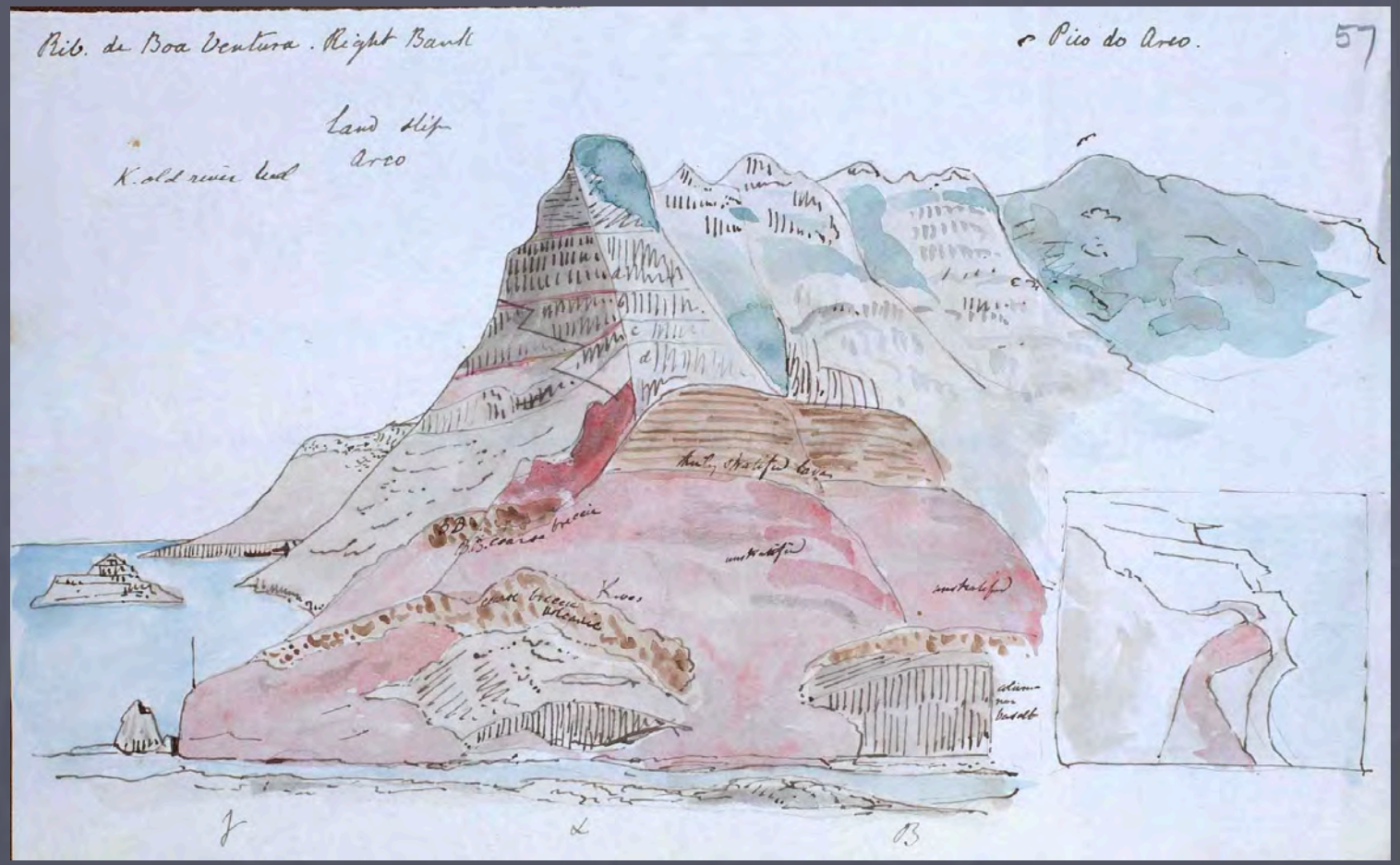
Tectonic Theory

Chapter 11: The Dynamic Planet

Chapter 12: Tectonics, Earthquakes, & Volcanism

The Theory – Charles Lyell

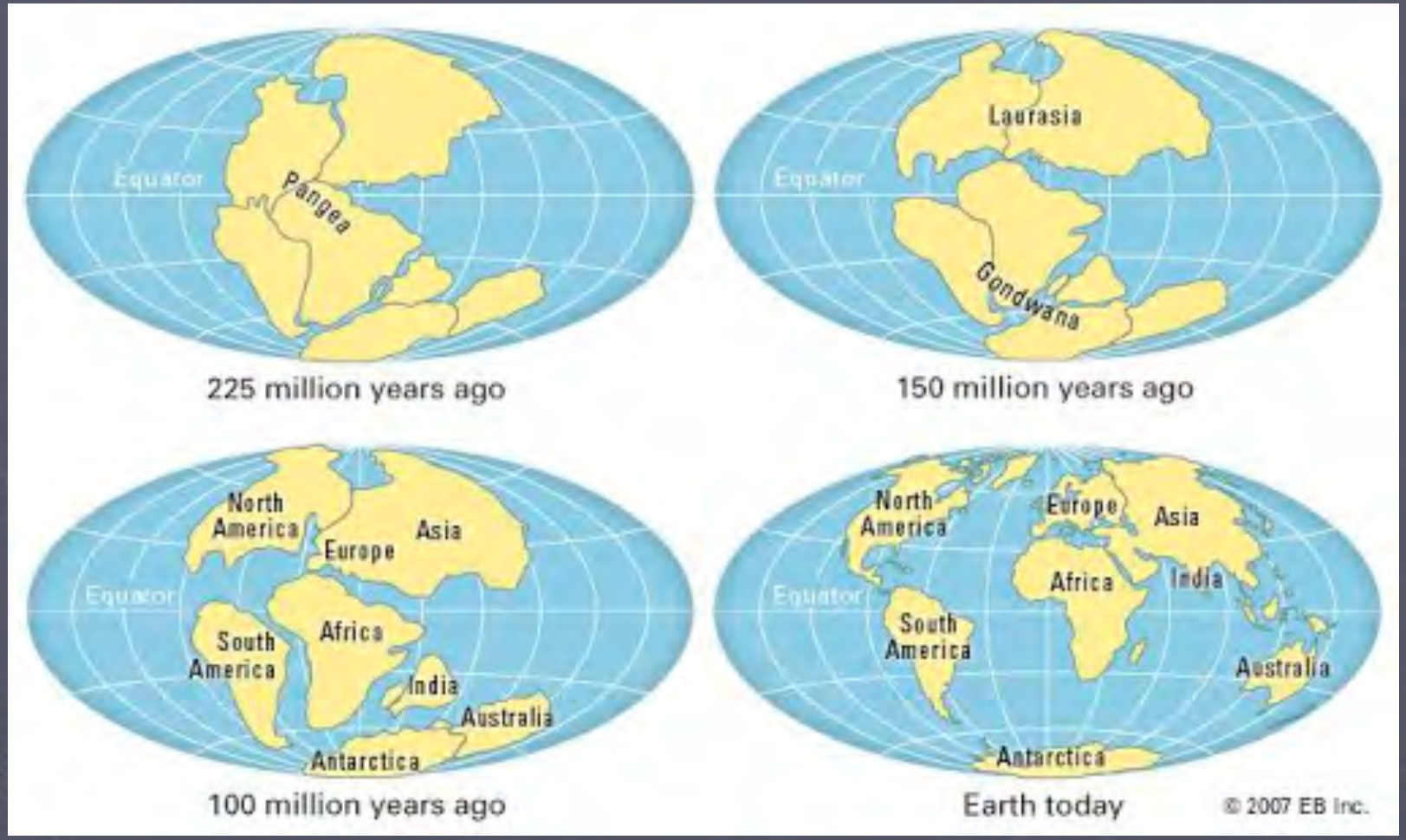
- **Uniformitarianism** - Physical processes going on today have been going on throughout Earth's history (Published in 1830-1833)
- **Stratigraphic Ages** - Idea that history of earth could be observed in strata of earth's layers



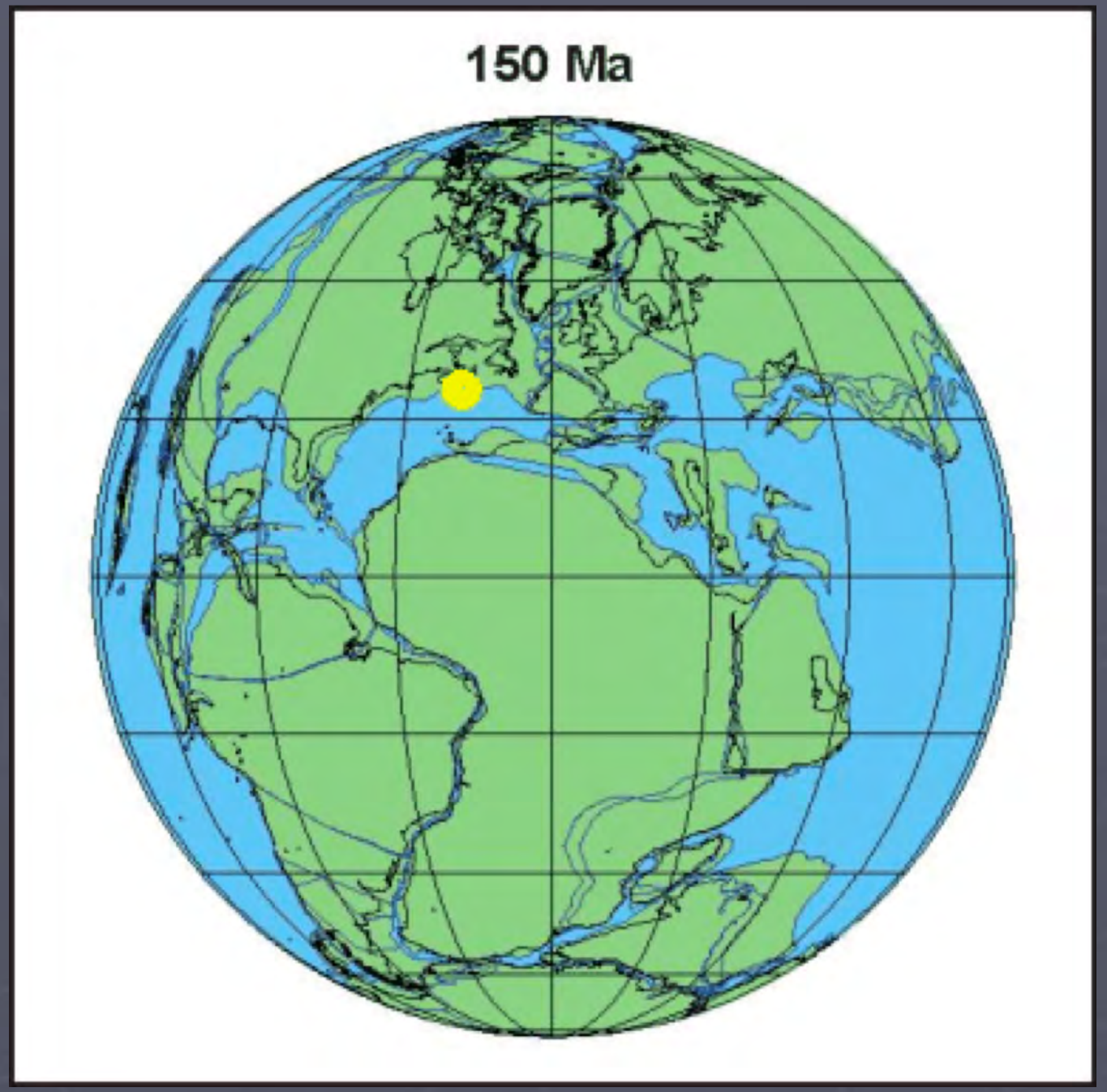
The Theory – Alfred Wegener

- Originally purposed by Antonio Snider-Pelligrini in 1858
- Theory further developed and associated with Alfred Wegener in 1912 (Published in *The Origin of Continents and Oceans* in 1915)
  - Trying to explain why look-alike plants and animals existed on different continents
  - Heavily criticized due to inability to explain mechanisms by which continents move

The Theory - Visualized



Continental Drift in Motion



The Theory – Alfred Wegener

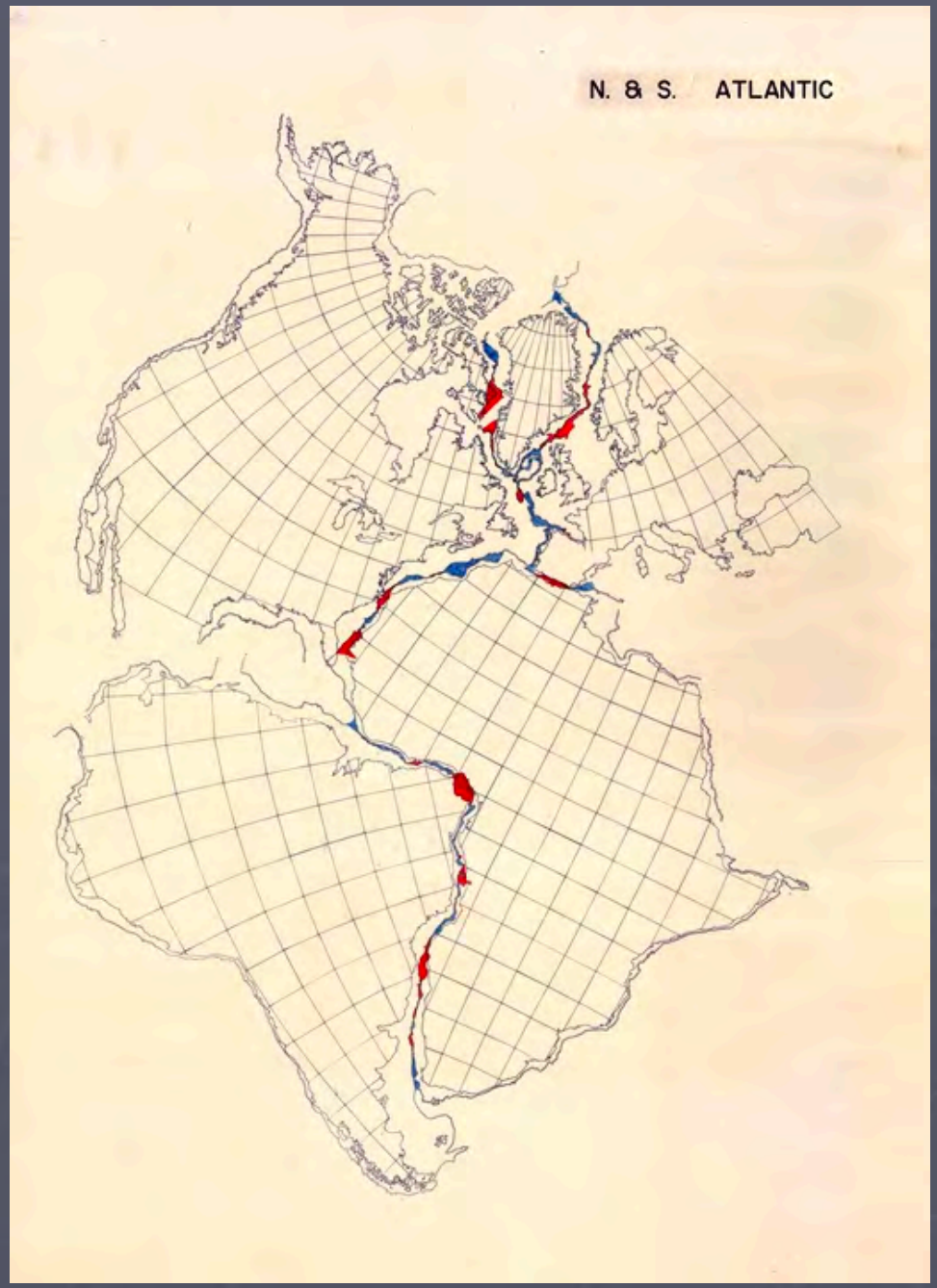
- Continental drift hypothesis:
  - Supercontinent called Pangaea began breaking apart about 200 million years ago
  - Continents "drifted" to present positions
  - Continents "broke" through the ocean crust

The Evidence

- Based on observations of similarities between continents
  1. Continental Slope Fit
  2. Geological composition and structure match
  3. Paleo-Biogeographic Evidence
  4. Paleo-Climate Evidence

The Evidence – Slope Fit

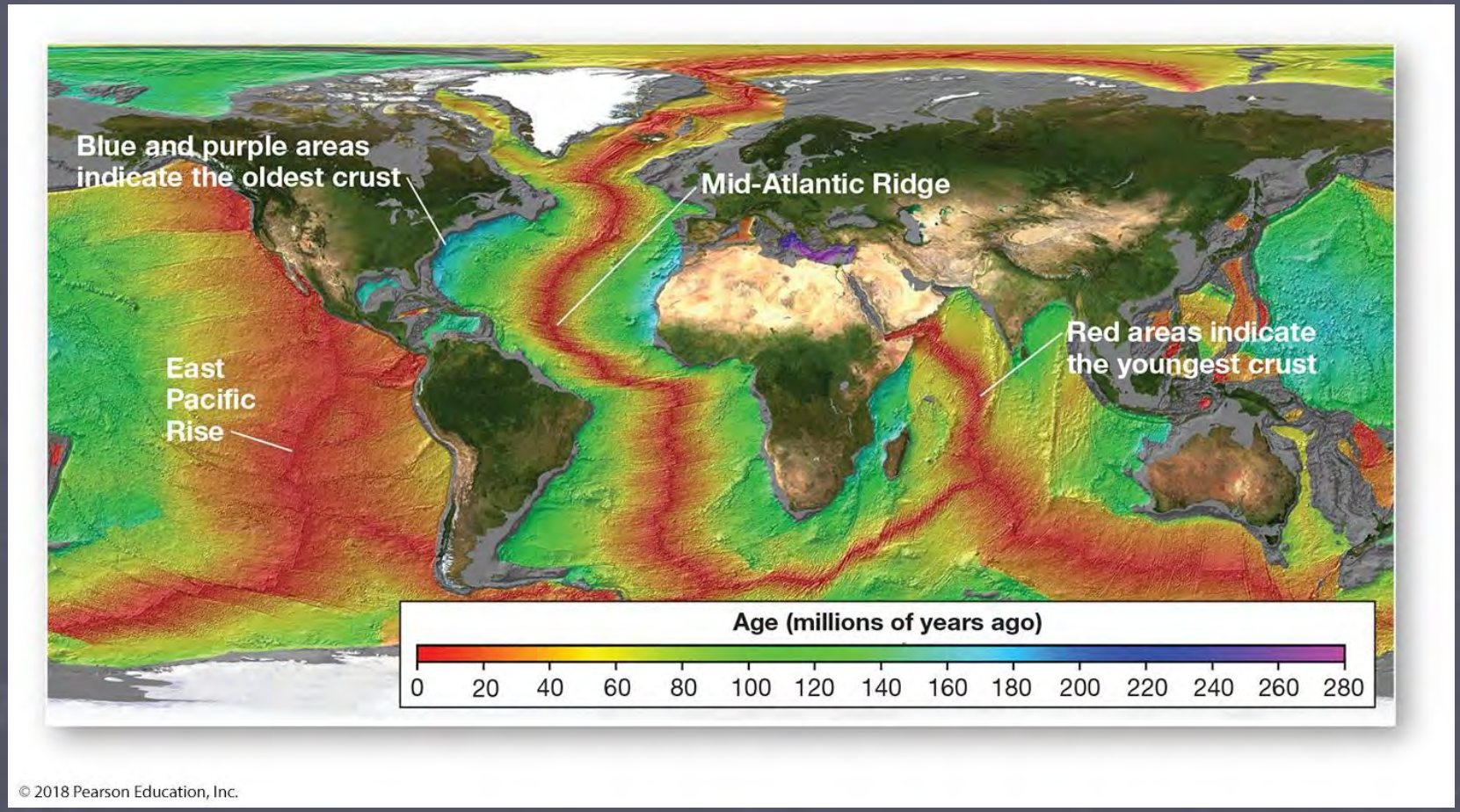
- Wegener (among others) recognized the apparent connections between coastlines of distant continents
  - Especially Africa and South America
  - Geologically match up as well



The Evidence – Matching Geological Folds

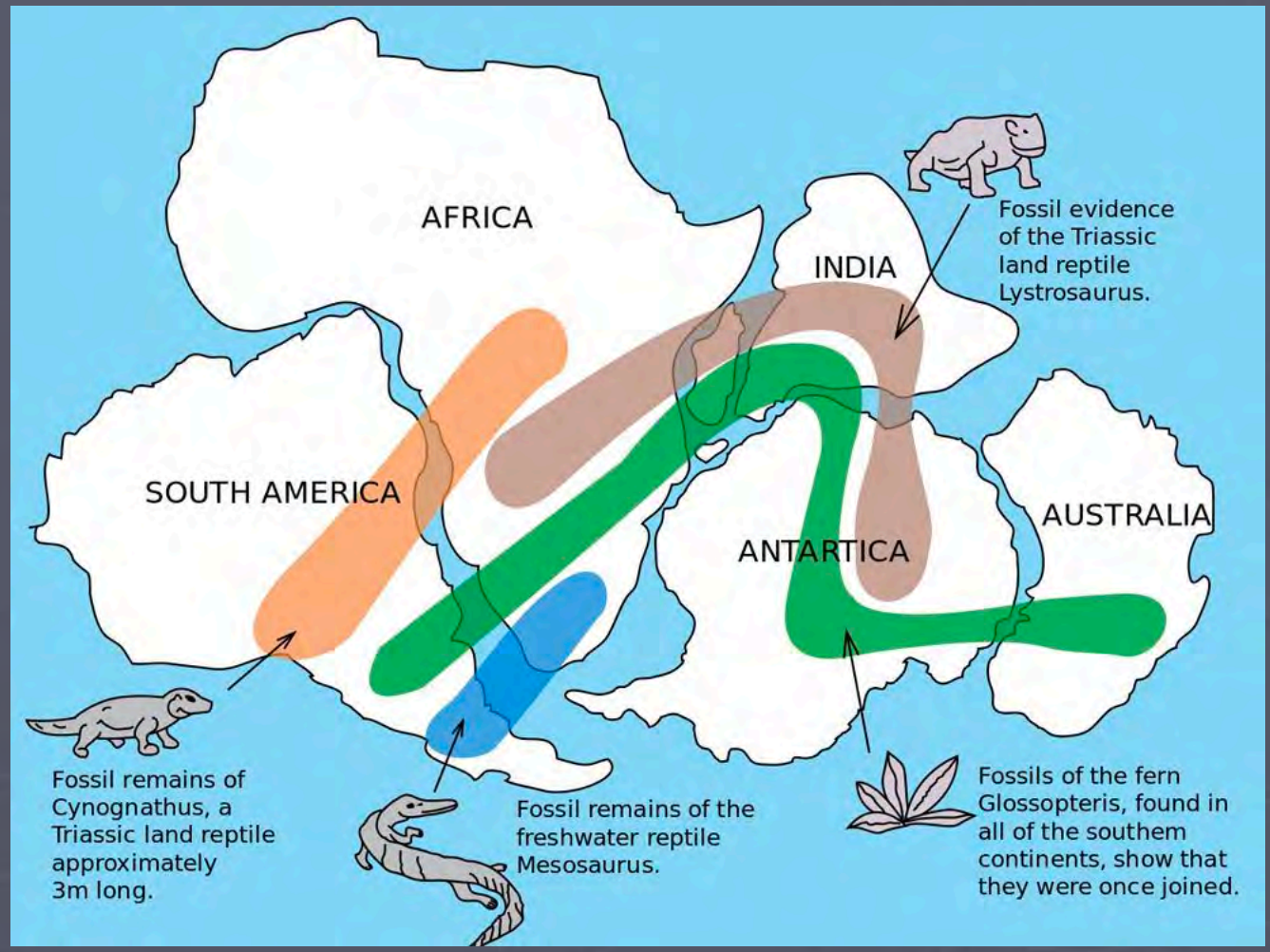
- Continuation of mountain ranges along continental boundaries

The Evidence – Geological Age of Land



The Evidence – Paleo-Biogeographic

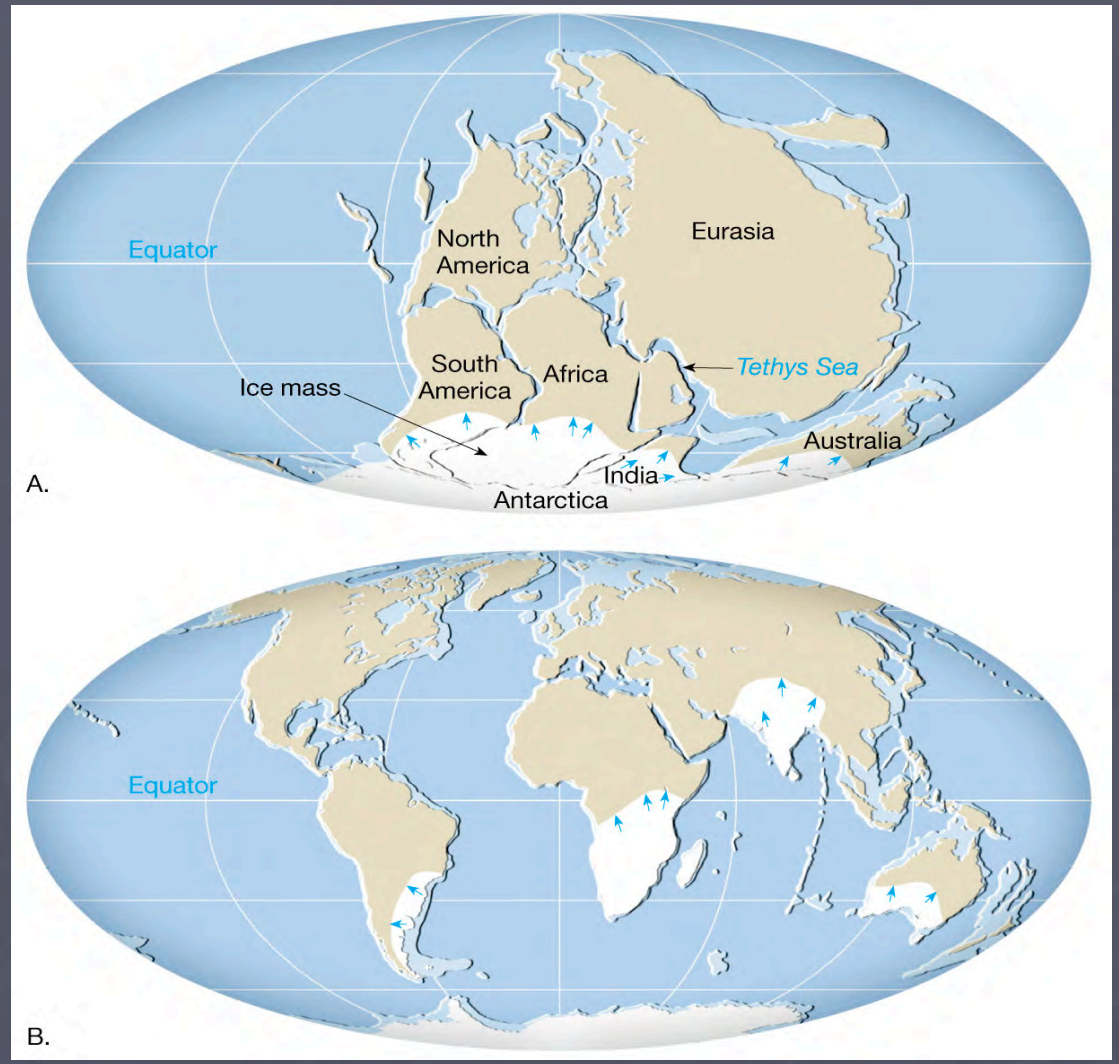
- Fossil record of same species found on multiple continents
  - Helped biogeography develop two main theories of biogeographic distributions
    - Vicariance and Dispersal



The Evidence – Paleoclimate Evidence

- Evidence of areas that are now temperate having once been in more tropical zones
- Effects of glaciation on areas that are now in tropical zones

Palm fossil from Utah Green River Basin



The Process

- Plate Tectonics Revolution of 1966
  - Number of papers published that supported Wegener's theory
  - Better understanding of Plate Tectonics
    - Plates sit atop plastic Asthenosphere
      - Convection heating moves plates
- Earth's Crust is made up of Continental *(felsic)* Plates, and Oceanic *(mafic)* Plates

As Discovery increases so does understanding

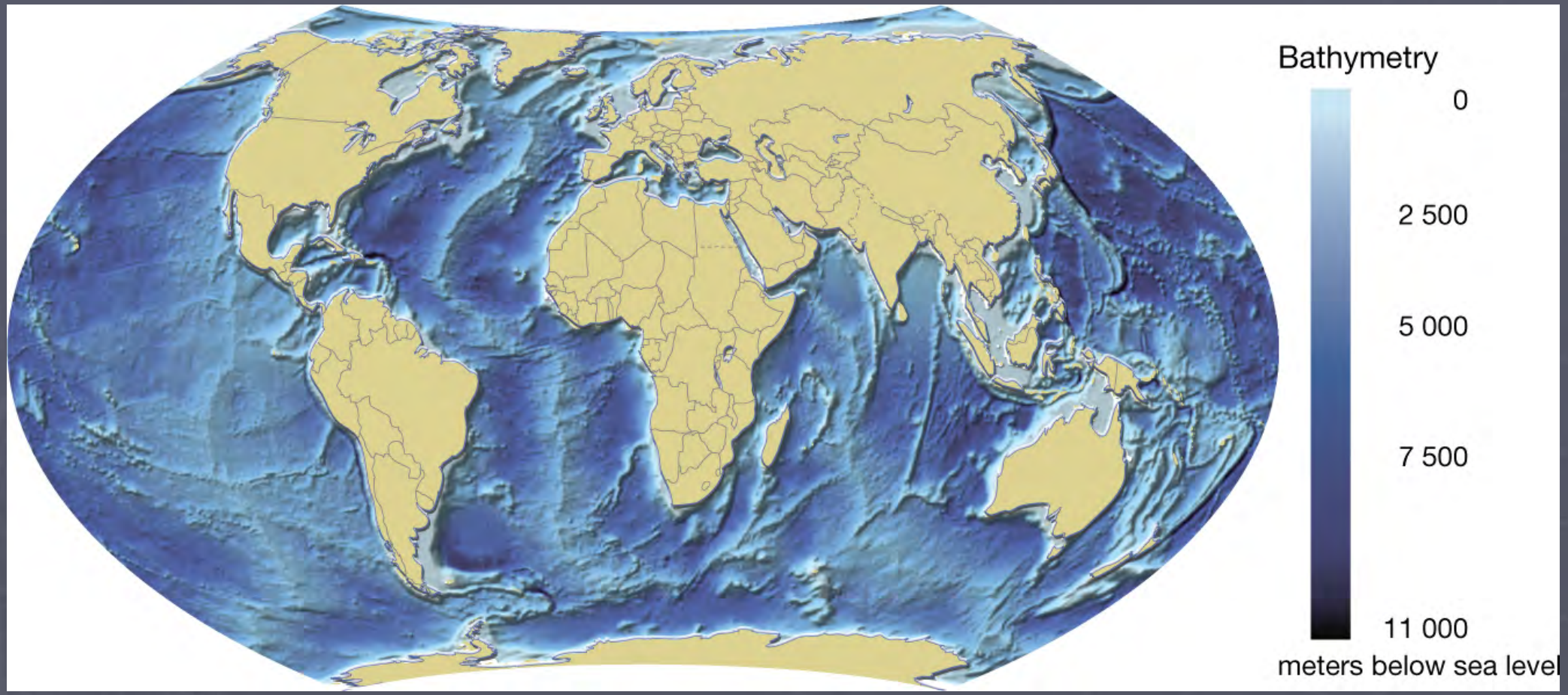
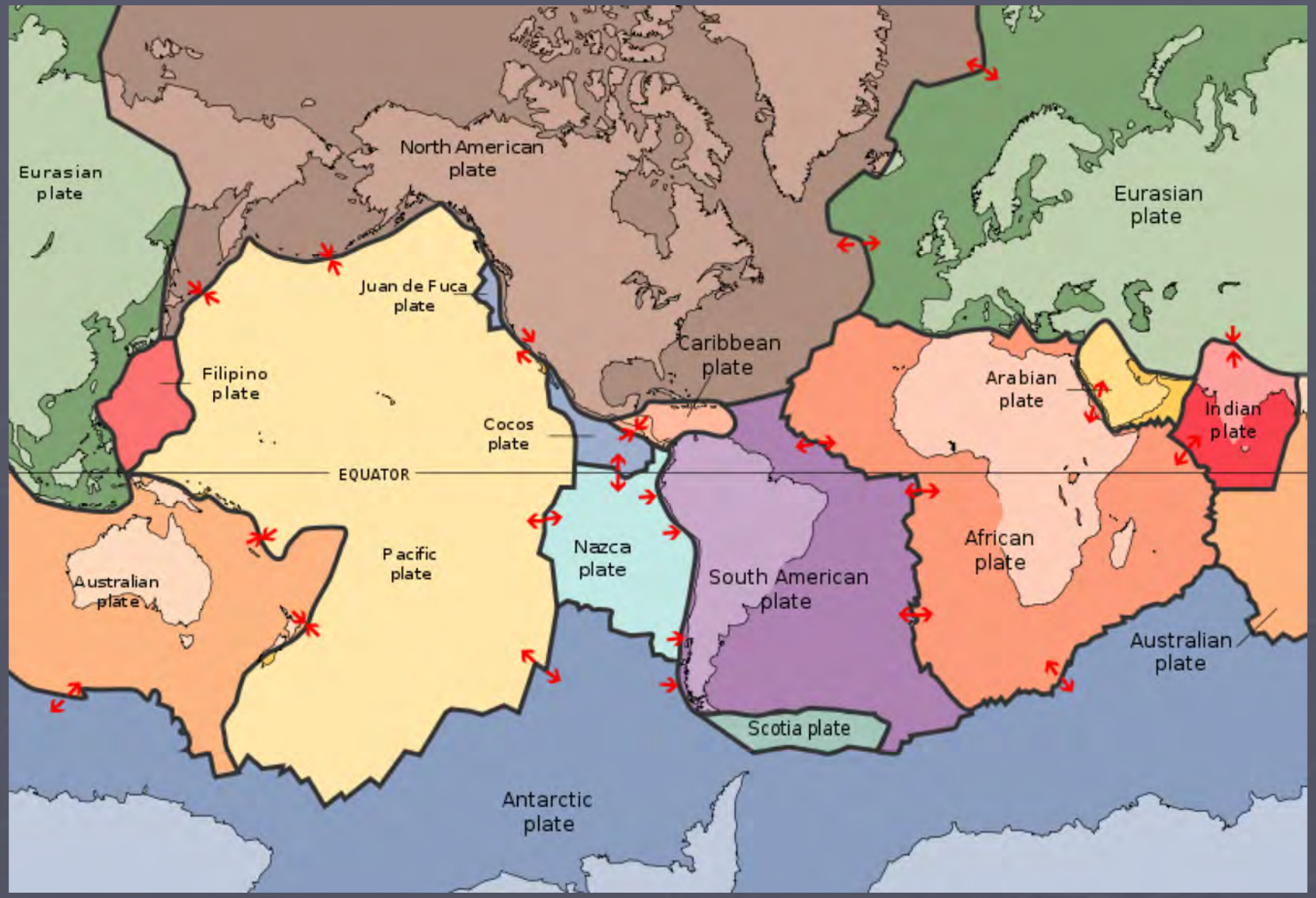


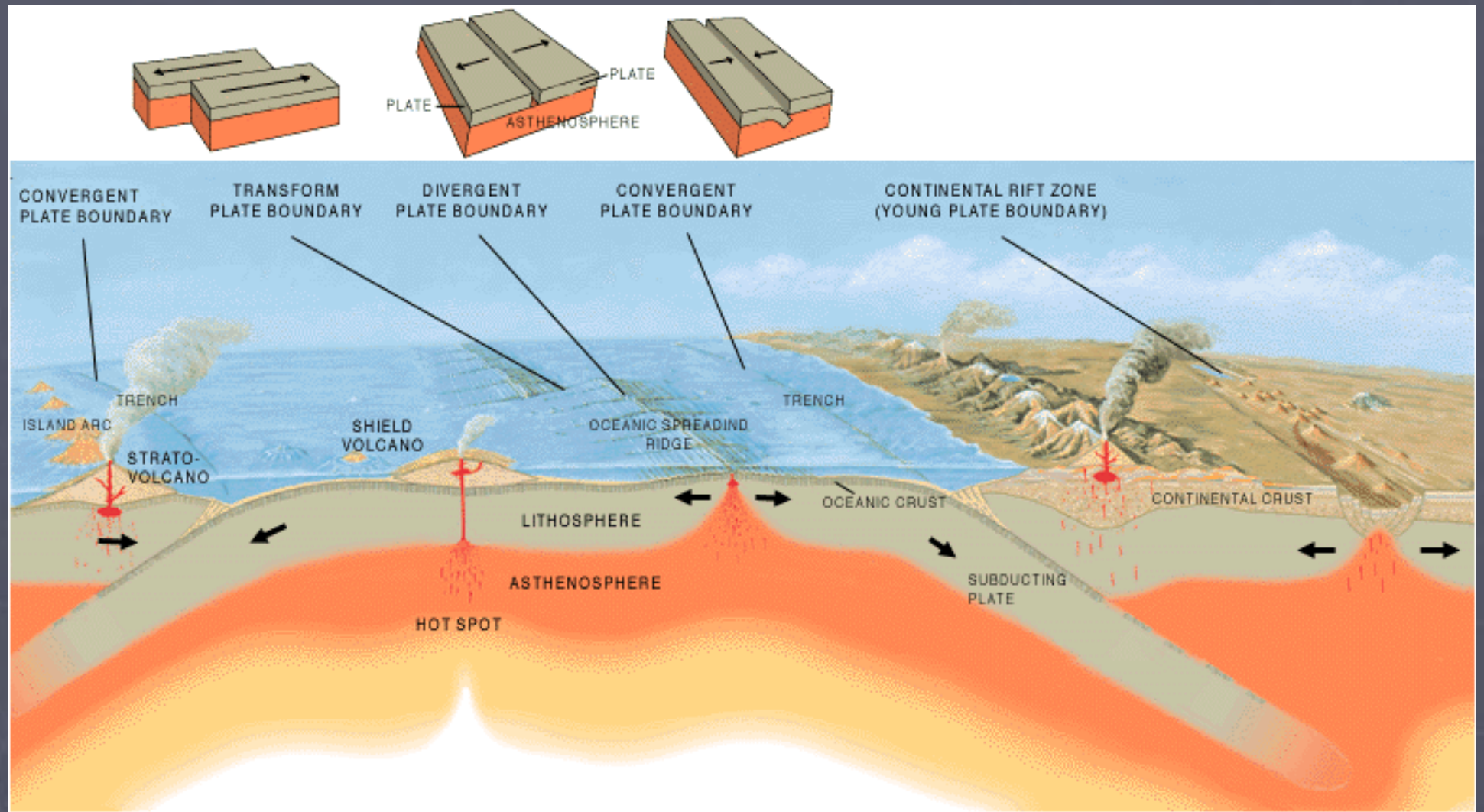
Plate Tectonics



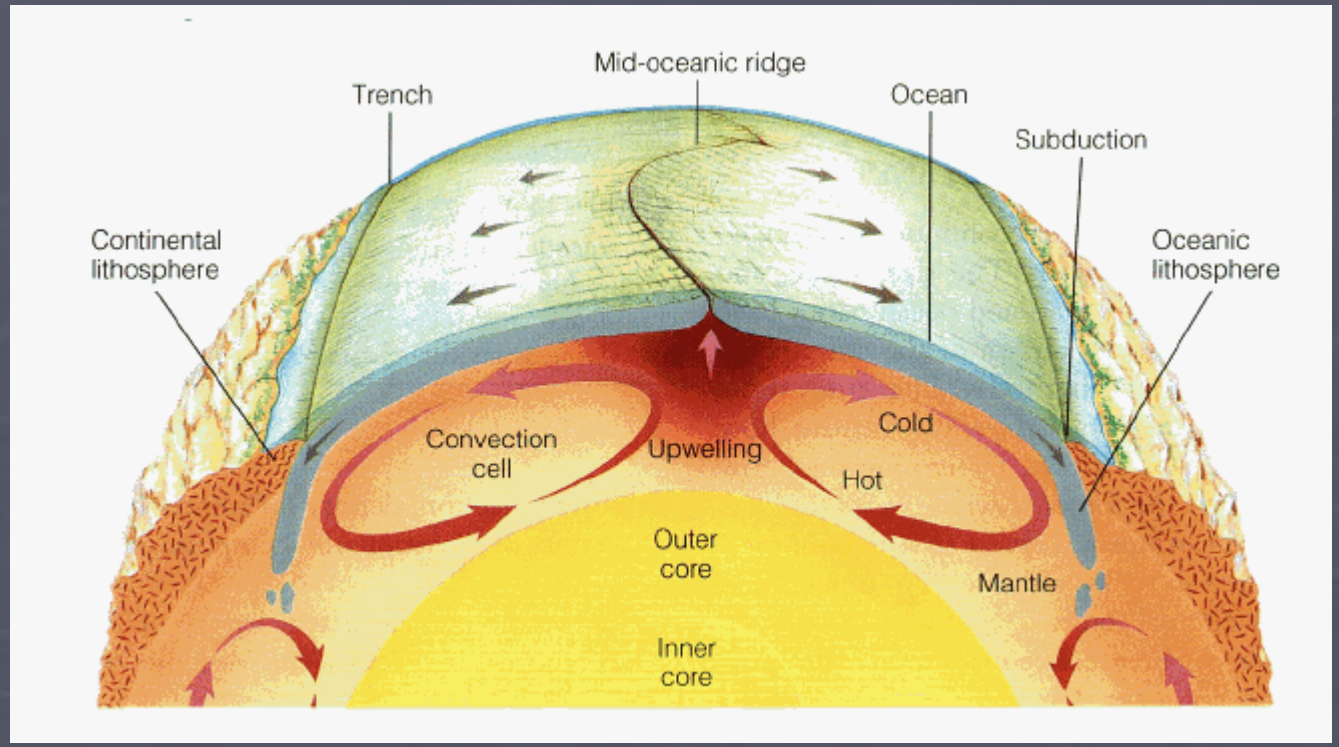
The Process – Plate Movement

- Plates moved by subterranean pressure and movement
  - Convergent Boundaries - Two plates collide causing **subduction**
  - Divergent Boundaries - Plates pulling apart crating rifts
  - Transform Boundaries - Plates moving parallel to one another, not resulting in subduction or separation

Three Types of Plate Boundaries

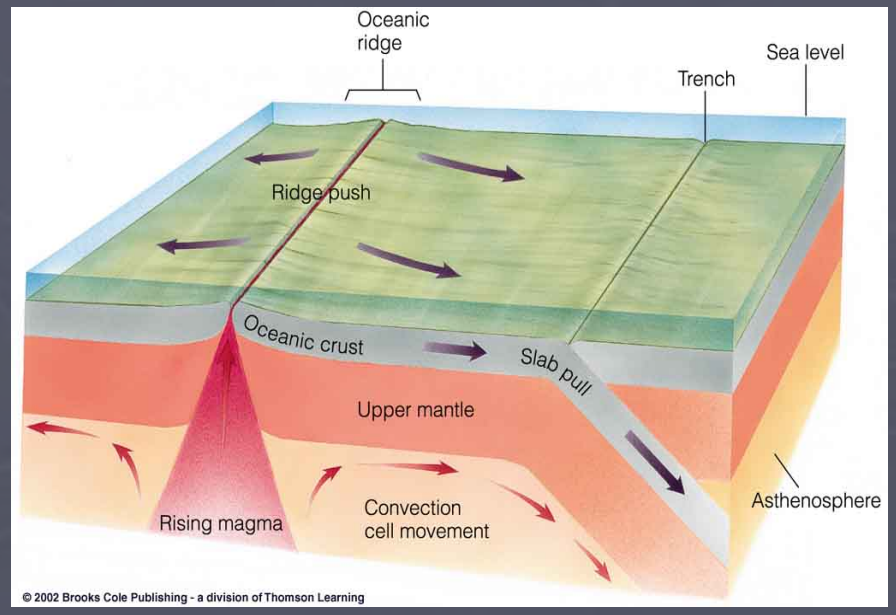


The Process – Earth's Heat

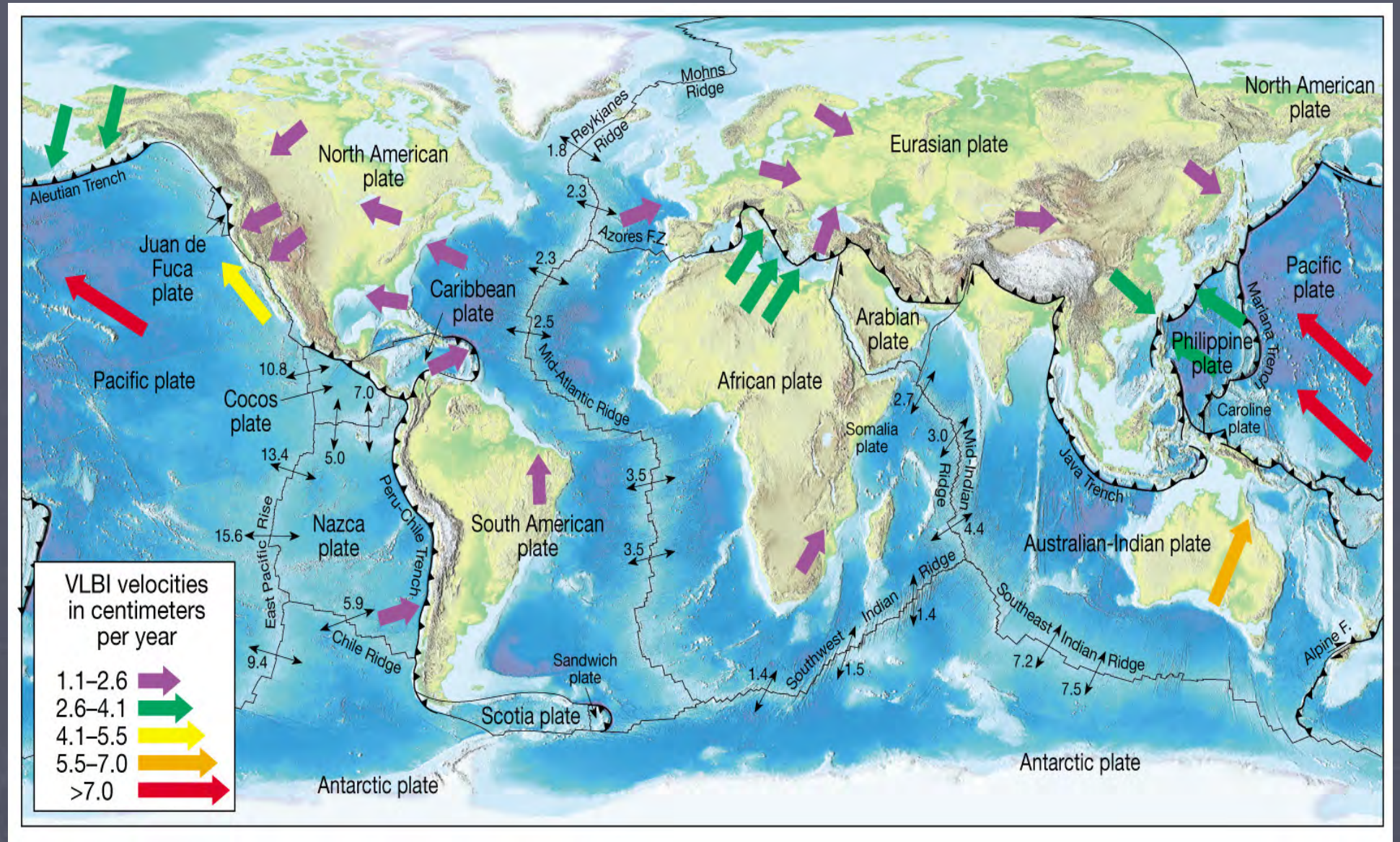


Slab Push and Slab Pull

- **Slab Push** - Rising magma pushes the ridges up and gravity pushes the ocean floor toward the trench
- **Slab Pull** - The slab is cold and dense and pulls the plate



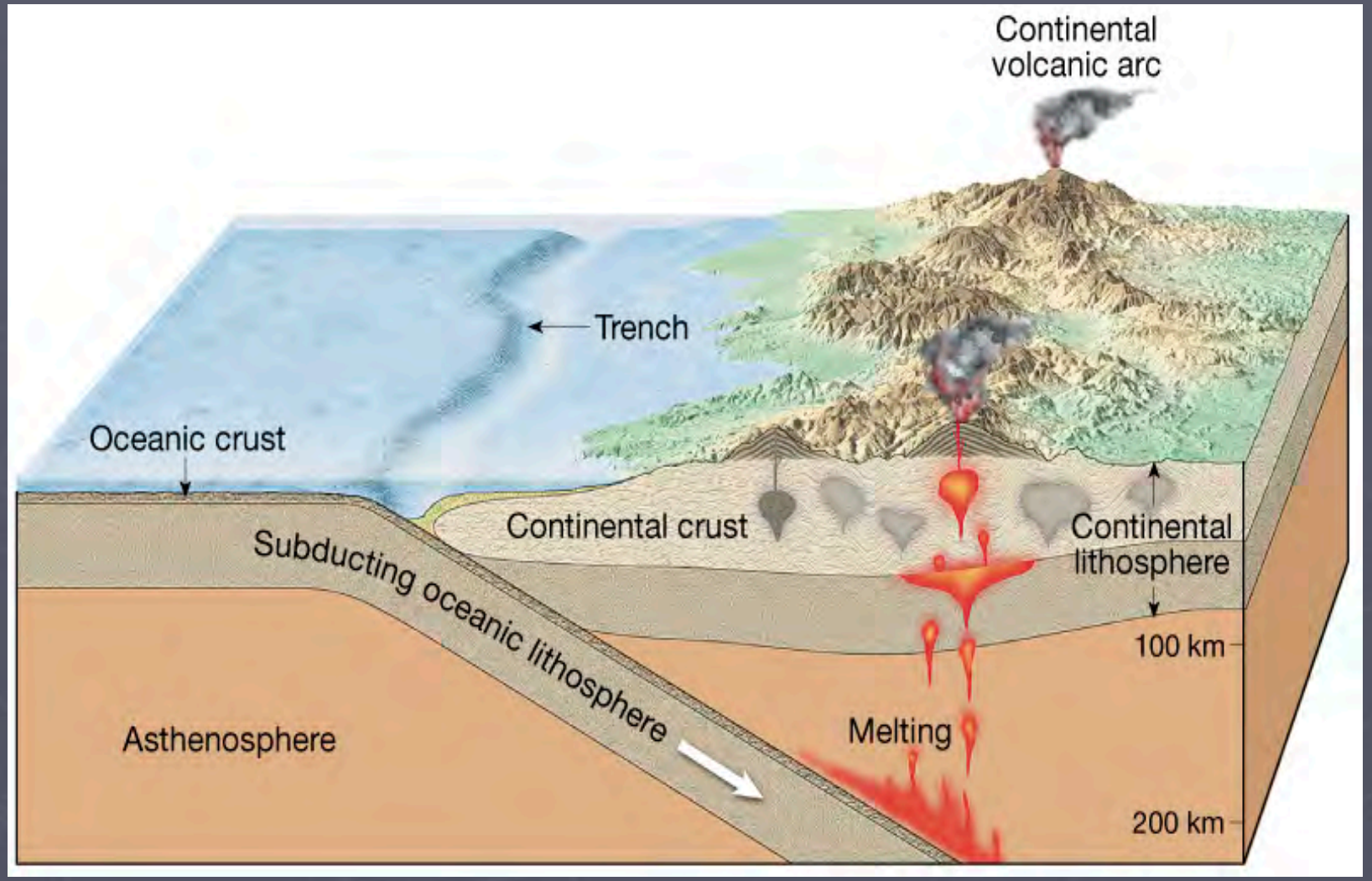
Directions and Rates of Plate Motions



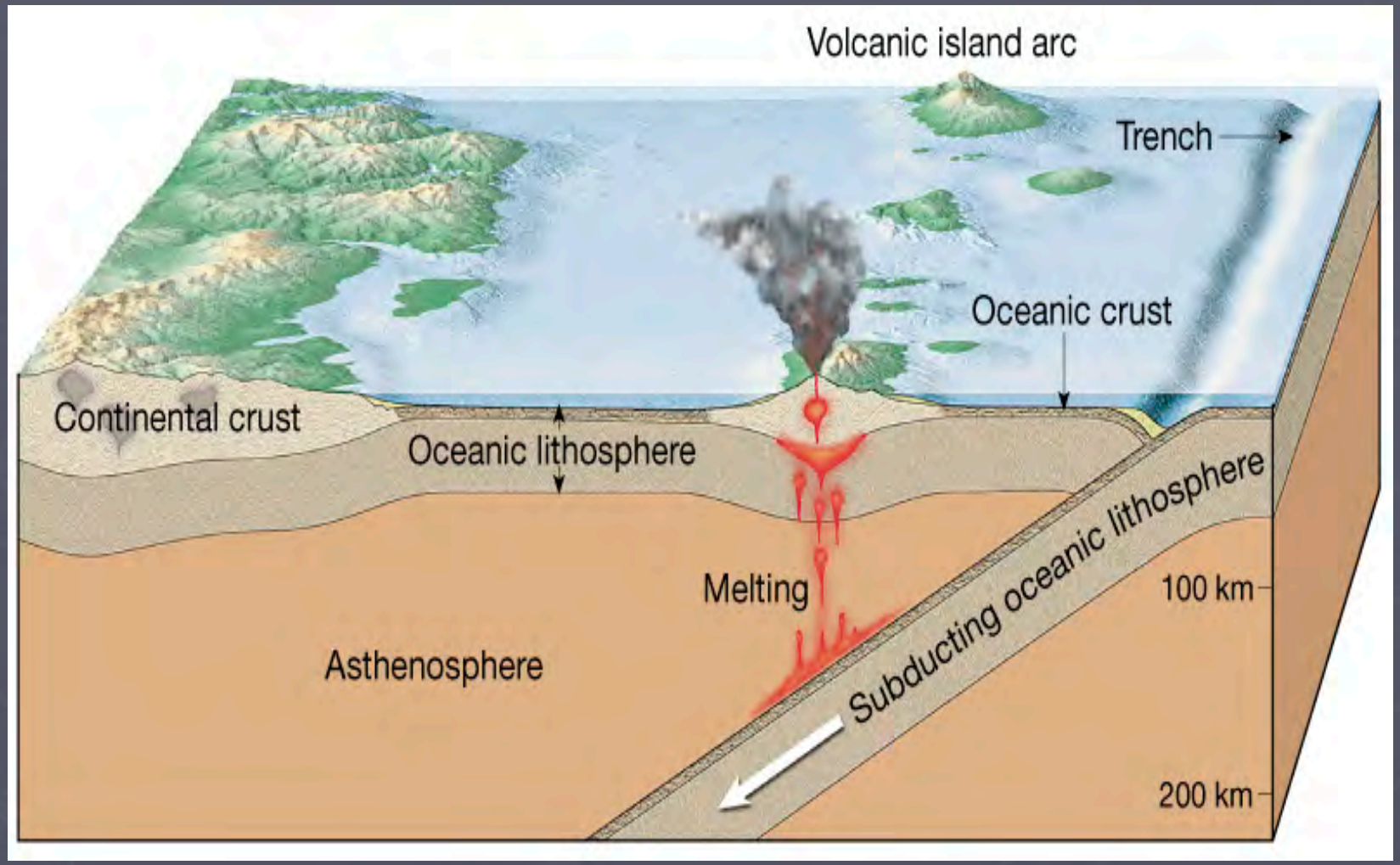
Convergent Boundaries

- Plates come together, an ocean trench forms and lithosphere is subducted into the mantle
  1. Oceanic to Continental Convergence
     - Denser oceanic slab sinks into the asthenosphere, creates coastal mountains
  2. Oceanic to Oceanic Plate Convergence
     - One subducts below the other, volcanic islands form along boundary
  3. Continental to Continental Plate Convergence
     - One subducts below the other, Mountain range form along boundary

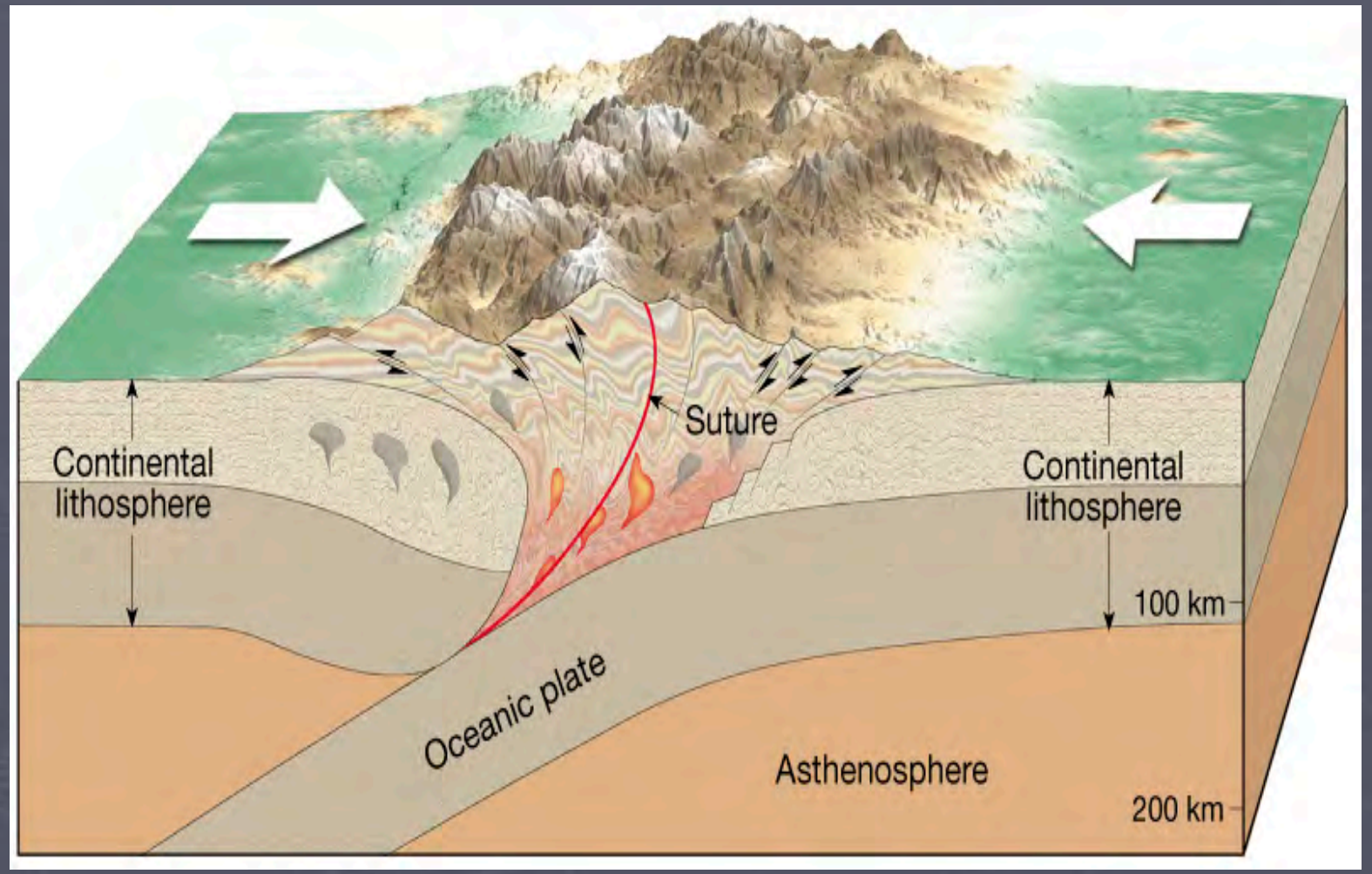
Oceanic-Continental Convergent Plate Boundary



Oceanic-oceanic Convergent Plate Boundary

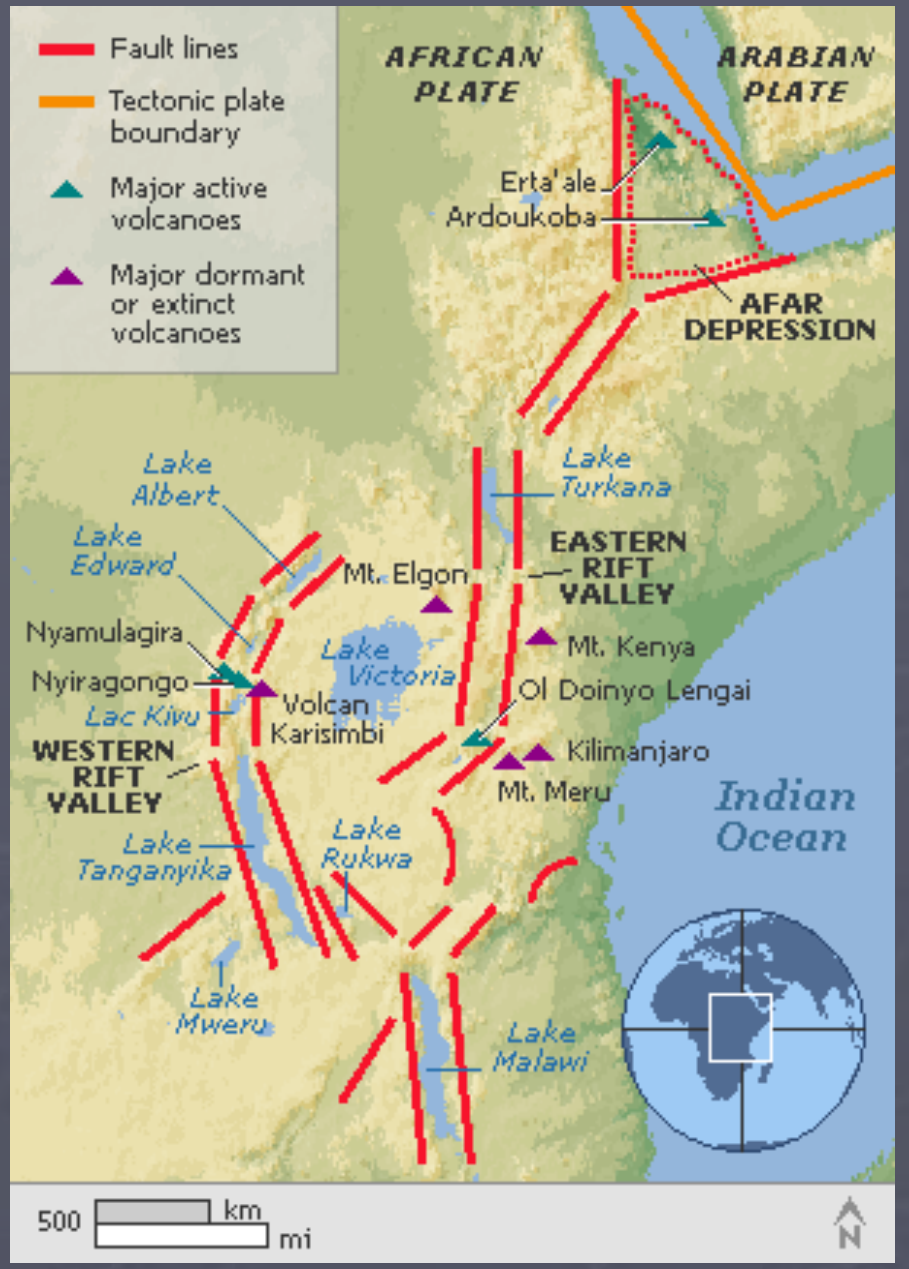


Continental-Continental Convergent Plate Boundary



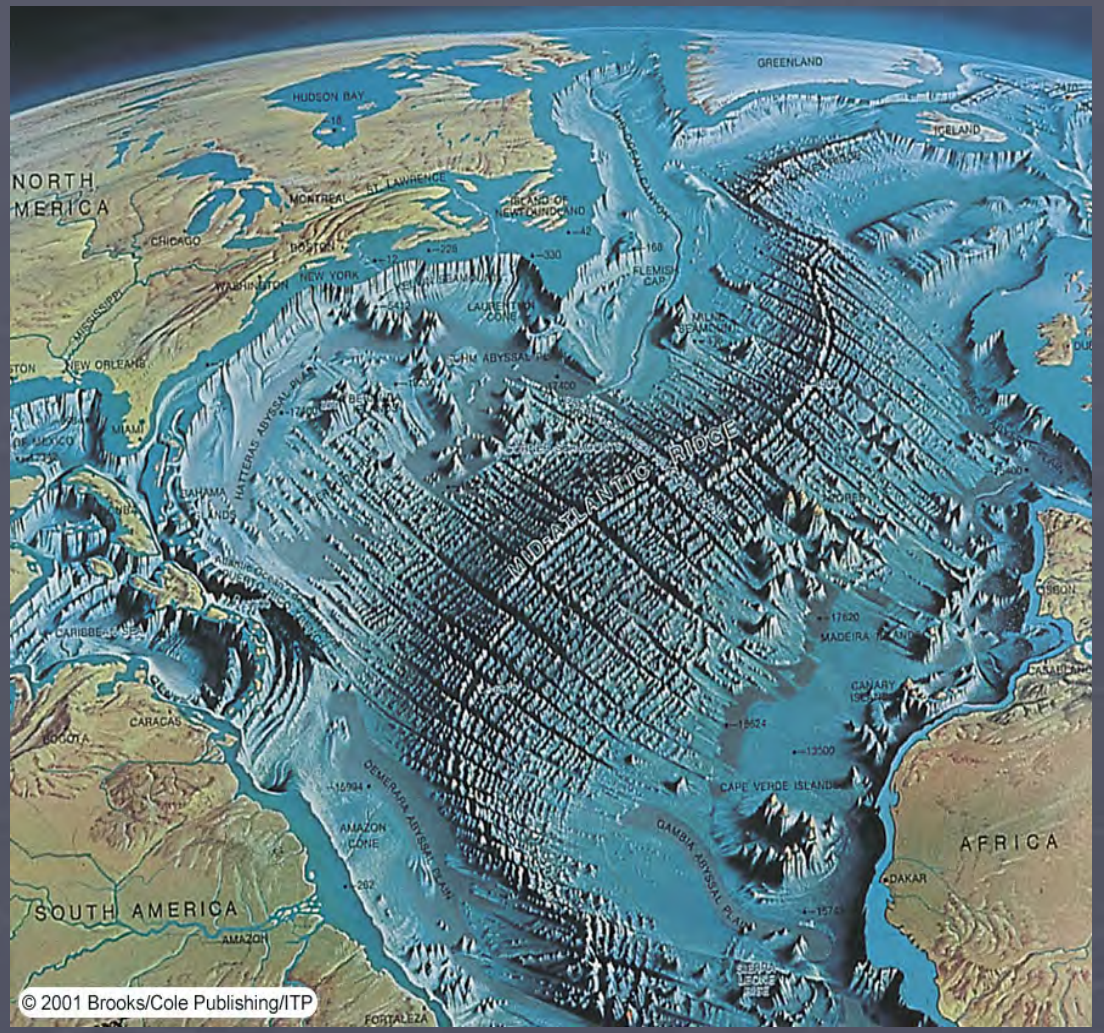
Divergent Boundaries

- Two plates pull apart from one another
- Mantle comes up between and creates new land or seafloor
  - Creates Ocean Ridges



Case Study: Mid-Atlantic Ridge

- Ocean Mapping has discovered Mid-Atlantic Ridge
  - Roughly 10,000 miles long



Case Study: Great Rift/Dead Sea (Jordan)

Case Study: Þingvellir (Iceland)

Transform Boundaries

- Plates move past each other
- Movement shatters rock and leads to many small earthquakes