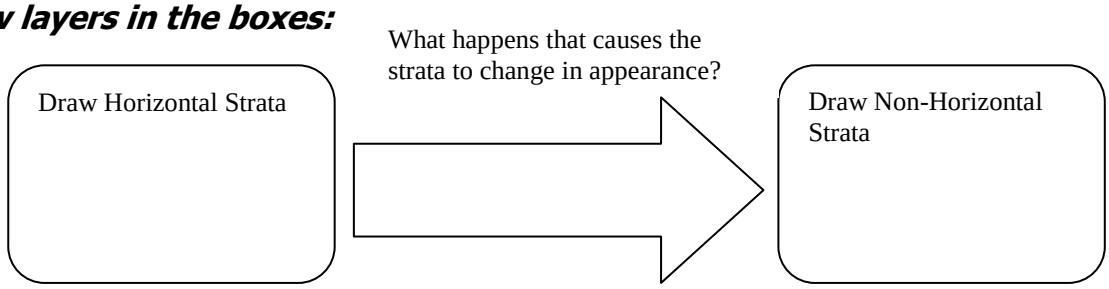
Topic 6: Earth's Dynamic Crust

6.1 Crustal Movement and the observable evidence

1. ***Tilted, folded or faulted rock layers –*** Sedimentary rock layers are formed in _____layers.
   So, when we observe rock layers that are tilted, folded or faulted, we know that crustal movement has occurred.

   Rock layers are often called _____.

Draw layers in the boxes:



2. ***Displaced fossils*** – Displaced fossils are fossils that are no longer found where the organism lived and/or died.
   ⋆ If _____ occurred, fossils formed in water may be found at _____ in mountains.

   ⋆ If _____ occurred, fossils that formed in shallow water may be found in _____ waters.

   What does subsidence mean? _____

Crinoid fossils like these were found at the summit of Mt. Everest.

3. ***Benchmarks*** – are disks that are attached to bedrock and the USGS records elevations of each. Over time, we can observe changes in _____.

6.2 The Theory of Continental Drift

1st View this video: *http://www.youtube.com/watch?v=_5q8hzF9VVE*
2nd Fill in notes for this section (rewind video as needed**)**

The Theory of Continental Drift – this theory states that the continents were once all part of one supercontinent called _____, and since have been moving or "drifting" around the surface of the Earth. The theory states the supercontinent existed approximately _____ million years ago. Alfred Wegener was the scientist that proposed this idea in the early 1900's. In fact, he _____ while collecting evidence for his theory in 1930.

Evidence that supports the Theory of Continental Drift:

1) Continental "fit" or map fit – Alfred Wegener first thought of this theory by noticing on a map how South America and Africa seemed to fit together like a jigsaw puzzle.

2) Matching fossils – Fossils of plants and animals that are found on the _____ coast of Africa and the _____ coast of South America suggest that the continents must have been connected at some time in the past.

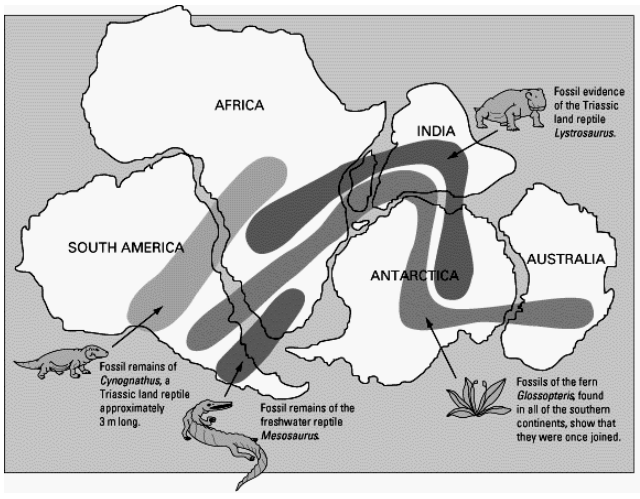
What are the 4 main fossils that helped correlate the continents?

_____

_____

_____

_____



3) Matching rock and geologic structures – Among others, mountains along the _____ coast of North America and the west coast of _____ are made of the same _____ of rock and the same _____ of rock. This suggests that the mountains were once part of the same structure and have been ripped apart when the continents moved away from each other.

4) Climate evidences – Wegener's theory was that the continents are moving and as a result they have been located in different places in the past. He found evidence that some continents had completely different climates in their past:

a. Glacial scratches were found on continents located in _____ climates proving they must have moved.

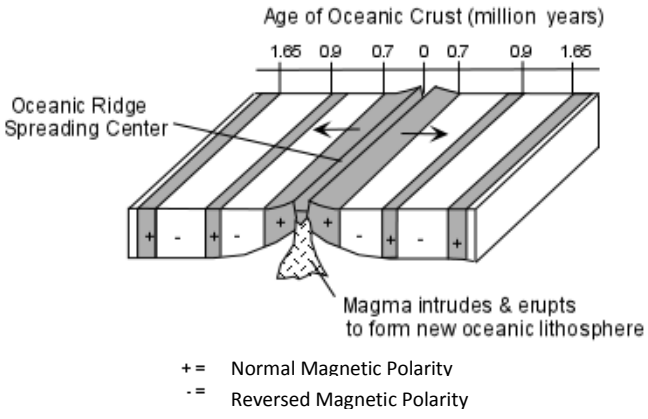
b. Coal beds are formed in tropical climates, but Wegener found coal on continents located in _____ climates proving they must have moved.

What's the problem?

Although Alfred Wegener had convincing evidence, his theory was unaccepted by the scientific community. Explain "why" his theory was unaccepted in a couple well written sentences.

6.3 The Theory of Plate Tectonics

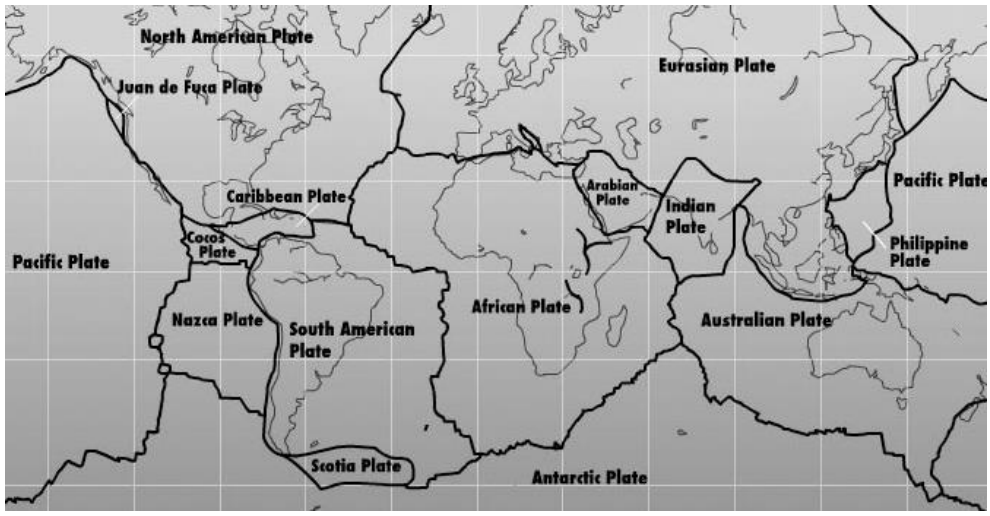
Seafloor Spreading discovery – In the 1950's-60's, increased ocean floor mapping led to the discovery of underwater mountains that we now call mid-ocean ridges or rifts. Upon greater investigation, new ocean floor rocks were forming at these locations and pushed out continuously in both directions away from the ridge. Magnetic observations of the ocean floor rocks showed different polarities:



- Normal polarity means when the rock formed, magnetic North was the same as it is today.
- Reversed polarity means when the rock formed, magnetic North was where the South pole is today.

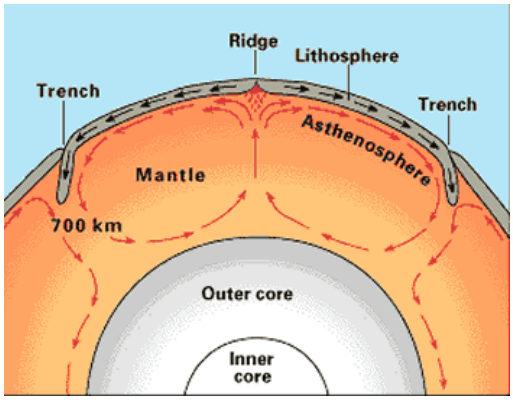
The Theory of Plate Tectonics **-** This theory states that the Earth's crust is made of 12-20 large, rigid plates that move above a very thick layer of liquid molten. These plates are constantly moving, and where two plates meet is called a *plate boundary*. At plate boundaries, exciting things happen like mountains are built, volcanoes form and earthquakes occur. Some tectonic plates consist of just oceanic crust and other tectonic plates have both oceanic and continental crust. The Theory of Continental Drift and the discovery of seafloor spreading are the main components of this important idea.

Listen and watch this music parody: **http://www.youtube.com/watch?v=hhxjAAnwNKM**



What causes the plates to move?

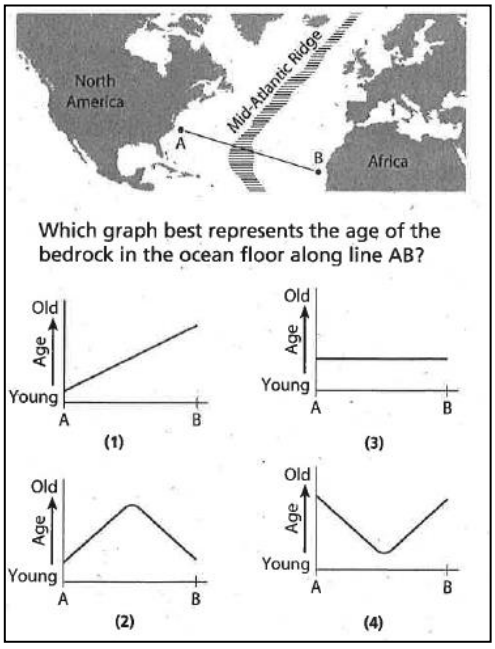
Convection currents within the Asthenosphere cause plate movement. Convection is the movement of a liquid or gas when there is a difference in density. The hotter material will be less dense, which causes it to rise. The cooler magma is more dense which causes it to sink. The plates are dragged by the Asthenosphere as it flows.

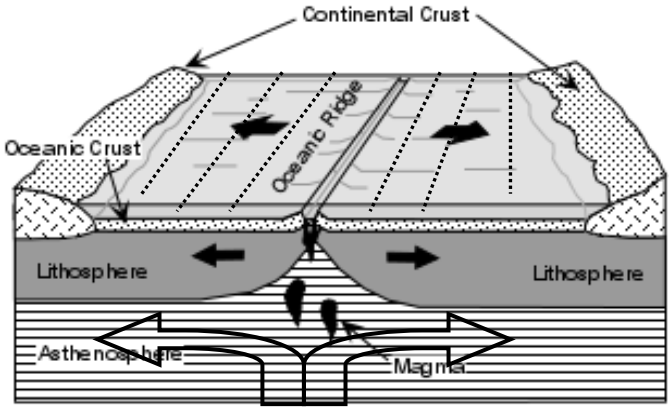


Three types of plate boundaries:

1. Divergent boundary - is where two plates are moving apart. The best example of this is the Mid-Atlantic ridge. At mid-ocean ridges, magma is rising from the Asthenosphere splitting the plates apart and dragging them as it flows away from the center. Some of the magma moves to the surface and solidifies into new ocean floor. It's very important to know that the youngest ocean floor rocks are located near the ridge and the oldest are near the coast.

Watch this video on divergent boundaries: http://www.youtube.com/watch?v=y1r5G-UG_N8
Watch this video of an actual mid ocean ridge: http://www.youtube.com/watch?v=YWyNQAKOIz0





Diverging Plate Boundary
Oceanic Ridge - Spreading Center

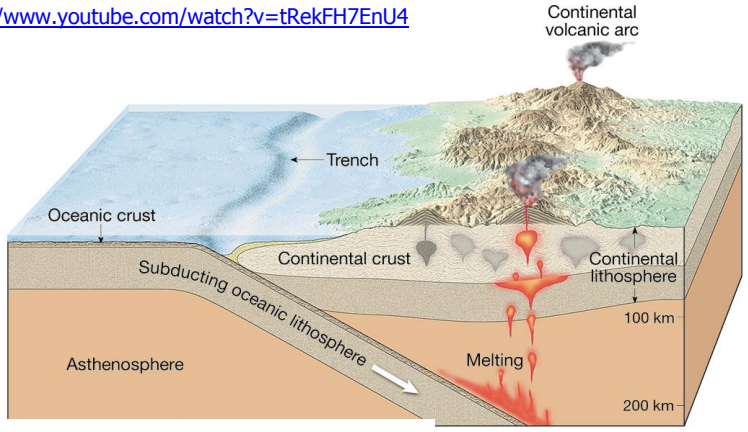
Based on your ESRT page 5, list at least three other mid-ocean ridges.

As the distance from the center of the ridge increases, the age of the rocks:

1. Decreases
2. Increases
3. Remains the same
4. Increases and decreases in a cyclic pattern

2. Converging boundary – is where two plates are moving toward one another and collide. There are ***two types of converging boundaries*** depending on the type of plates involved. Watch this video: http://www.youtube.com/watch?v=tRekFH7EnU4

a. ***Oceanic plate moving into continental plate***: This causes the oceanic plate to **subduct** below the continental plate and melt into the Asthenosphere. This area is called a **subduction zone** and a trench forms which is normally the deepest part of the ocean. It can also cause volcanoes to form on the continents from the magma coming up.

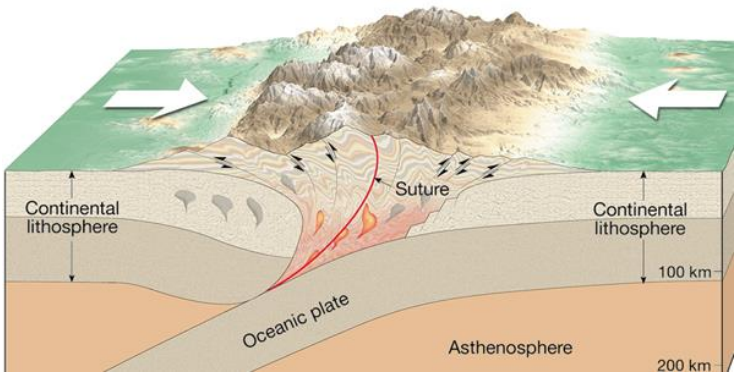


Example: At the west coast of South America, the Nazca Plate (oceanic) is moving into the South American plate (continental). See your ESRT page 5.

b. Continental plate moving into continental plate:

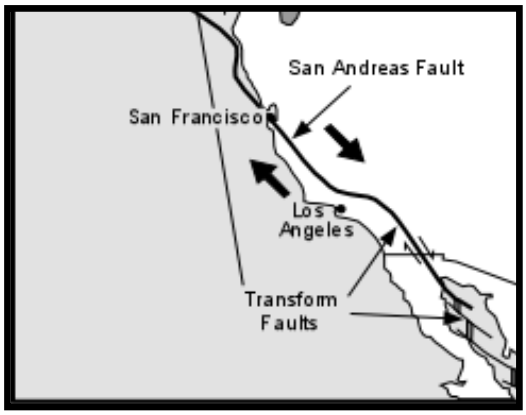
This causes earthquakes and mountain building. Regional metamorphism results from the extreme pressure created between the two plates.

Example: The Indian plate is colliding with the Eurasian plate creating the Himalayan Mtns.



3. Transform (a.k.a. sliding) boundary: This occurs when any two plates are sliding past one another in parallel directions. This causes major earthquakes.
Watch this video: http://www.youtube.com/watch?v=MoB5BHk3D94

Example: This type of boundary exists between the Pacific plate and the North American plate in California which is known as the San Andreas fault. It's responsible for the large number of major earthquakes that California receives.



Example: A large number of transform boundaries exist at diverging boundaries. The picture below is a typical diverging plate boundary. Notice that the mid-ocean ridges are not in a perfect "line" because as the lithosphere tears apart, it breaks unevenly. This causes sections of the plate to slide parallel to each other forming a transform fault or boundary.