Geology 101-539
Class 2-Test 1
Thursday, September 4, 14

Chapter 2: Plate Tectonics: The Unifying Theory
Part 1 of 2

Outline

- The discovery of plate tectonics
  - Continental drift
  - Seafloor spreading
  - The great synthesis 1963-1968
- Earth's tectonic plates
  - Divergent boundaries
  - Convergent boundaries
  - Transform-fault boundaries

Continental Drift

- Large scale horizontal movements cause earth's major topographical features
  - Mountains
  - Oceans basins
- Alfred Wegener (1880-1930)
- Proposed in 1912 based on observation of drifting ice sheets
- His analogy was used with icebergs floating on the water and drifting around
- Geographic Fit Of The Continents…
  - One of the first pieces of evidence use to argue for continental drift
  - All continents were once together in a supercontinent called Pangea
    - North America, South America, Africa, Europe example map
- Fossil Match Across The Atlantic
  - Paleontologists
    - Animals and plants diverge in evolution after the postulated breakup time
- Rejection and Acceptance of Continental Drift
  - Initially rejected by geologists
    - Geologists said it is too good to be true
    - New data after WWII led to 1960s plate tectonic revolution
    - Ocean Drilling started happening

        - Different data from magnetic, sonar, ocean drilling, etc, led to this revolution. (Earth Science Revolution)
    - Now fully embraced
        - Textbooks re-written

Seafloor Spreading

- Convection in the Earth's mantle could break up and push continents apart
- Arthur Holmes (1890-1965)
- He worked with the idea of convection
    - Heat rises and cool sinks
- Harry Hess (1906-1969)
- He used the hypothesis of mantle convection to explain seafloor spreading, island arcs, gravity anomalies and serpentine rocks
- He worked on a cruise ship and use that to his advantage to create and collect data
- History of the ocean basins, 1962
- He is the father of modern plate tectonics
- Iceland
    - An opening rift along the Mid-Atlantic ridge
    - …new ocean crust forms at mid-ocean ridge
- Earthquakes and Volcanoes
    - Their locations are predicted by plate tectonics
    - The Pacific "Ring of Fire" shows the volcanic and earthquake activity now know to be associated with convergence and destruction of lithospheric plates

Plate Tectonics: The Great Synthesis

- Plates comprises top of the mantle, oceanic crust, and or continental crust, called lithosphere **Could Be Test Question
- Plates slide over partially molten, weak mantle region called asthenosphere
- Plates are tens of km thick…
- In relative motion w.r.t. each other driven by mantle convection
- Lithospehere
    - Cold, outer rigid (brittle) shell of the Earth (100km) containing the plates. The coldest part
- Asthenosphere
    - Heat-softened (viscous) part of the mantle beneath the lithosphere
- …plate motion causes earthquakes and builds mountains

Plate Boundaries and Displacement Rates…

- relative plate motions shown in mm/year

- Number associated with arrow
- What is the explanation for why the Pacific Plate is larger than the other plates?
    - Pacific Plate is the fastest moving/growing plate.

The 3 Types of Plate Boundaries

- Transform
    - At transform-fault boundaries plates slide horizontally past each other
        - Ex: California
- Divergent
    - At divergent boundaries, plates move apart and create new lithosphere
        - Ex: Iceland
- Convergent
    - At convergent boundaries, plates collide and one is pulled into the mantle and recycled
        - Ex: Alaska

- Transform Plate Boundary
    - San Andreas Fault, runs along the coast of California
    - Ones that occur in the ocean floor, South American Plate/African Plate
    - Makes the rocks on either side different ages
- Divergent Plate Boundary
    - Volcanoes and earthquakes concentrate
    - Mid Atlantic Ridge-North American Plate/ African Plate
    - East African Rift Valley-African Plate/Somali Subplate
        - Africa continent is breaking into opposite directions
    - Parallel valleys; volcanoes and earthquakes
- Convergent Plate Boundaries
    - Ocean-continent
        - ...Continental arc volcanoes are formed
        - Most common form of convergent plate boundaries
    - Peru-Chile trench-Nazca Plate/South American Plate
    - Andes Mountains-South American Plate
    - Ocean-Ocean
        - ...Island arc volcanoes are formed
    - Japan Trench- Eurasian Plate/Pacific Plate
    - Japanese Islands (Island arc)- Eurasian Plate
    - Continent-Continent
        - Fold and thrust mountains are formed, ex: Himalayas