

Ocean 201 week 3 Lecture 1: Continental Drift (M.J. Mottl)

Text from slides

Tectonics: a branch of geology that deals with the major structural (or deformational) features of the Earth and their origin, relationships, and history...

Tectonic Structure of Continents

- **Craton** or **shield**: Stable part of a continental block that has not experienced deformation for a long time...
- **Mobile Belt**: a compressional mountain belt: long narrow region of crust that has been deformed recently and repeatedly

Shrinking Earth Theory

Prevailing theory in the early 20th century

(This theory was wrong and is a good example of how ideas in science can and do change...)

- 1) Earth was formed in a molten state. It is still solidifying and shrinking as it cools.
- 2) Shrinkage causes the previously cooled crust to wrinkle:
Large wrinkles = continents and ocean basins
Small wrinkles = mountain belts.
Motion is mainly vertical, not horizontal...
- 3) Continents are drained as ocean basins warp down and flooded as they fill up with sediment.

Theory of Continental Drift (Alfred Wegener, 1912)

- Continents are moving laterally across the face of the Earth.
- Continents were joined together in the distant past as a single supercontinent.
- Supercontinent (Pangaea) was surrounded by a superocean (Panthalassa).
- Supercontinent split apart and its pieces are still moving apart today...
- *Motion is mainly horizontal, not vertical...*

Evidence for Continental Drift: I

- Fit of continents (first map and suggestion by Francis Bacon, 1620!)
- Mobile belts near continental margins, NOT randomly distributed.
- Hypsometry of Earth suggests two types of crust, isostatically supported.
- Earth is **oblate spheroid**:
(6367 +/- 11 km radius; viscous liquid, permits *isostatic compensation*).

Evidence for Continental Drift: II

- **Distribution of living organisms**
- **Distribution of fossil organisms**
- **Distribution of paleoclimatic indicators in rocks**: Glacial tills, Desert sands, Tropical soils, Coal beds, Coral reefs

Problems with Continental Drift

- Cause (?): Wegener postulated that earth tides and centrifugal forces or “polflucht” (“flight from the poles”) were the driving forces...
- Ideas were rejected by many geophysicists because :
 - Lack of a suitable mechanism: the forces Wegener suggested were too weak to move continents.
 - How could continents “plow through” the ocean floor?
 - Too unconventional: hard to accept even if it made sense.
 - Wegener was a meteorologist so he was considered an outsider.
 - European and N. American geologists mostly rejected his ideas.

Support for Continental Drift

- South African and Australian geologists, however, tended to accept Wegener’s ideas because the geology of those continents seems rather incomplete:
- Major geologic structures in S. Africa & Australia end abruptly at coastlines and seem cleanly cut apart.
- Missing parts of these geologic structures reappear on another continent across the ocean.
- Paleo-evidence mentioned before...
- ***Paleomagnetic evidence uncovered in the 1950’s led to a revival of Wegener’s ideas...***

Revival of Continental Drift Theory

- Kiyoo Wadati (1935) speculated that earthquakes and volcanoes may be associated with continental drift.
- Hugo Benioff (1940) plotted locations of deep earthquakes at edge of Pacific “Ring of Fire”.
- Earthquake are not randomly distributed...
- Many coincide with oceanic ridge system... suggested Earth divided into distinct sections
- Evidence of ***polar wandering***.

And now, on to Seafloor Spreading...