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EARTH SCIENCE – UNIT 4 – CHAPTER 10 NOTES

PLATE TECTONICS

10.1 Continental Drift
- theory that the continentals have moved along Earth's surface over time
- proposed by Alfred Wegener in 1912
- his theory was rejected (not believed) until after his death
- he couldn't explain HOW, WHEN, or WHY the continents moved
- his theory was based on the shapes of the continents
- the continents fit together like puzzle pieces
- his theory needed more evidence from fossils, climate, and rocks to be accepted by others

10.1 Evidence For Continental Drift
1. PANGAEA
   - a large landmass that began to break apart 200 million years ago
2. FOSSIL CLUES
   - similar fossils were found on inter-locking continents
   EX. 1: Mesosaurus was found in South America and in Africa. It never could have crossed the Atlantic Ocean, so it must have been able to walk between the two continents. Therefore, they must have been connected.
   EX. 2: Glossopteris (fossil fern) was found in Africa, Australia, India, South America, and Antarctica. Why did this fern grow in so many places?
3. CLIMATE CLUES
   - many continents used to have very different climates
   EX. 1: There is evidence of glaciers in South America, Africa, India, and Australia. Perhaps these continents were all connected and found near the south pole.
   EX. 2: There is fossil evidence of warm-weather plants found on islands in the Arctic Ocean, which is by the north pole. Perhaps these islands used to be near the equator.
4. ROCK CLUES
   - similar rock structures are found on inter-locking continents
   EX. 1: The Appalachian Mountains in the eastern USA are geologically similar to mountains found in Greenland and in western Europe.
   EX. 2: The mountains in eastern South America and geologically similar to mountains in western Africa.

10.2 Seafloor Spreading
- Seafloor spreading means that the Atlantic Ocean is getting bigger (spreading apart).
- Over time, North America and Europe/Africa will be farther apart.
- This happens VERY SLOWLY over the course of MILLIONS of years!
- When the oceanic crust "bumps into" continental crust, subduction zones (trenches) are formed.
- The thinner (less dense) oceanic crust goes underneath the thicker (more dense) continental crust.

SHOW DIAGRAM OF SEAFLOOR SPREADING

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10.2 Evidence For Seafloor Spreading

1. The youngest rocks in the Atlantic Ocean are found at the Mid-Atlantic Ridge.
2. Rocks become older and older as you move away from the Mid-Atlantic Ridge in BOTH directions.

THIS PROVES THAT NEW OCEAN MATERIAL IS PRODUCED AT THE MID-ATLANTIC RIDGE. OLDER MATERIALS ARE THEN PUSHED OUTWARD.

3. The oldest ocean crust is 200 million years old.
4. The oldest continental crust is 4 billion (4000 million) years old.

THIS PROVES THAT OCEANIC CRUST IS CONTINUOUSLY REGENERATED. WHEN THE OCEANIC CRUST SPREADS OUT AND REACHES THE CONTINENTAL CRUST, IT FORMS A "SUBDUCTION ZONE" OR TRENCH. THIS MEANS THAT THE OCEANIC CRUST GOES UNDERNEATH THE OLDER, THICKER CONTINENTAL CRUST.

5. Earth's magnetic field has reversed itself many times in Earth's long history.
6. There are alternating bands of normal and reversed magnetic alignment in the oceanic crust.

THIS (AGAIN) PROVES THAT, THROUGHOUT EARTH'S HISTORY, THE OCEANIC CRUST IS CONTINUOUSLY REGENERATED AND SLOWLY SPREADS OUT FROM THE MID-ATLANTIC RIDGE.

10.3 Theory of Plate Tectonics

- Earth's crust and upper mantle are broken into sections.
- The upper mantle consists of 2 parts: the lithosphere and the asthenosphere.
- Lithosphere = the top part of the upper mantle (less dense part of the mantle)
- Asthensosphere = the lower part of the upper mantle (more dense part of the mantle)
- The crust (also known as PLATES) float around on top of the mantle.

SHOW DIAGRAM OF CRUST, LITHOSPHERE, AND ASTHENOSPHERE

10.3 Three Types of Boundaries

1. DIVERGENT PLATE BOUNDARY (DPB)
   - 2 plates moving away from each other
   EX. 1: North American plate moving away from the Eurasian and African plates
   → Mid-Atlantic Ridge (oceanic example)
   EX. 2: African plate is starting to separated in northern Africa
   → Great Rift Valley (continental example)
2. CONVERGENT PLATE BOUNDARY (CPB)
   - 2 plates moving toward each other
   EX. 1: Nazca plate moving toward the South American plate
   → Andes Mountains and the Peru-Chile Trench
   EX. 2: Philippine plate moving toward the Eurasian plate
   → island arc of Japan and a trench
   EX. 3: Indo-Australian plate is moving toward the Eurasian plate
   → Himalaya Mountains (separating India and Asia)
3. TRANSFORM FAULT BOUNDARY
   - 2 plates sliding past each other
   EX: Pacific plate is sliding past the North American plate
   → San Andreas Fault in California

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10.3 Convection Currents

- based on the idea that cool air sinks and warm air rises
- in the Earth's mantle, cool magma sinks and warm magma rises
- Cool air/magma is MORE DENSE than warm air/magma. Therefore, it sinks.
- Warm air/magna is LESS DENSE than cool air/magma. Therefore, it rises.
- Convection currents in the upper mantle are the cause for plate tectonics.
- Basic steps for a convection current:
    1. Warm (less dense) magma rises to the surface.
    2. When the magma reaches the surface, it moves the plate horizontally.
    3. As it moves the plate, the magma cools down.
    4. The cool (more dense) magma sinks back down into the mantle.
    5. When the magma becomes warm again, this cycle will repeat.

SHOW DIAGRAM OF A CONVECTION CURRENT AT A DPB
SHOW DIAGRAM OF A CONVECTION CURRENT AT A CPB