Plate Tectonics:

Continental Drift

Plate tectonics is a unifying theory that attempts to explain natural phenomena such as earthquakes and volcanoes.

Continental Drift Review

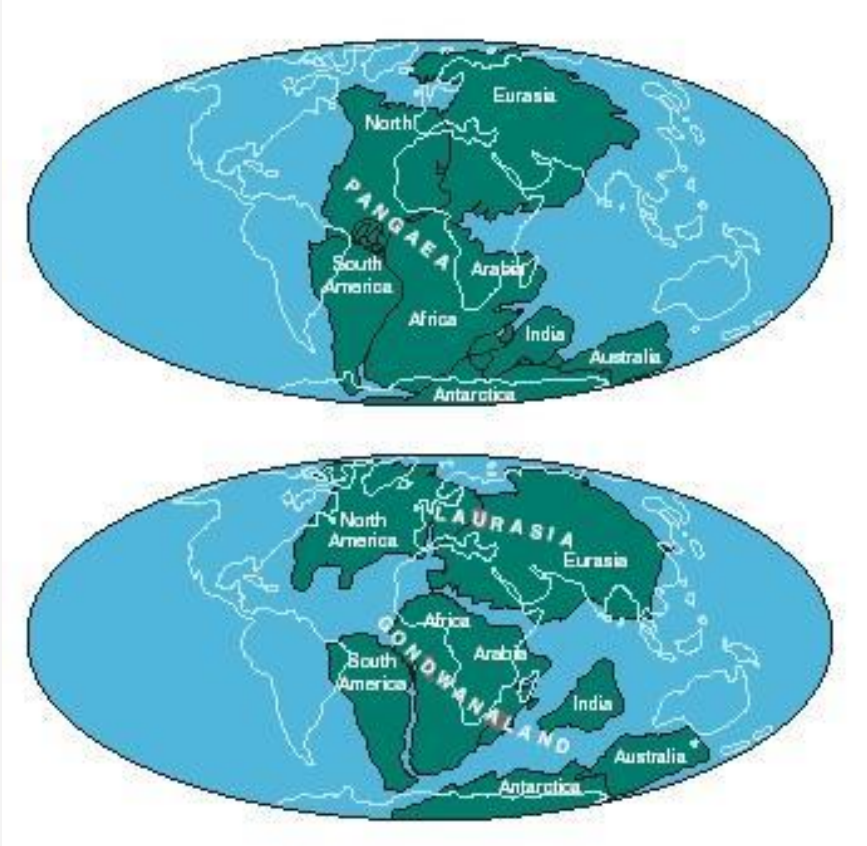
- Alfred Wegener -1912
  - large "supercontinent" (Pangaea) existed and then split into pieces

- Wegener not able to provide MECHANISM for his theory

Evidence for Continental Drift

- Jigsaw puzzle fit of the continents
- Fossil of plants and animals of the same age on continents separated by oceans
- Glacier evidence in Brazil, where it is tropical
- Identical rocks in mountain ranges, now separated by the Atlantic Ocean
- Coal which only forms under wet / warm conditions have been found beneath the Antarctica ice

Evidence for Continental Drift



The rebirth of continental drift after World War II

After World War II, there was a sustained effort by the U.S. to chart the ocean floor

A. This exploration, combined with several other discoveries, led to a rebirth of the continental drift model

B. By the late 1960s, virtually all geologists accepted continental drift. This was a major paradigm shift––The textbooks had to be rewritten

C. What evidence led to this thought revolution?

Supporting evidence for Plate Tectonics Theory:

- **1. Discovery of the Mid-Atlantic Ridge (Ewing)** - Ocean floor mapping led to the discovery of a global mid-oceanic ridge mountain chain zig-zagging around the continents.
- **2. Magnetic Variations on the Ocean Floor (Palaeomagnetism)** - during cooling, minerals in the Basaltic rock, align themselves along the Earth's magnetic field - producing almost symmetrical magnetic patterns in the rocks either side of the Mid-Atlantic ridge (alternating stripes of magnetically different rocks).
- **3. Theory of Sea-Floor Spreading (Hess) -** development of new oceanic crust.

Seafloor spreading

- Since World War II research vessels with sonic depth recorders have crisscrossed the oceans, resulting in the construction of detailed maps of the ocean surface

- Mid-ocean ridges were found to be dominant features of the ocean floors

Examples

1. Mid-Atlantic Ridge

2. East Pacific Rise

Paleomagnetism and polar wandering

- The earth is structured as if a giant bar magnet is oriented north-south within the earth
- The orientation today is not exactly north-south, but is off by 11 degrees
- Compass needles line up with magnetic field
- We don’t completely understand why the earth acts as a magnet, though it is probably related to its liquid metal outer core
- Perhaps this metal core acts as a generator, or dynamo, which generates its own electric field––a field that changes over time.

The rules of Plate Tectonics

- 1. Continental crust is less dense, or lighter, than Oceanic crust so it doesn't sink. It is never destroyed and is considered permanent.
- 2. Oceanic crust is more dense so it can sink below Continental crust. It is constantly being formed and destroyed at ocean ridges and trenches.
- 3. Continental crust can carry on beyond the edges of the land and finally end far below the sea. This explains why the edges of all the continents don't have deep trenches right up against their coastlines.

The rules of Plate Tectonics

- 4. Plates can never overlap. This means that they must either collide and both be pushed up to form mountains, or one of the plates must be pushed down into the mantle and be destroyed.
- 5. There can never be gaps between plates, so if two plates move apart, as in the middle of the Atlantic, new rock will be formed to fill the space.
- 6. We know the Earth isn't getting bigger or smaller, so the amount of new crust being formed must be the same as the amount being destroyed.

The rules of Plate Tectonics

- 7. Plate movement is very slow. This is partly why Wegener's original ideas were ignored. Nobody could 'see' the continents moving. When the plates make a sudden movement we call it an Earthquake.