



Chapter 2

THE SEA FLOOR

Water Planet

- 71 % of globe is covered by oceans
- Oceans are one interconnected system known as “World Ocean”



Structure of Earth

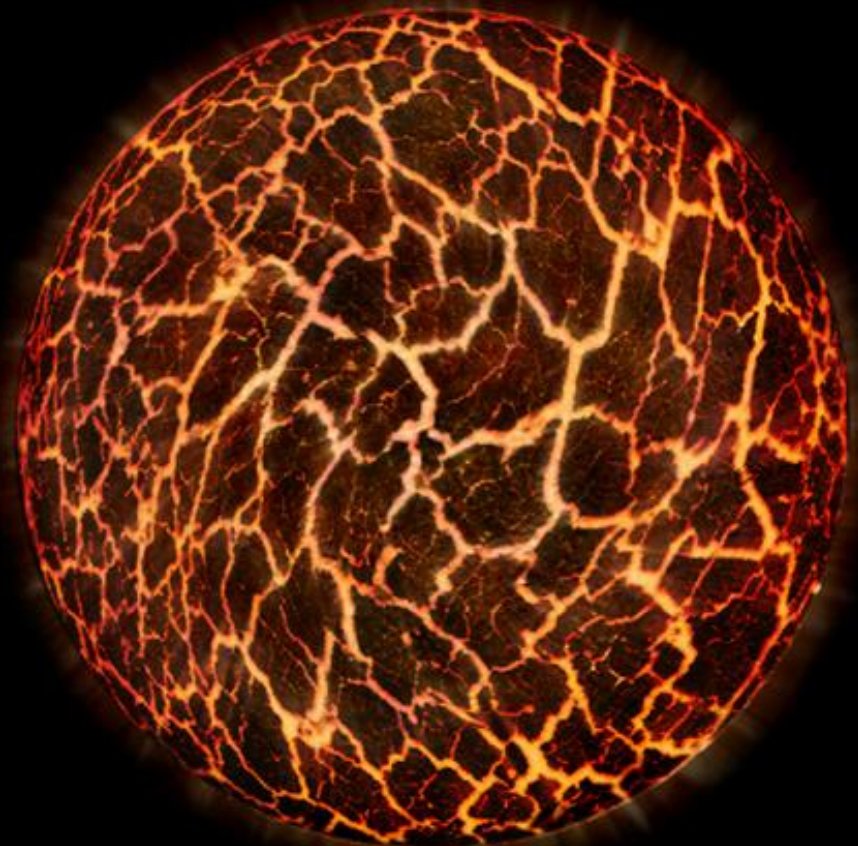
- Big bang: 13.7 billion years ago
- Earth B-day 4.5 billion years ago

**How
OLD?**



- Early Earth probably molten
- Materials settled within planet according to density
- Density: mass of a substance PER unit of volume

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

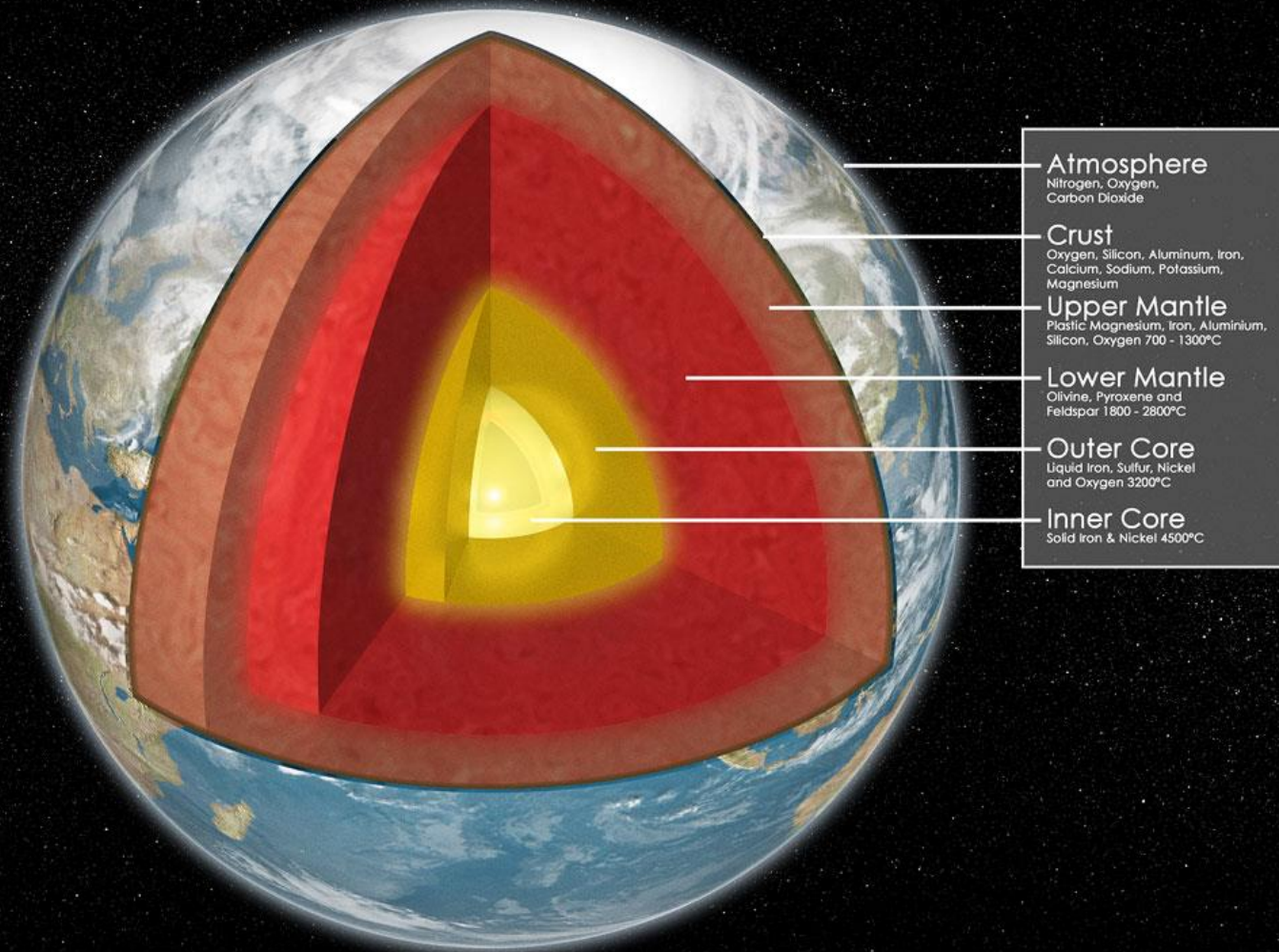




Earth Layers

- As materials sank or floated according to their density, layers started forming

Earth: Cross Section





Internal Structure

- Rigid inner core of iron due to extremely high temperature and pressure
 - liquid outer core
- Mantle (plastic)-near melting point of rock
- Crust: continental/oceanic – relatively thin

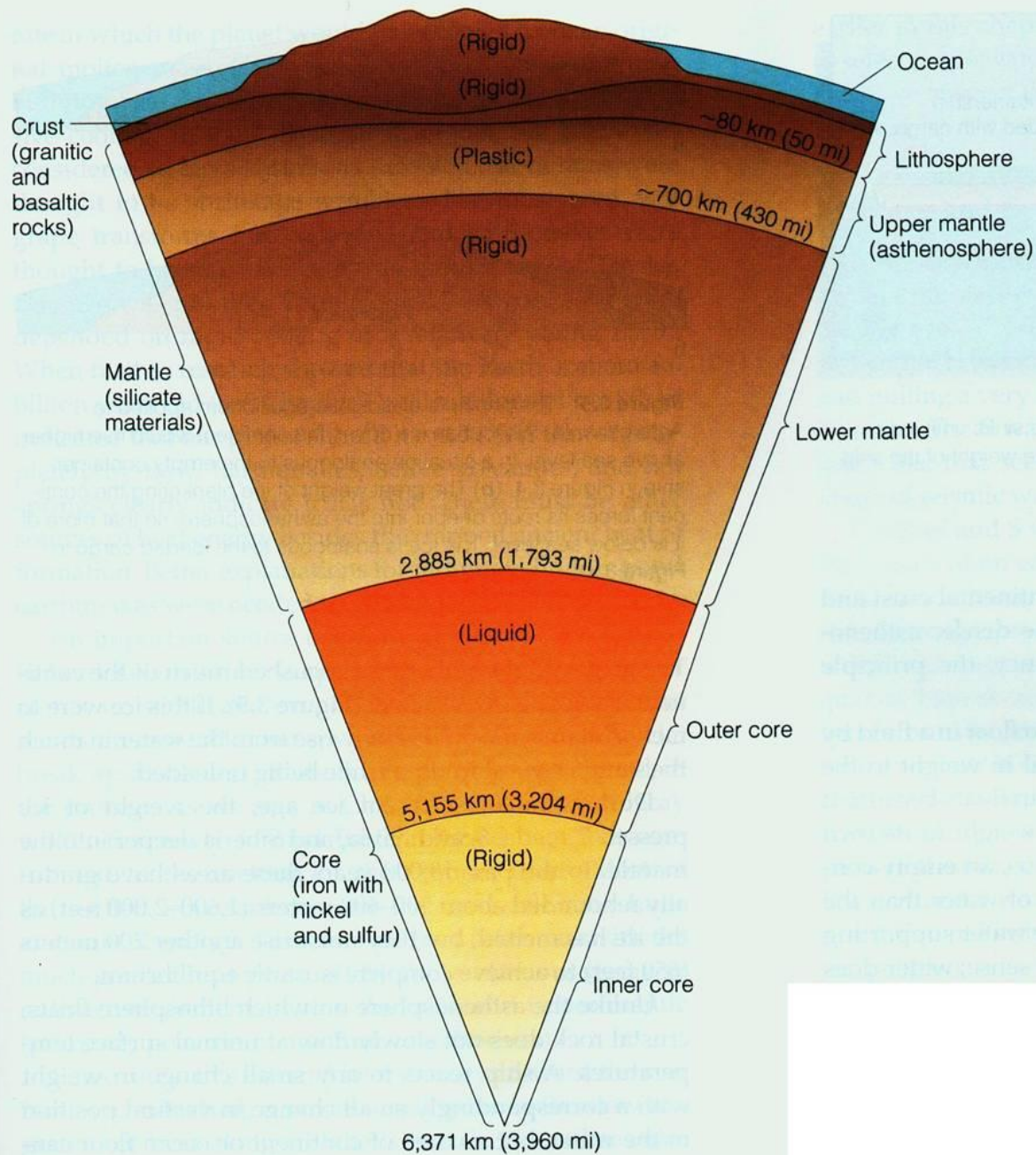
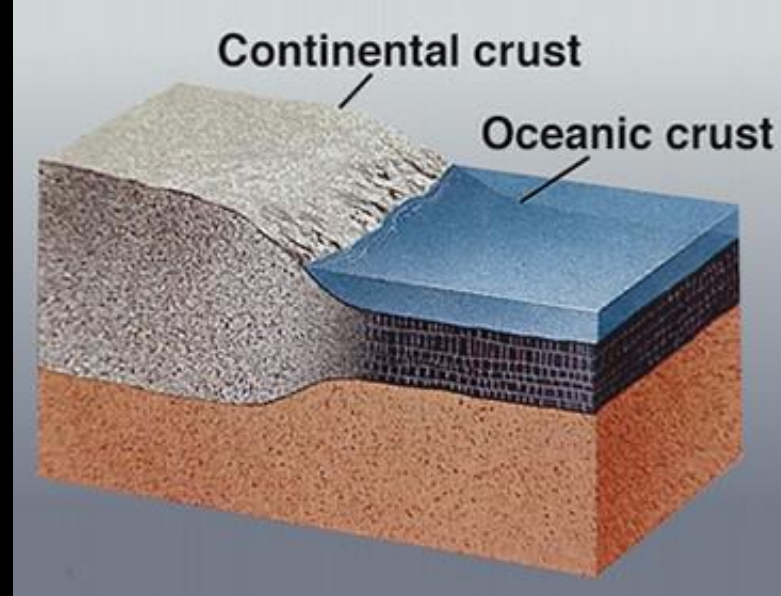


Figure 3.2 The chemical and physical organization of the Earth's

Crust



- Lies in the lithosphere layer
- Surrounds the planet, most is submerged under water
- Oceanic crust: BASALT (dense)
- Continental crust: GRANITE (less dense)



Early Evidence of Continental Drift

- 1620 –noted that continent coasts fit like puzzle pieces
 - geological formations/ fossils match up across Atlantic ocean
- 1912, Wegner's hypothesis of continental drift and "supercontinent" called Pangaea
 - (didn't explain HOW continents moved)
- 1950-60's: Theory of Plate tectonics



Our Crust is Broken up into Plates

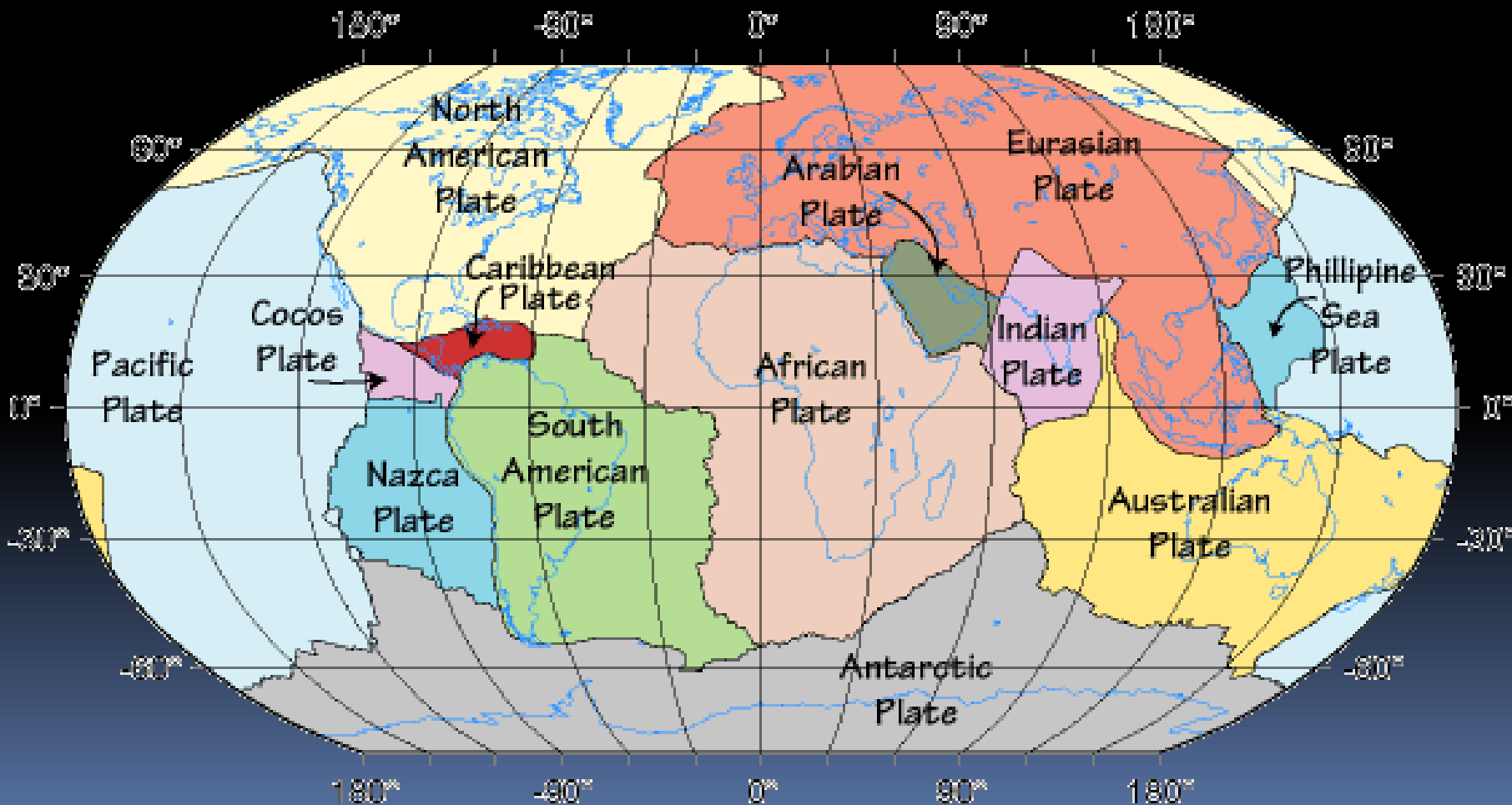
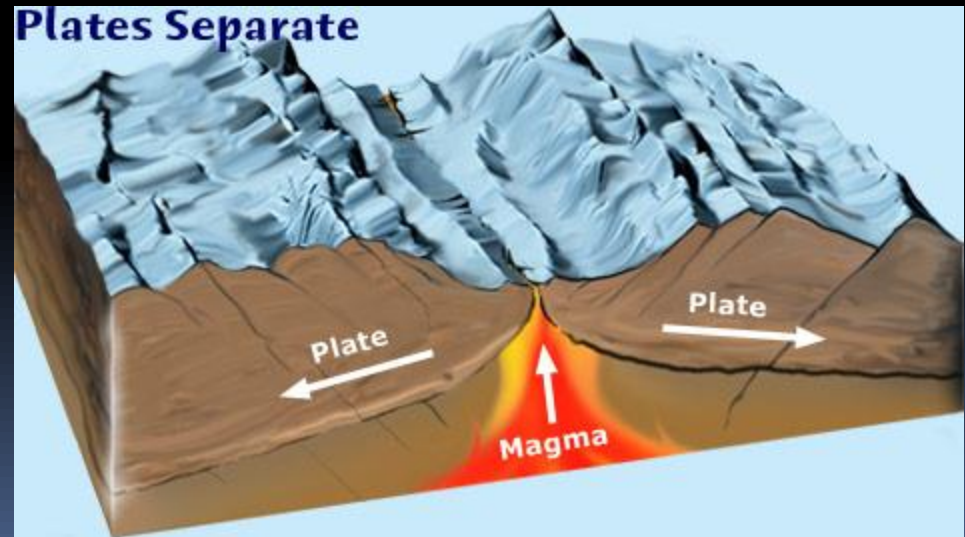
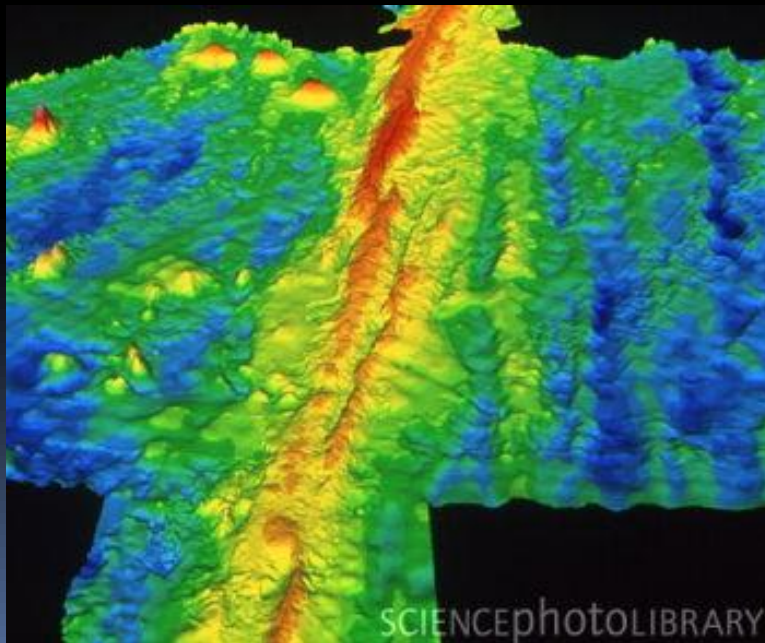
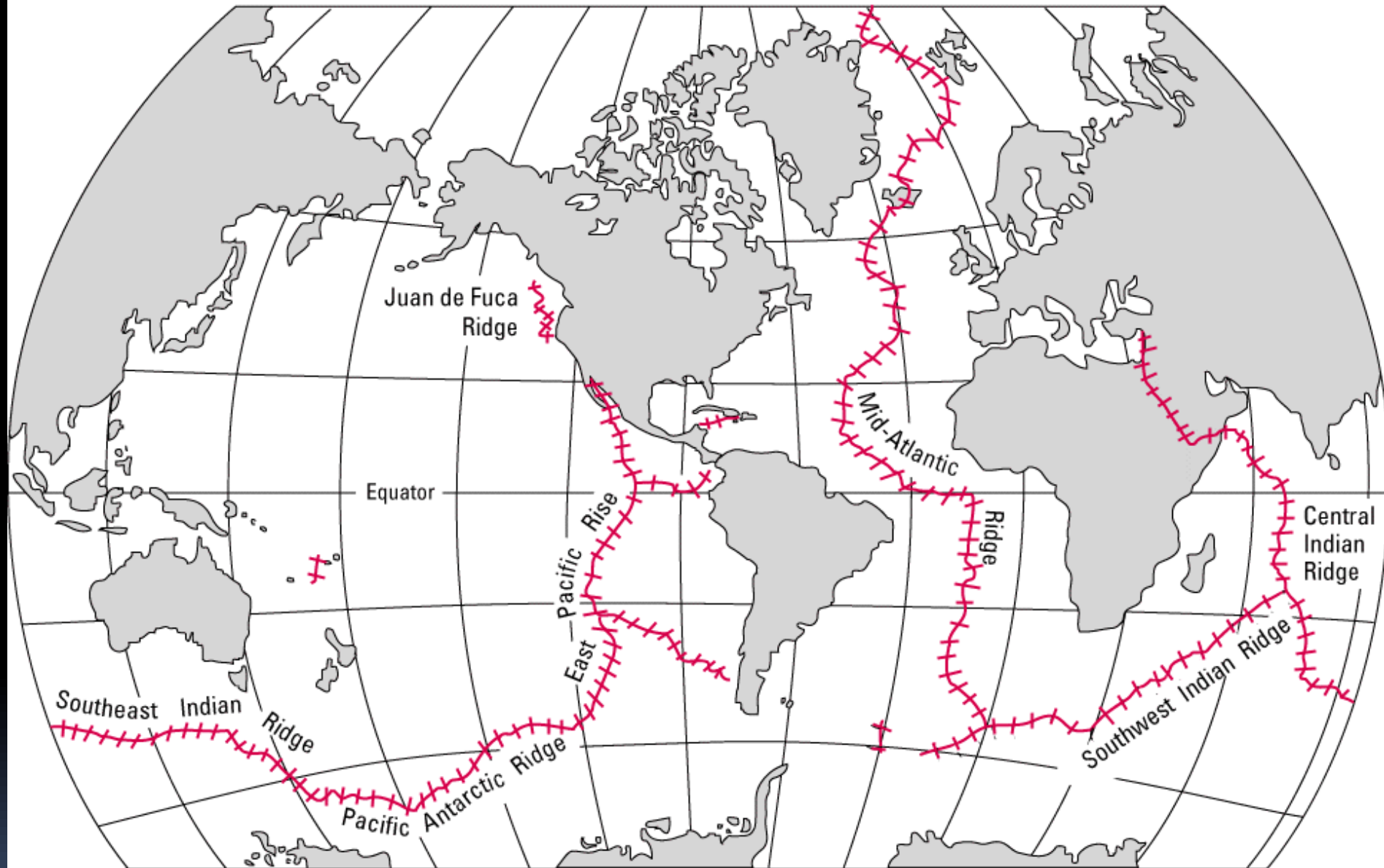


Plate boundary 1: Divergent (Mid-Ocean Ridge)

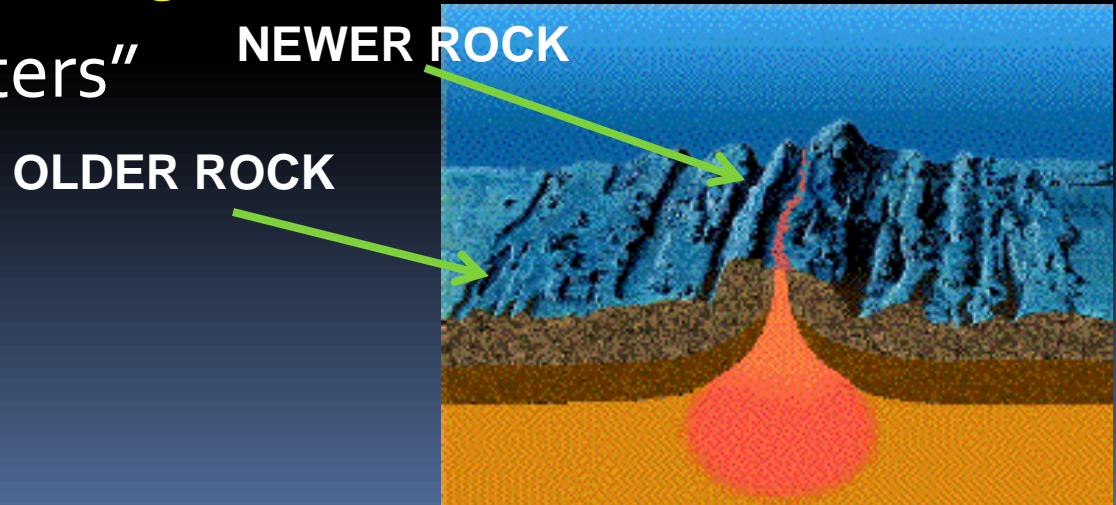
- Sonar allowed for survey of sea floor
- Ridges- continuous chain of volcanic mountains around globe
- Largest geological feature on earth



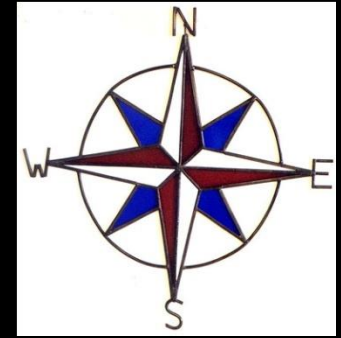


Creation of Sea Floor

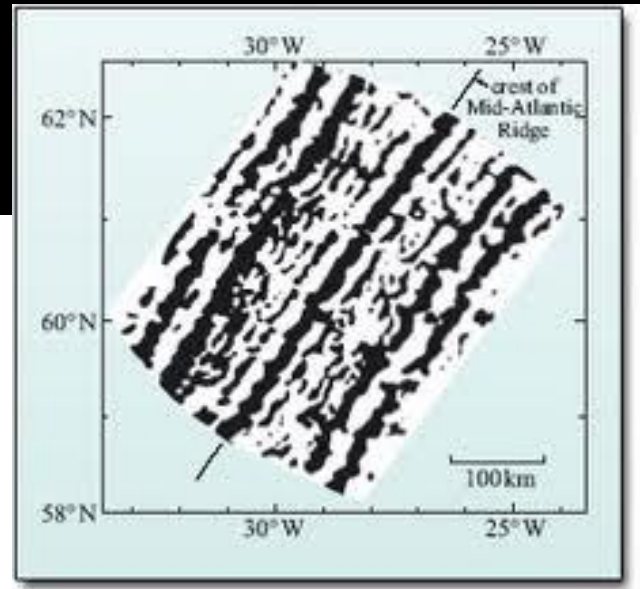
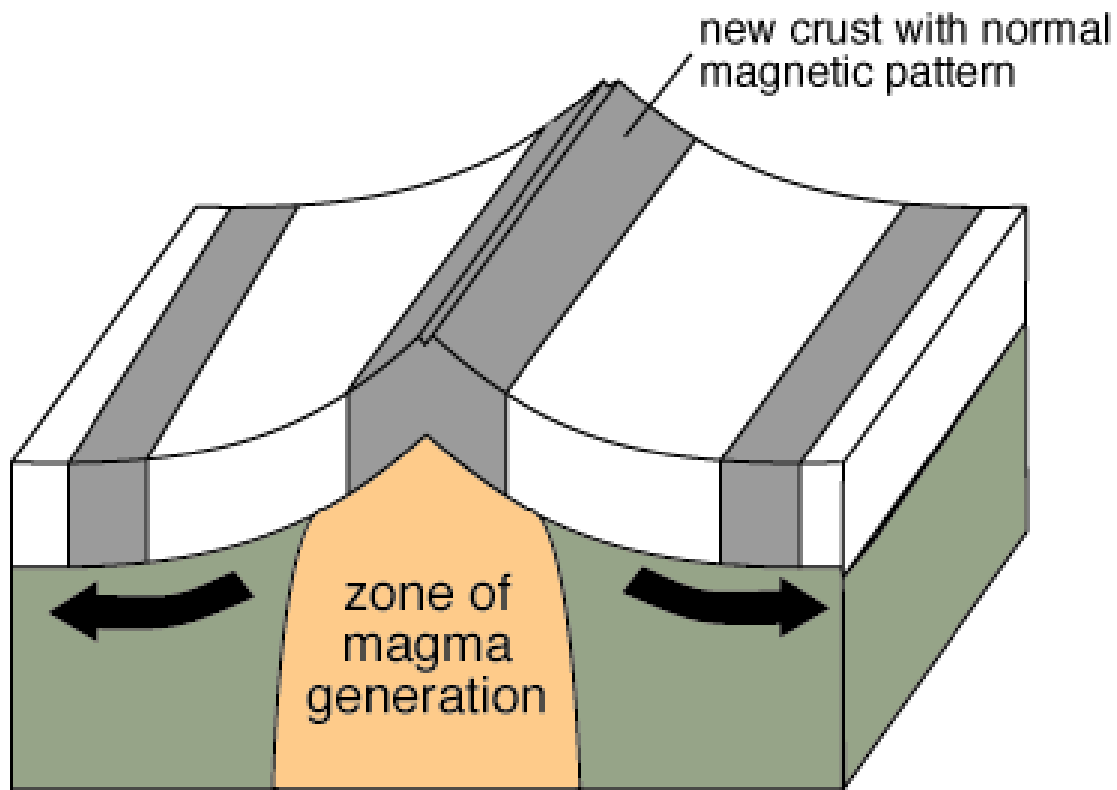
- Huge pieces of oceanic crust separating at MOR creating cracks in crust called **rifts**
- Pressure is released, magma from mantle pushes up oceanic crust to form **ridge**
- Cools rapidly and solidifies, **new lithosphere (rock) formed at ridges**
- “spreading centers”



Evidence of Sea Floor Spreading



- Earth's magnetic field reverses direction about every 700,000 years
- Cause related to movements of magnetic particles in molten outer core
- Patterns of stripes on sea floor running parallel to mid-ocean ridge
- Bands alternate between "normal" and "reverse" magnetization



At the present time, rocks record a normal pattern because the north magnetic pole is in the northern hemisphere.

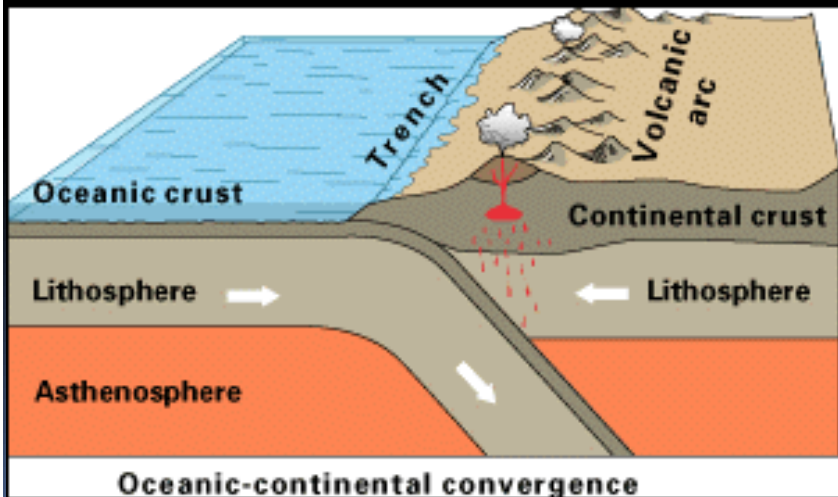
Plate Boundary 2: Convergent Boundary

- When plates collide, the result is largely dependent on **DENSITY** and **BOUYANCY**
- Crust is destroyed and recycled back into interior of Earth, as one plate dives under the other (**SUBDUCTION ZONES**)
- Often form mountains and volcanoes



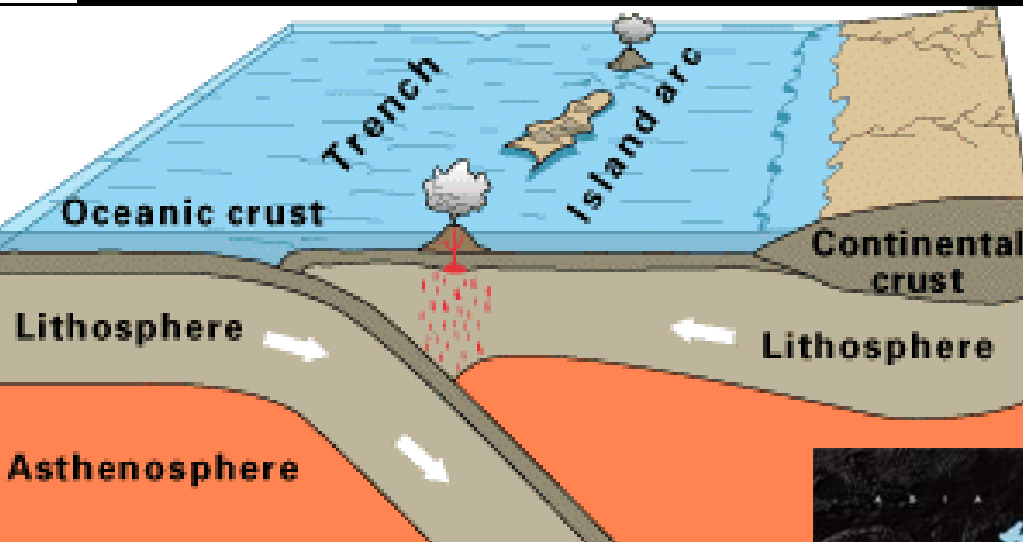
Continental vs. Oceanic

- Oceanic plate will subduct
- A deep trench forms at subduction zone
- Overriding continental plate is lifted up and mountains form/earthquakes
- Pressured gases and magma rise and erupt

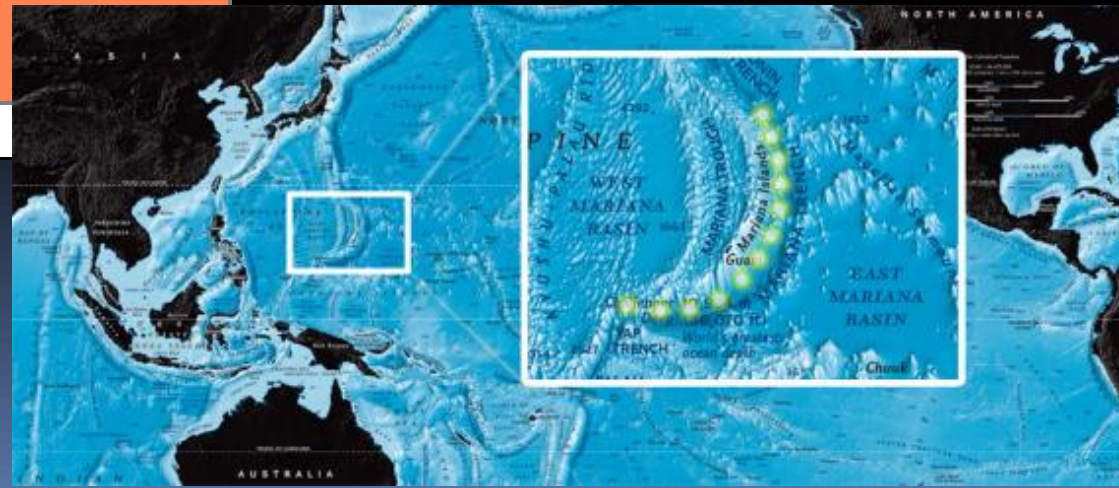


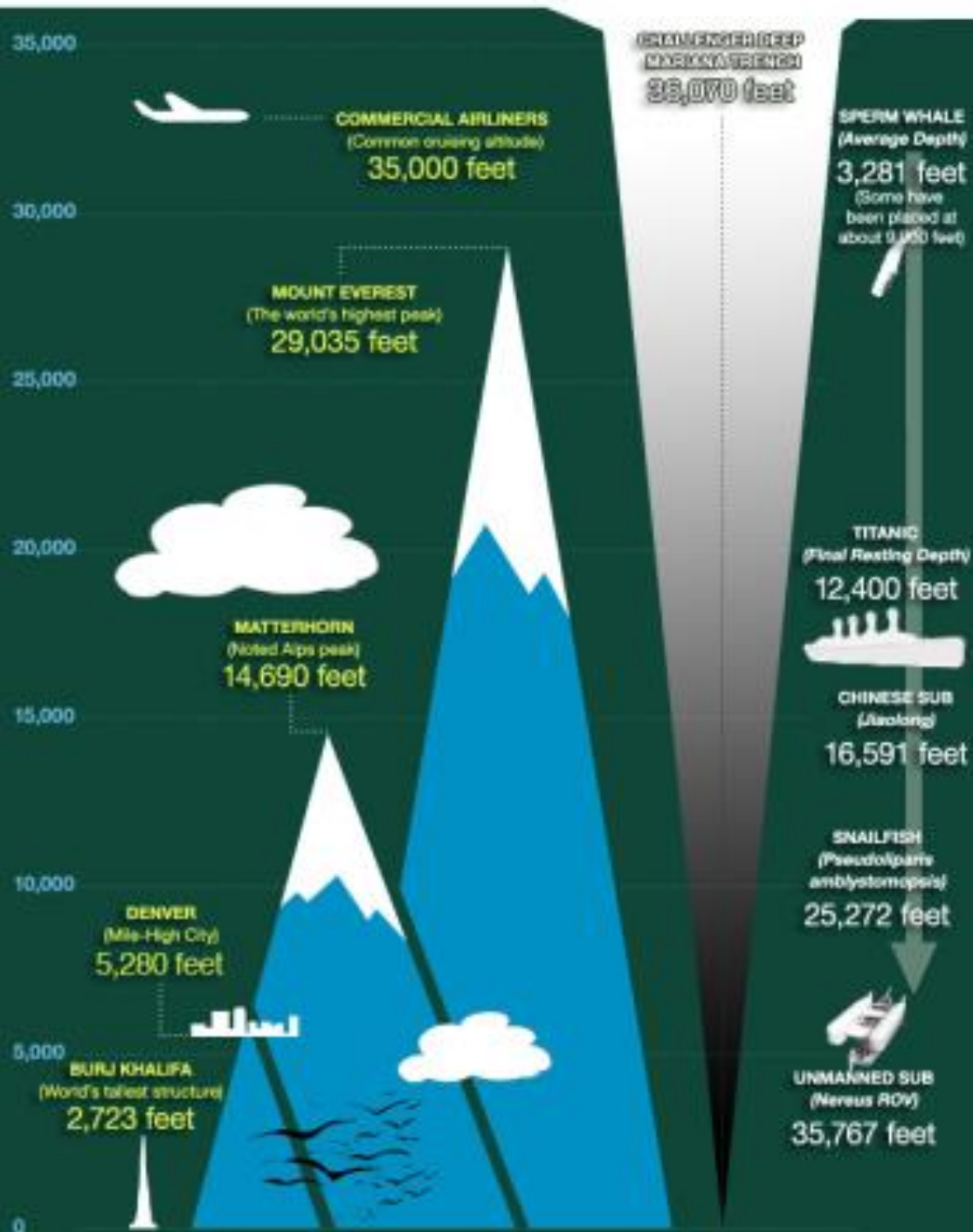
Oceanic vs. Oceanic

- The **most dense** of the two **will subduct**, form trench
- Curved volcanic mountain chain forms above subducting plate (island arcs)



Oceanic-oceanic convergence





Continental vs. Continental

- because of low density, neither tends to subduct
- - get “welded together” or cause buckling and fold as mountain ranges

HIMALAYANS

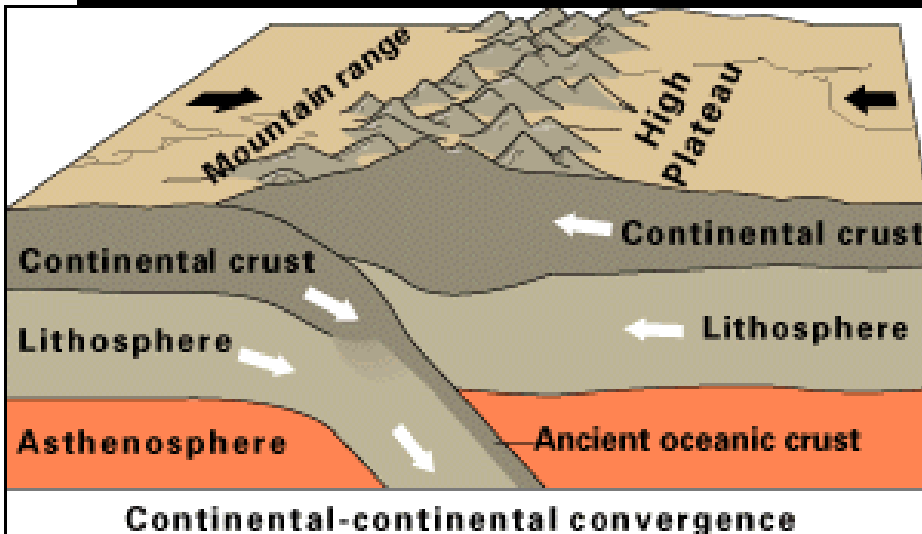


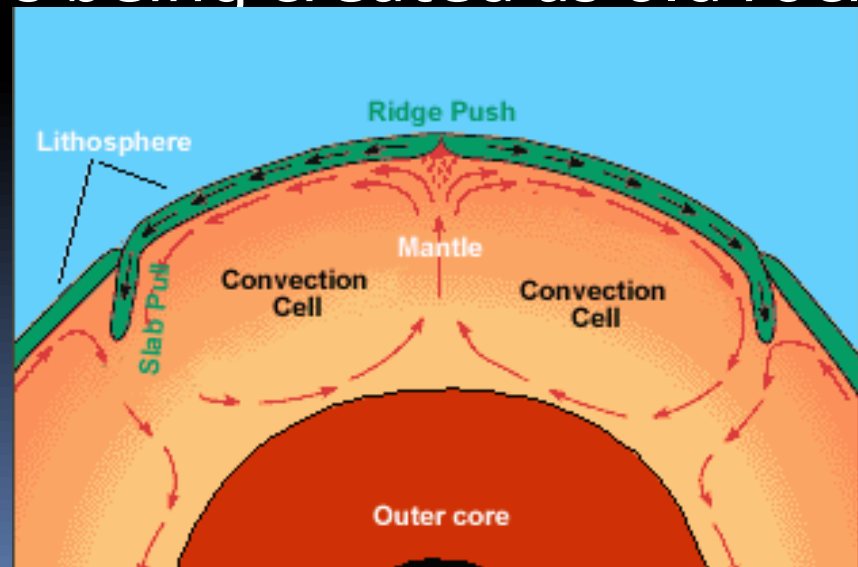
Plate boundary 3: Transform-fault

- Plates slide past each other
- **Not creating, nor destroys lithosphere**
- Builds friction that eventually “gives” causing an earthquake
- Ex: San Andreas Fault



It's a cycle!

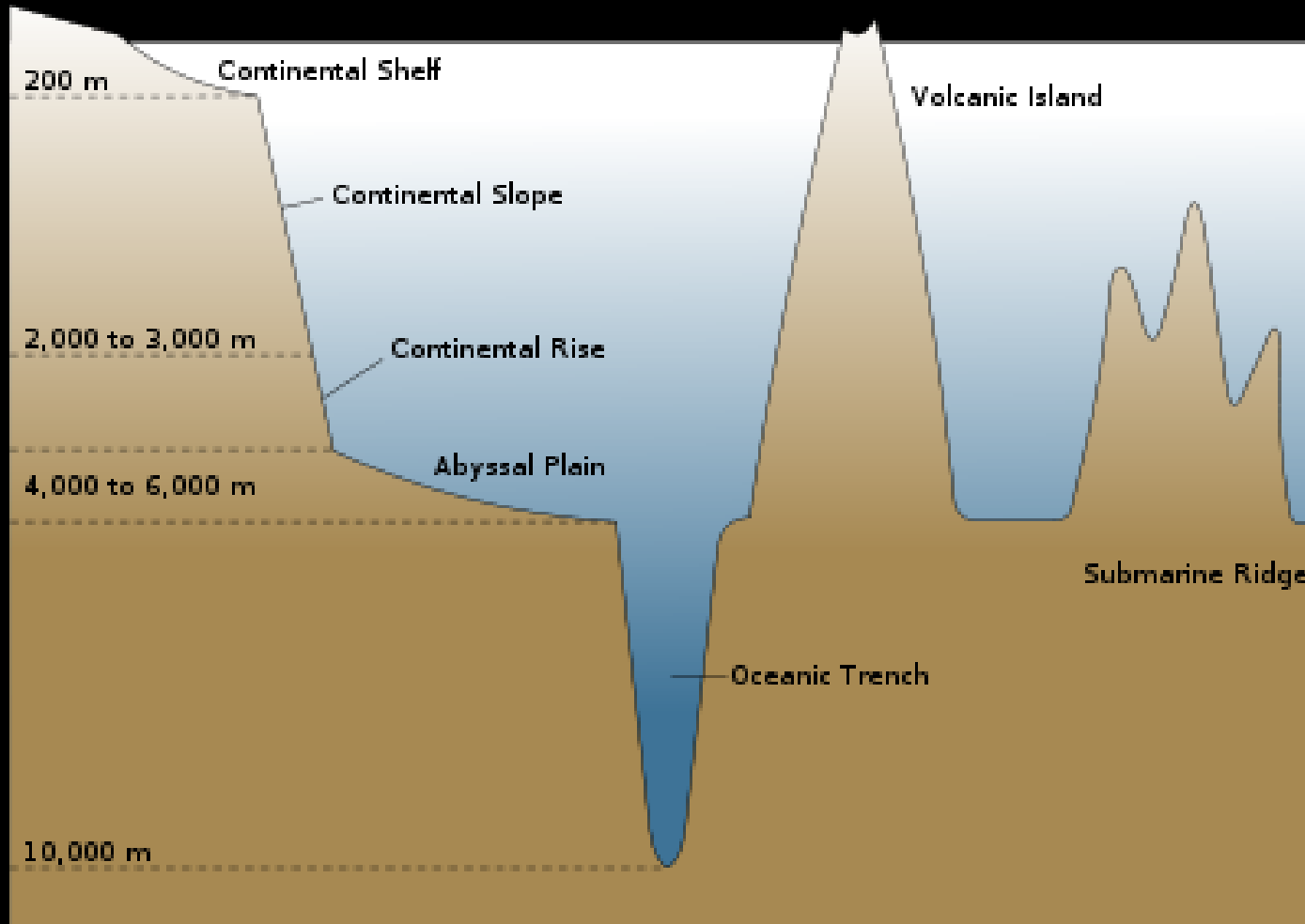
- Convection causes old lithosphere to subduct into mantle and pulls the plate along (slab pull)
- “Ridge push” allows plates to separate at MOR, allowing magma to come up; form new lithosphere
- New rock is always being created as old rock is destroyed



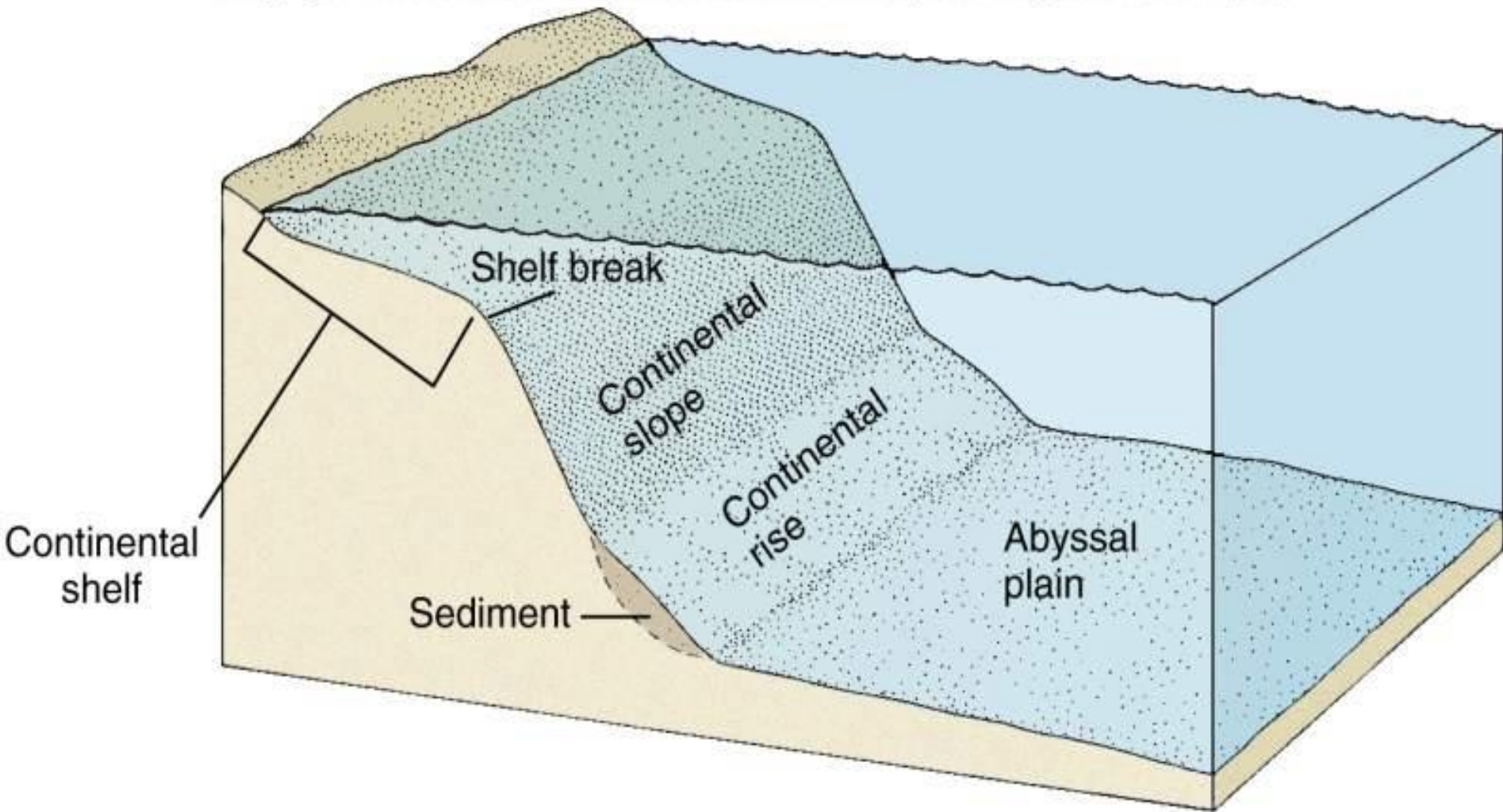
Continental Margins

- **Continental shelf** is shallow and biologically richest
- **Continental Slope**: below shelf, steep, leads to sea floor
- **Continental rise**: base of slope, sediment collects here
- **Abyssal plain**: sea floor

Continental Margins

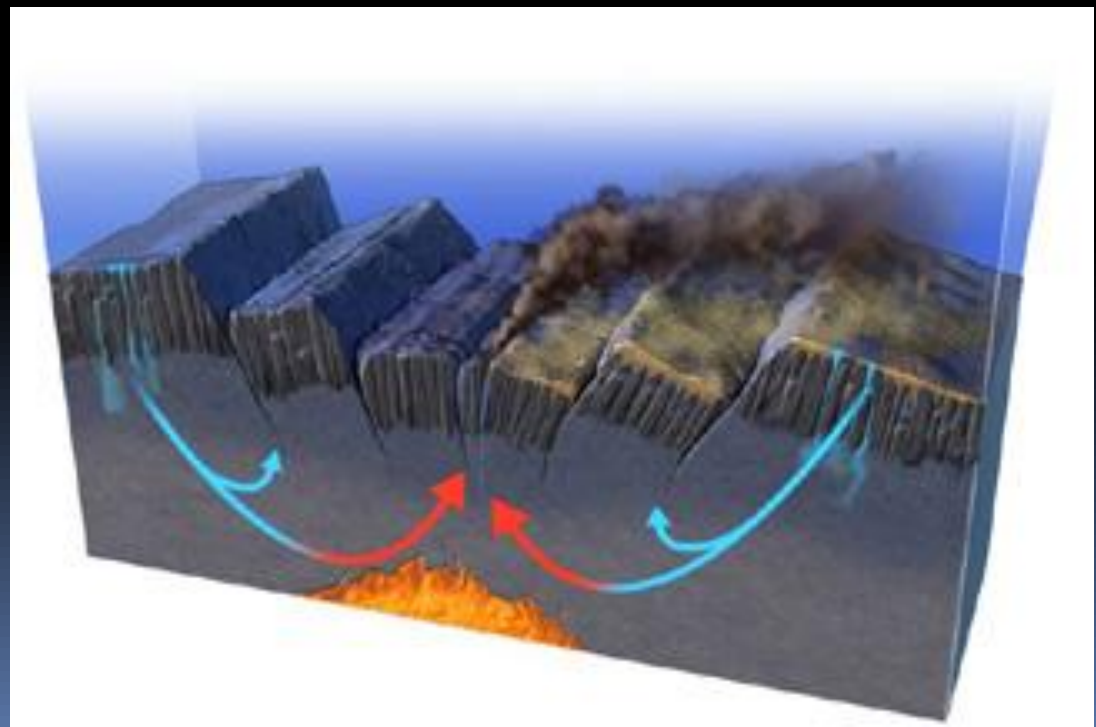


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Hydrothermal Vents

- Seawater seeps into cracks in floor
- heated by underlying mantle
- Forces back up through crust at 50-68°F



Black smokers

- Some vents are hotter 350°C (660°F)
- Hot water seeps through cracks, dissolving minerals (sulfides)
- Emerging through vent, surrounding cool water causes minerals to solidify.
- Minerals deposit at vent

