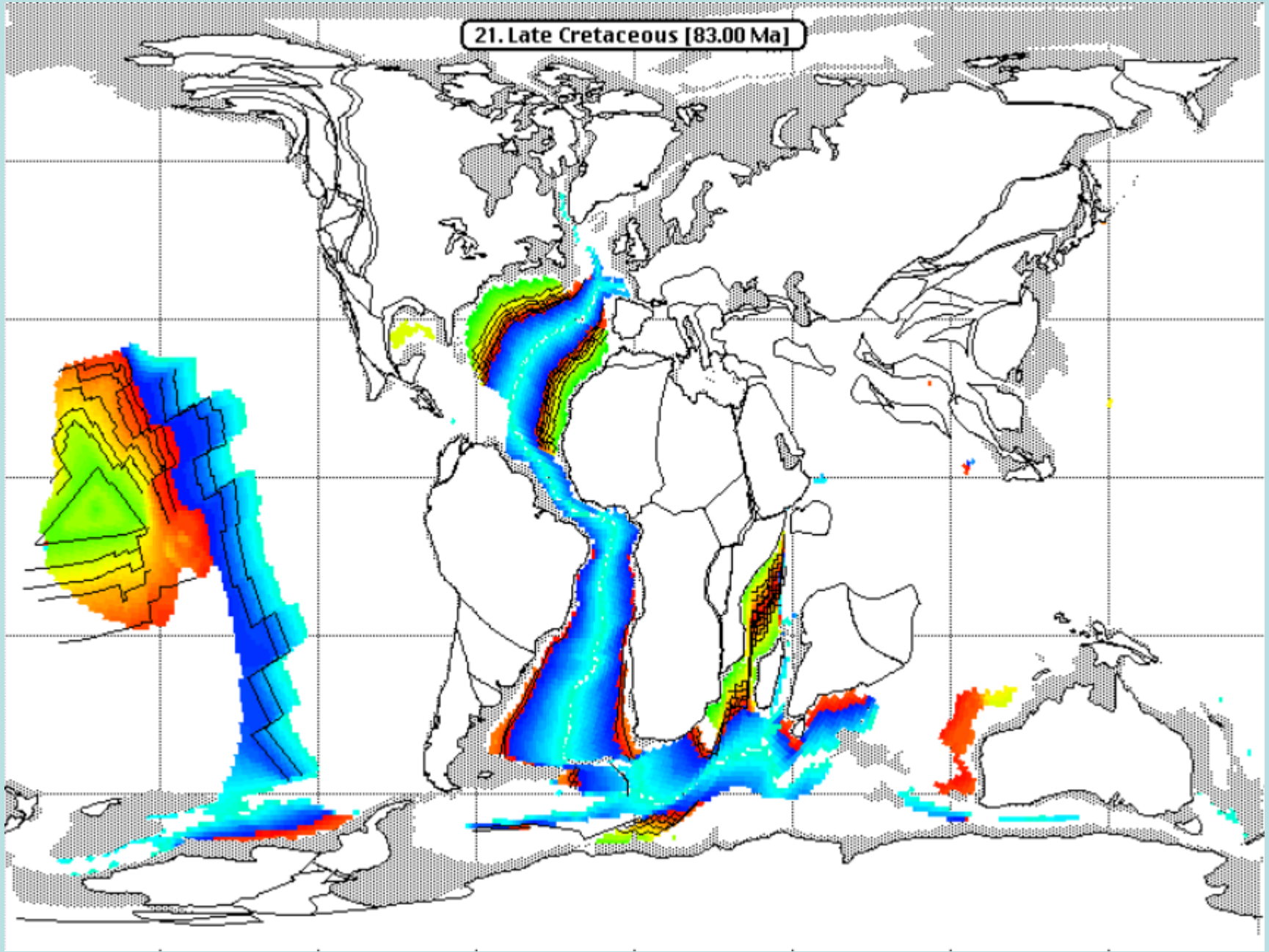
Present [0.00 Ma]



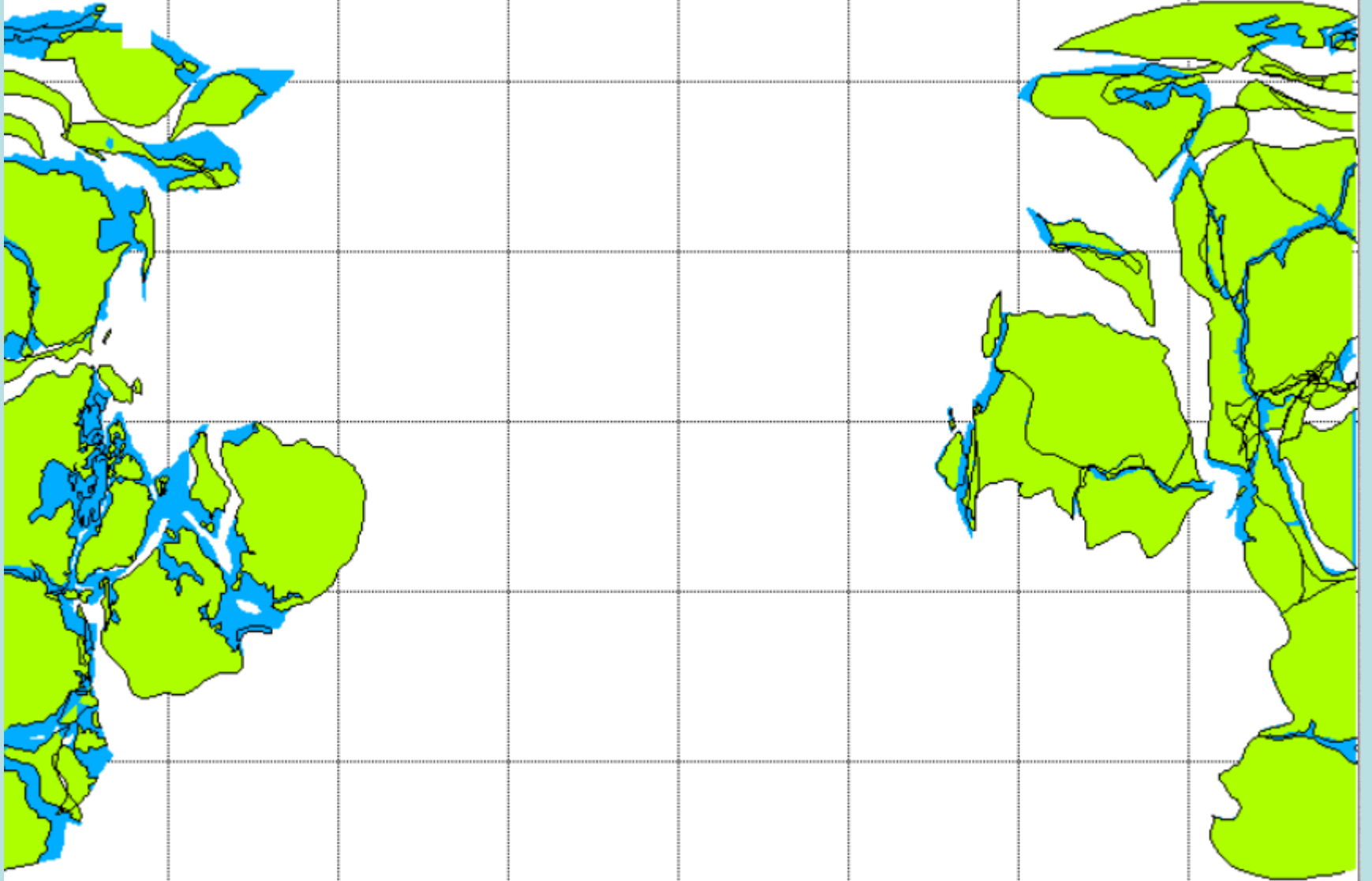
26. Miocene [10.00 Ma]



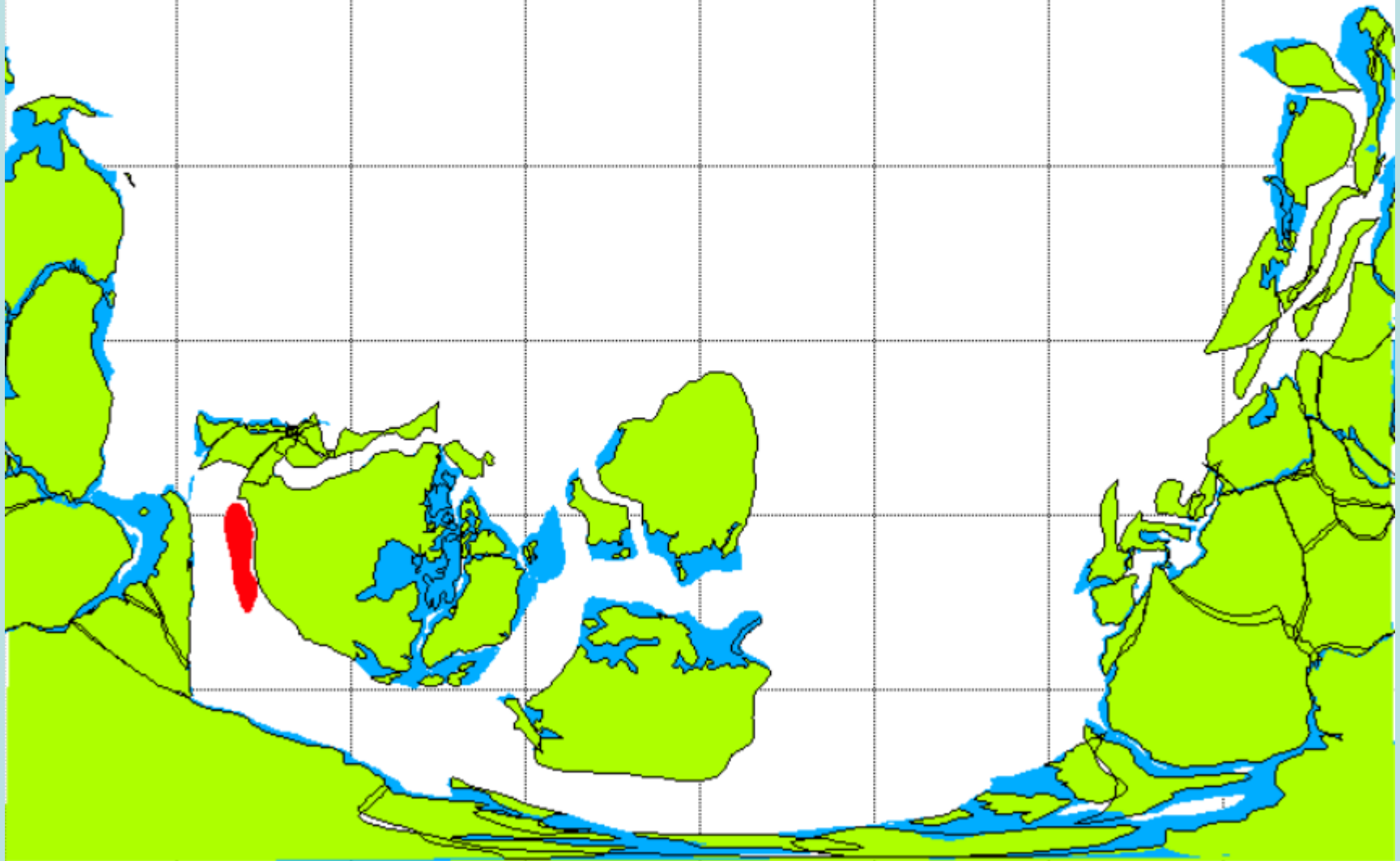
21. Late Cretaceous [83.00 Ma]



Precambrian [750.00 Ma]

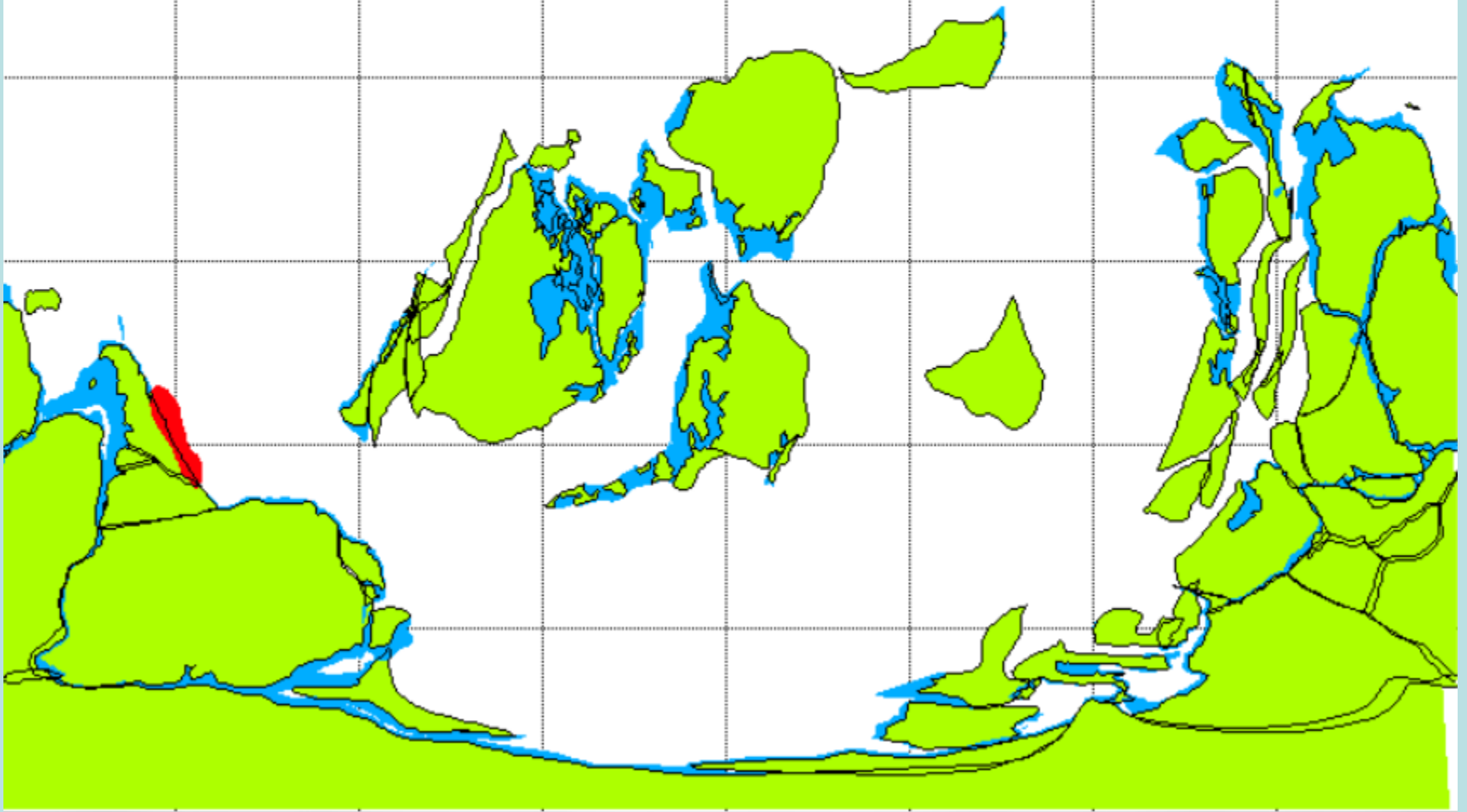


1. Early Cambrian [542.00 Ma]



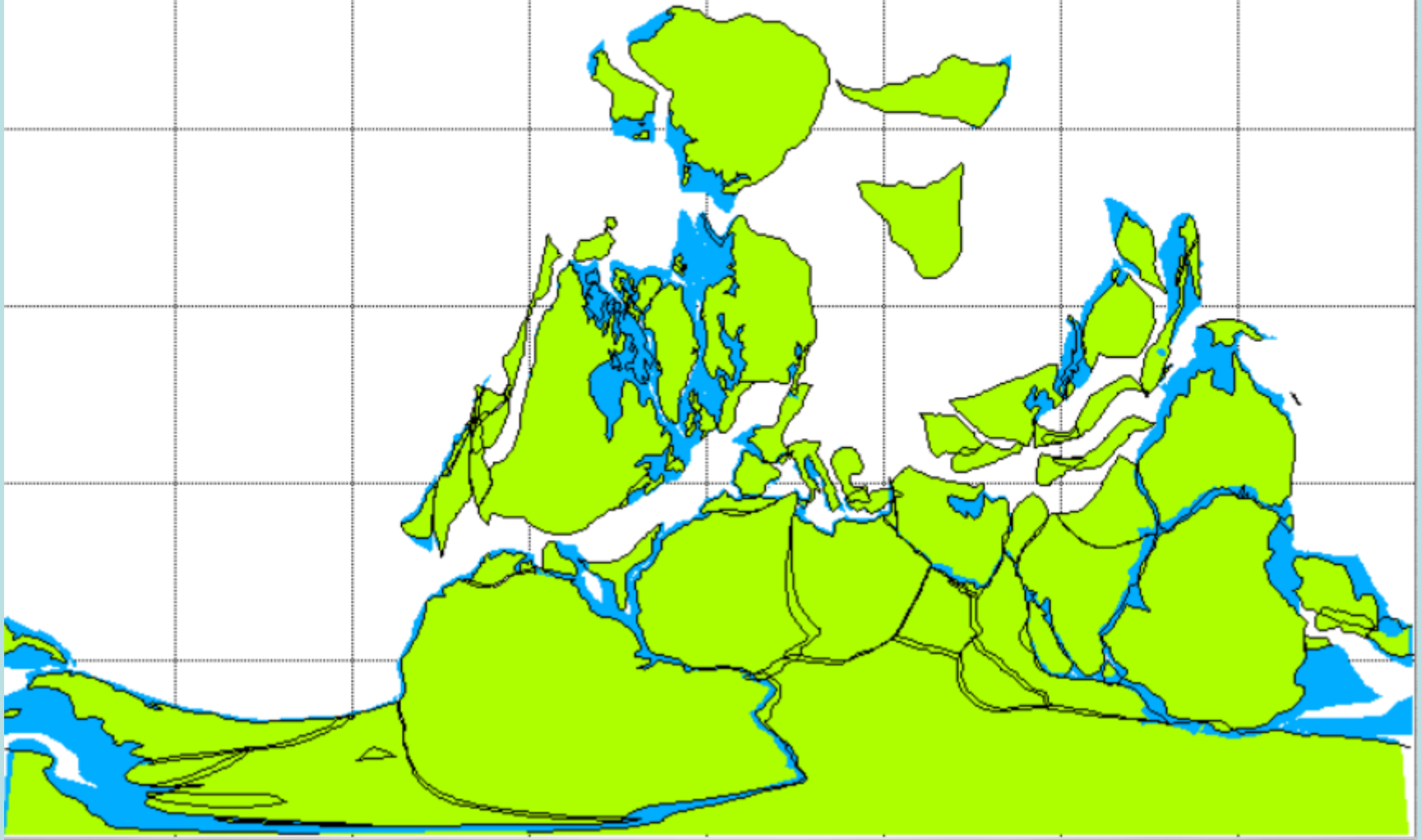
4. Middle & Late Ordovician [440.00 Ma]

Taconic Orogeny, New England



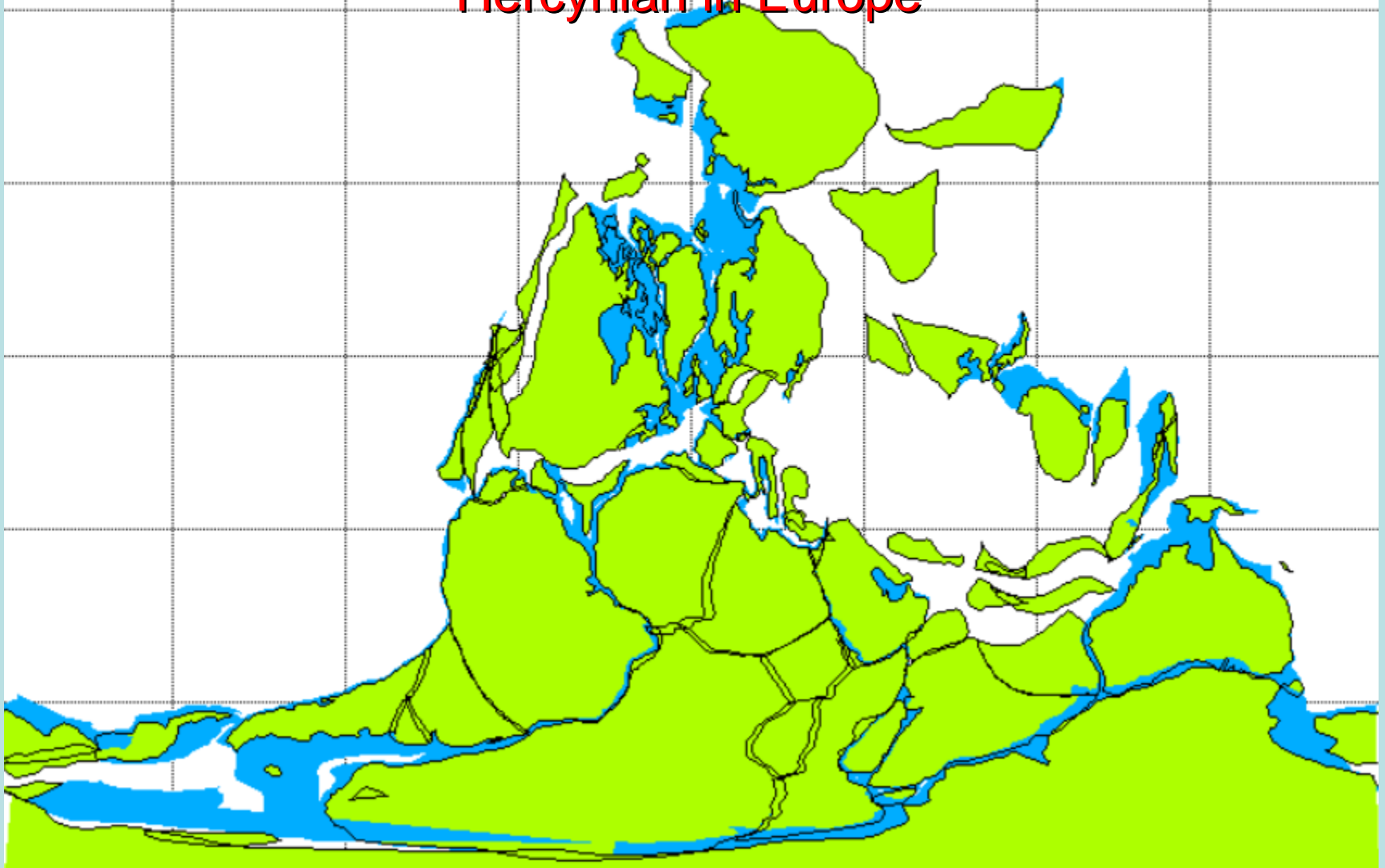
8. Late Devonian [370.00 Ma]

Acadian Orogeny, Northeast Caledonides in Scandinavia



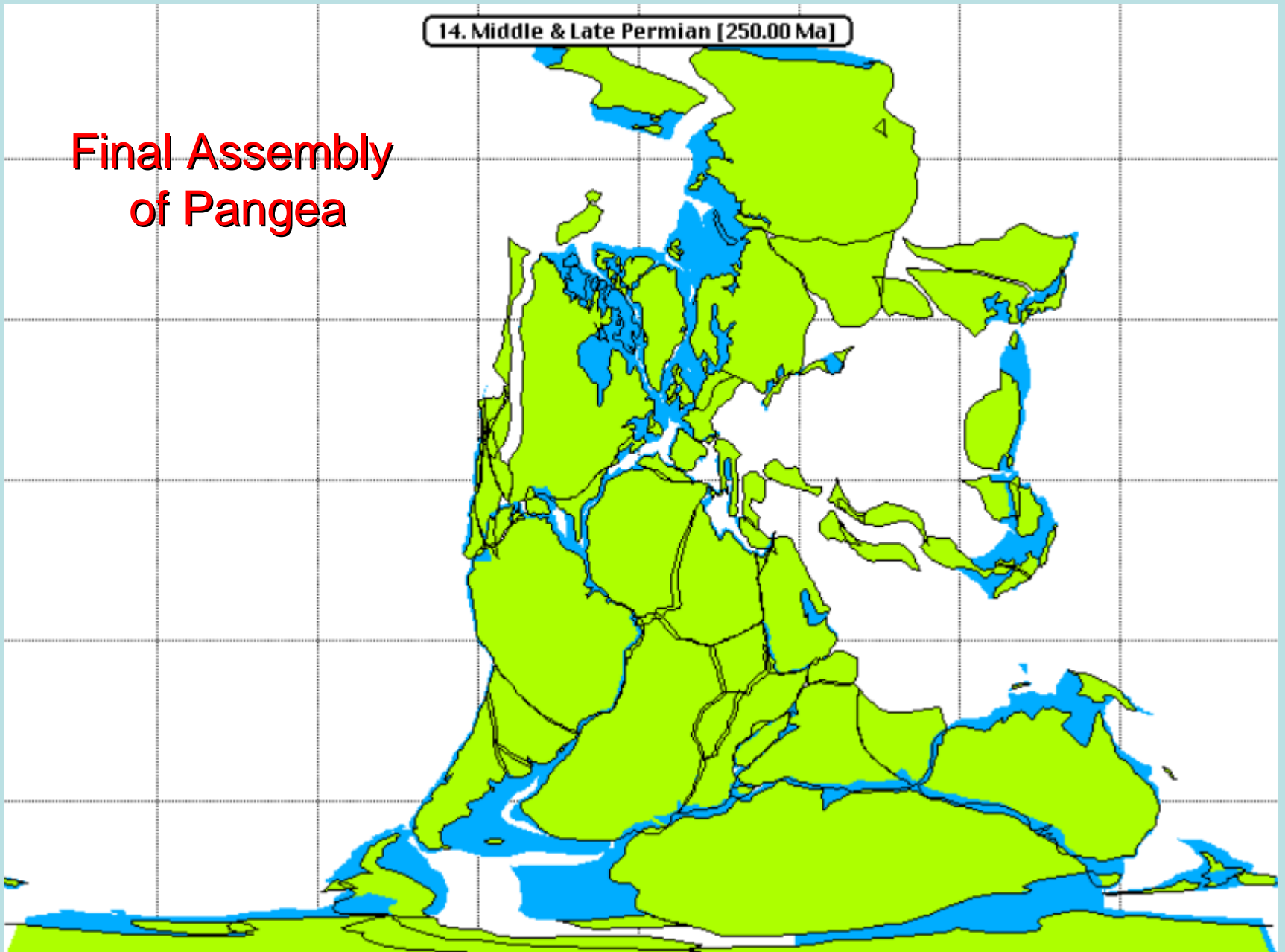
10. Serpukhovian [333.00 Ma]

Appalachian Orogeny, Eastern NA Hercynian in Europe



14. Middle & Late Permian [250.00 Ma]

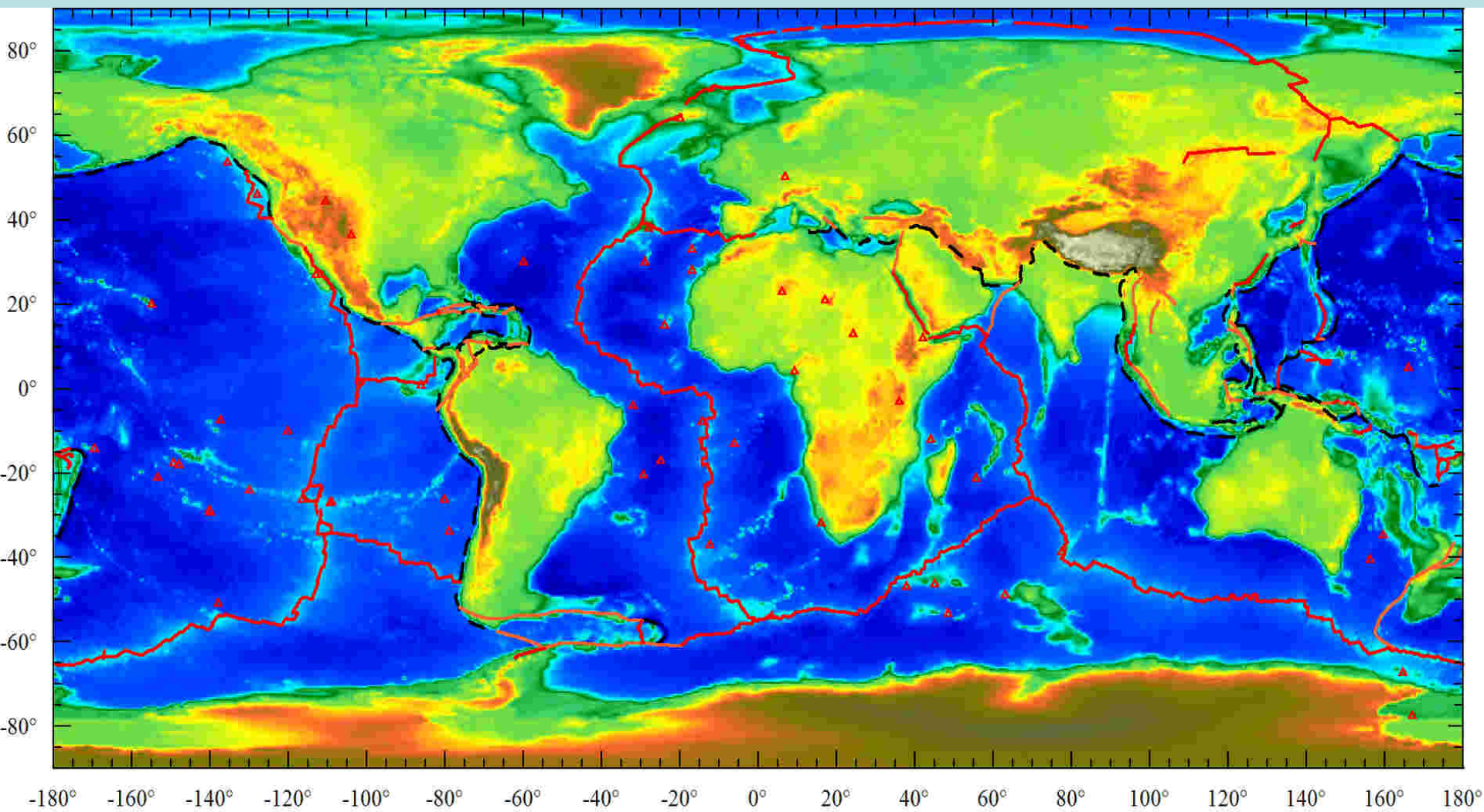
Final Assembly
of Pangea



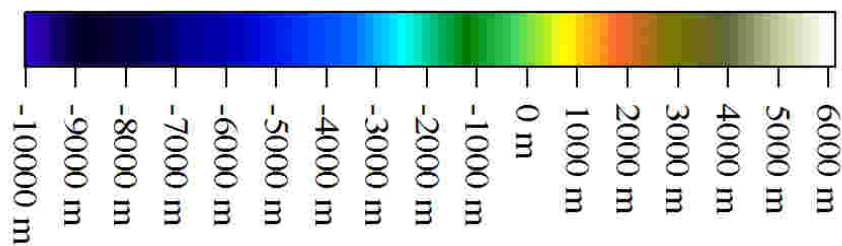
**Geologists Can Predict the
Future too!**



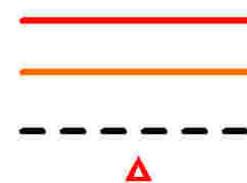




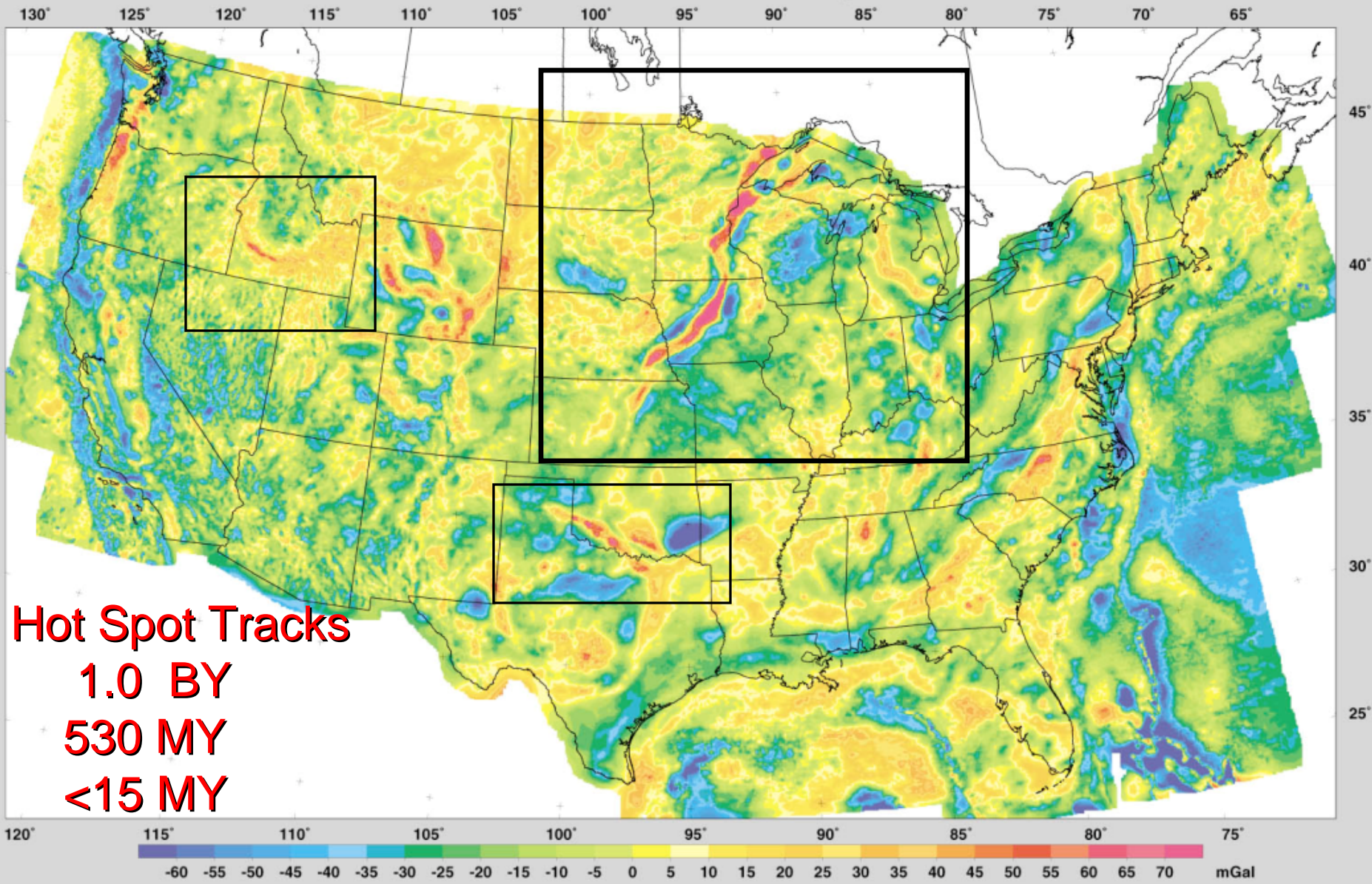
Elevation



Ridge
Transform
Trench
Hotspot

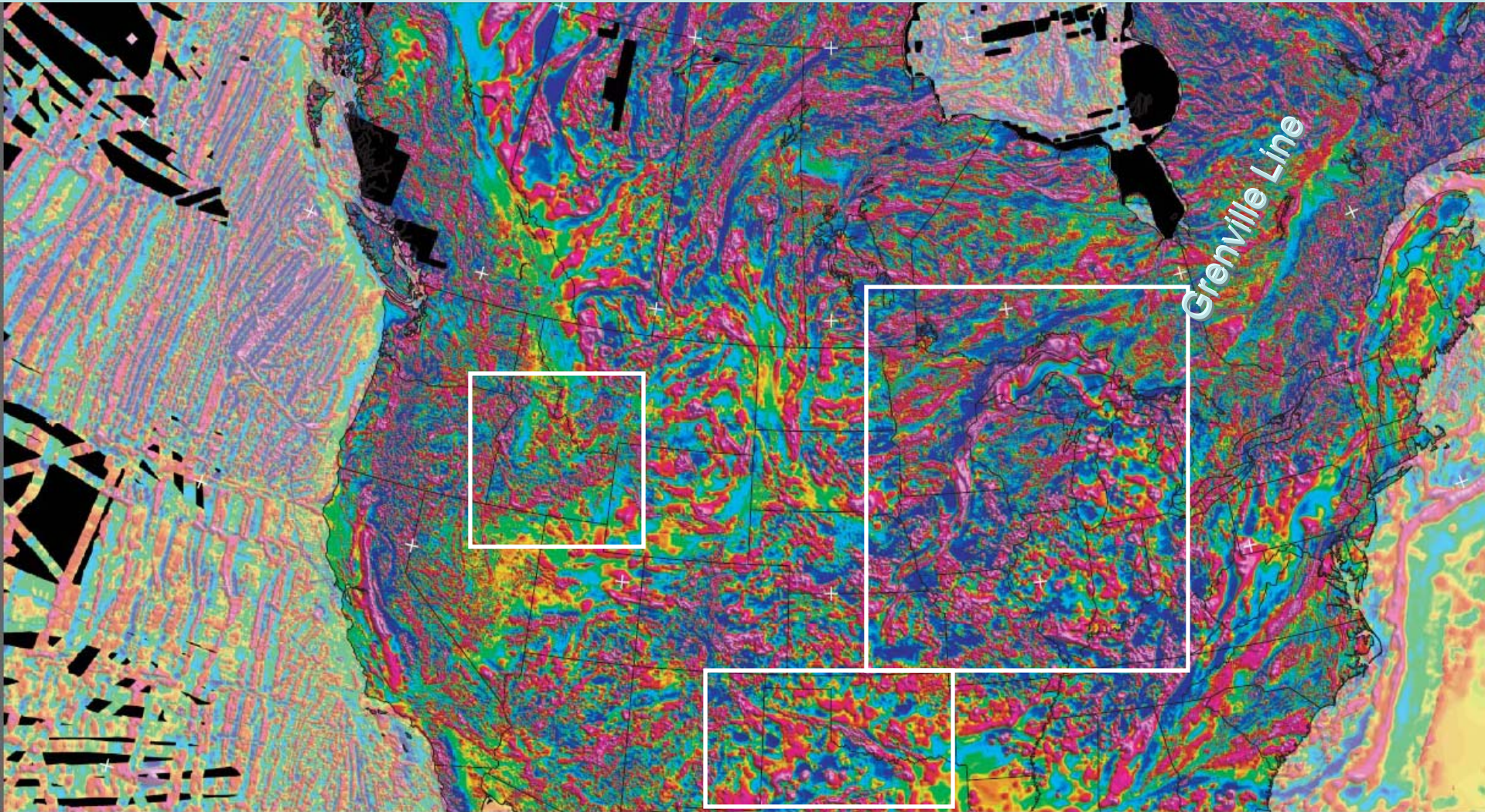


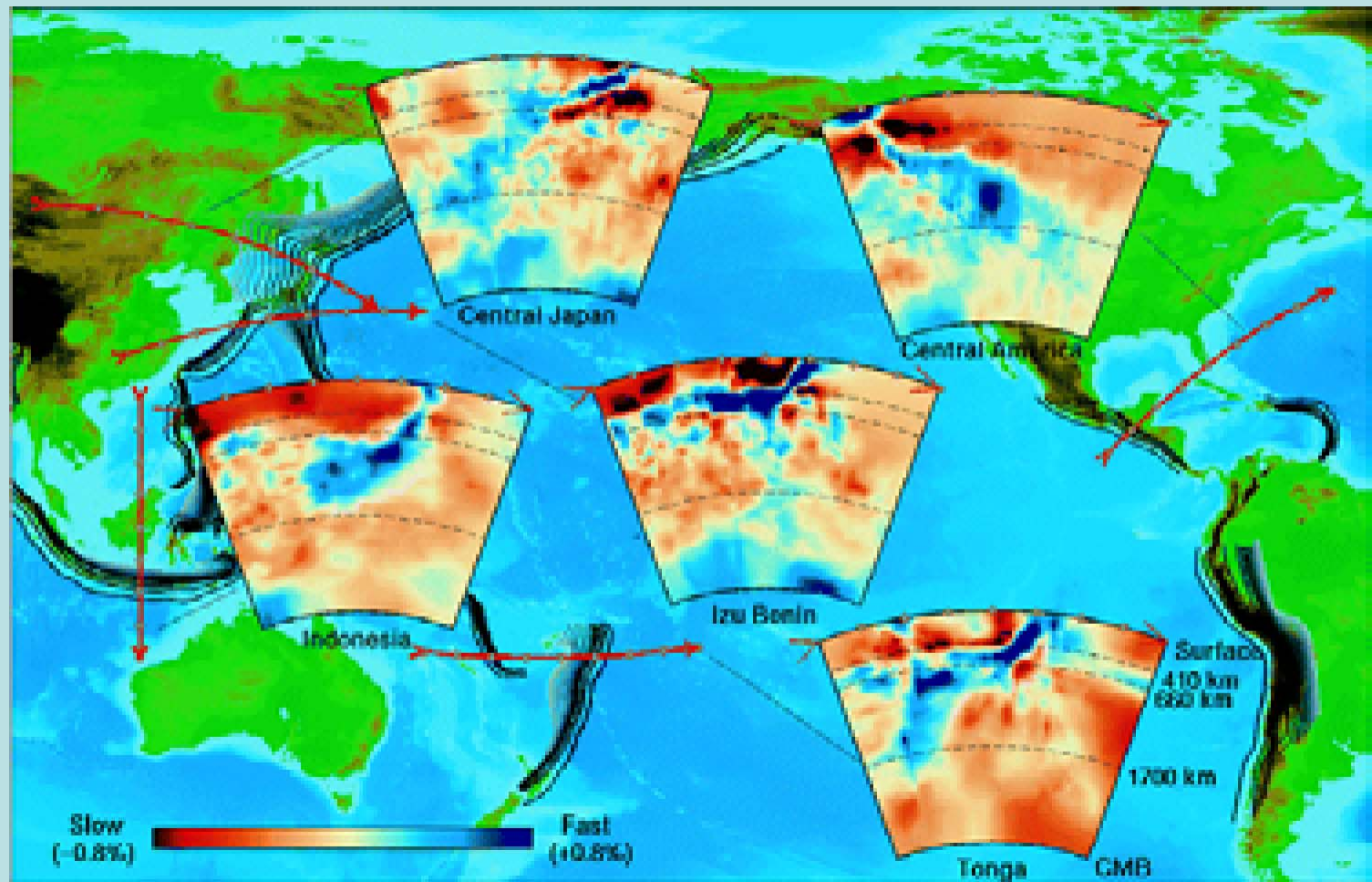
U.S. Isostatic Residual $d=30\text{km}$, $\rho=0.35\text{g/cc}$



US Gravity Map-Midcontinent "Rift"

US Magnetic Map





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Pilbera Pillow Basalts ~ 3,500 MY



**Pilbera Block, NW Australia~ 3,000 MY old Stromatolites
Life Saved the Earth?**

