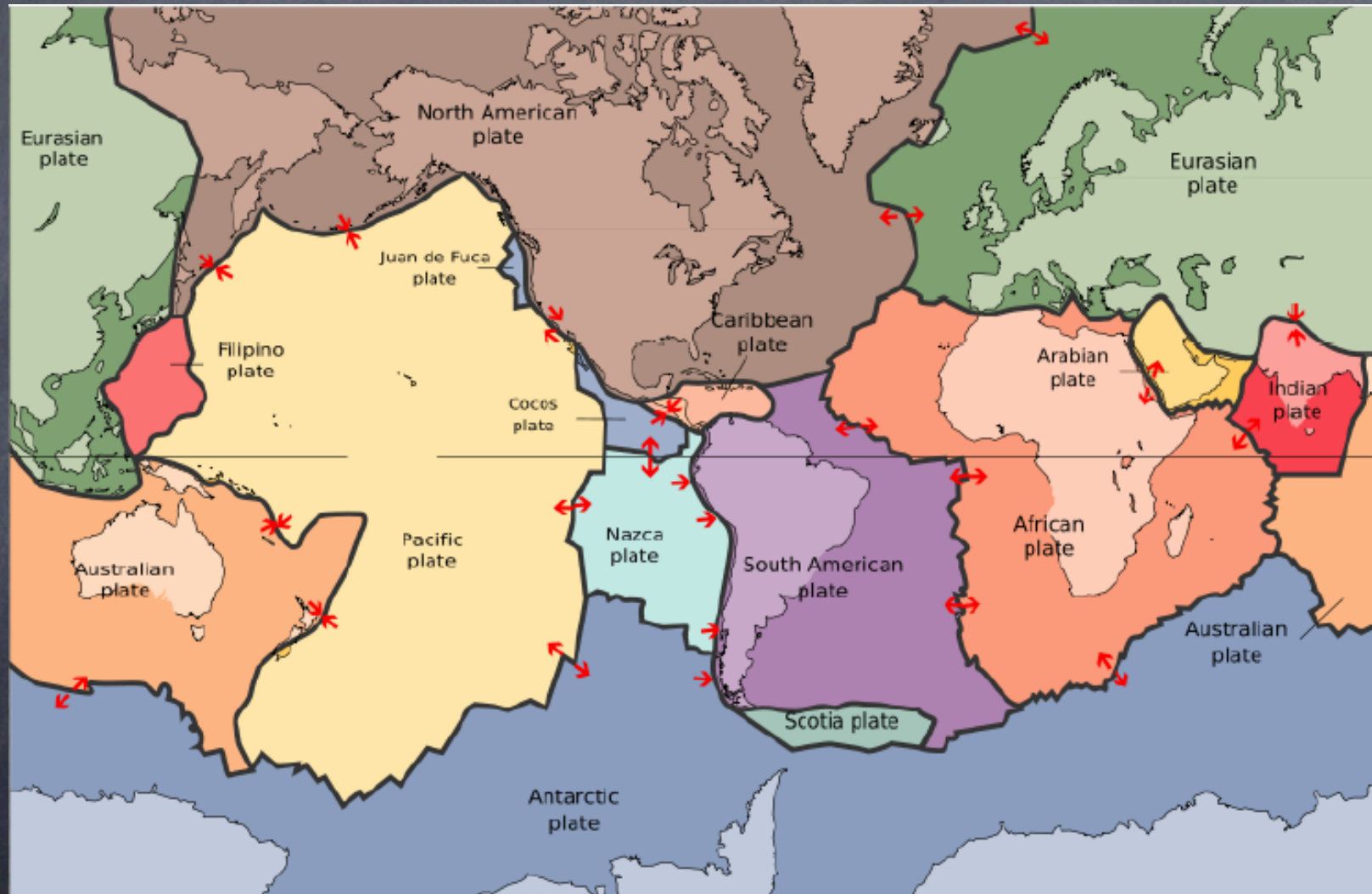


# Chapter 28 - Plate Tectonics



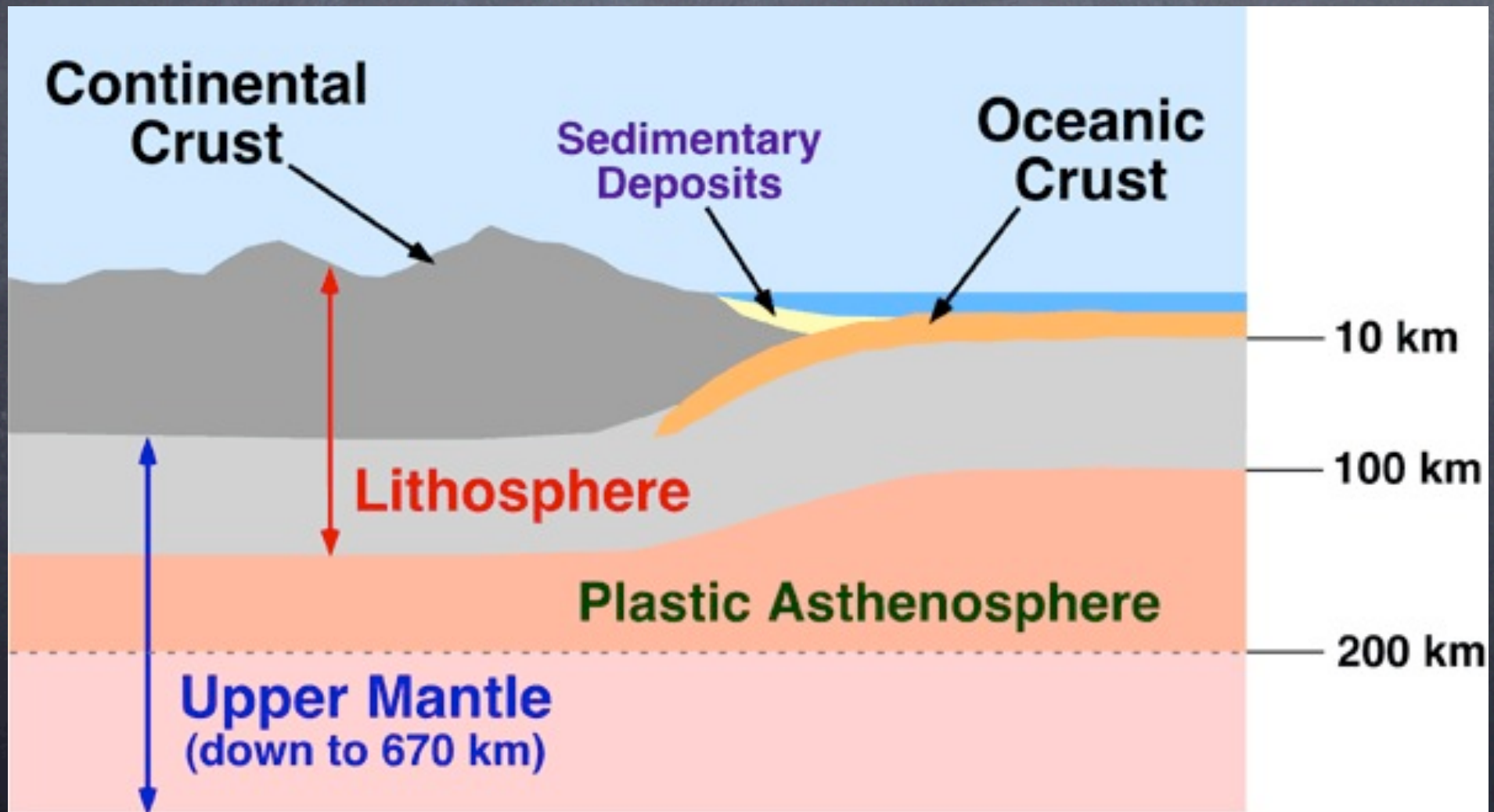
Mantle - 1800 mi. thick "heavy" iron-rich rocks (gabbro)

Crust - oceanic - 6 mi. thick iron-rich rocks (basalt)

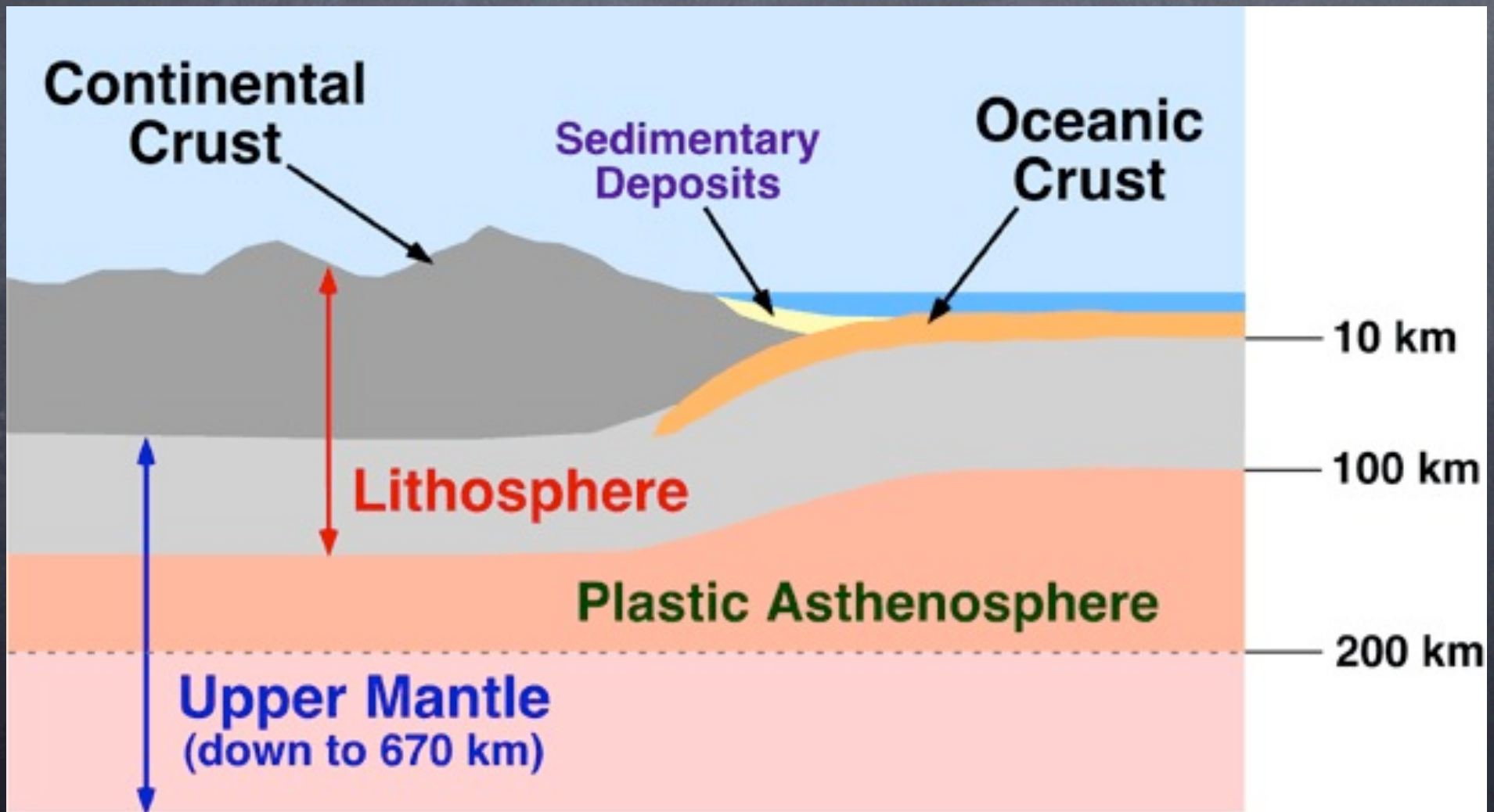
continental - 40 mi. thick, lighter silica-rich rocks (granitic). The continents ride over the denser oceanic crust.



Lithosphere - 60 mi. thick layer of crust and top part of mantle. It's rigid and broken into the plates.



Asthenosphere - below lithosphere.  
Partially melted material which  
causes convection currents.



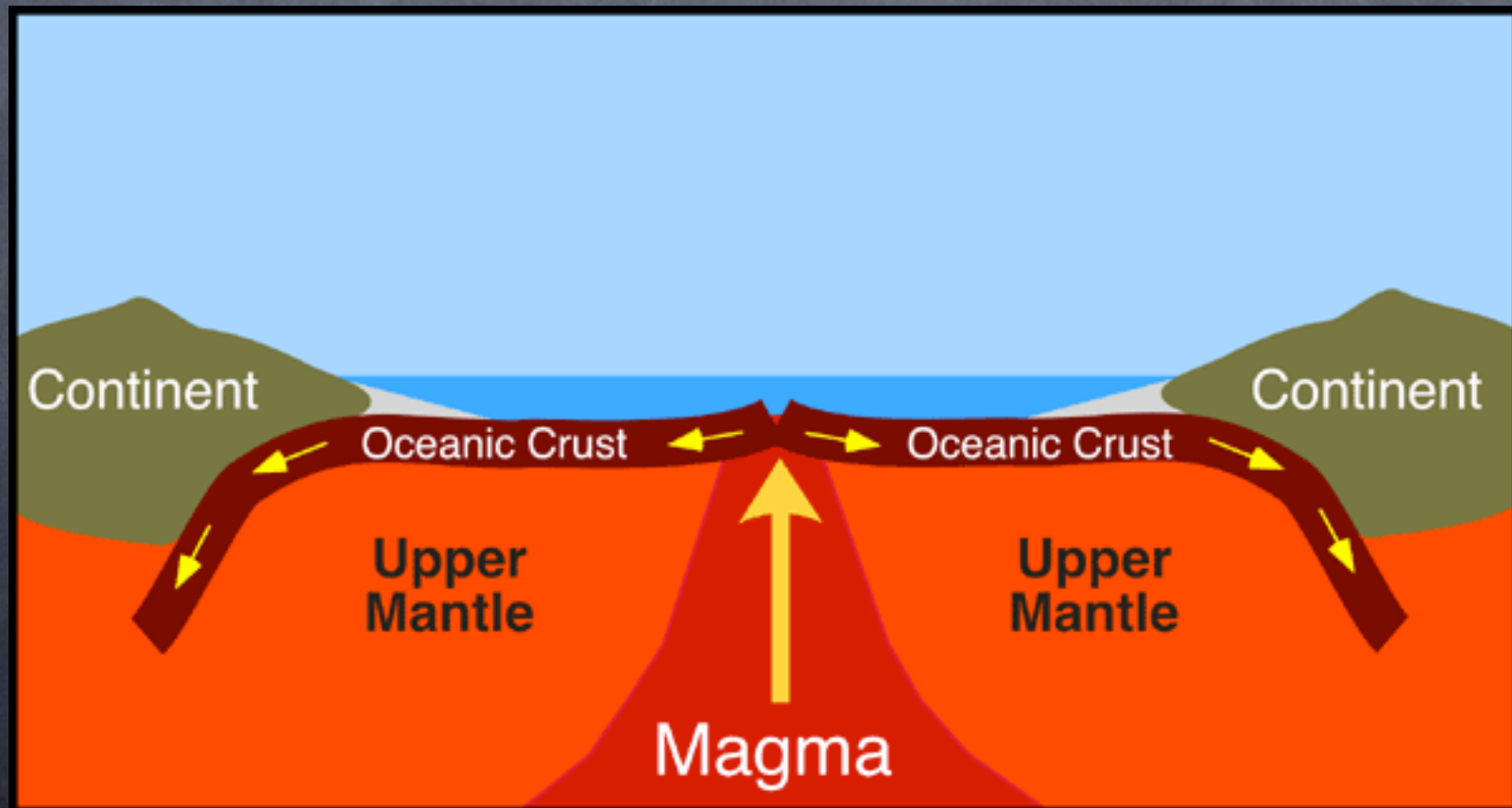
# Continental Drift -



- Pangaea moved apart to form the 7 continents. (Pangaea - all lands)

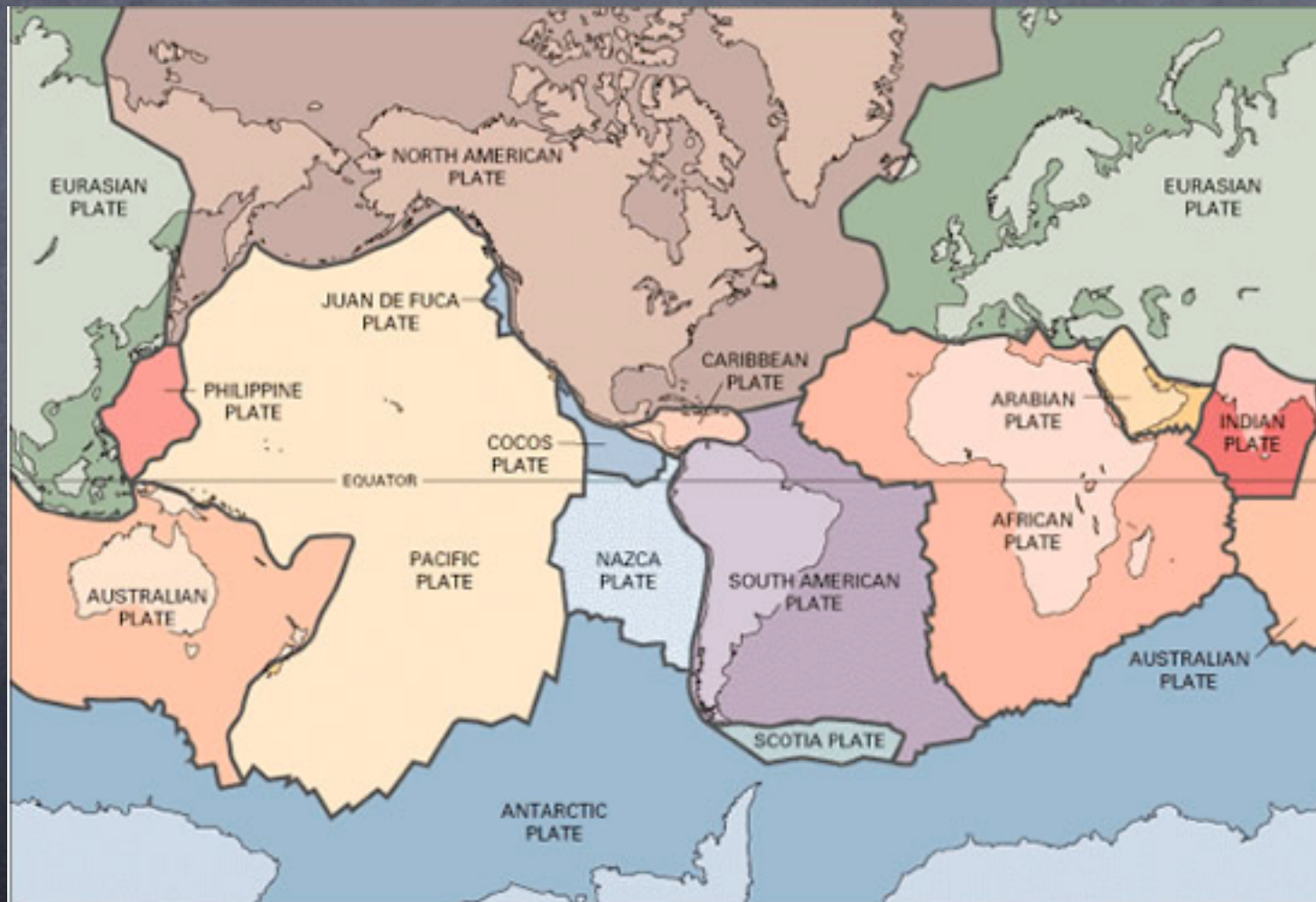
# Sea-floor Spreading -

- Mid-ocean ridges - under sea mountain ranges where tectonic plates flow apart from each other.



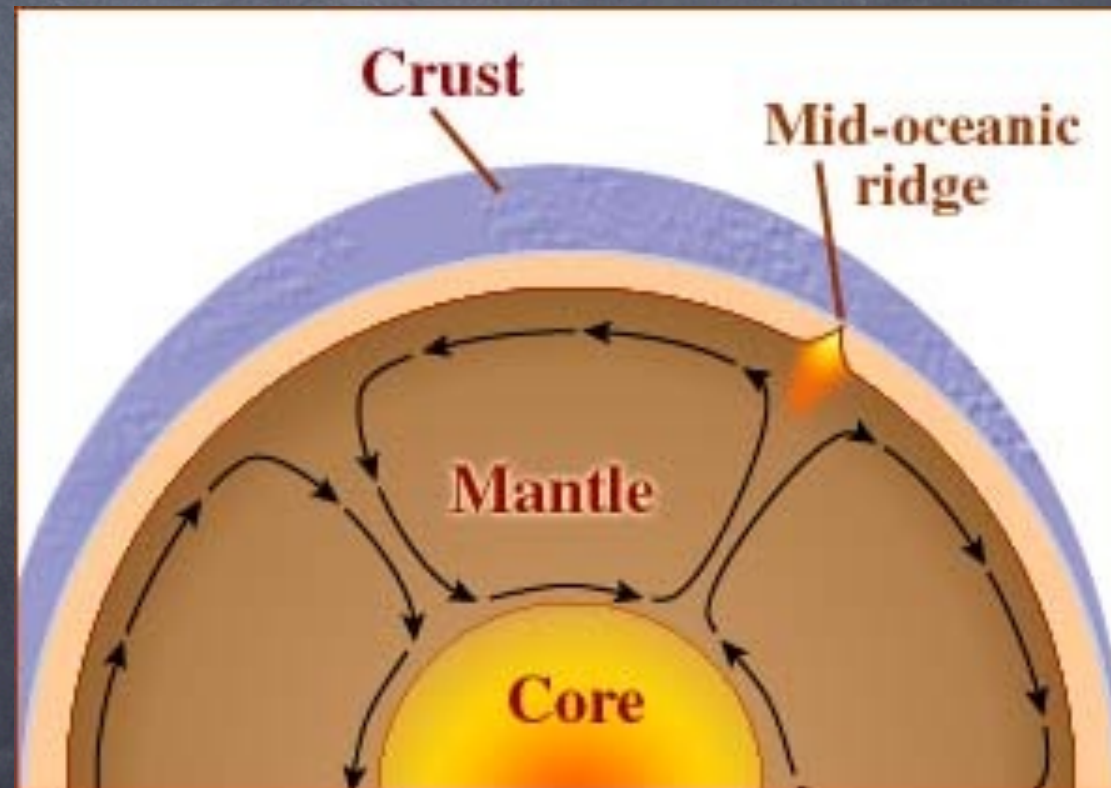
# Plate Tectonics –

- movement of Earth's surface solid rock plates (crust). This movement causes earthquakes and volcanic eruptions.



# Plate Boundaries (3)

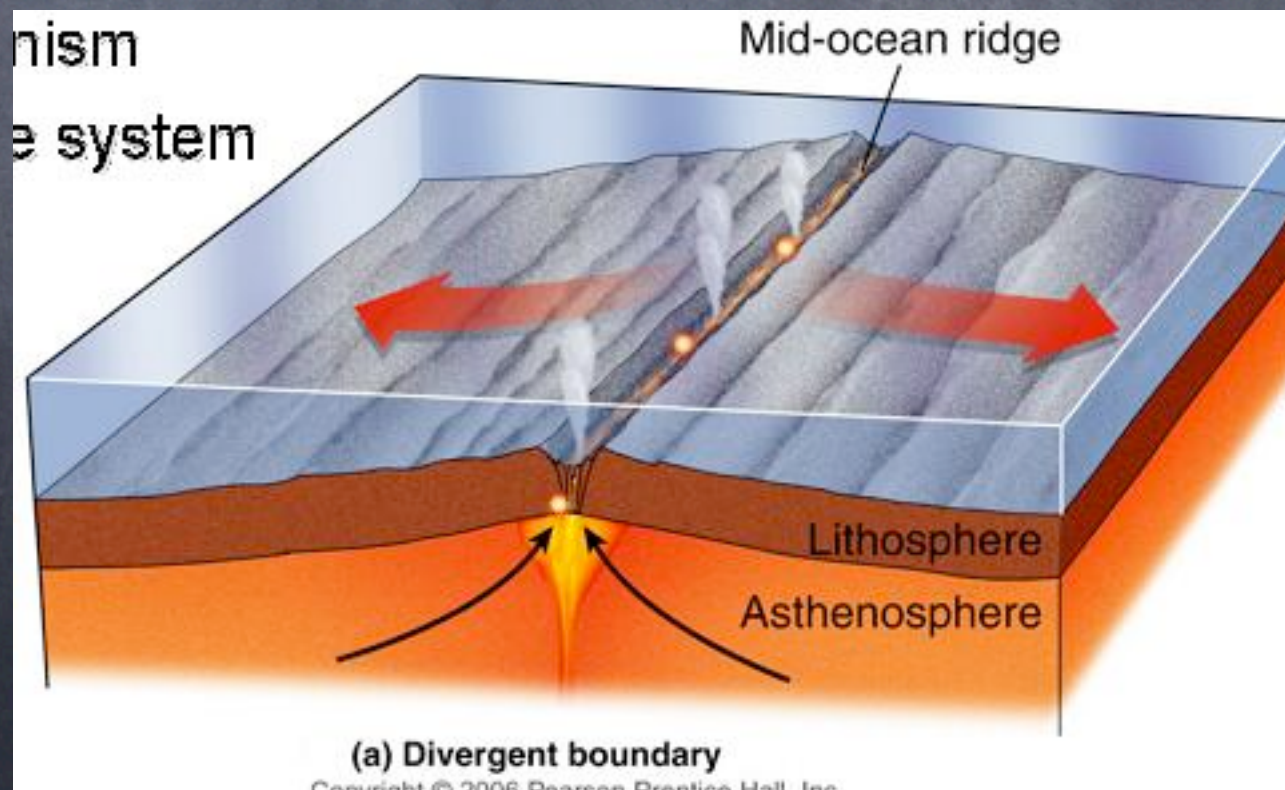
1) Diverging Boundaries – “spreading centers” found over **RISING** convection currents. Plates move apart here where new rock rises up to the surface and pushes the older rock aside.





# Diverging Boundaries:

a) mid-ocean ridge - Mid-Atlantic Ridge, East Pacific Rise



(not to scale)

Heat rising in mantle causes:

1) hot mantle rock to rise

2) melt to form beneath the lithosphere

3) magma to rise and solidify forming ocean crust

4) plates to move apart, cool, and thicken

*Crust*

*Lithosphere*

*Asthenosphere*

# Smokers



pillow lavas

1532  
2813  
0.0

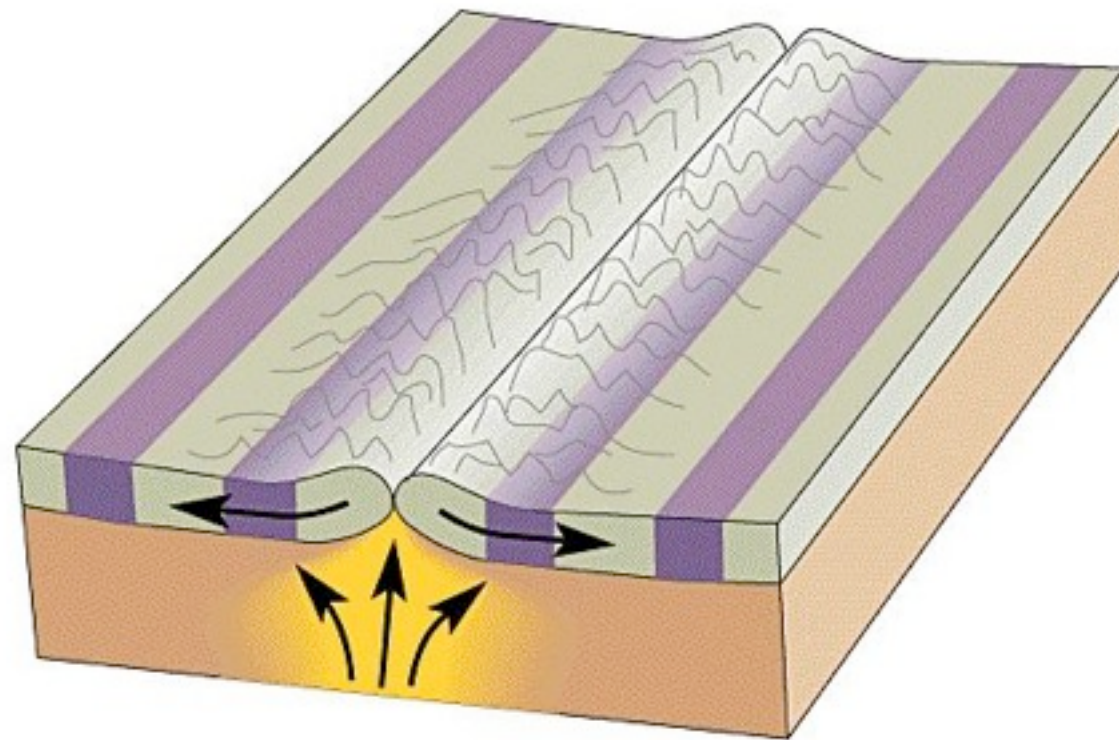


# Diverging Boundaries -

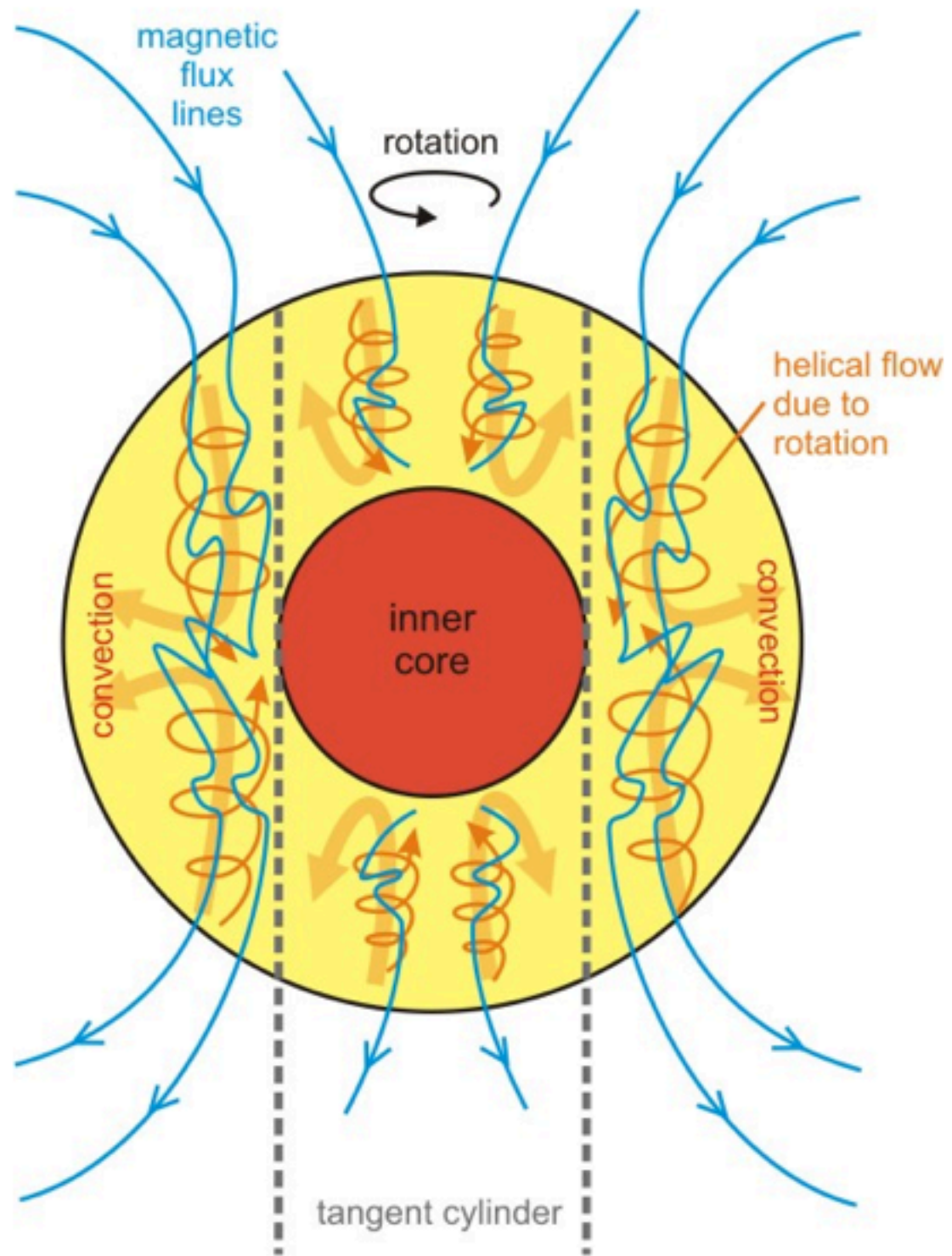
b) rift valley - Ex: East African Rift Zone (between Somalia Plate and African Plate.)



Earth's magnetic polarity reverses  
- iron minerals in oceanic basalts point to magnetic North and stay that way as rock hardens.

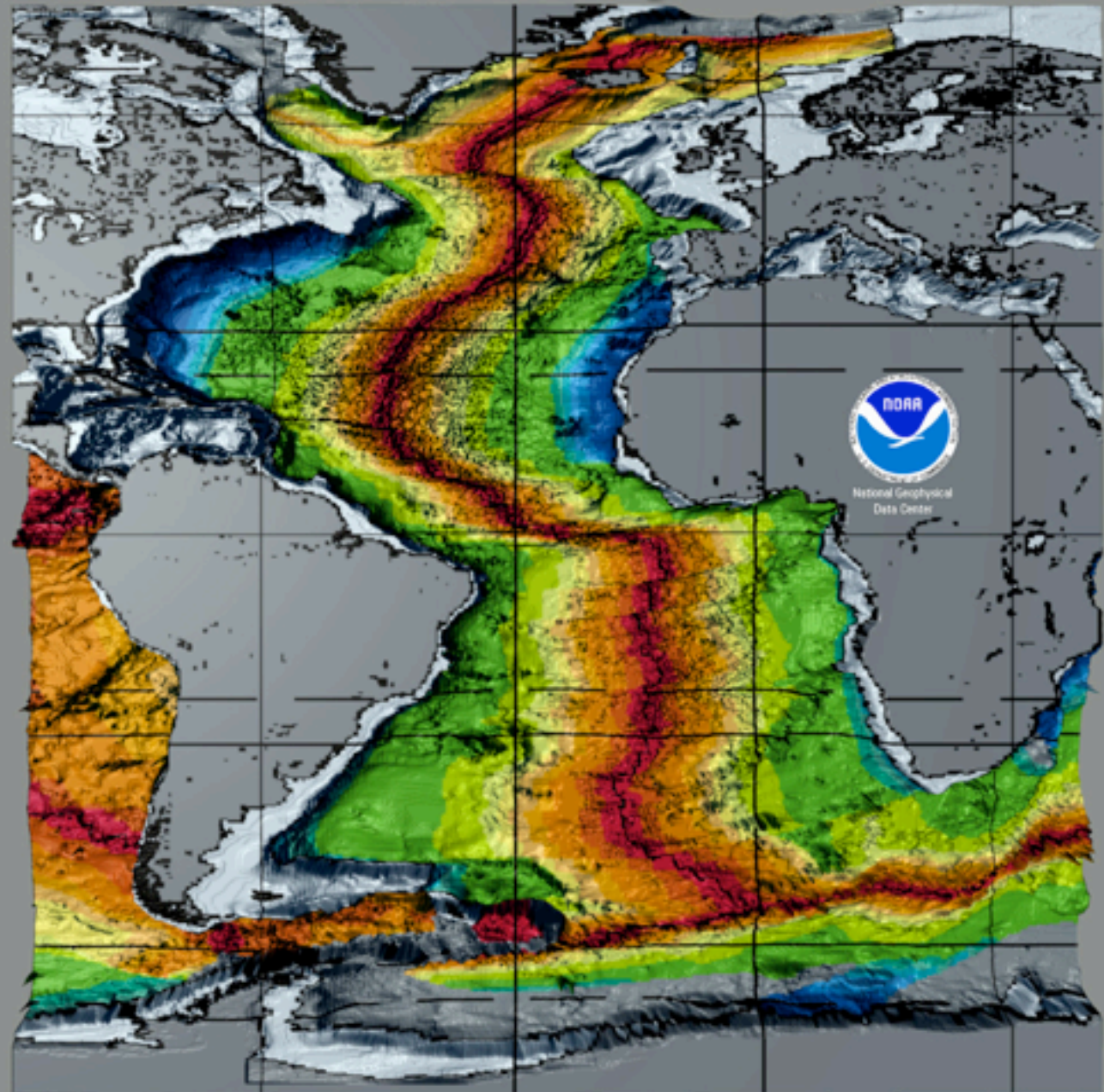


■ Magnetic field oriented as it is today  
■ Magnetic field reversed

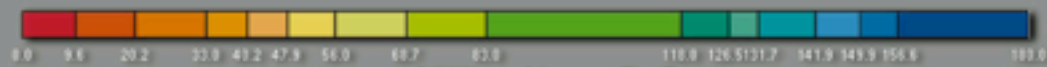


# Crustal Age

A full world view is coming soon to this Web site!



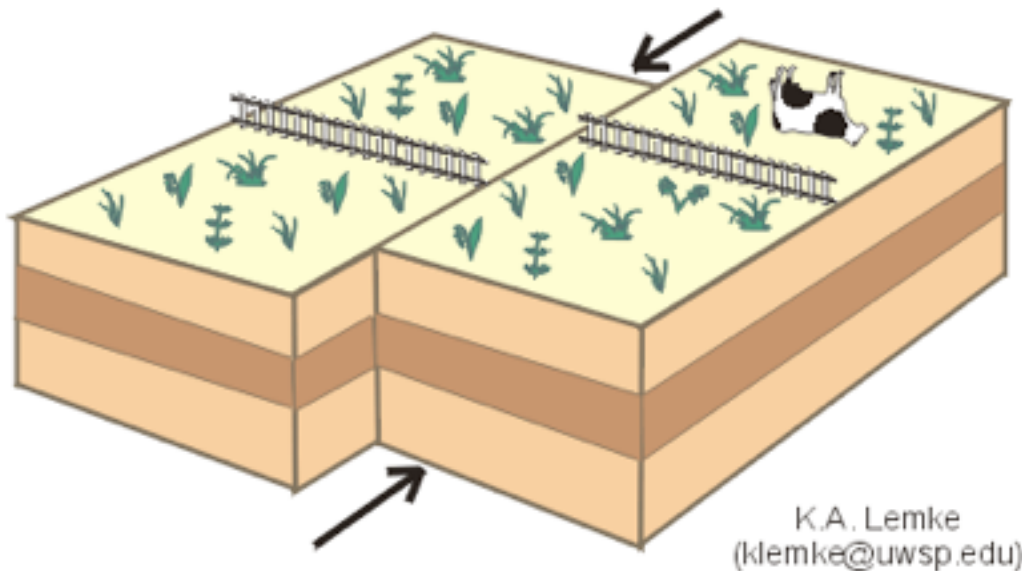
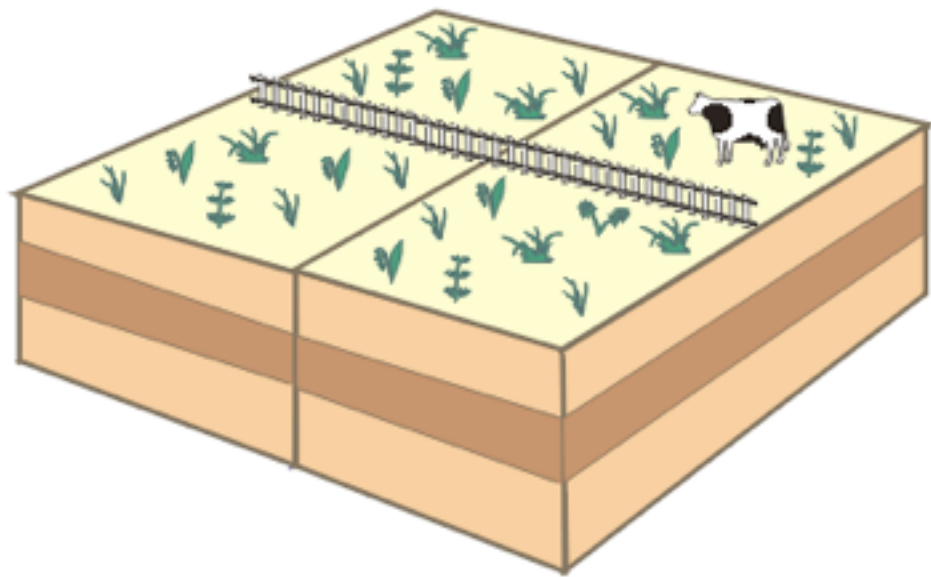
For information on this and other images produced by NODC's Marine Geology and Geophysics Division, contact Peter Stone at [plstone@ngdc.noaa.gov](mailto:plstone@ngdc.noaa.gov)



Million Years B. P.

Data for the image from "Digital Age Map of the Ocean Floor" by Miller, Roest, Royer, Gahagan, and Schöller, Scripps Institution of Oceanography Ref. Series No. 93-10





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(klemke@uwsp.edu)

2) Sliding Boundaries - transform fault boundaries.

Ex. - San Andreas Fault moves  $\sim 5\text{cm/year}$ .

Fault - break in Earth's crust where movement occurs.

# California's San Andreas Fault



Map copyright © 2006 David K. Lynch



Olema  
(epicenter) -  
12' fence  
displacement  
from 1906  
earthquake.

Carrizo Plain -  
between San  
Luis Obispo and  
Bakersfield





Crystal Springs  
Reservoir – the  
fault runs right  
through the lakes  
next to Hwy 280



### 3) Converging Boundaries

a) Collision Boundary - two continental plates collide and form a mountain range. Ex. Himalayas.

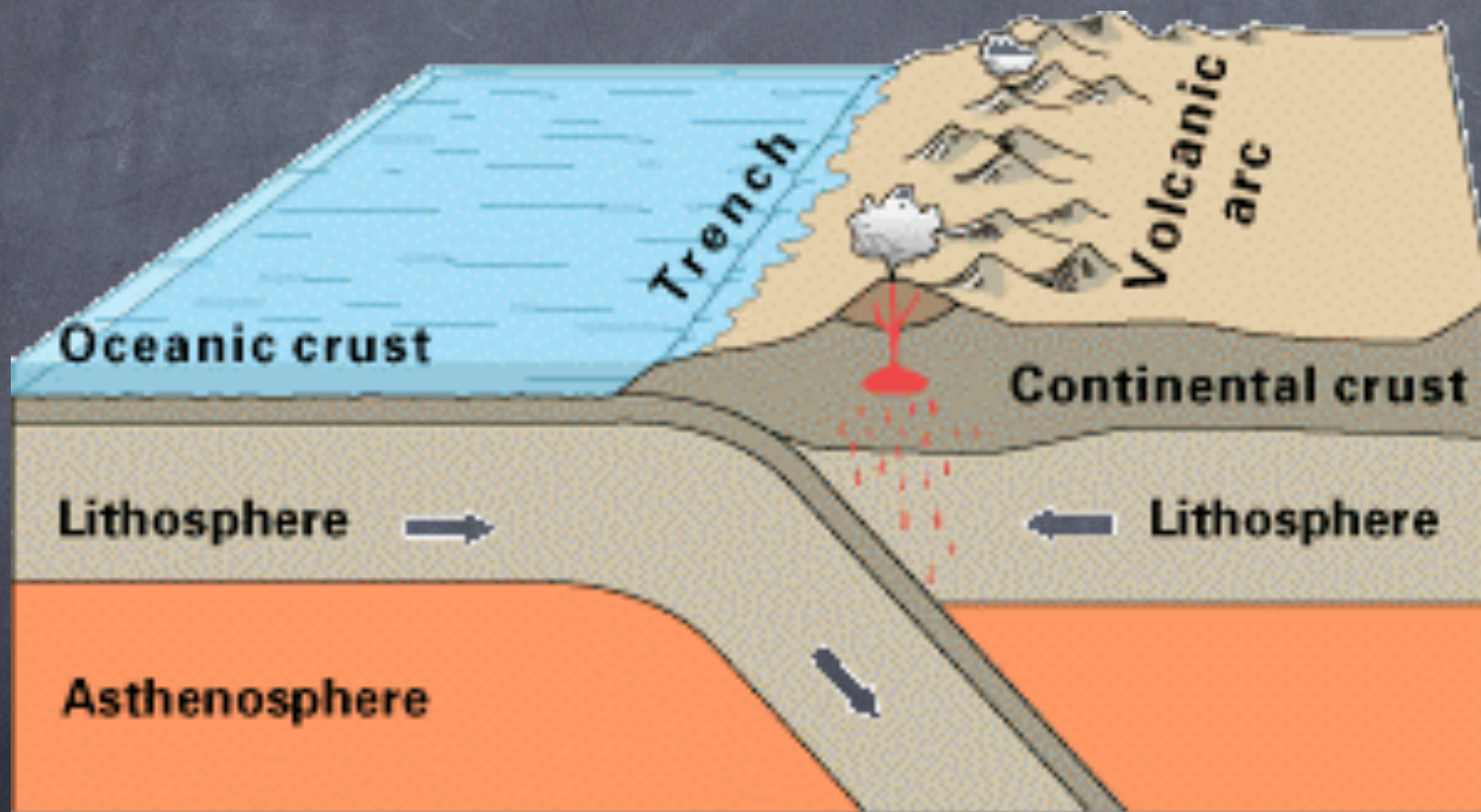




# Mount Everest

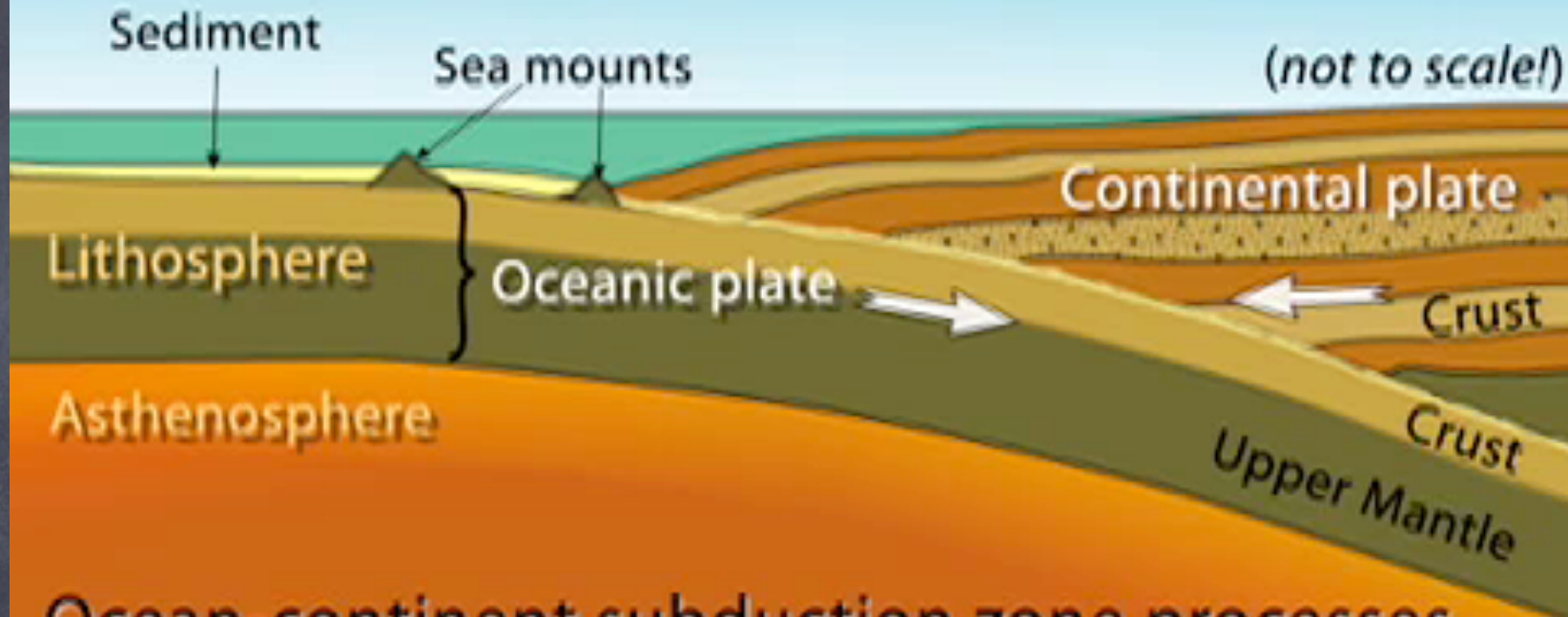


b) Subduction Boundaries -  
“heavy” ocean plate collides with and  
plunges below “lighter” continental  
plate.



Oceanic-continental convergence

# Convergent Boundary



Ocean-continent subduction zone processes

- 1) Plates locked—stress & deformation
- 2) Plates release—earthquake & tsunami

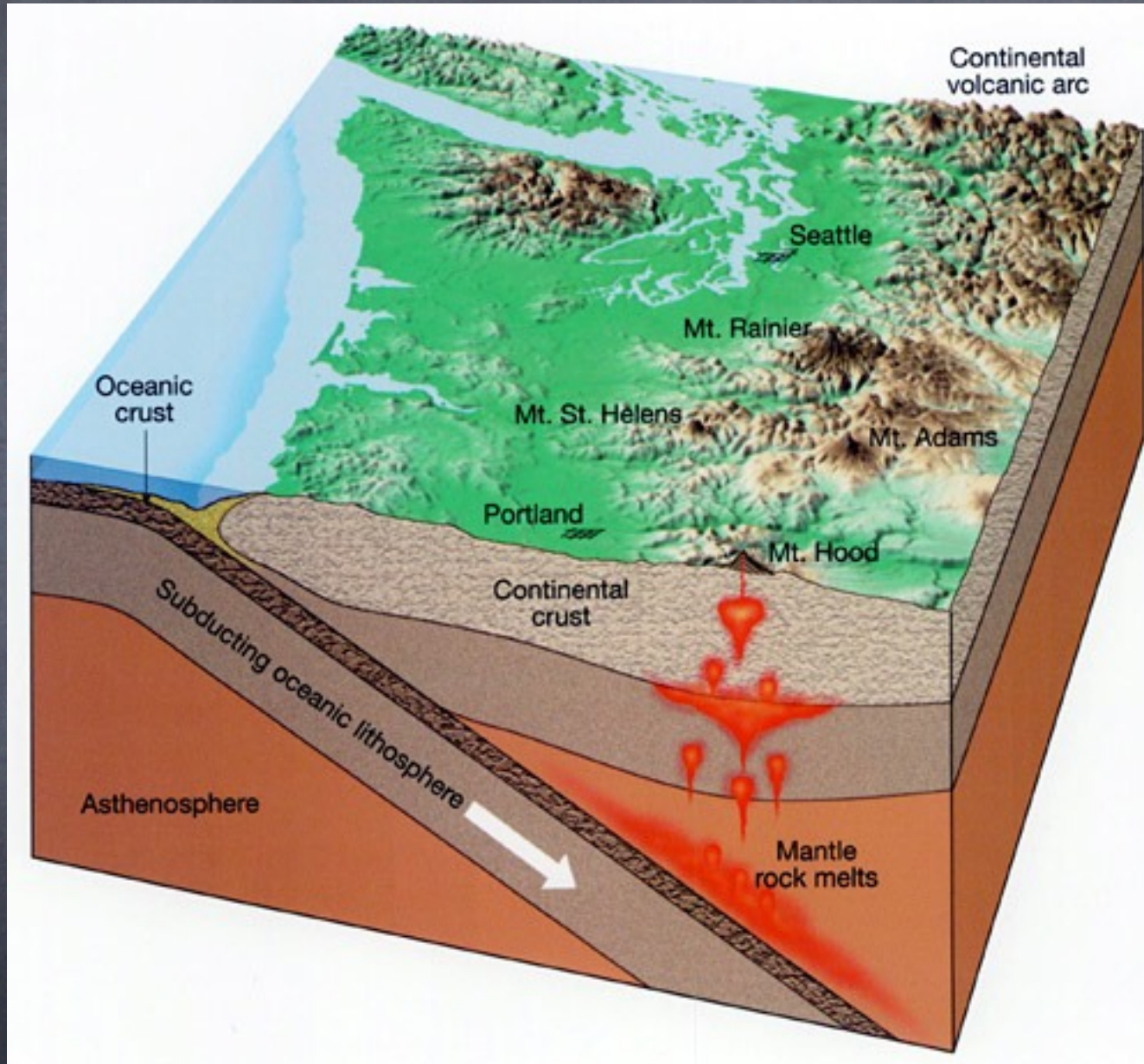


These form deep-sea trenches in oceans and volcanic mountain ranges on continents.

Ex. - Marianas Trench (up to 36,000' deep)



# Ex. - Cascade Range





# Ex. - Andes Mountains



- craton – an ancient continental core which usually contains the oldest rocks.

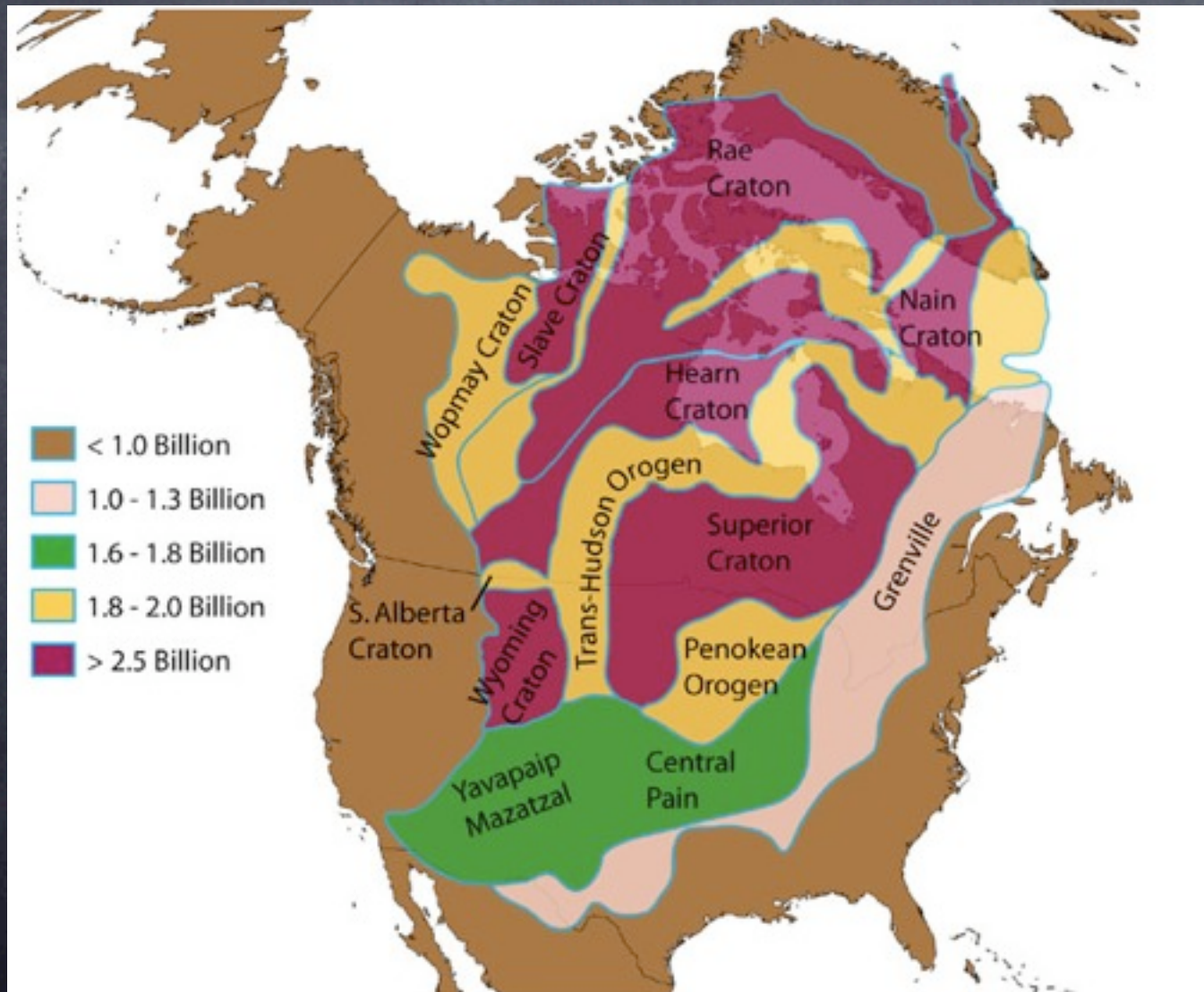






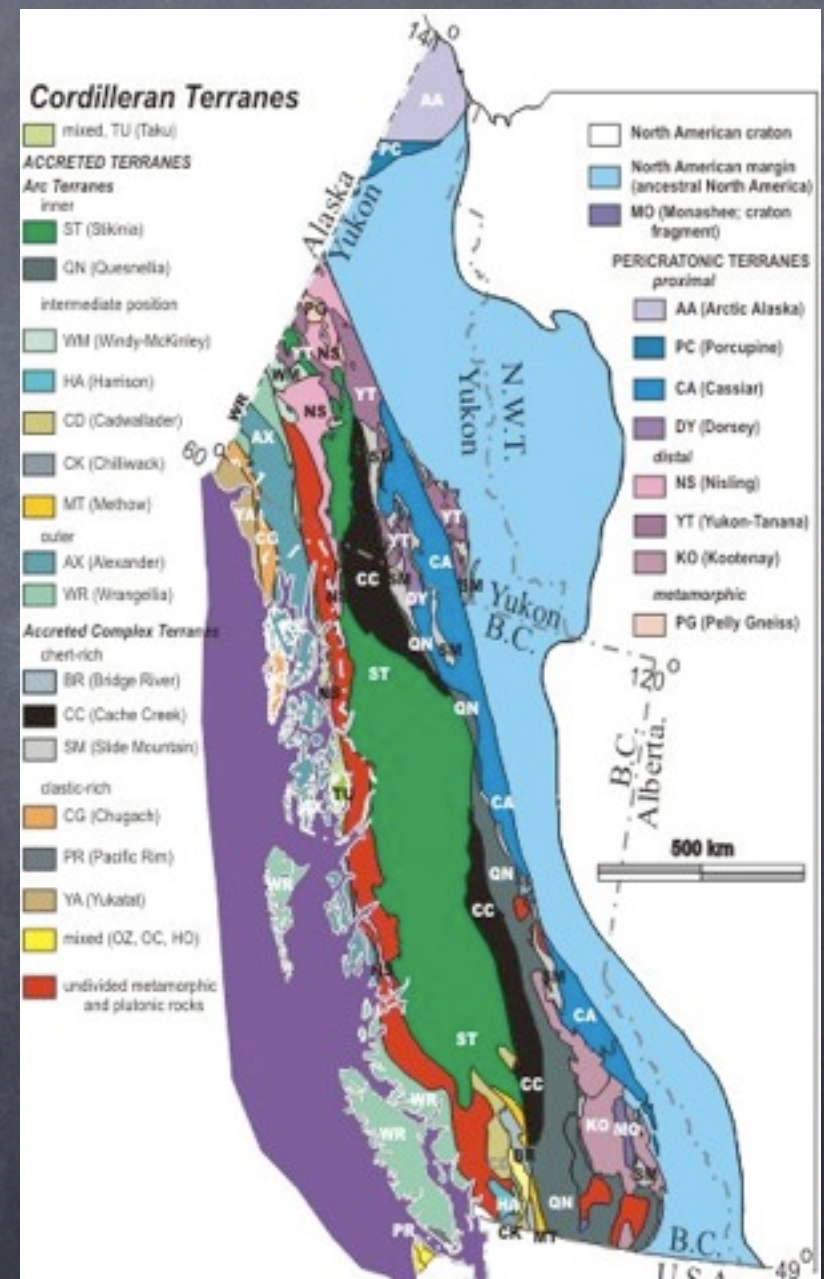
- ① Canadian Shield – North American craton exposed on the surface. Elsewhere it is buried beneath the surface from the Rockies to the Appalachians.

- North American craton shows how our continent looked 2.5 billion years ago. The rest of the continent was added since that time.



4 sources of additional material:

1) oceanic crust scraped off at subduction boundary.

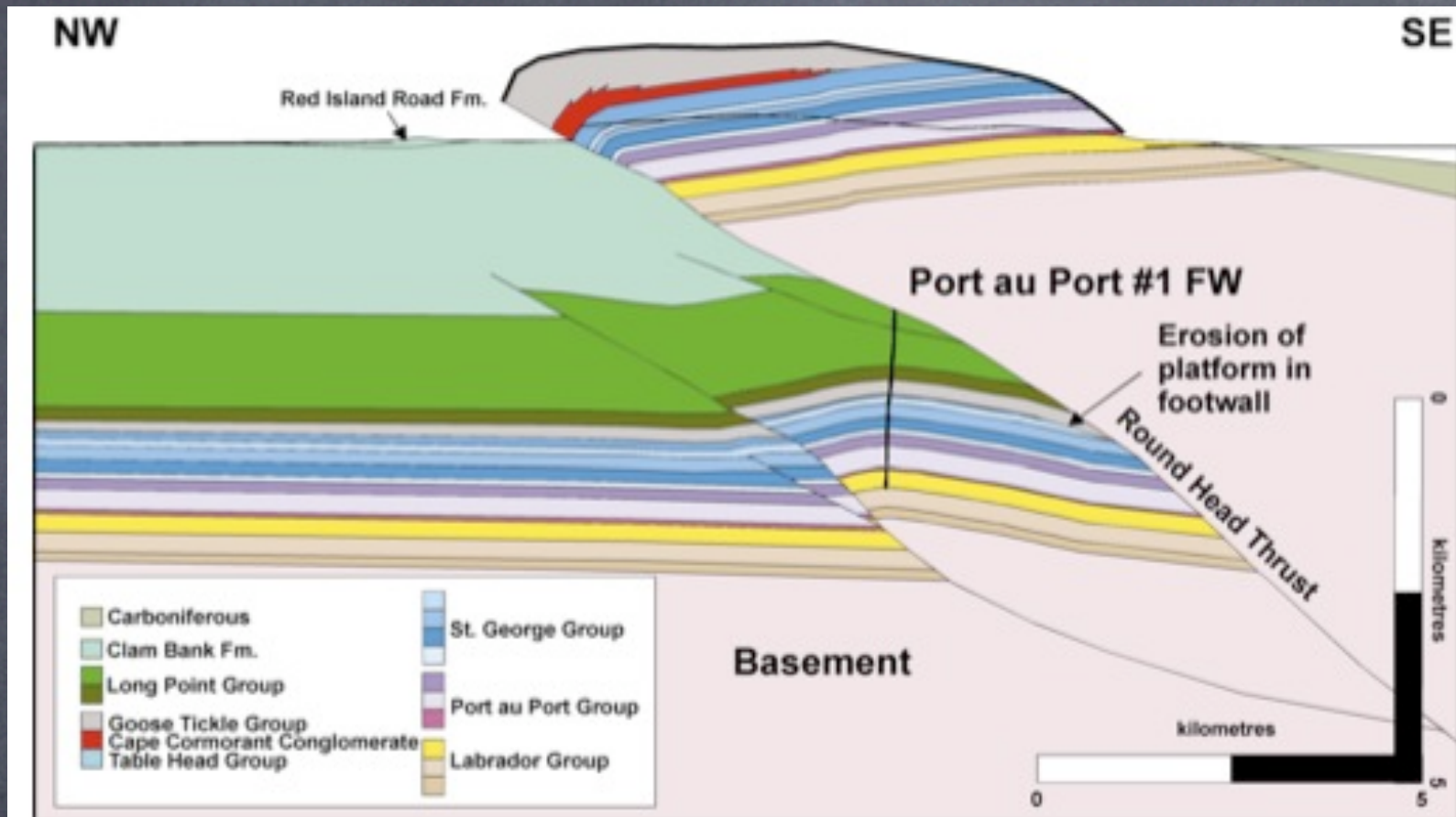


## 2) Volcanic rock and volcanic island chains



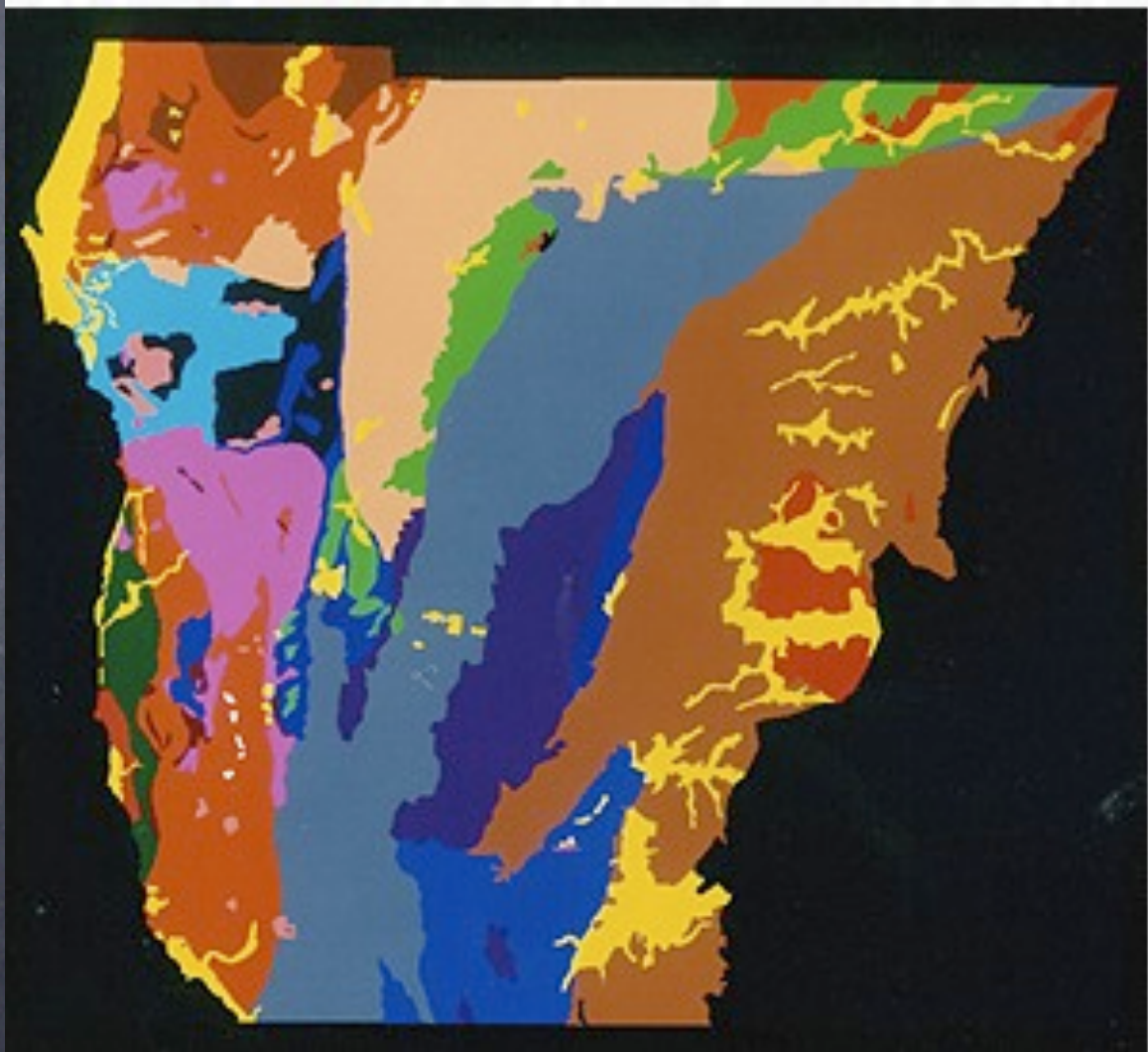


- 3) water deposited sediments from lakes, rivers and streams

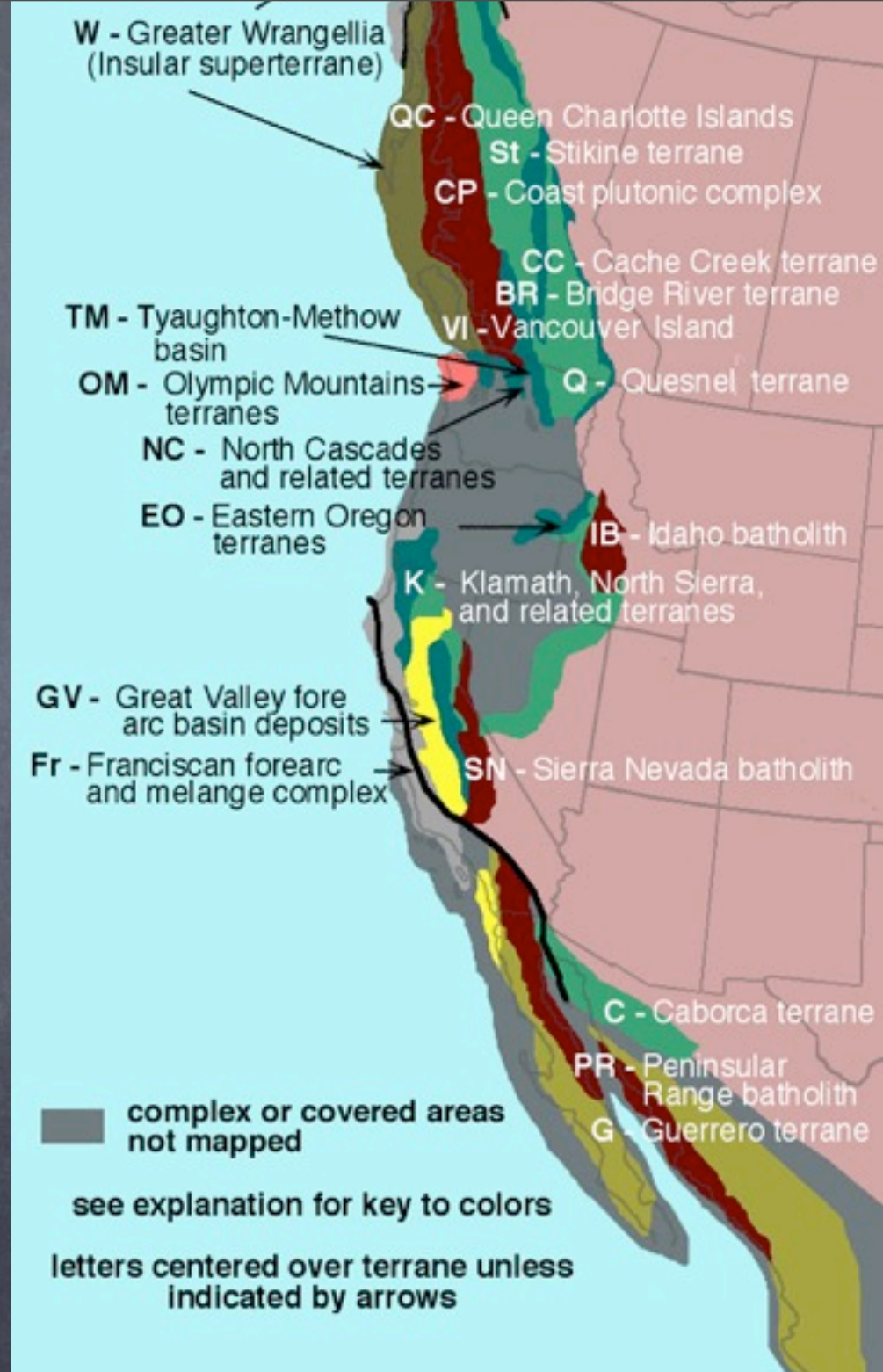


- 4) thin-skinned thrust faults - thin, horizontal sheets of rock collide forcing older rock layers on top of younger layers.

- terrane – block of lithospheric plate which attaches to a craton. Three characteristics:



- 1) Terranes are bounded by faults.
- 2) Terranes have unique rock types and fossils.
- 3) Terranes have unique magnetic polarity.





The Cache Creek terrane (labeled cc) has fossils that match ones found in Japan!

