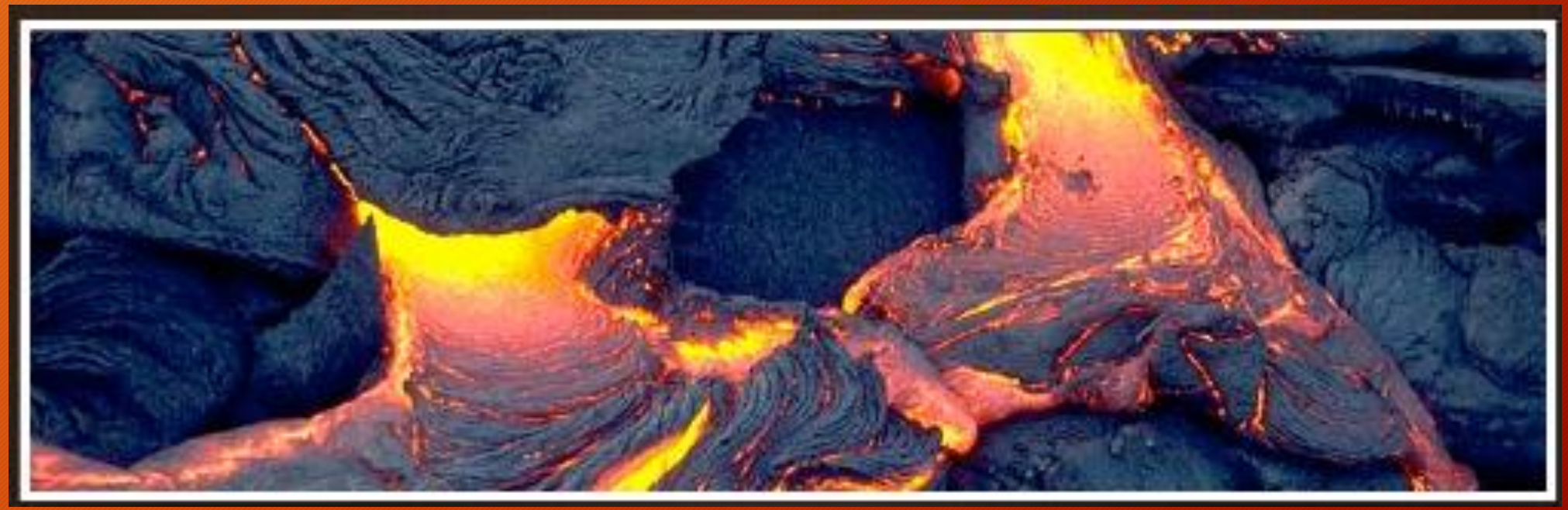
The Dynamic Earth

Unit Topics

- Topic 1: Earth's Interior
- Topic 2: Continental Drift
- Topic 3: Crustal Activity
- Topic 4: Crustal Boundaries
- Topic 5: Earthquakes

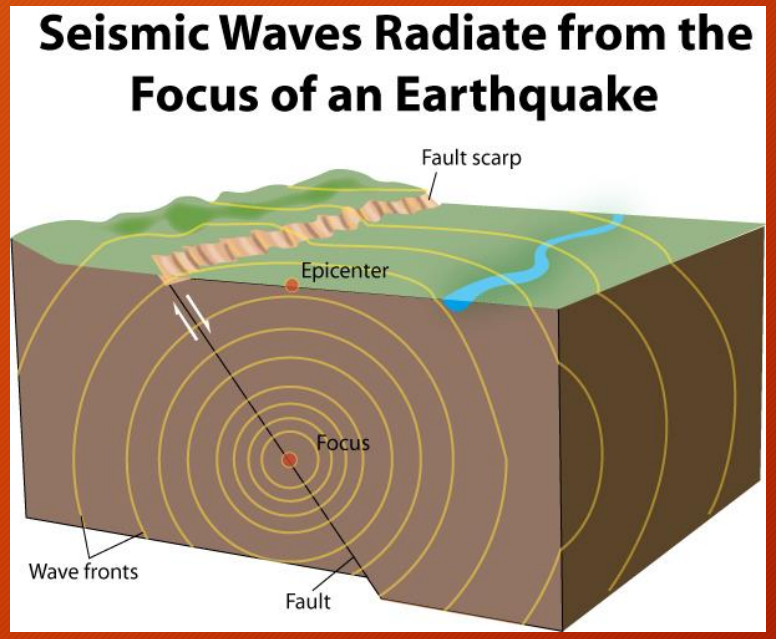
Topic 1: Earth's Interior

- Essential Question: What are the layers and properties of Earth's interior?



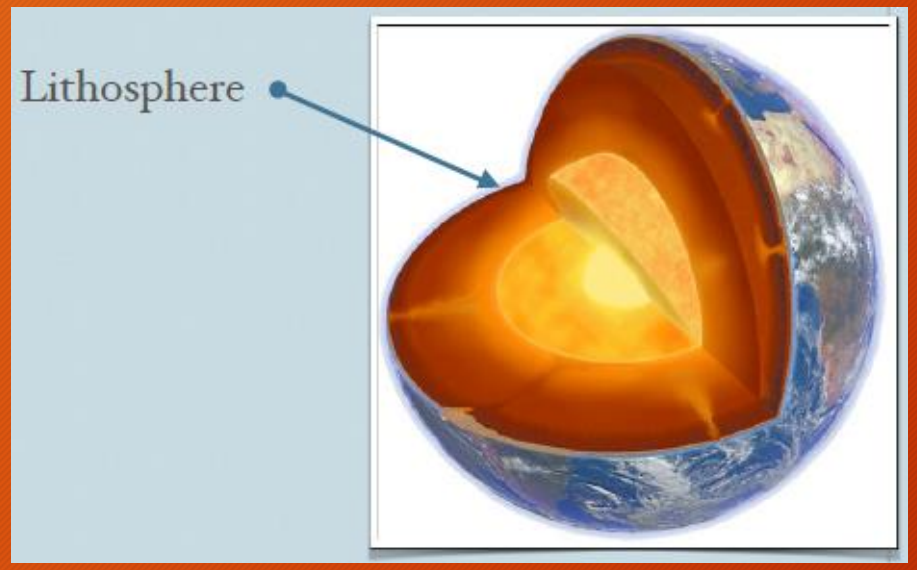
Topic 1: Earth's Interior

- Earth's interior structures are known through the study of seismic waves
- Seismic waves refract, reflect, change velocity, and are absorbed depending on the material they are moving through



Topic 1: Earth's Interior

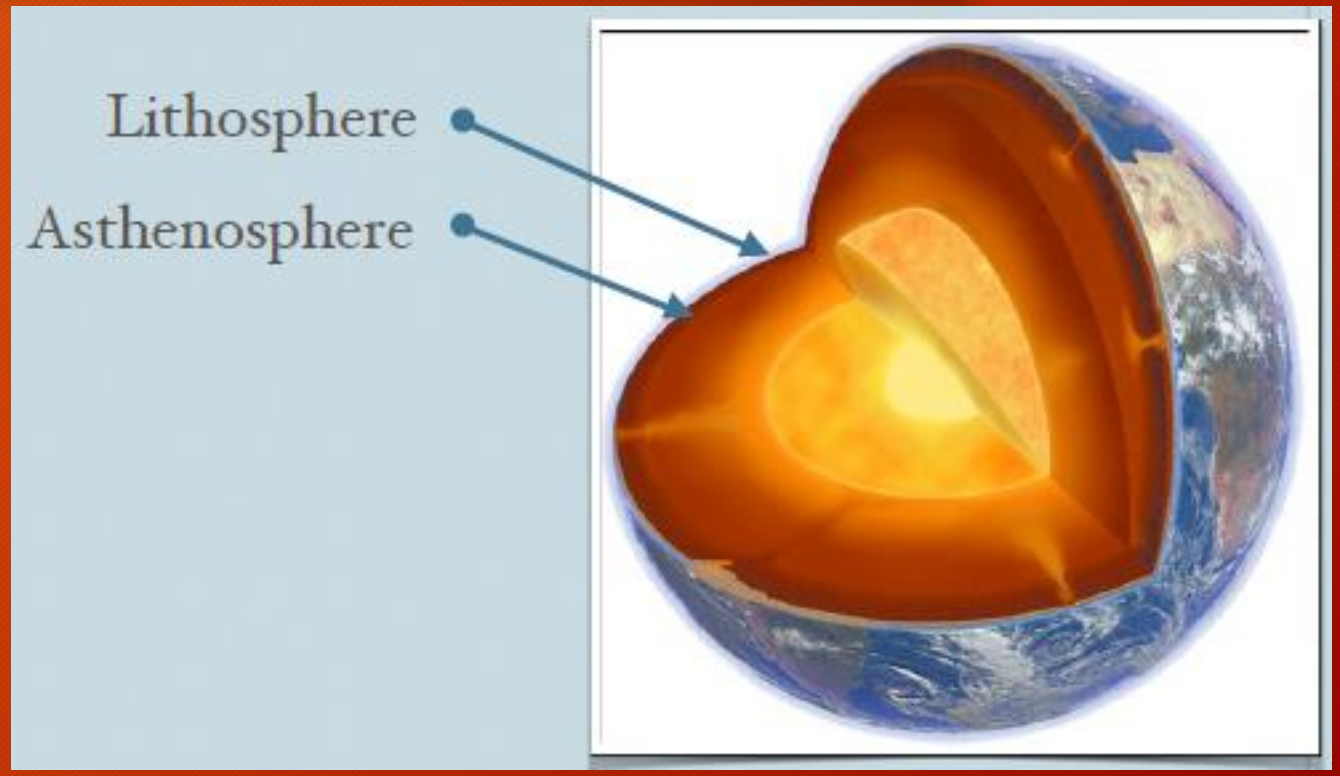
- Lithosphere: Earth's crust and outermost layer
  - Continental Crust: thickest (100km) and least dense (2.7 g/cm^3) part of the lithosphere
  - Oceanic Crust: thinnest (2-3km) and most dense (3.0 g/cm^3) part of the lithosphere



Topic 1: Earth's Interior

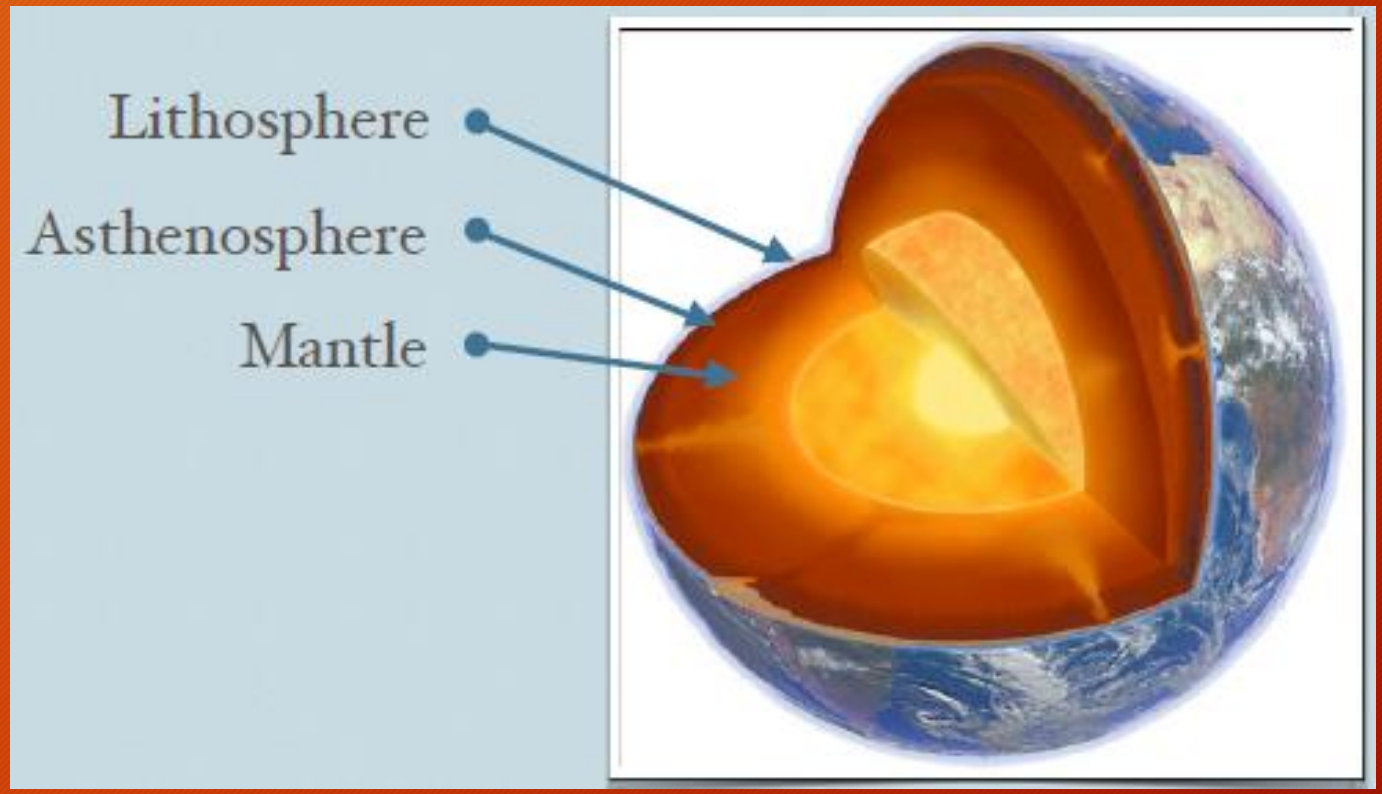
- MOHO: thin boundary separating the lithosphere from the asthenosphere

- Asthenosphere: a partially-melted layer that allows parts of the lithosphere to move
  - Discovery: a decrease in velocity from earthquake waves



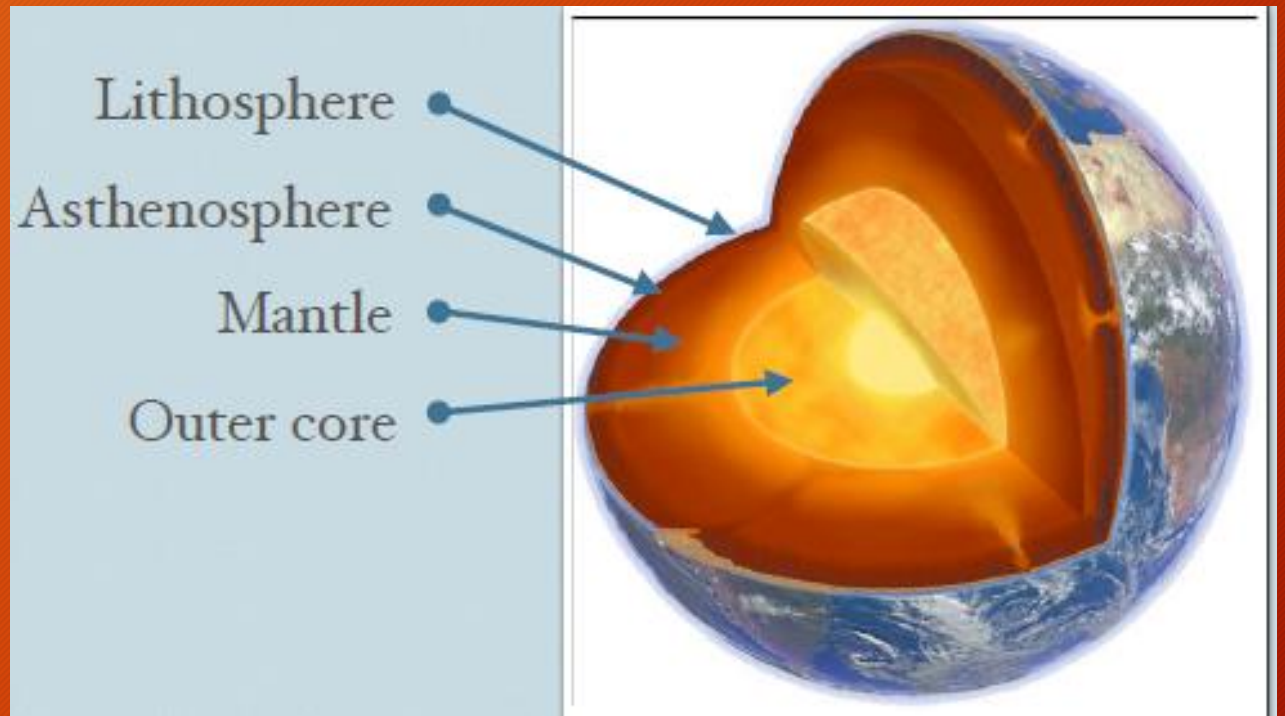
Topic 1: Earth's Interior

- Mantle: thickest part of Earth (80%) between the crust and outer core



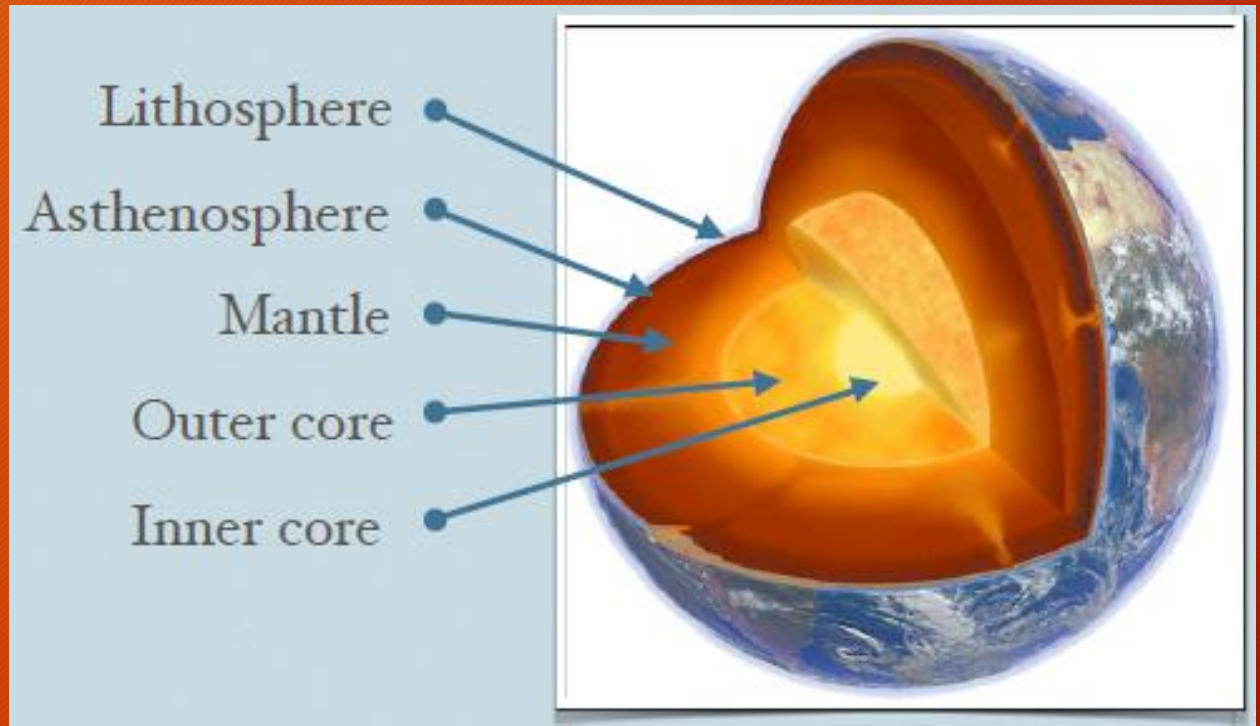
Topic 1: Earth's Interior

- Outer Core: liquid layer of Earth's interior between the mantle and inner core
  - Discovery: absorption and refraction of earthquake waves



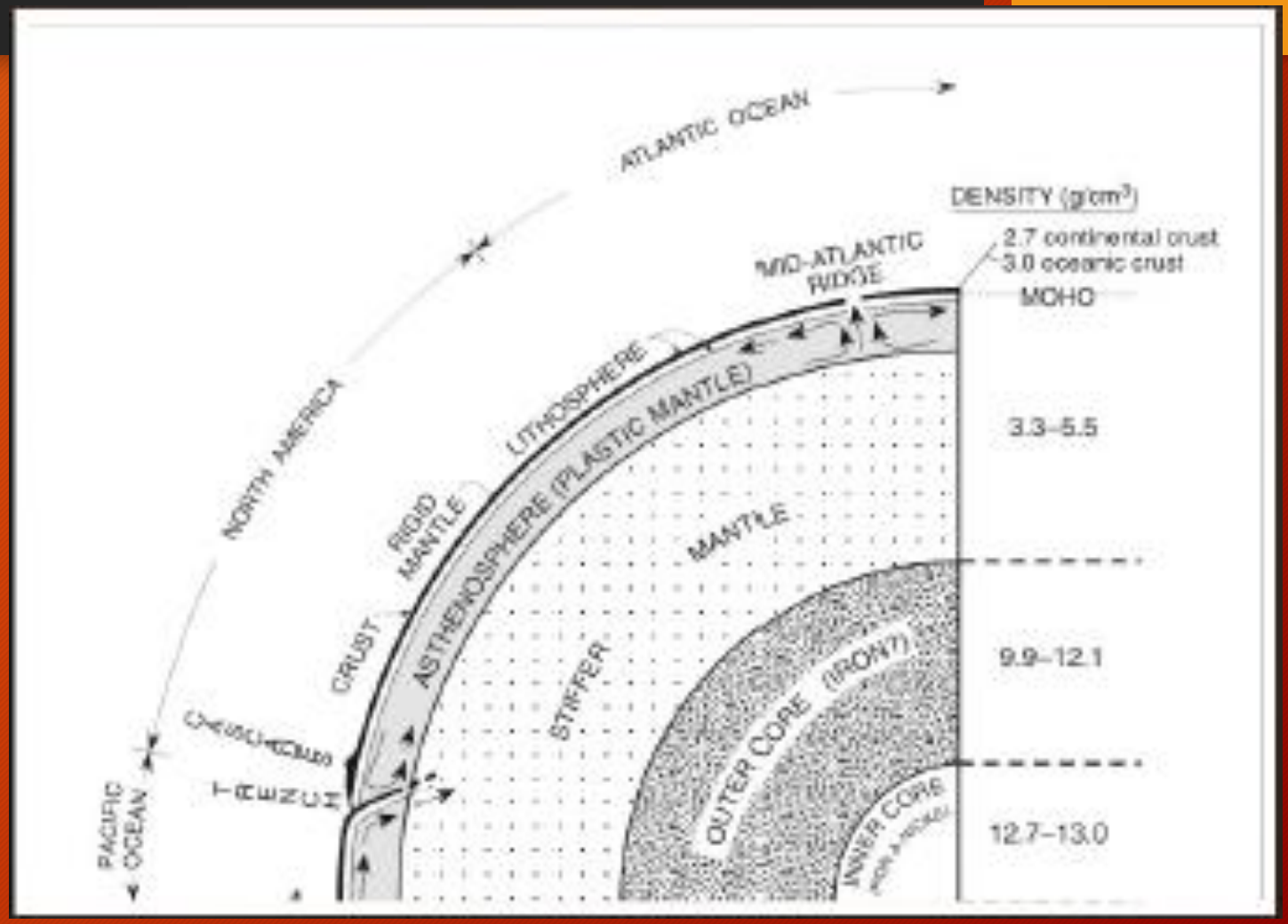
Topic 1: Earth's Interior

- Inner Core: solid innermost layer of Earth's core; composed of iron (Fe) and nickel (Ni)
  - Discovery: an increased velocity of earthquake waves



Topic 1: Earth's Interior

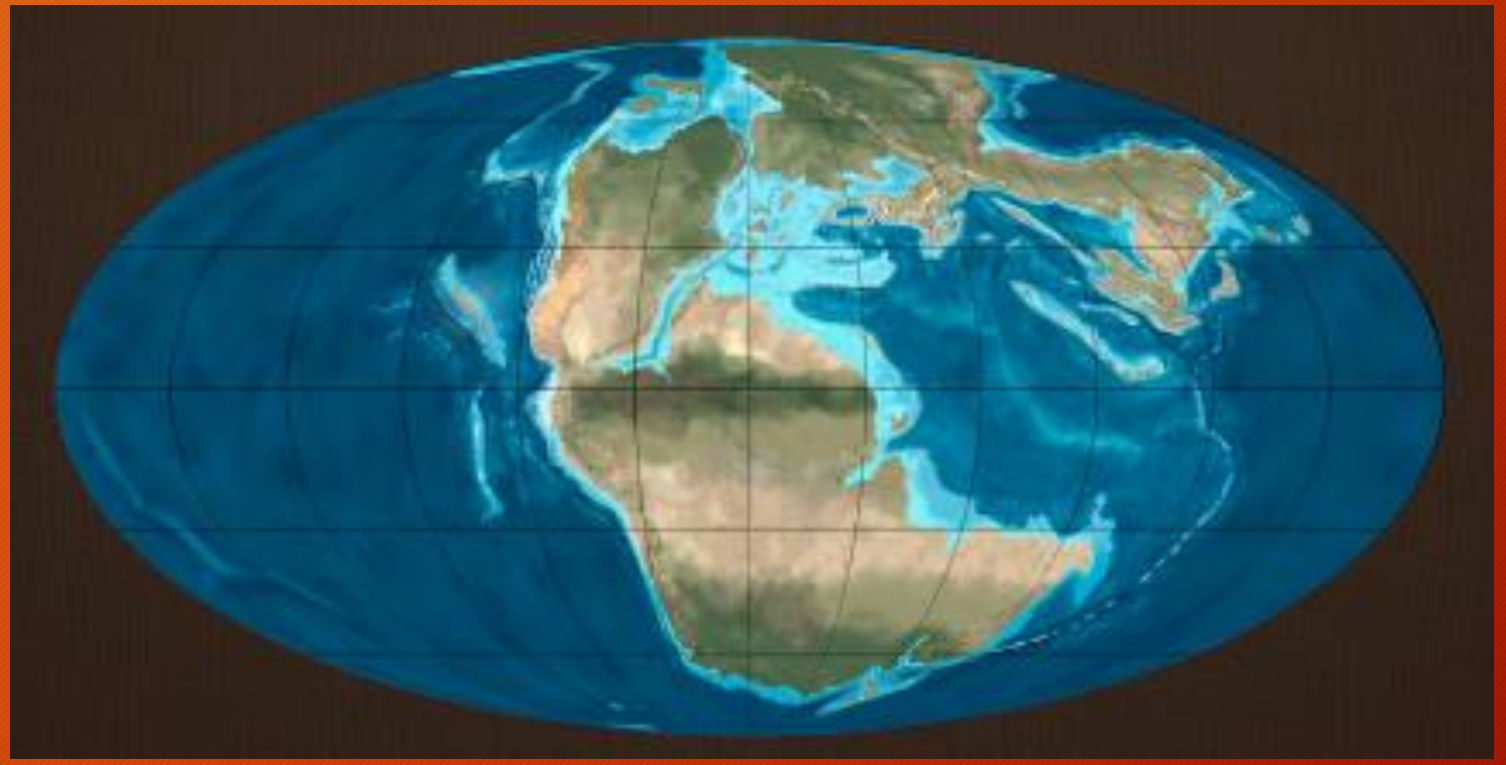
- Notes pg. 9: Color-code each layer of Earth's interior
  - Crust/Lithosphere: Green
  - Asthenosphere (Plastic Mantle)/Stiffer Mantle: Orange
  - Outer Core: Red
  - Inner Core: Purple



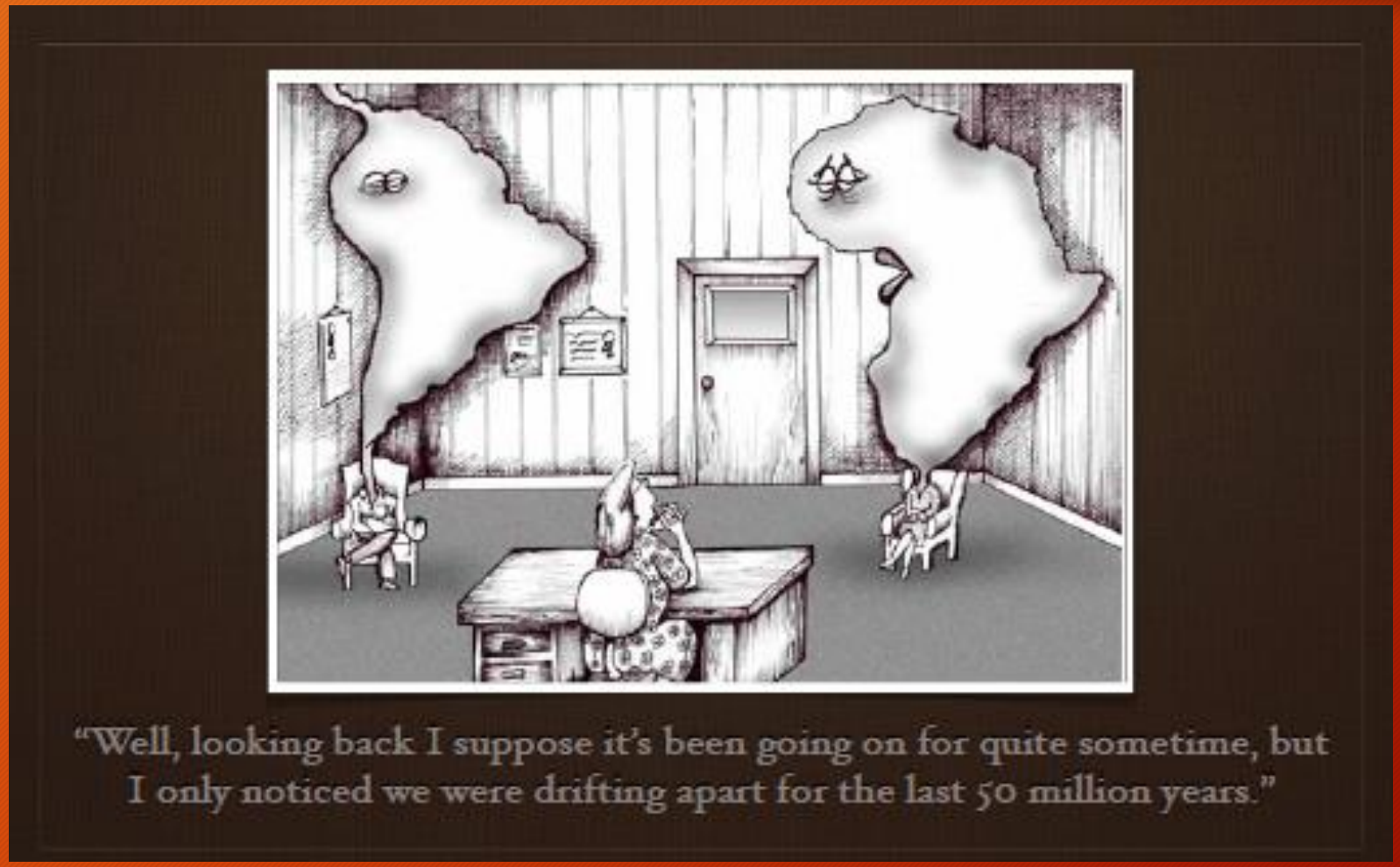
Questions?

Topic 2: Continental Drift

- Essential Question: What is continental drift?



Topic 2: Continental Drift



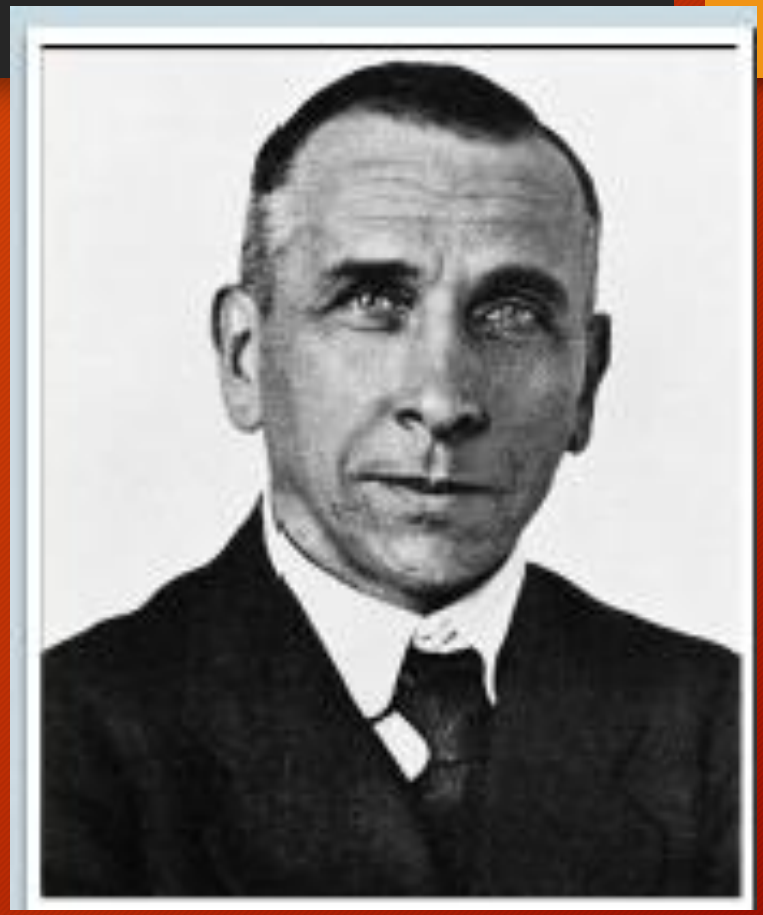
Topic 2: Continental Drift

- Continental Drift: the theory that all continents were once a single landmass and have since drifted apart
- Pangaea: aka “all Earth”; super-continent that existed 200 million years ago

Topic 2: Continental Drift

Alfred Wegener

- German geologist and meteorologist
- Proposed the theory of continental drift
- Hypothesized a gigantic super-continent



Topic 2: Continental Drift

- Evidence of Continental Drift:
  1. Similarities in the shape of Africa's west coast and South America's east coast

Topic 2: Continental Drift

- Evidence of Continental Drift:
  2. Fossil remains of the Mesosaurus in South America and South Africa

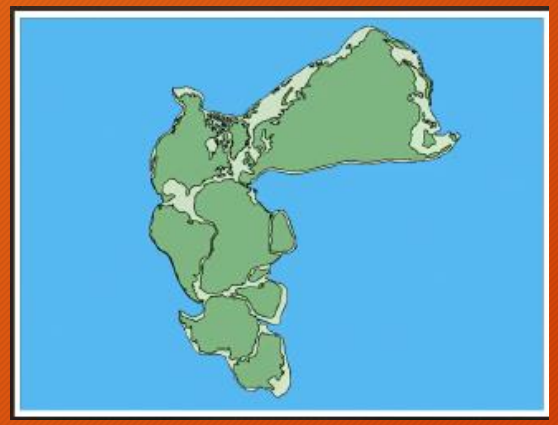
Topic 2: Continental Drift

- Evidence of Continental Drift:
  3. Fossil remains of the Glossopteris in India, South America, Africa, & Antarctica

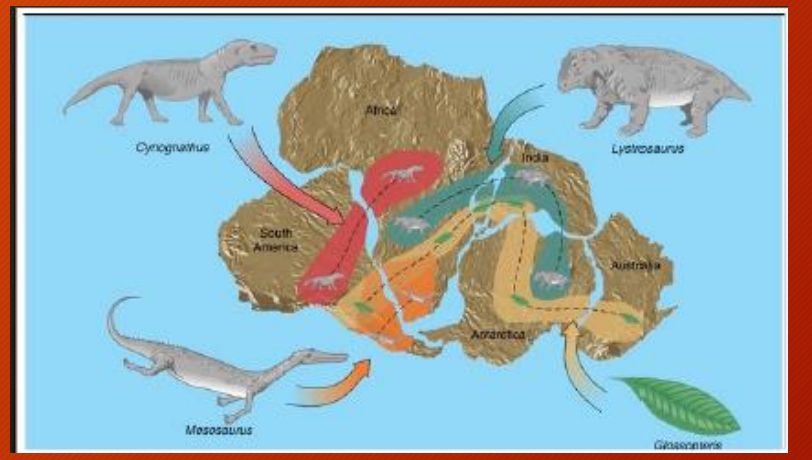
Topic 2: Continental Drift REVIEW

- What are the main pieces of evidence that support continental drift?

(1) Continent Shapes



2) Rock & Fossil Evidence



- Brainstorm: What do YOU think might have been the main problem people had with Wegener's theory of continental drift?

No answer/explanation for WHY the plates are moving!!

Questions?

Topic 3: Crustal Activity

- Essential Question: What are plate tectonics and how do they affect Earth?

Topic 3: Crustal Activity

- Plate Tectonics: the study of the formation and movement of plates
- Plates: sections of Earth's lithosphere that move around
- Lithosphere: Earth's solid outer crust
- Asthenosphere: Partially-melted layer below the lithosphere that moves slowly

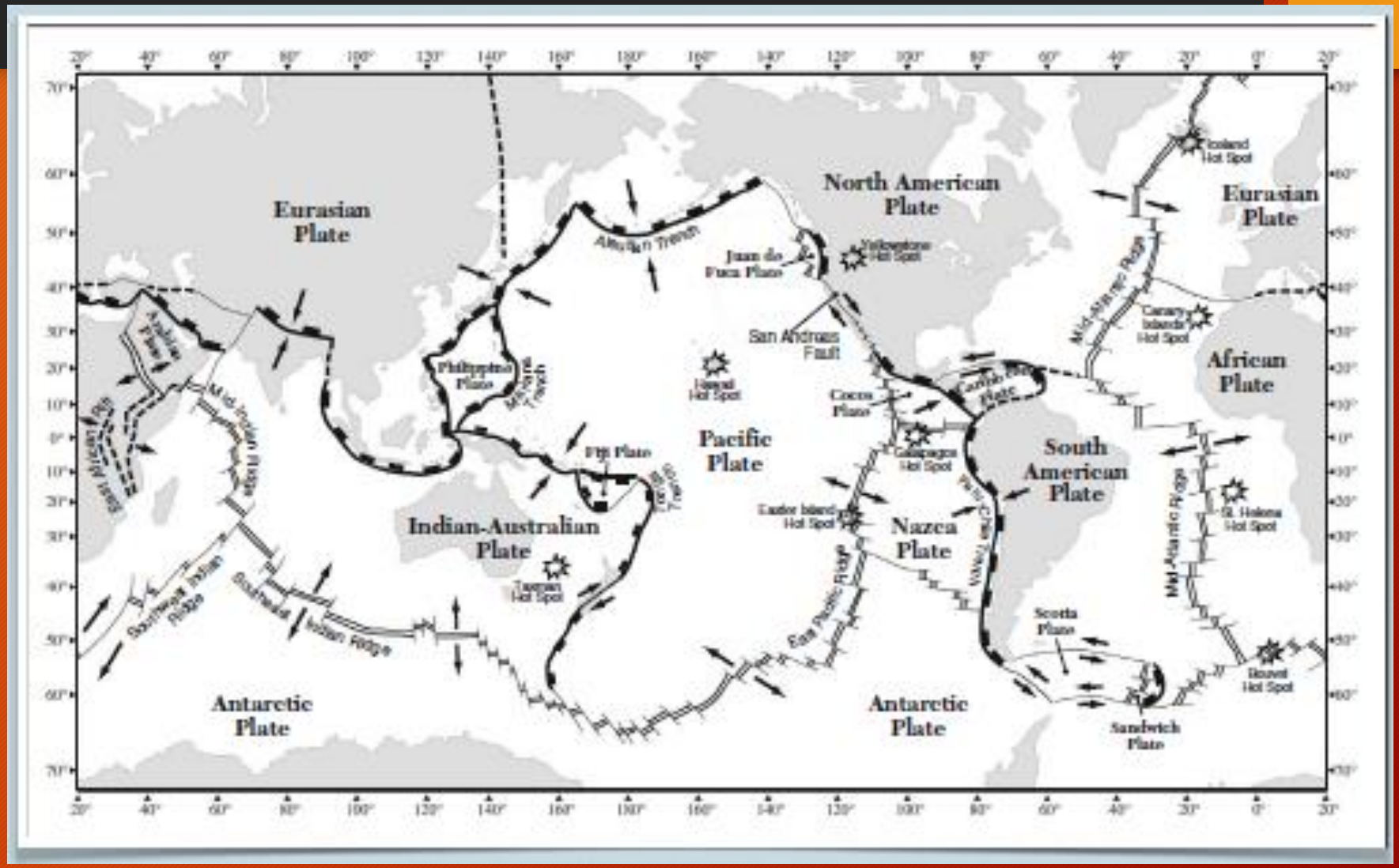
Topic 3: Crustal Activity

- Earth's surface consists of a dozen major plates & some minor ones
- The plates are moving at rates close to 10 cm/year

Topic 3: Crustal Activity

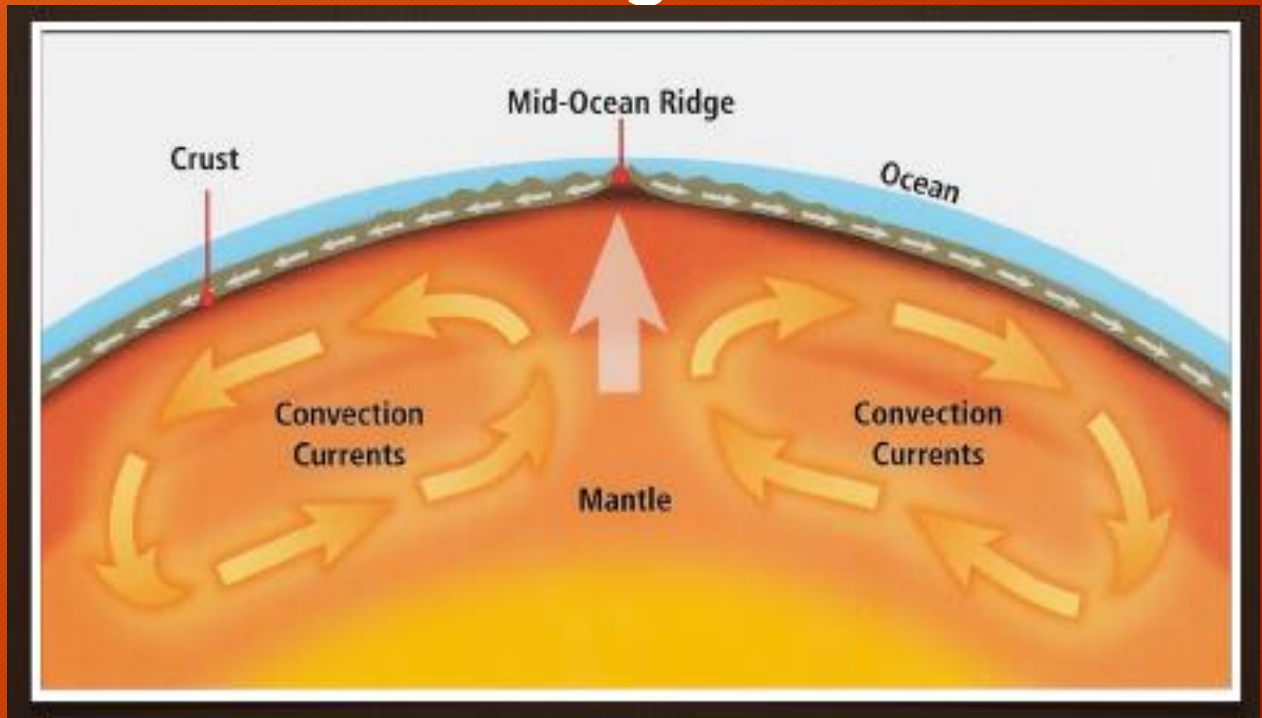
Topic 3: Crustal Activity

Circle **AND** number **ALL** of the plates in your notes. Can you find ALL of them?



Topic 3: Crustal Activity

- Convection Currents: driving force of plate movement
  - Magma heats up causing it to expand and rise
  - Magma cools down causing it to contract and sink



Topic 3: Crustal Activity

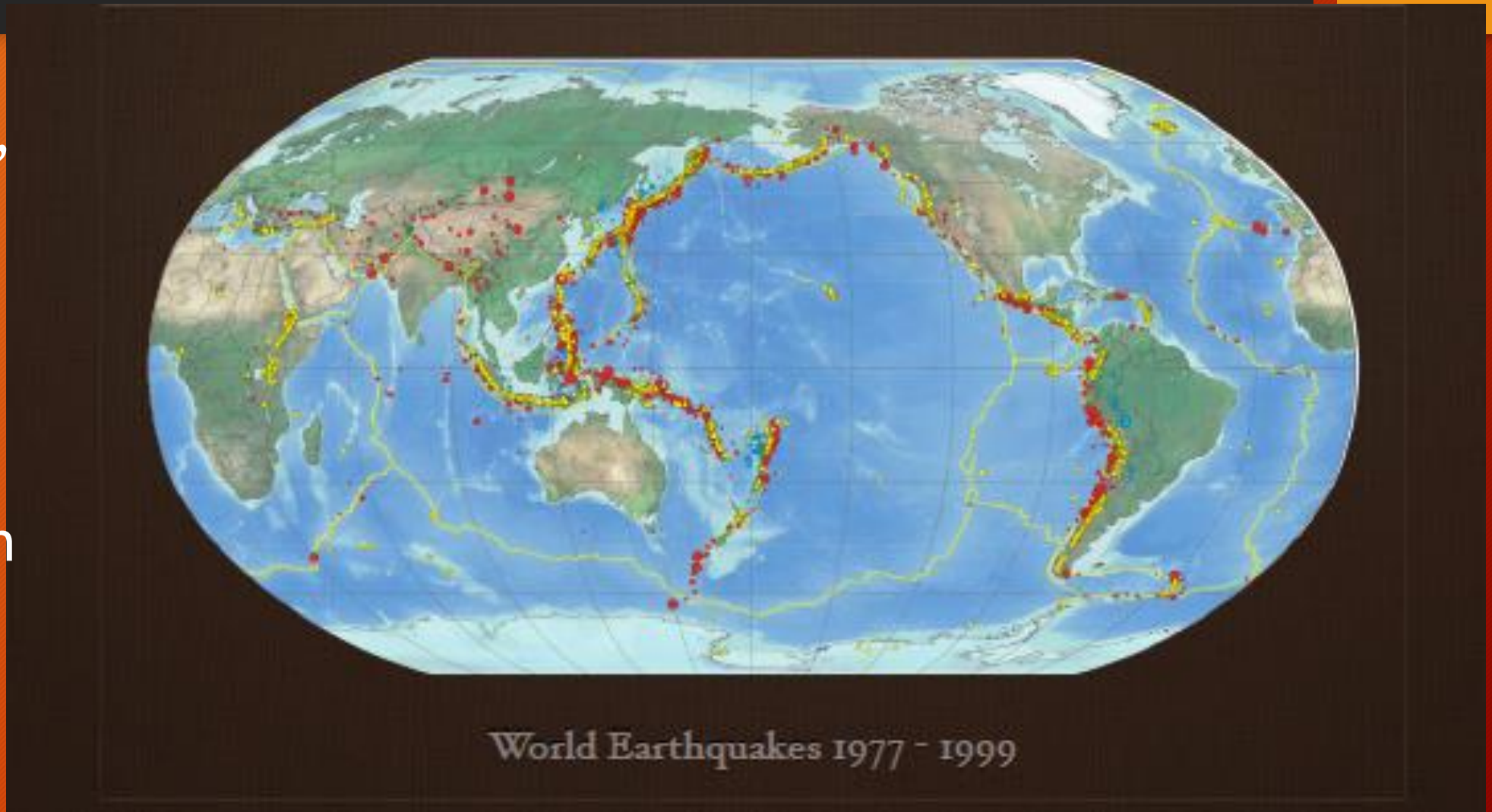
- The plates (solid lithosphere) are moving on top of the asthenosphere (liquid magma) due to density differences
- The idea of continental drift has been around since the 1900's, but lacked enough scientific evidence to support the theory
- New advancements after World War II helped provide the evidences needed to validate the Theory of Plate Tectonics

Topic 3: Crustal Activity

- Earthquake Evidence
  - Scientists noticed that earthquakes do not occur at random locations, but throughout the world along isolated belts
  - When plotted on a map they outline the plate boundaries

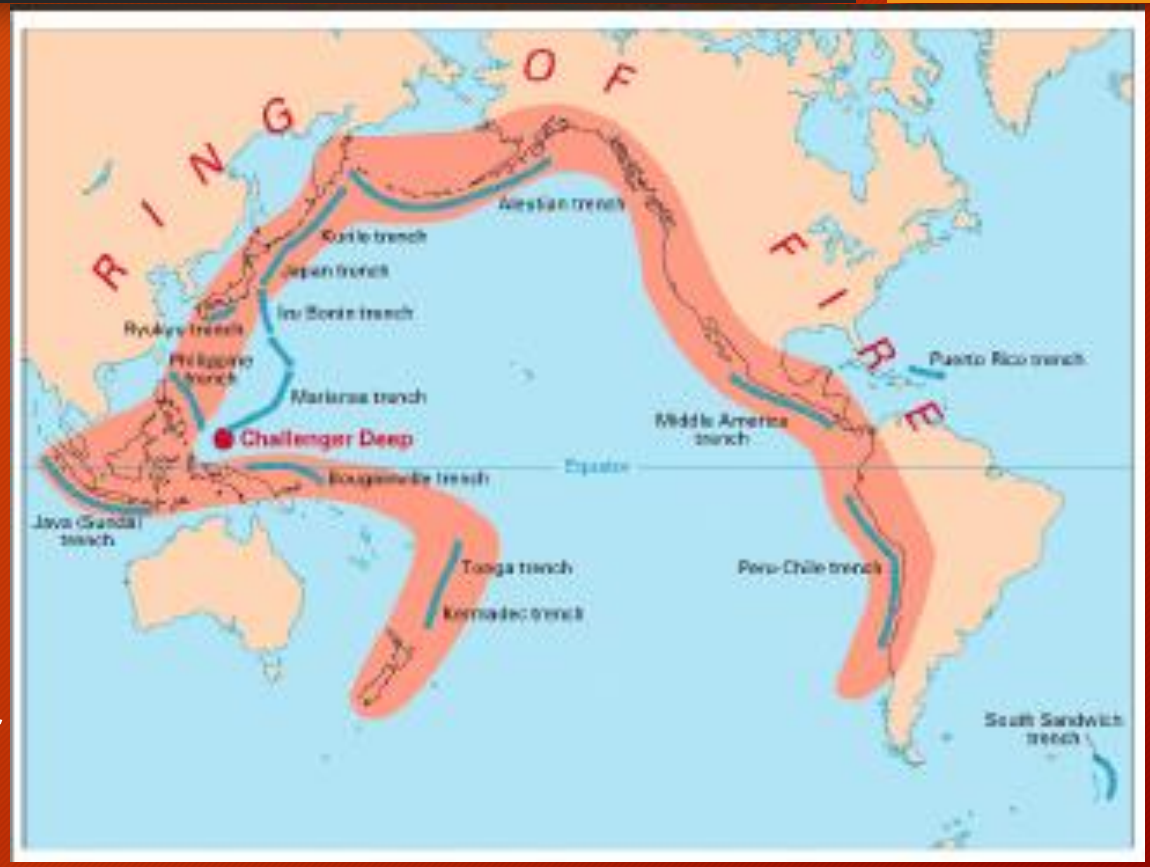
Topic 3: Crustal Activity

In your notes, highlight where earthquakes occur using a red colored pencil/crayon



Topic 3: Crustal Activity

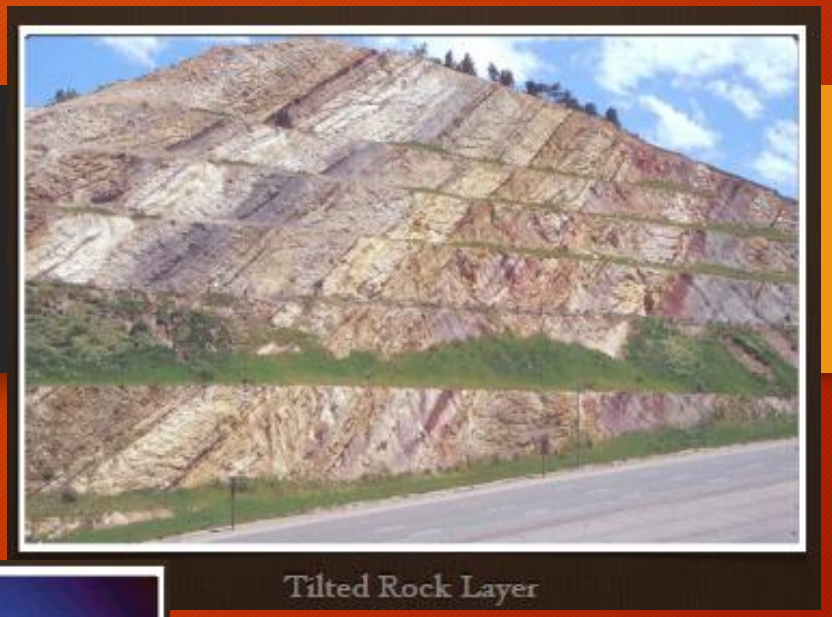
- Volcanic Evidence
  - Occurs at plate boundaries where plates are interacting
  - Ring of Fire: isolated belt around the Pacific Ocean where 90% of the world's volcanoes exist



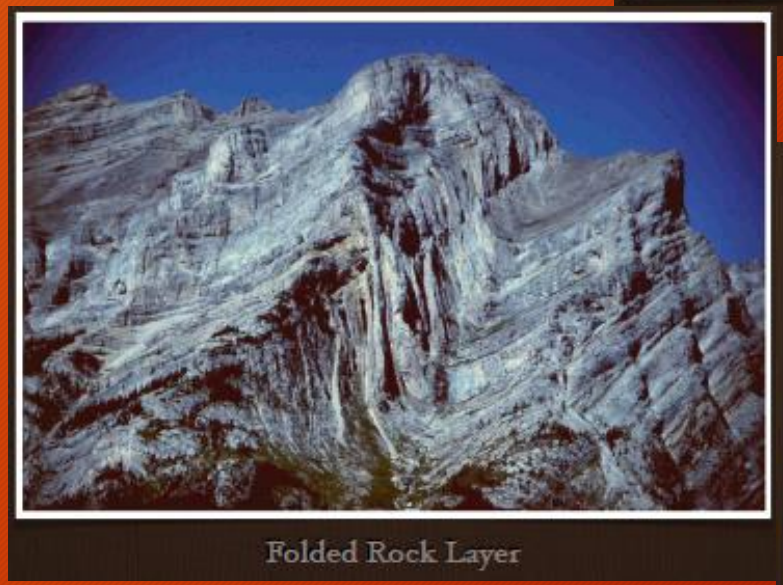
In your notes, highlight and label the "Ring of Fire" using a red colored pencil/crayon

Topic 3: Crustal Activity

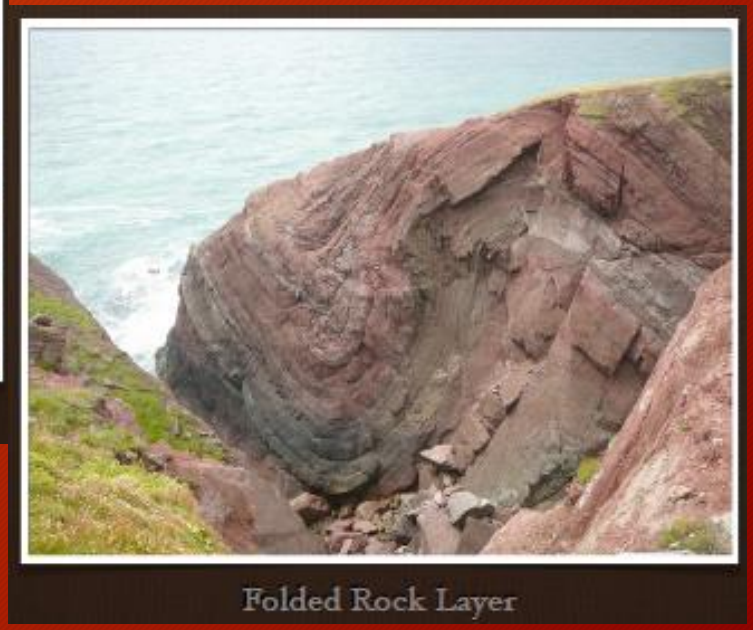
- Rock Evidence
  - Sedimentary deposits and igneous lava flows are usually placed down in horizontal layers
  - Sometimes movement along boundaries causes these layers to tilt /// or fold www



Tilted Rock Layer



Folded Rock Layer



Folded Rock Layer

Topic 3: Crustal Activity

- Mountain Evidence
  - As plates collide they sometimes are pushed upward
  - Fossilized marine organisms can be found at high altitudes in rocks

Questions?

Topic 4: Crustal Boundaries

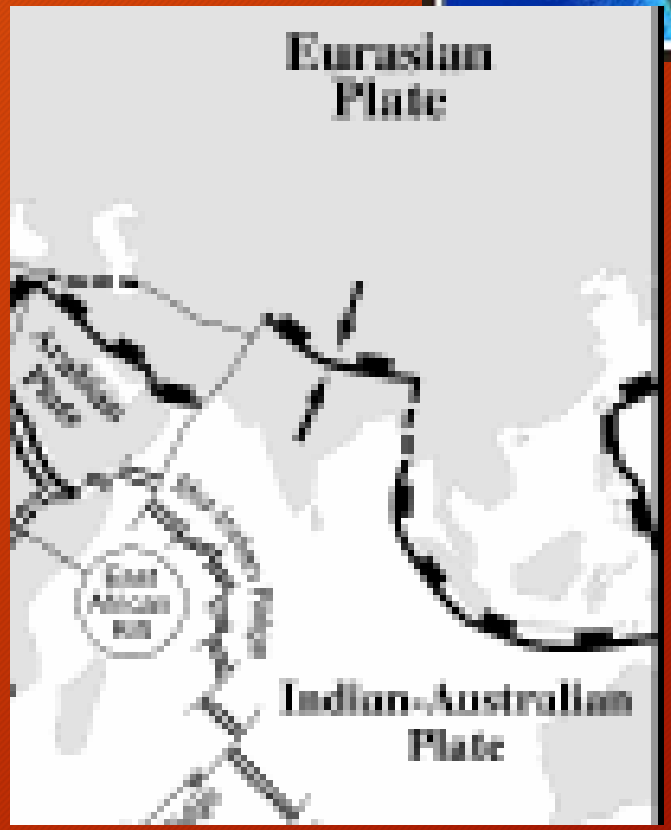
- Essential Question: How do plates interact at their boundaries?

Topic 4: Crustal Boundaries

- Tectonic plates are constantly moving and interacting
- As they move across the asthenosphere and form plate boundaries, they interact in various ways
- Types of plate boundaries:
  - Convergent →←
  - Divergent ←→
  - Transform ↑↓

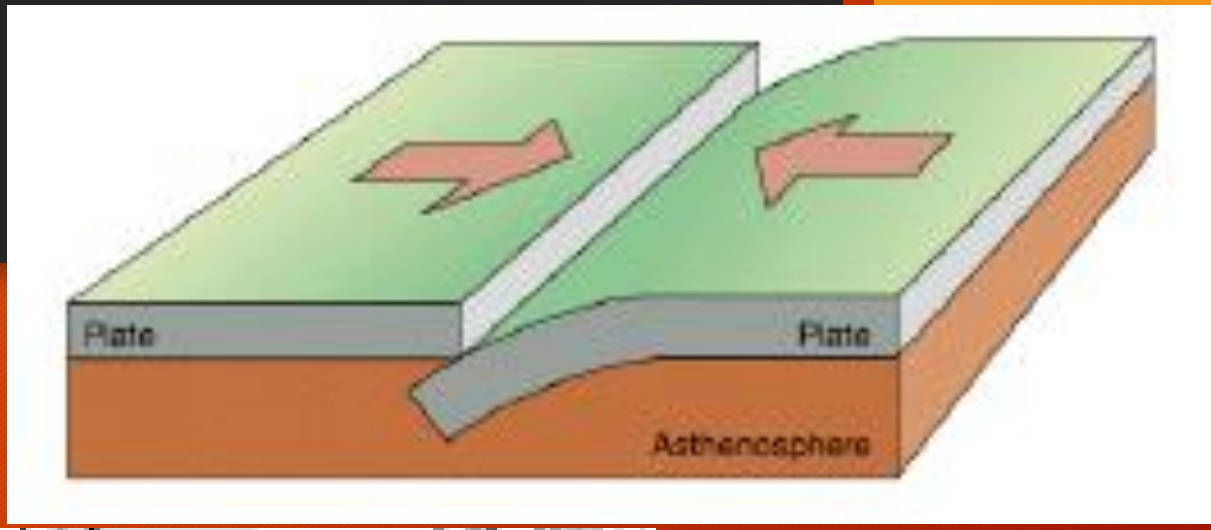
Topic 4: Crustal Boundaries

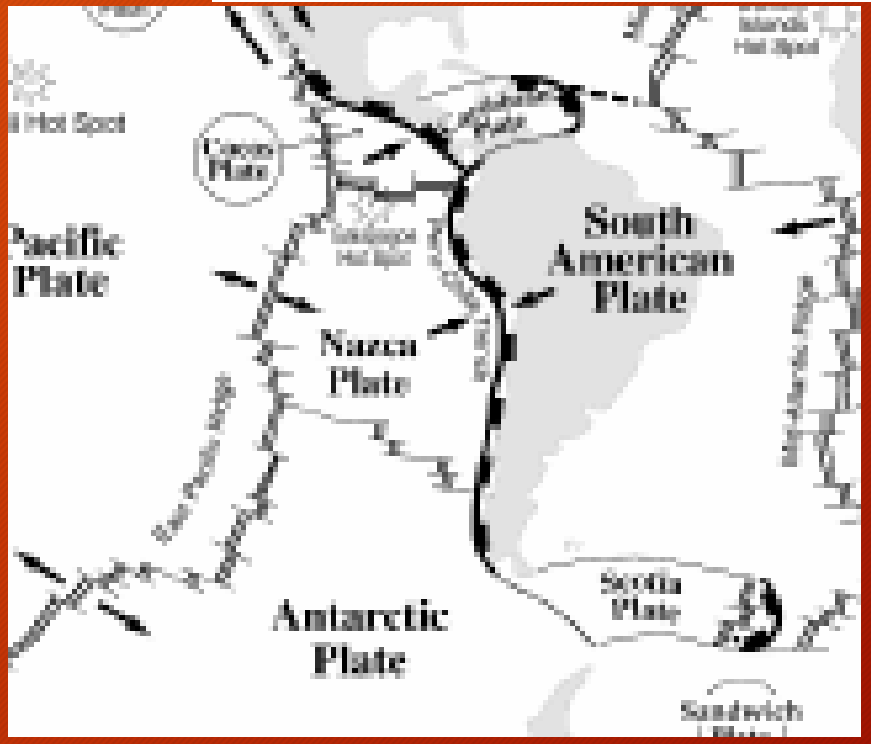
- Convergent Boundary: boundary where 2 lithospheric plates are coming together
  - Example: the India plate pushing upward into Eurasian Plate and creating the Himalayan Mountains



Topic 4: Crustal Boundaries

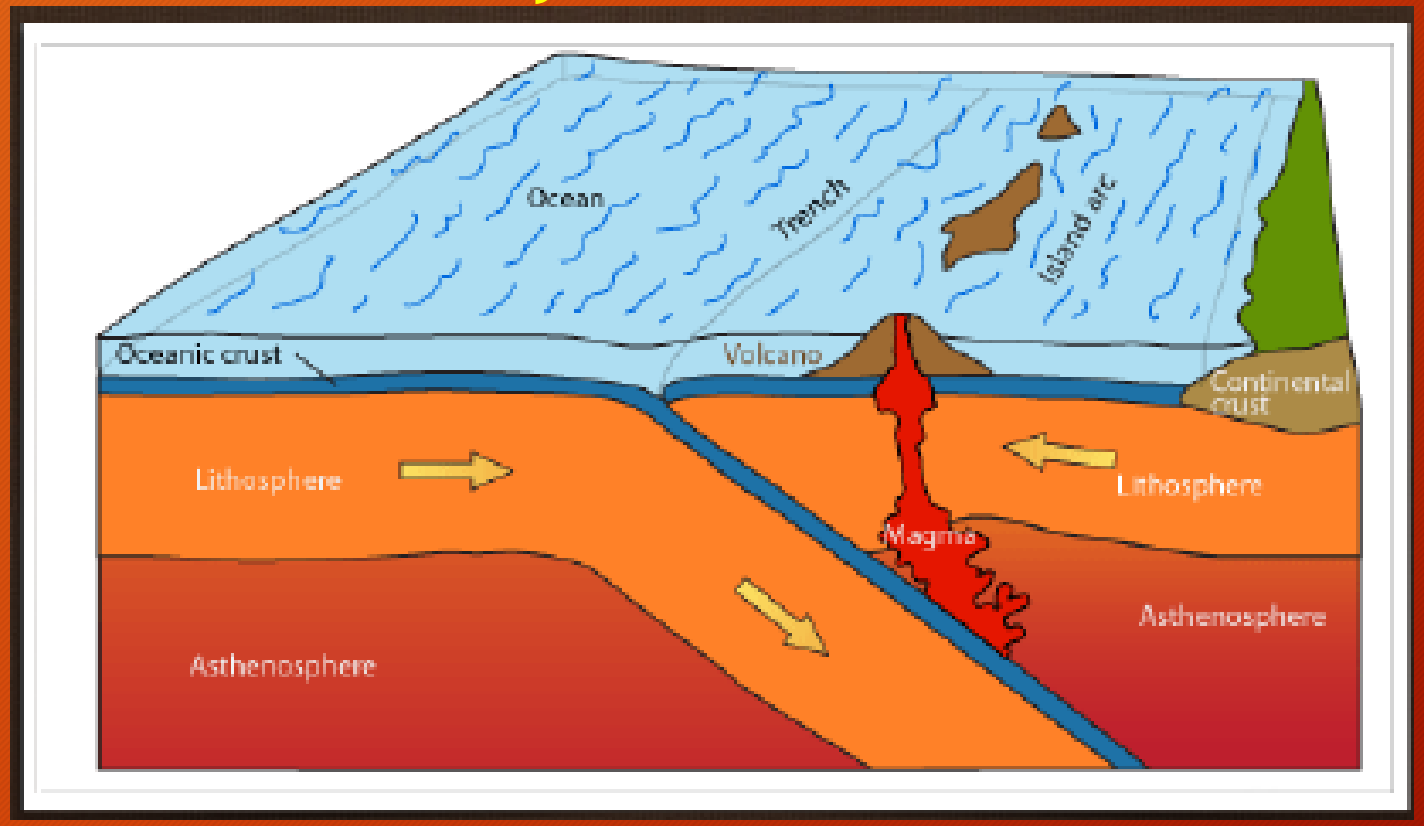
- Subduction: the process where one plate is pushed below another & consumed in the mantle (creates a trench)
  - Example: the Nazca Plate being consumed under the South American plate





Topic 4: Crustal Boundaries

- Three Types of Convergent Boundaries:
  - Ocean-Ocean Boundary



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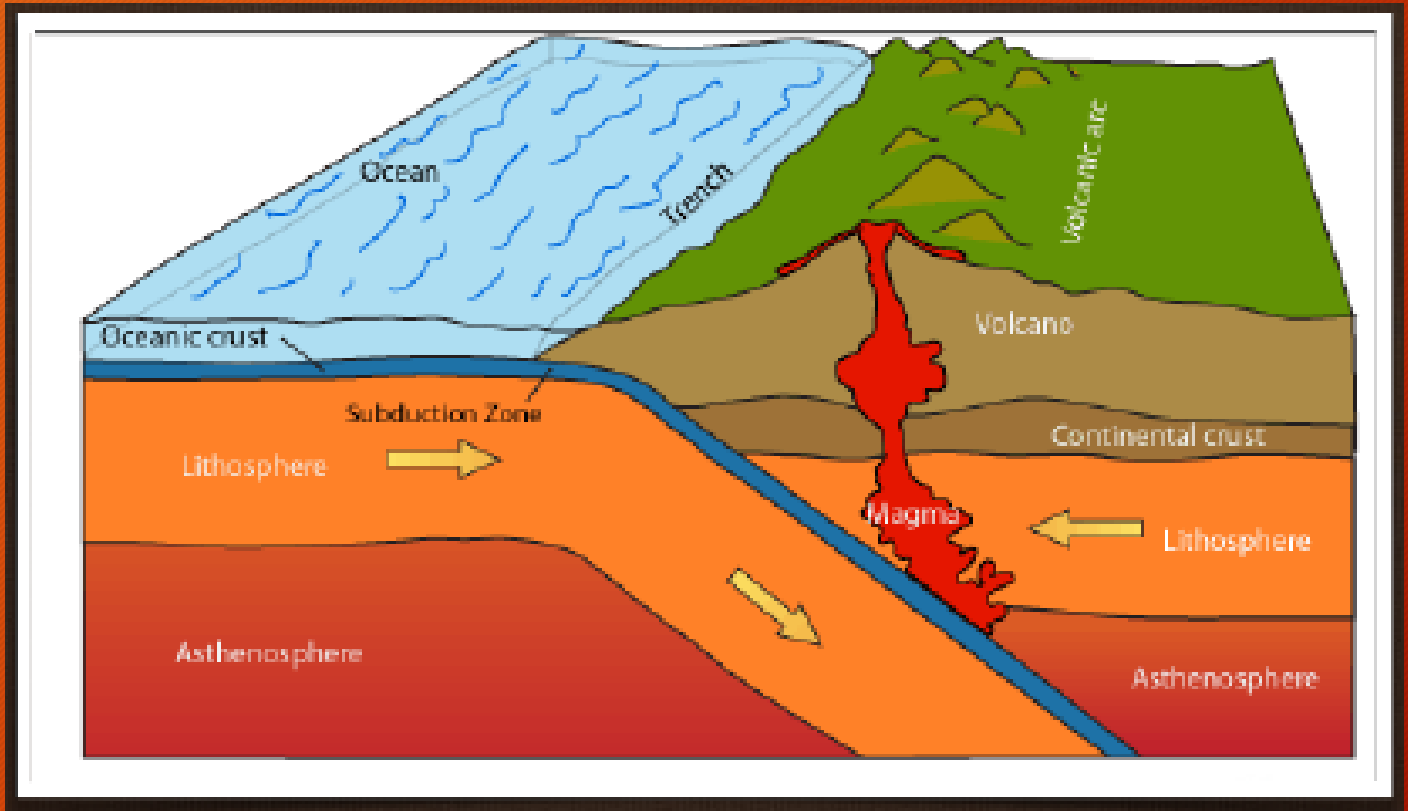
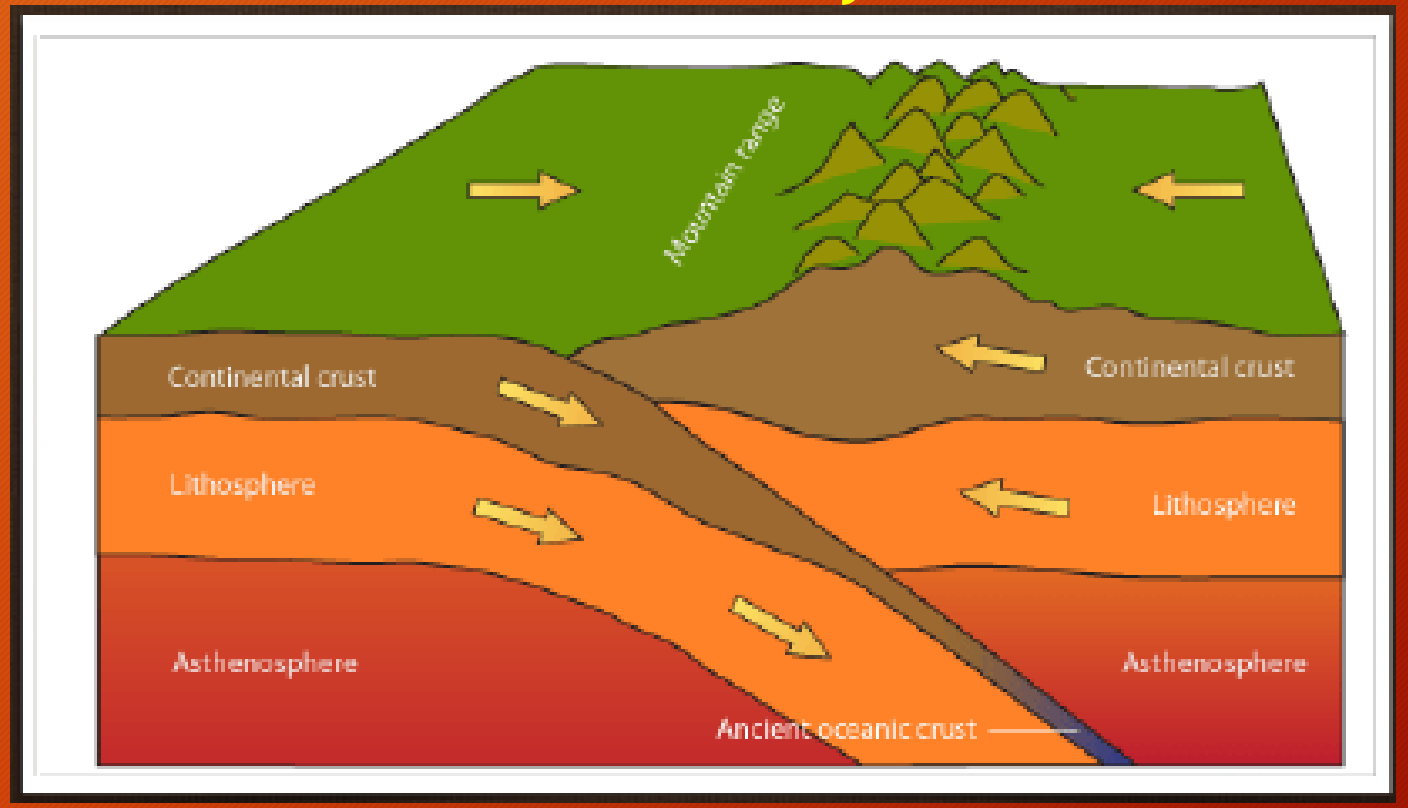
- Three Types of Convergent Boundaries:
  - Ocean-Continental Boundary



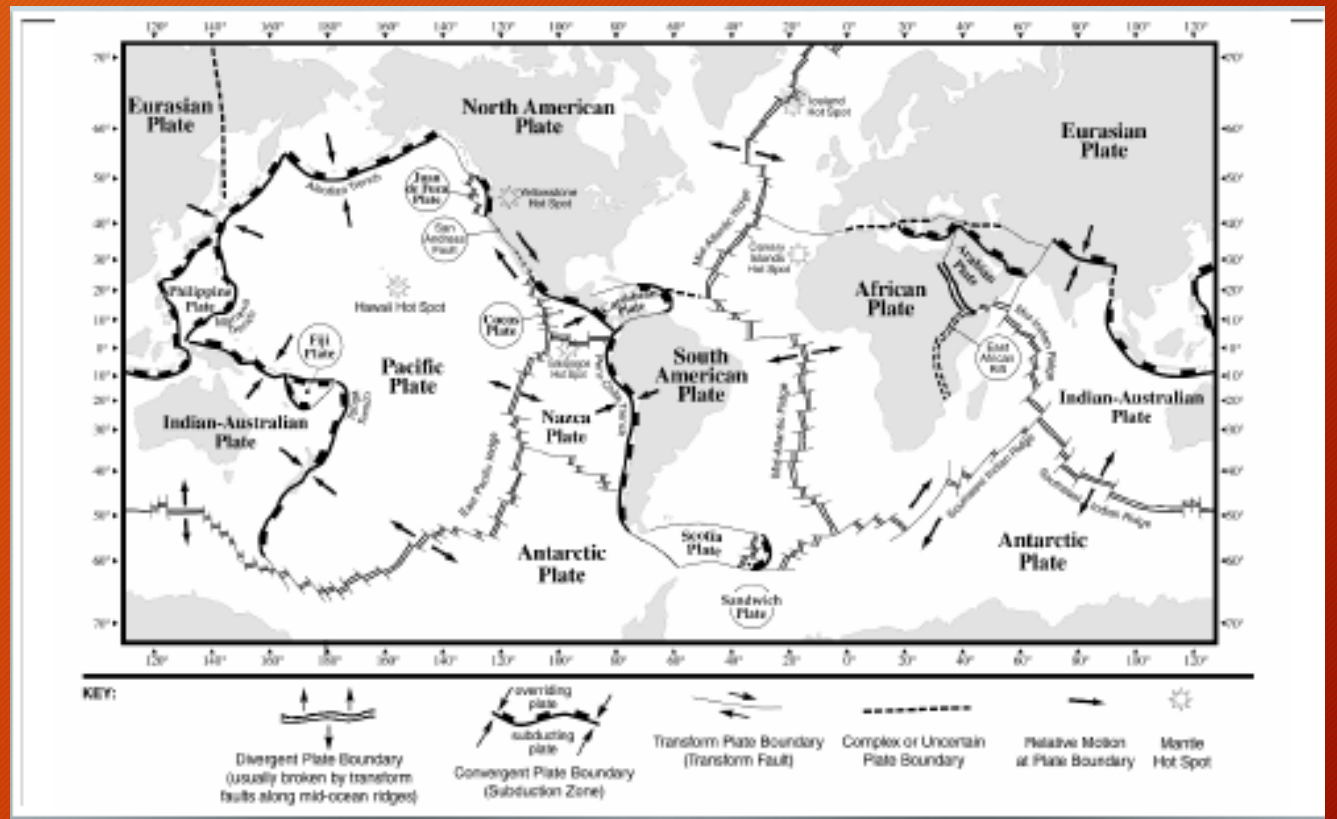
Topic 4: Crustal Boundaries

- Three Types of Convergent Boundaries:
  - Continental-Continental Boundary



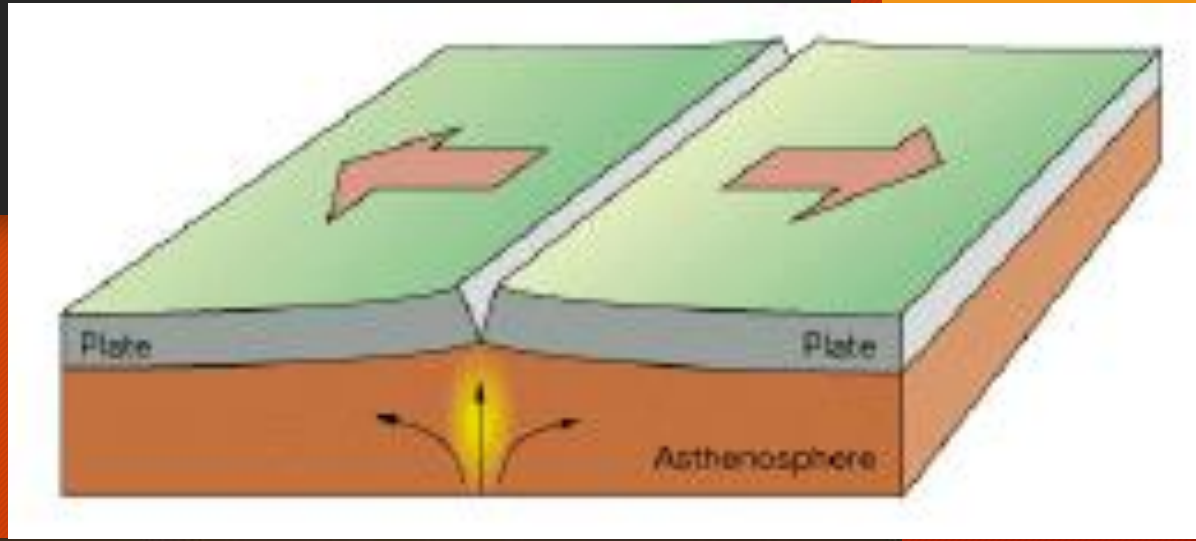
Topic 4: Crustal Boundaries

- Notes Page 7: Identify the symbol & highlight ALL of the Convergent Boundaries



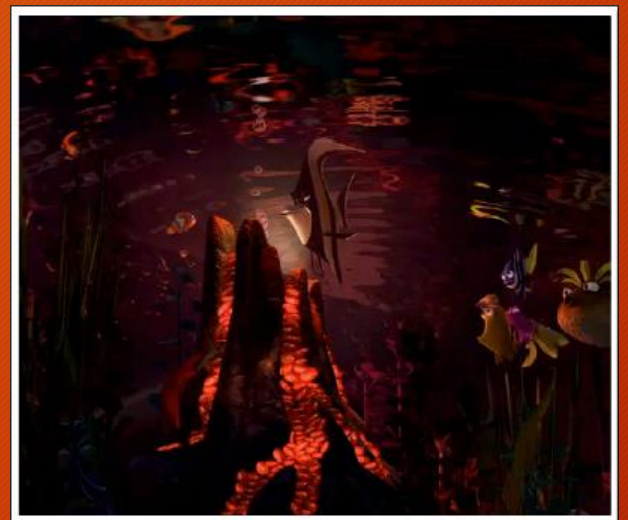
Topic 4: Crustal Boundaries

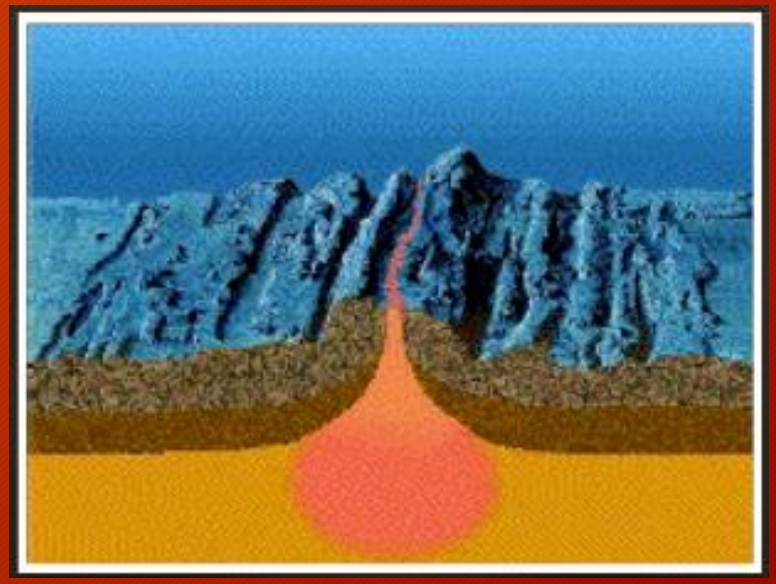
- Divergent Boundary: boundary where 2 lithospheric plates are moving apart
  - Example: part of the Mid-Atlantic Ridge emerges from the ocean and splits Iceland in half



Topic 4: Crustal Boundaries

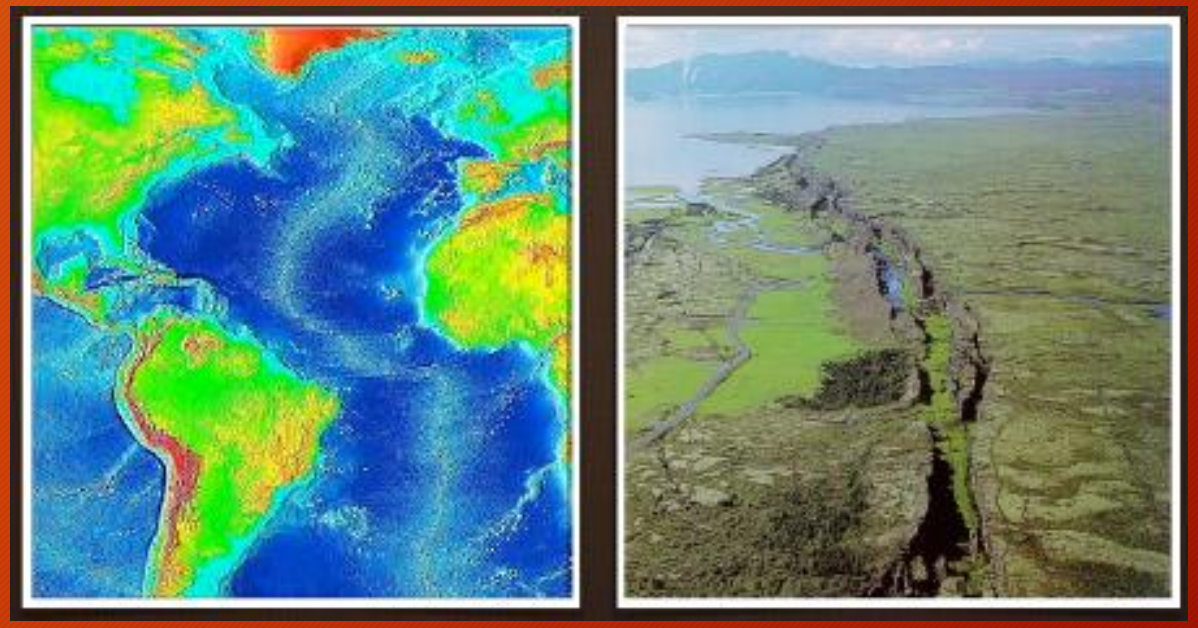
- Sea-Floor Spreading: the process that causes the ocean floor to expand when 2 plates move apart
  - Video
- Mid-Ocean Ridge: underwater mountain range created from a divergent plate boundary





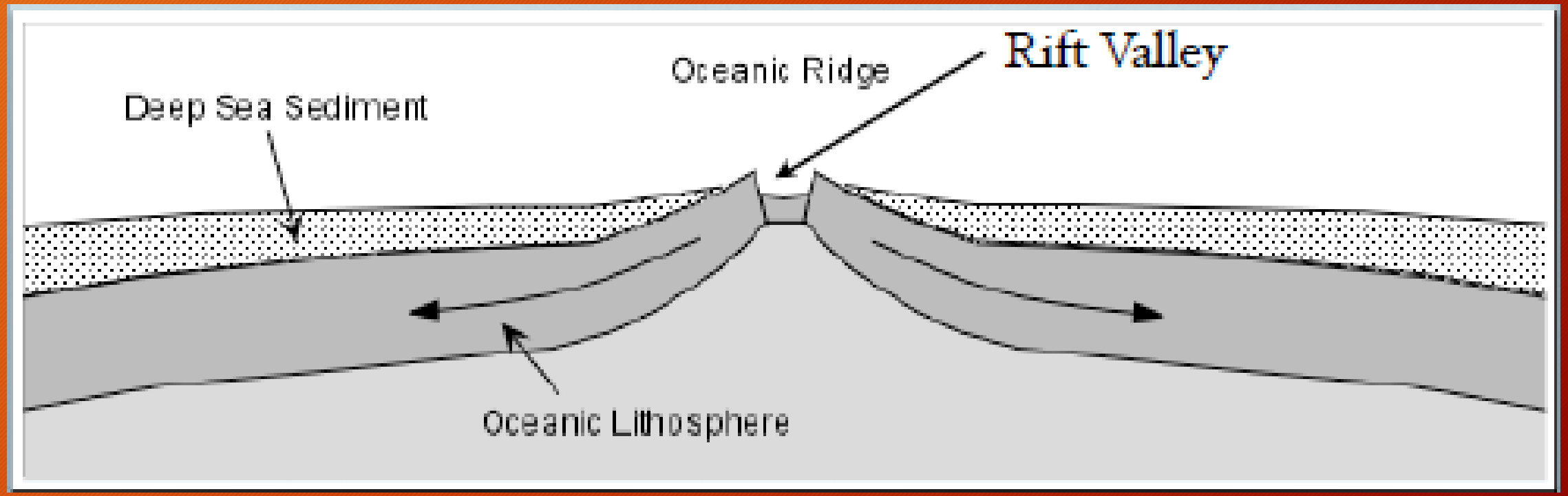
Topic 4: Crustal Boundaries

- Mid-Atlantic Ridge: a mid-ocean ridge in the middle of the Atlantic Ocean
  - Separates the N. (North) and S. (South) American Plates from the Eurasian and African Plates



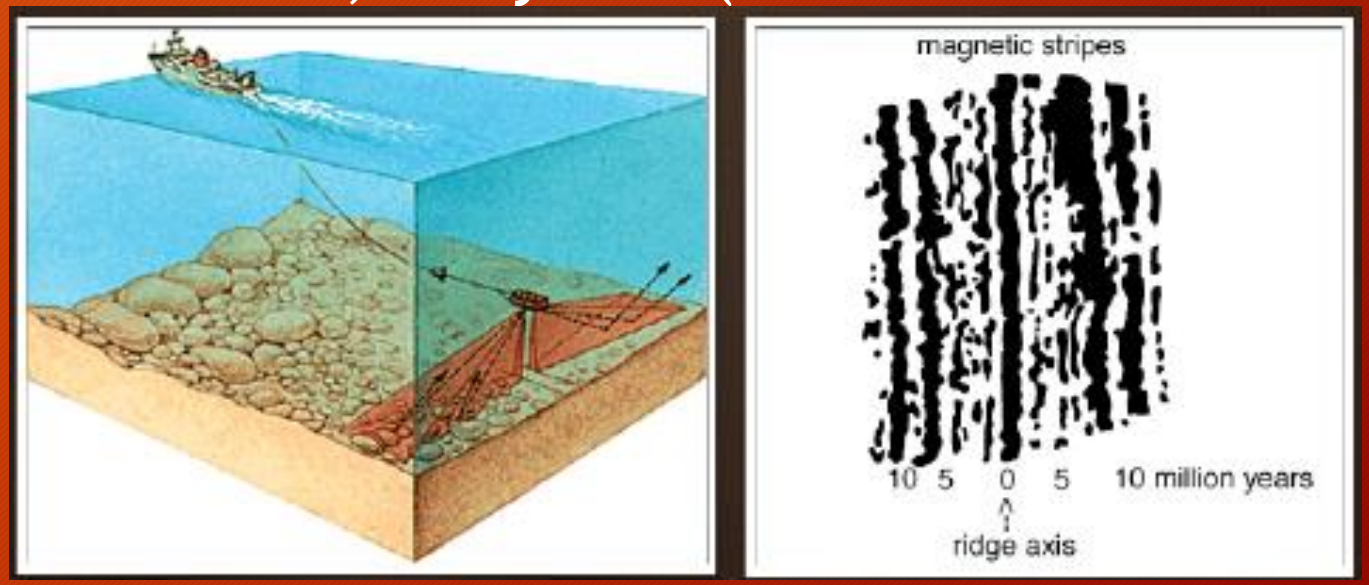
Topic 4: Crustal Boundaries

- Rift Valley: long, narrow valley that runs the entire length of a mid-ocean ridge system



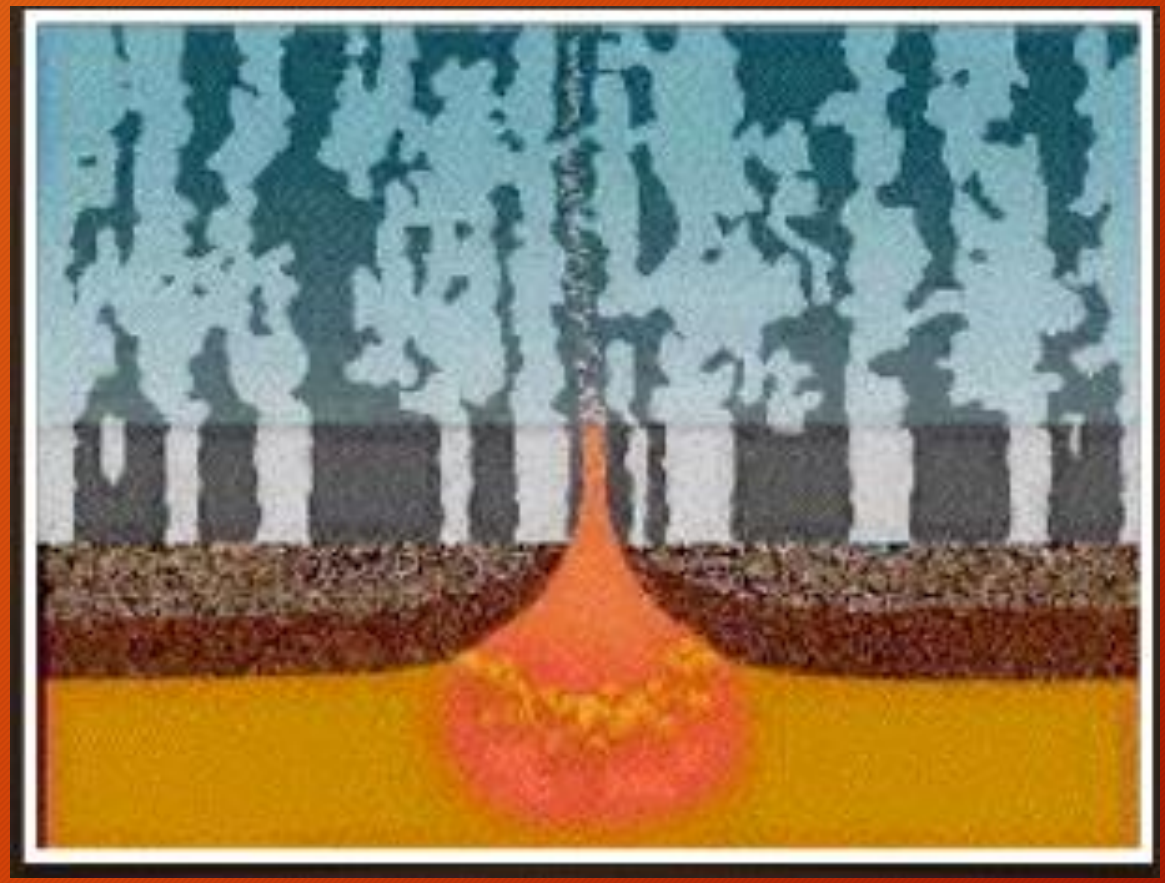
Topic 4: Crustal Boundaries

- Divergent Plate Boundary Evidence
  - Scientists dragged a magnetometer across the ocean floor and discovered a unique magnetic pattern where stripes of normal and reversed polarity parallel mid-ocean ridge flipping every 200,000 to 300,000 years (the last one was 781,000 years ago)



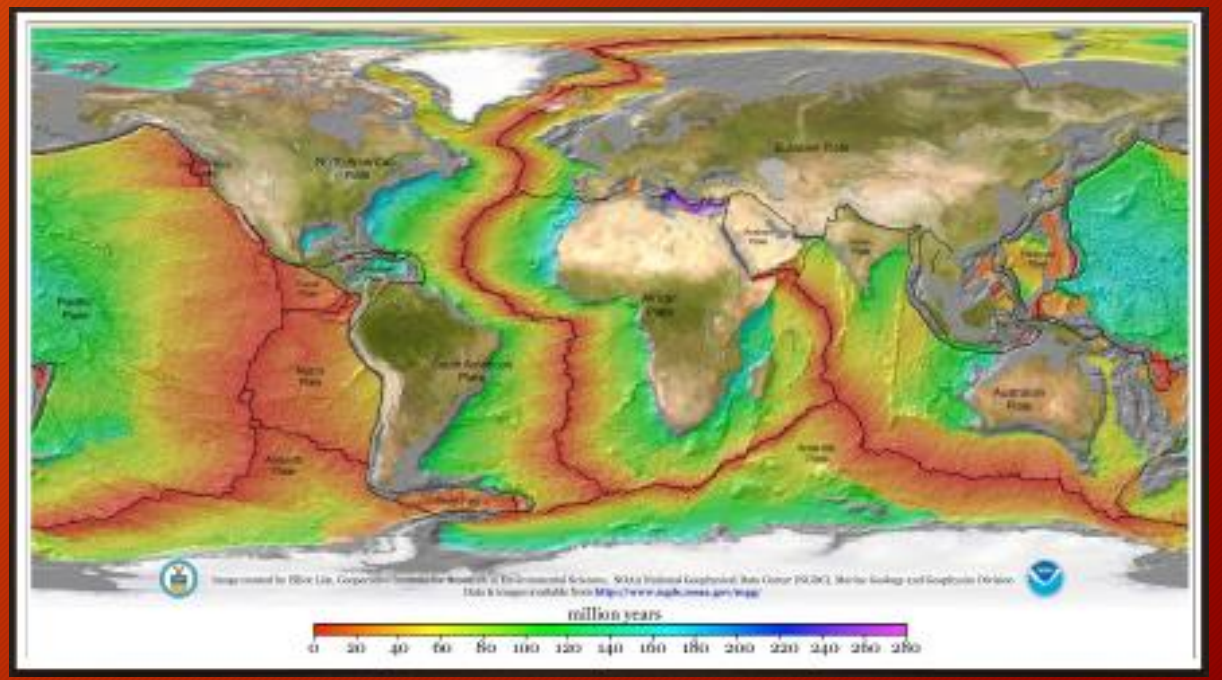
Topic 4: Crustal Boundaries

- Divergent Plate Boundary Evidence



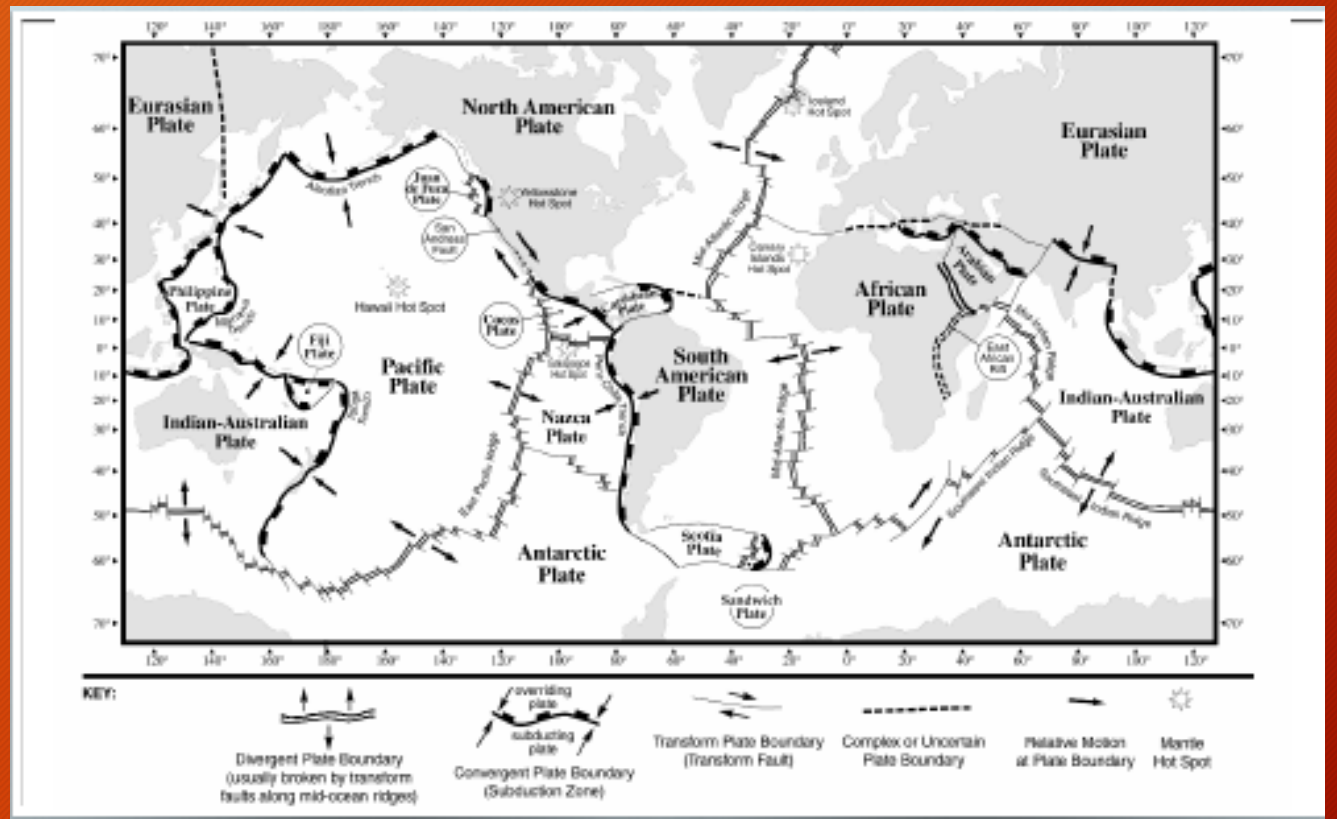
Topic 4: Crustal Boundaries

- Divergent Plate Boundary Evidence
  - Rock samples of the deep ocean floor show that basaltic oceanic crust becomes progressively younger as you approach the mid-ocean ridge



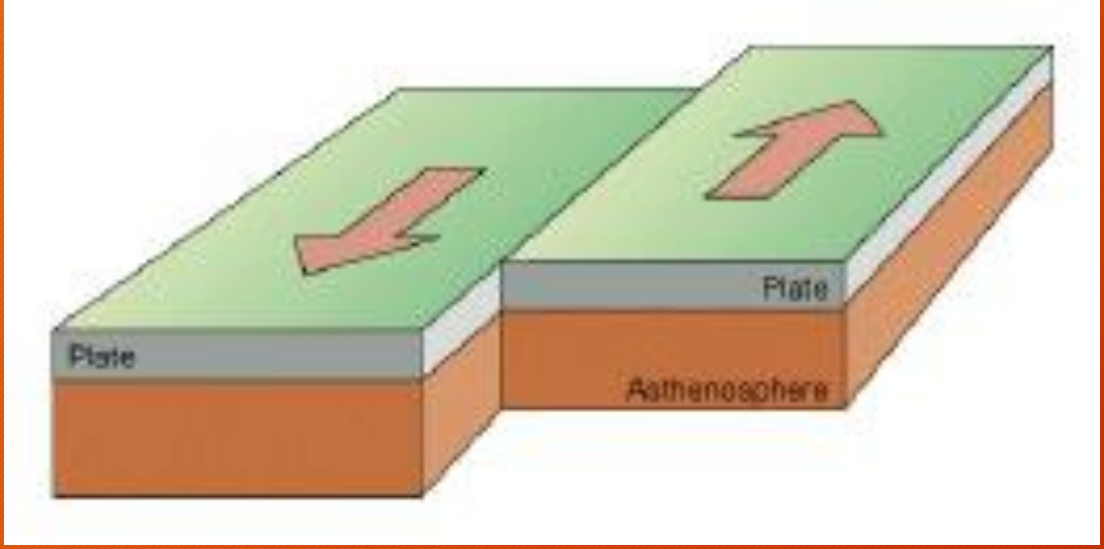
Topic 4: Crustal Boundaries

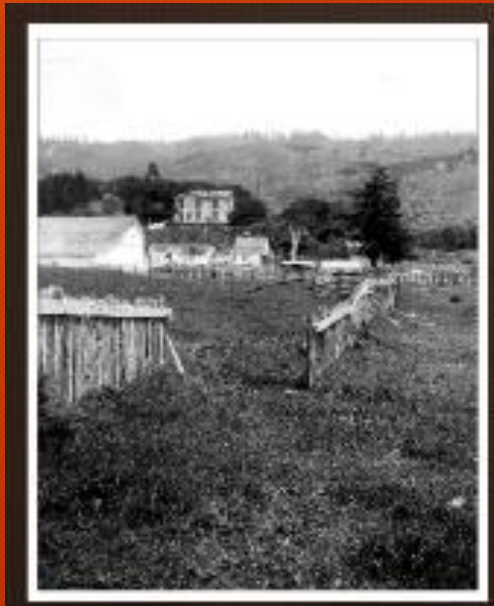
- Notes Page 7: Identify the symbol & highlight ALL of the Divergent Boundaries



Topic 4: Crustal Boundaries

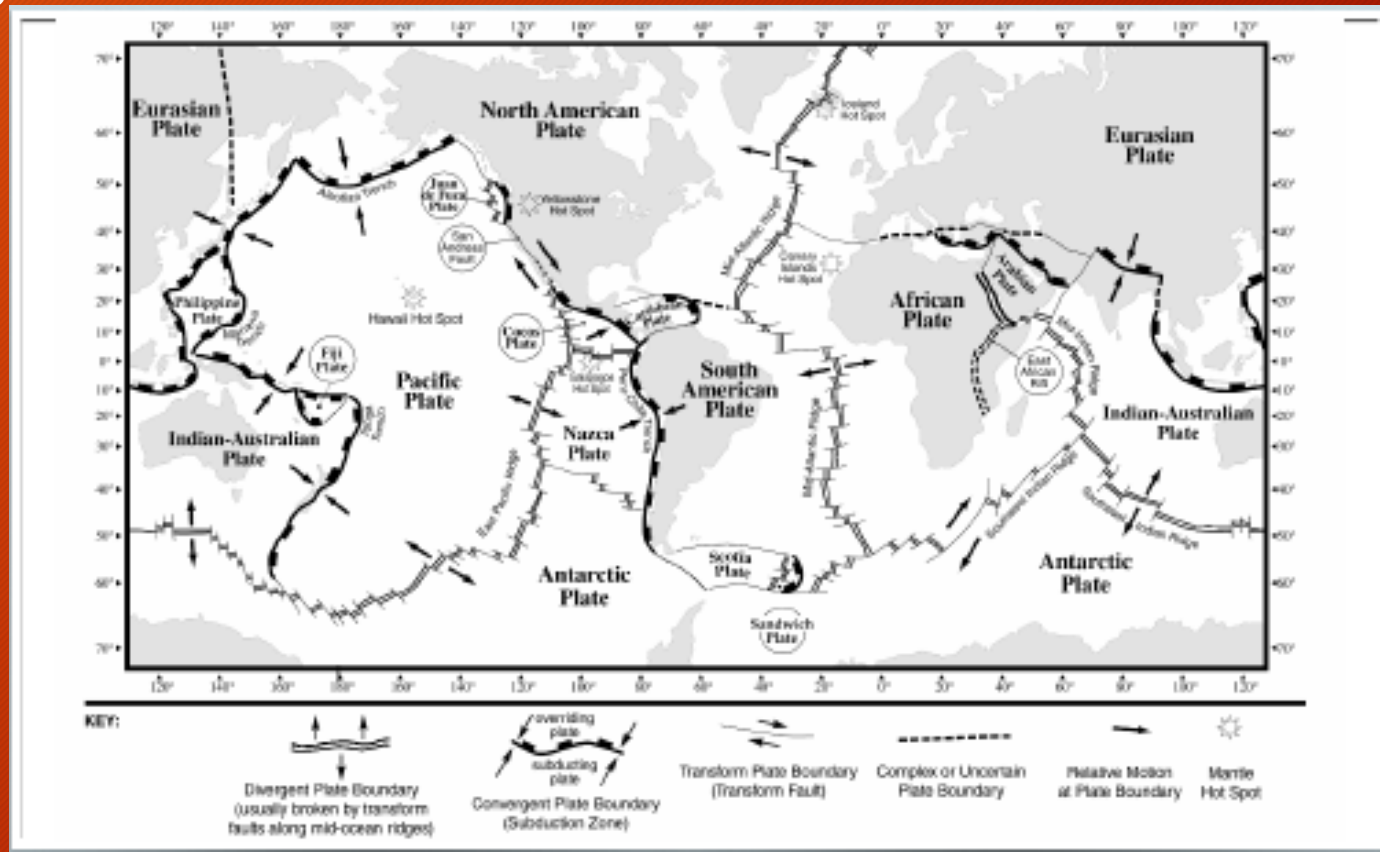
- Transform Boundary: boundary where 2 lithospheric plates are sliding past one another
  - Example: the San Andreas Fault is 800km long and runs throughout California





Topic 4: Crustal Boundaries

- Notes Page 7: Identify the symbol & highlight ALL of the Transform Boundaries



Questions?

Topic 5: Earthquakes

- Essential Question: What are earthquakes and how do we locate them?

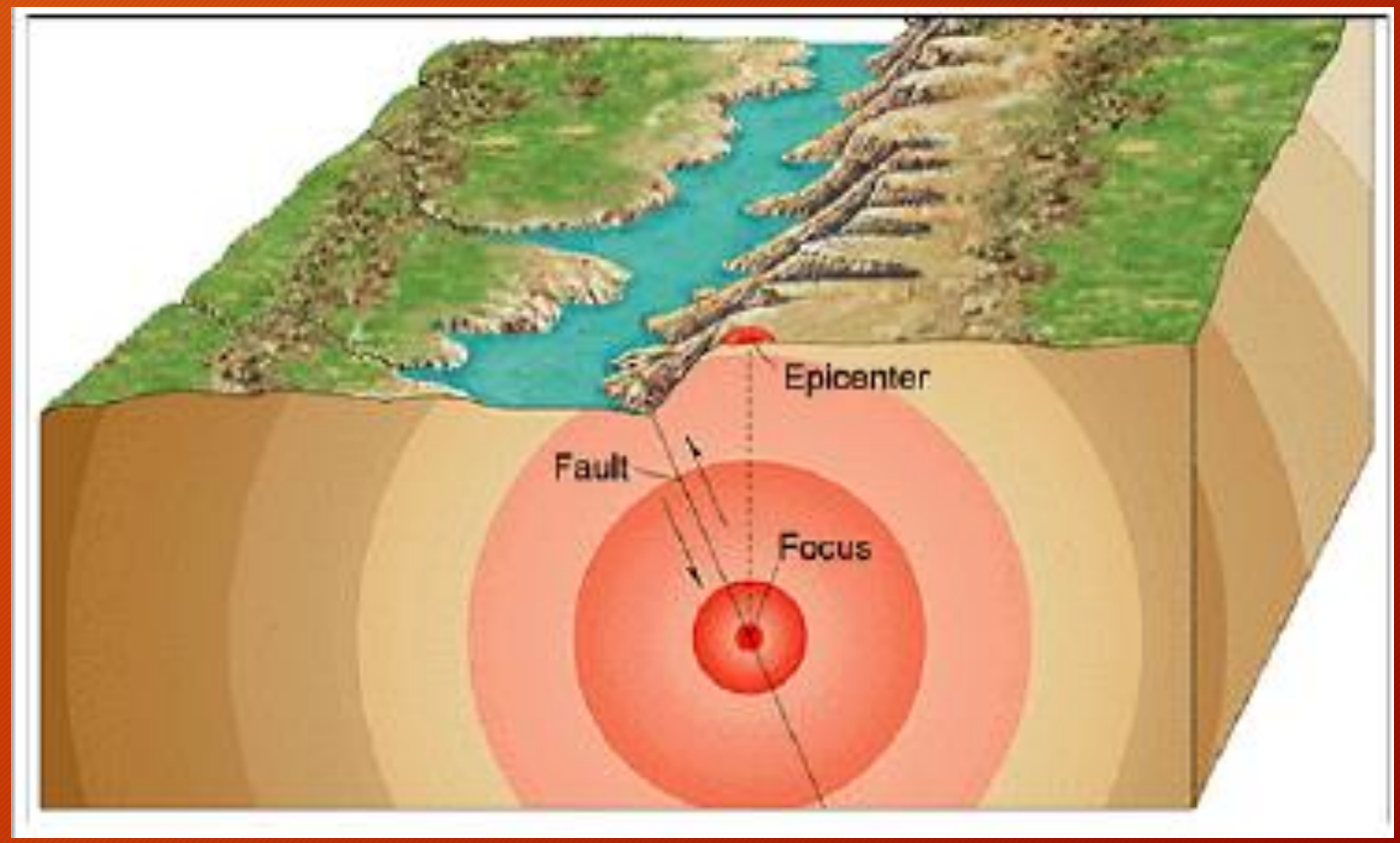
Topic 5: Earthquakes

- Earthquake: a natural shaking of the lithosphere caused by a release of energy stored in rocks
  - Most earthquakes are caused by a movement along a fault where potential energy is given off as a seismic wave

Topic 5: Earthquakes

- Epicenter: the location on Earth's surface directly above the focus

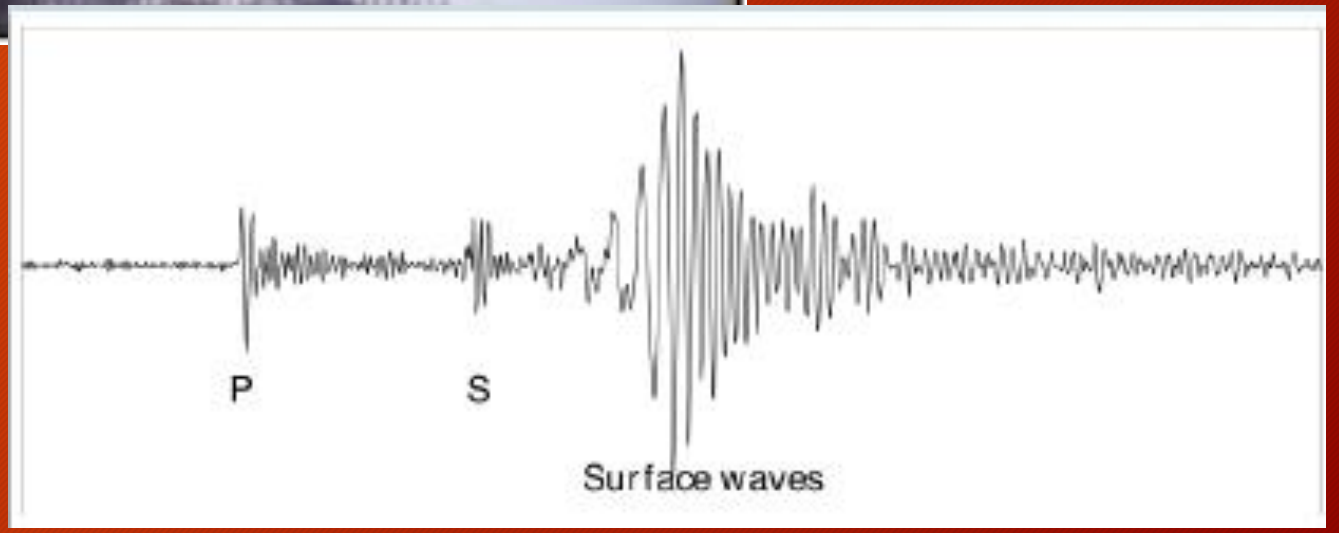
- Focus: the point inside the Earth where the earthquake starts



Topic 5: Earthquakes

- Seismometer: an instrument used to measure and record ground movements

- Seismogram: the record from a seismometer



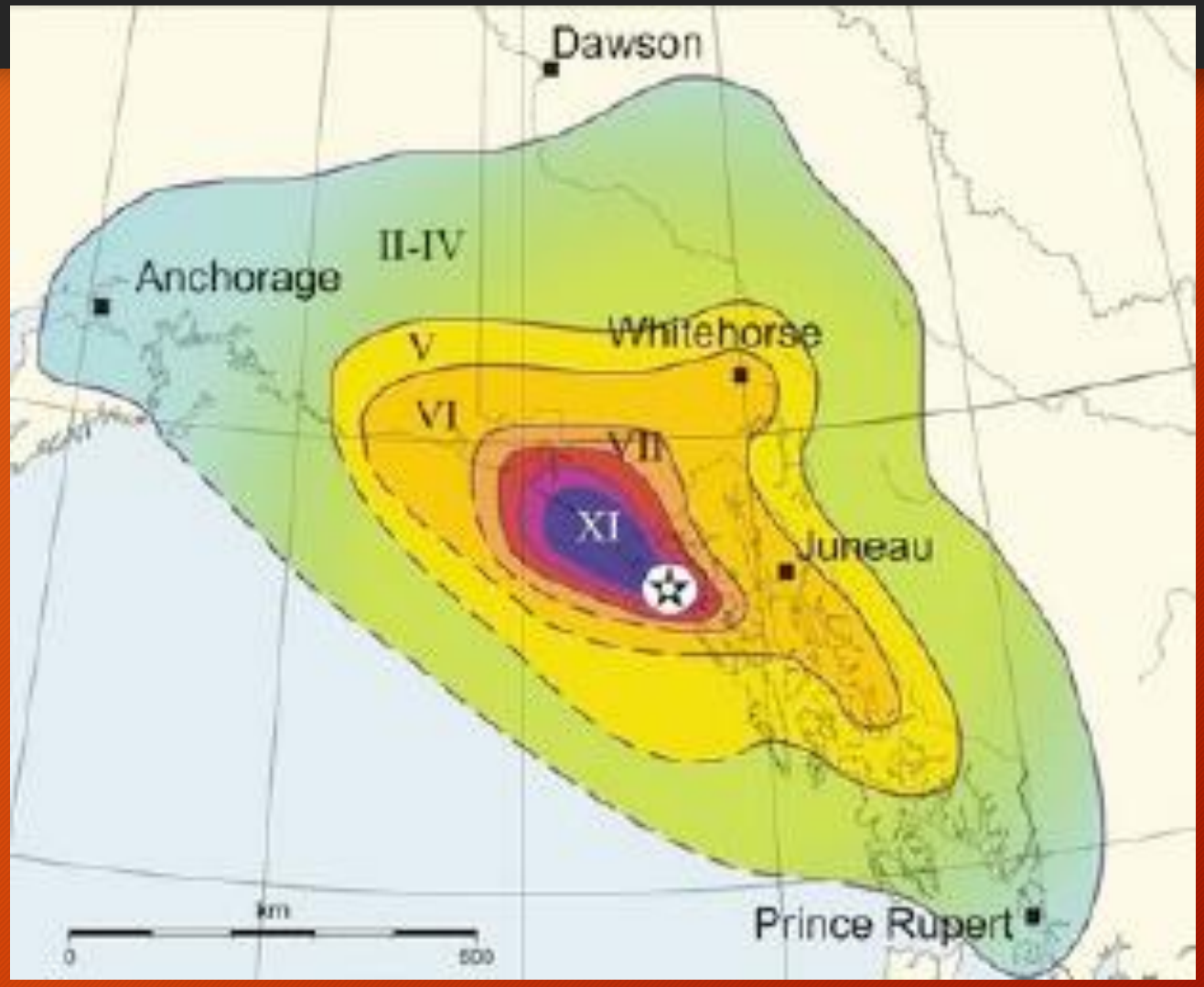
Topic 5: Earthquakes

- Mercalli Scale: the scale that measures the intensity of an earthquake based on the effects to Earth's surface, humans, objects in nature, and other man-made structures
  - The values will differ based on the distance from the epicenter
    - Highest intensities are closer
    - Lower intensities are farther away

Topic 5: Earthquakes

Intensity	Type of Damage
I	Instrumental
II	Feeble
III	Slight
IV	Moderate
V	Rather Strong
VI	Strong
VII	Very Strong
VIII	Destructive
IX	Ruinous
X	Disastrous
XI	Very Disastrous
XII	Catastrophic

Topic 5: Earthquakes



Topic 5: Earthquakes

- Richter Scale: logarithmic scale that measures the amount of energy released during an earthquake

- Magnitude: a number to quantify the amount of seismic energy released from an earthquake

Topic 5: Earthquakes

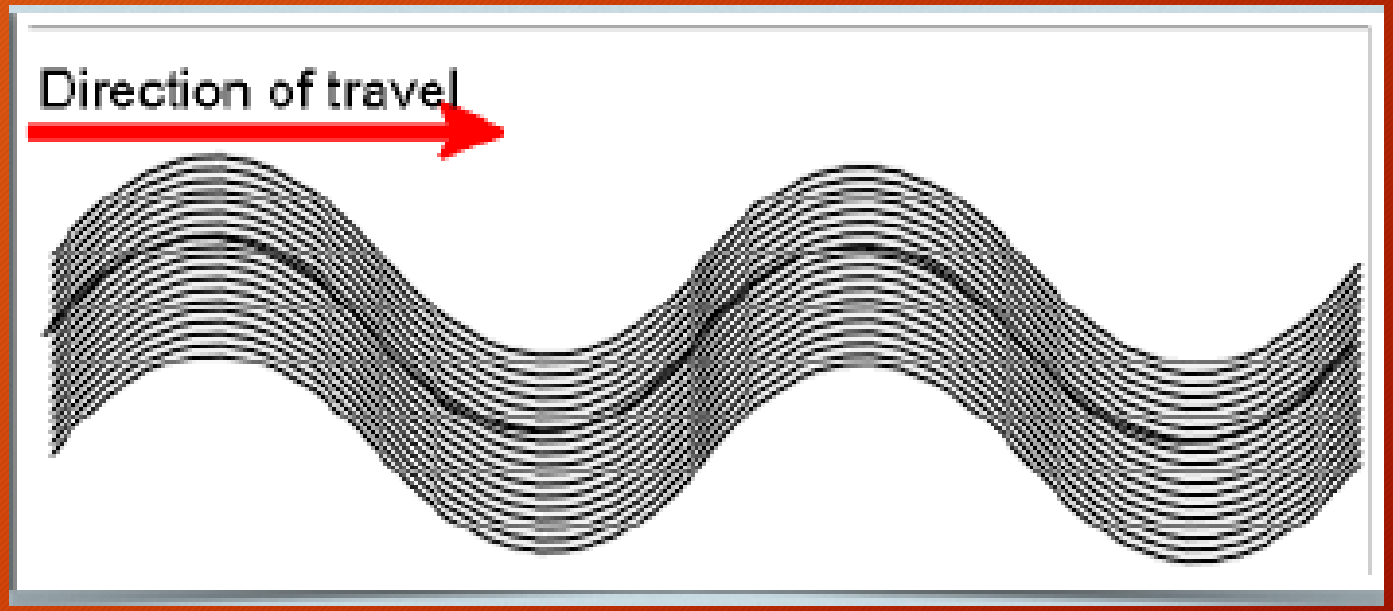
- The Richter Scale's magnitude is determined from the following measurements:
  - Seismogram's amplitude (height) of waves
  - Distances from other seismographs
  - Epicenter distance

Topic 5: Earthquakes

- Primary Wave (P-wave)
  - Fastest waves
  - Travel through solids, liquids, and gases
  - Compressional: travels in the direction of wave movement

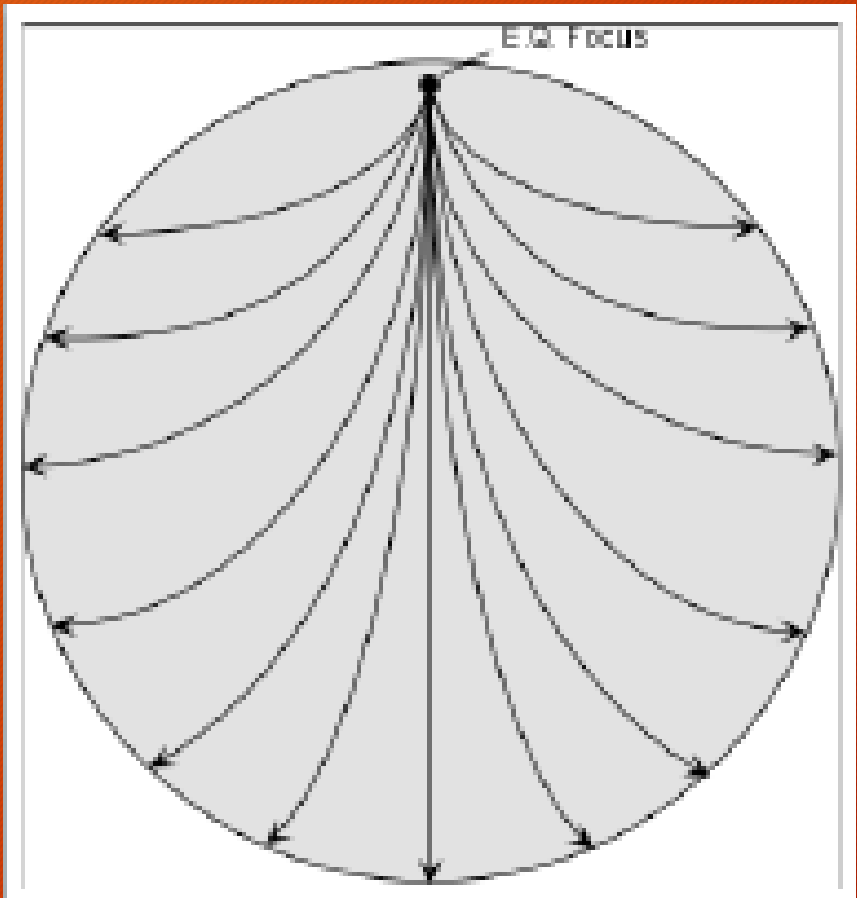
Topic 5: Earthquakes

- Secondary Wave (S-wave)
  - Slower waves
  - Travel through solids only
  - Shear: travels in right angles to the direction of wave movement



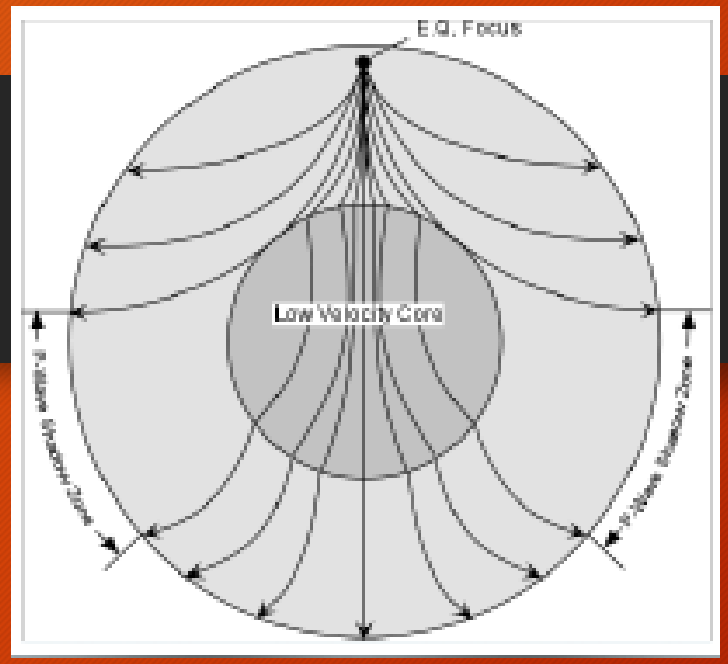
Topic 5: Earthquakes

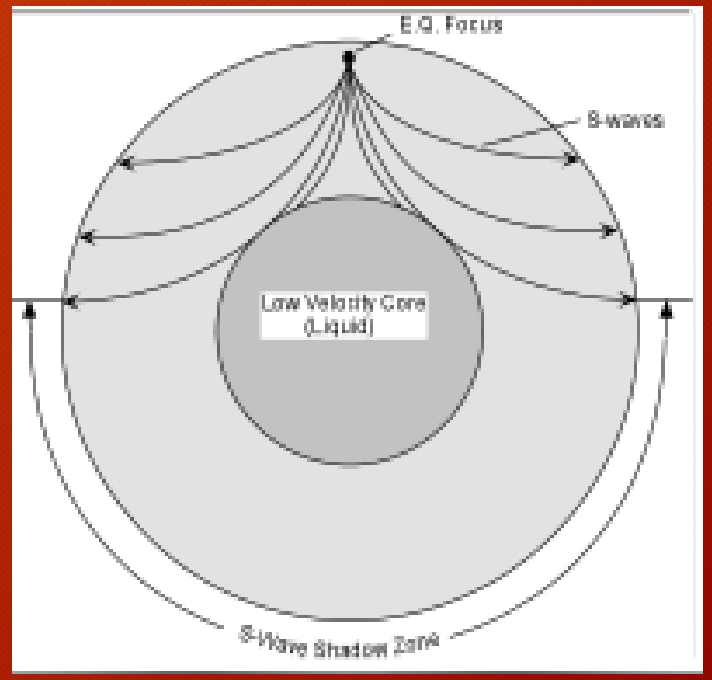
- Seismic waves radiate away from the focus



Topic 5: Earthquakes

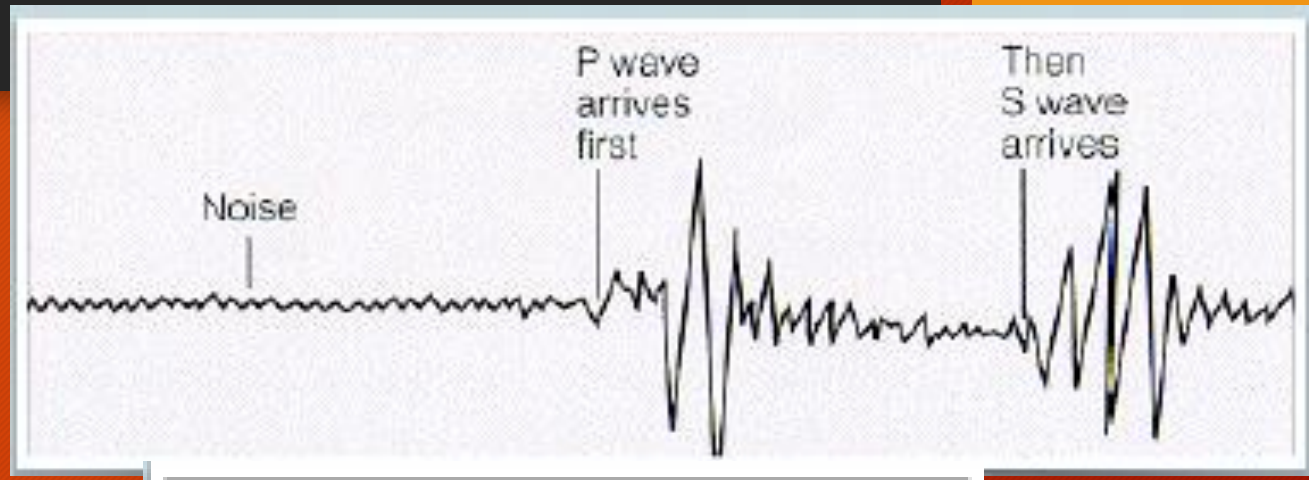
- Shadow Zone: area in which no seismic waves are detected (felt) due to the liquid outer core
  - P-waves are refracted (change direction) when they reach the liquid outer core
  - S-waves are absorbed when they reach the outer core and are NOT transmitted through to the other side

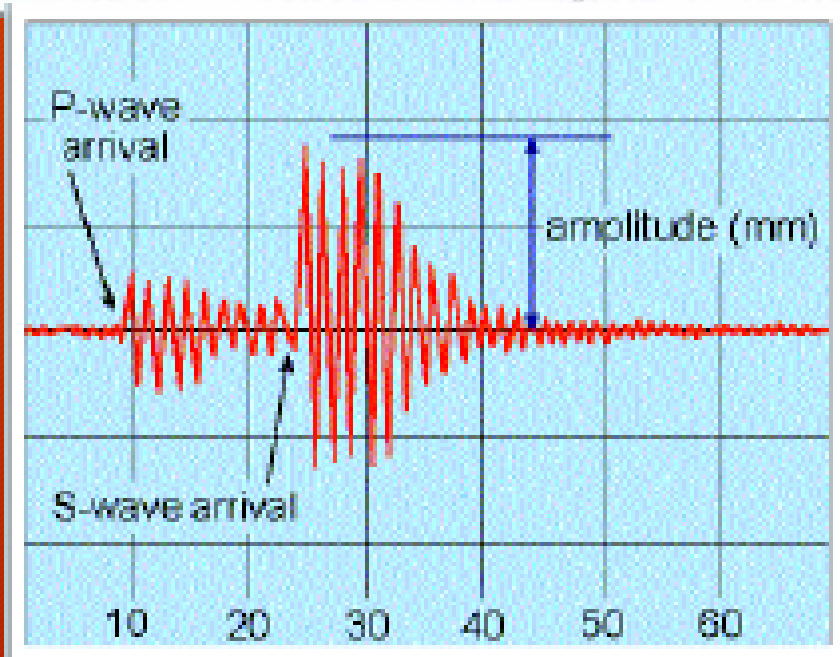




Topic 5: Earthquakes

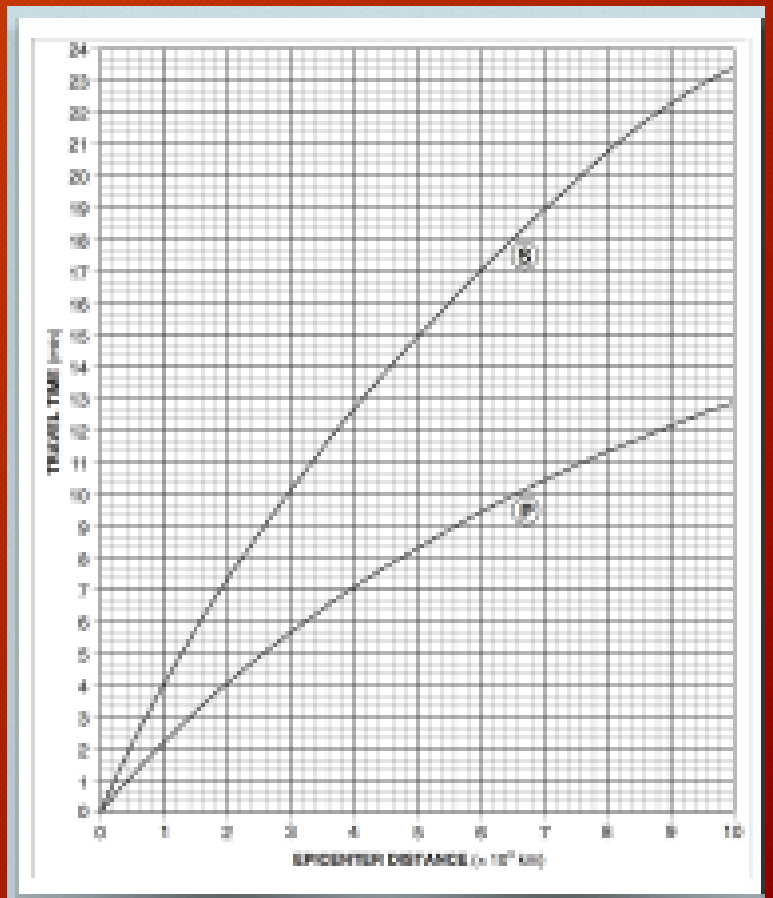
- Epicenters are located using the velocity differences between the p-wave and s-wave
  - Since the p-waves travel faster than s-waves, as your distance increases from the earthquake's epicenter, the arrival time between the two waves will be greater





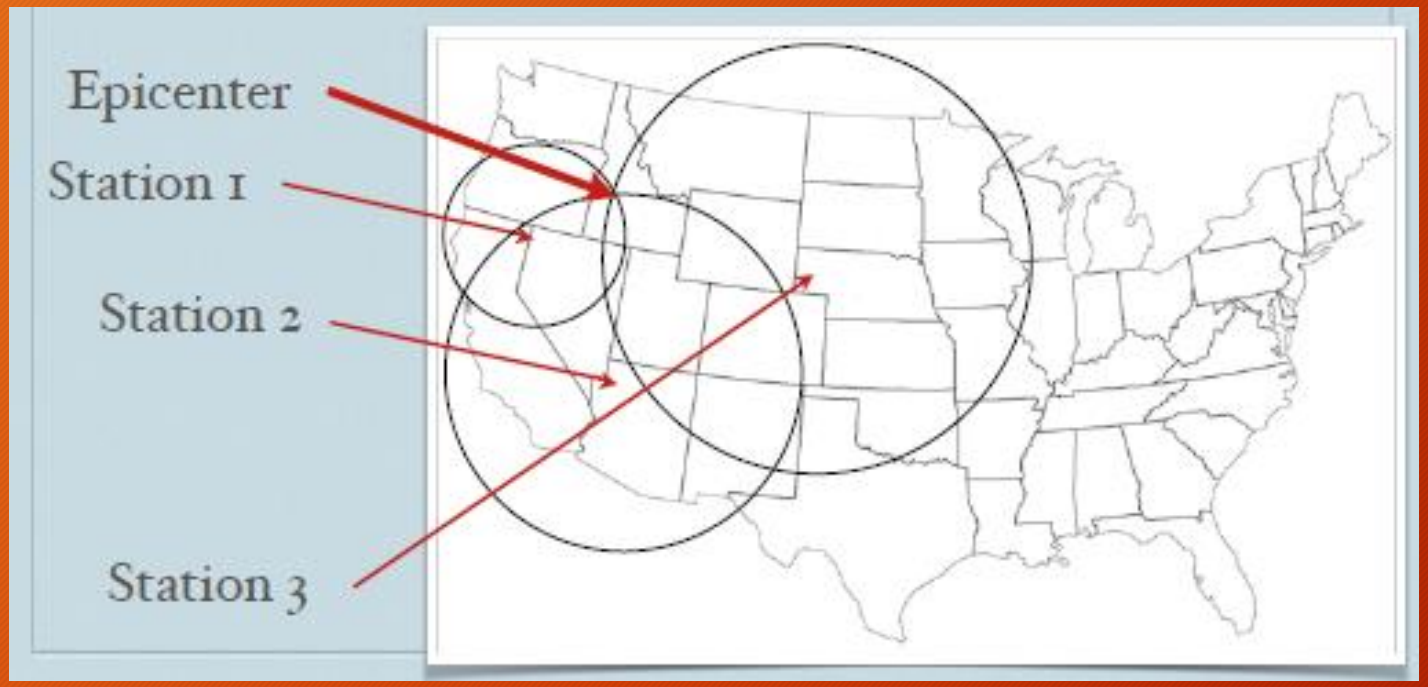
Topic 5: Earthquakes

- Distance to the epicenter is determined by comparing the arrival times and using the ESRT (pg. 11)



Topic 5: Earthquakes

- To find the epicenter location, you need to triangulate a position using 3 different seismometer stations



Questions?