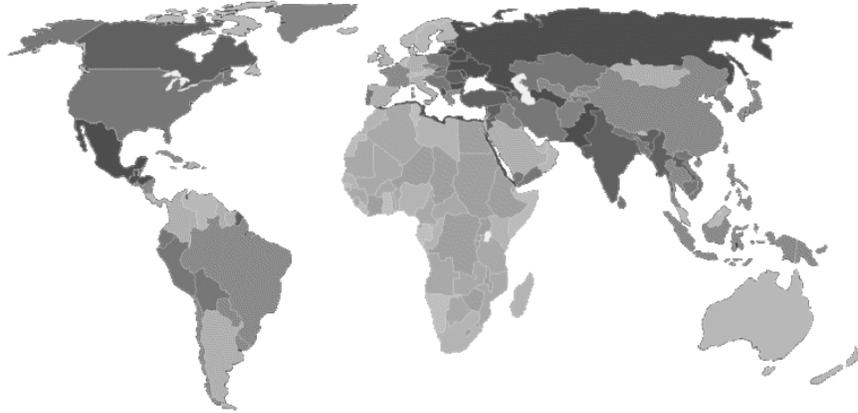


## PLATE TECTONICS

The theory that pieces of Earth's lithosphere (plates) move slowly on top of the asthenosphere.

*Evidence*

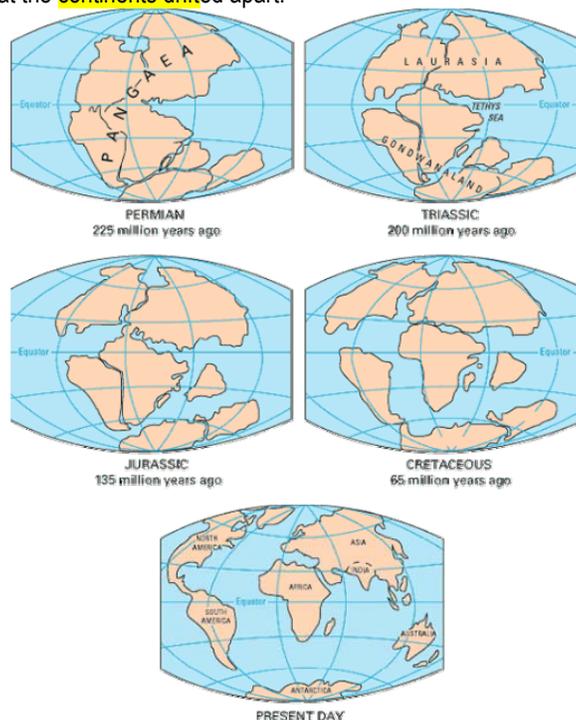
- Mapmakers noticed that continents looked like puzzle pieces



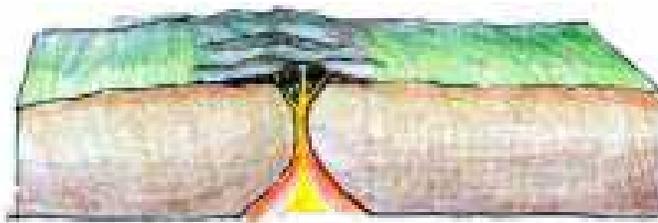
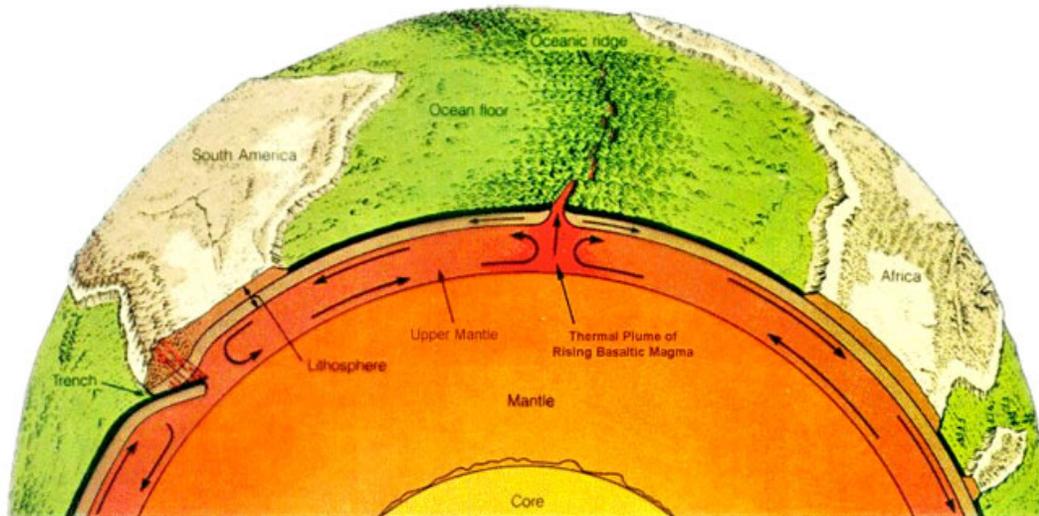
- Similar fossils at the edge of continents that were separated by oceans
- Presence of mountains

*History of the Theory*

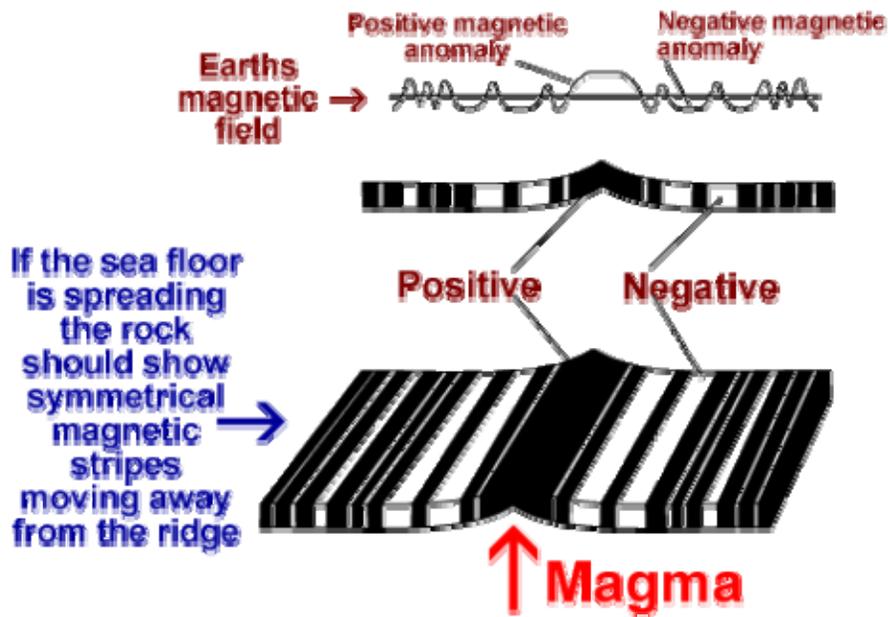
- Alfred Wegener**: German scientist who in 1910 proposed the idea that all the continents were joined together in a super-continent called **Pangaea**.
  - He then proposed that the **continents drifted** apart.



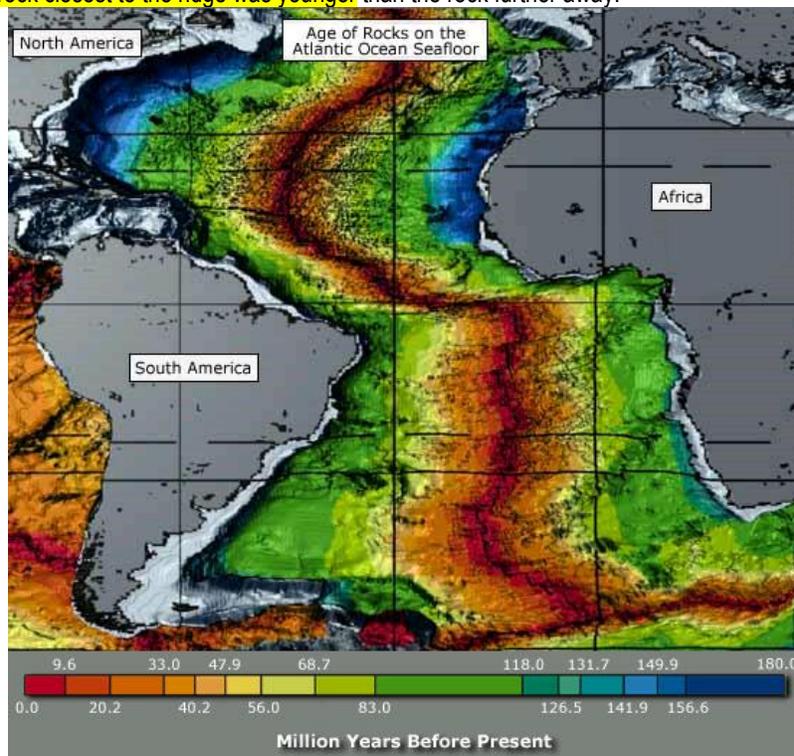
- Problem with Wegener's idea:
  - How did continental drift occur?
    - What force could move continents?
    - How could continents plow through rock?
- **Sea-floor Spreading**
  - 1960: American geologist **Harry Hess** proposed the idea that underwater mountains form from cracks in the crust where magma pushes upward.



- Mapping of ocean floor in mid 1900s showed a **mid-ocean ridge** in the Atlantic Ocean.
- Hess' idea was supported by magnetic stripes on the ocean floor showing **magnetic reversal**
  - The magnetic poles flip about every 250,000 years
  - If continental drift by sea-floor spreading has occurred, then there would be magnetic stripes on the ocean floor (which there are).



- Also, the rock closest to the ridge was younger than the rock further away.



- **Subduction**: the process of oceanic plates sinking into the mantle as sea-floor spreading occurs.
- Sea-floor spreading provided a **mechanism for the continental drift** that Wegener proposed.
- Cause of Sea-floor spreading and continental drift
  - **Convection currents** in the asthenosphere.
    - Hot magma rises to the lithosphere, spreads out, and drags the plates with them.
    - When the rock cools, it sinks back to the bottom of the mantle.

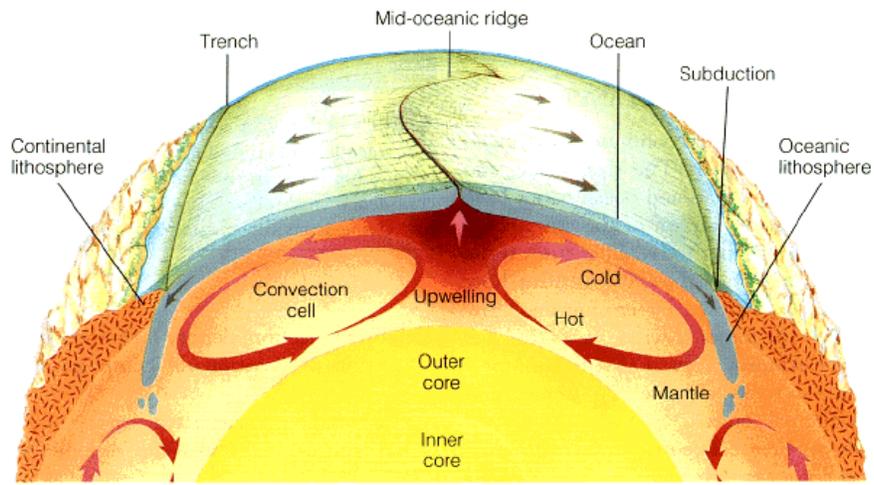
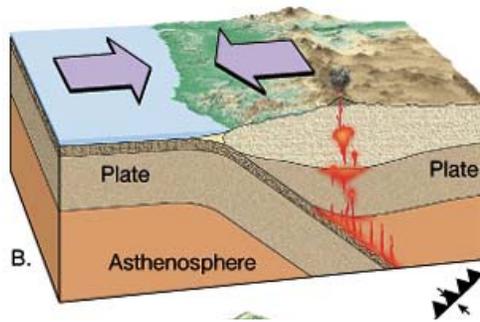
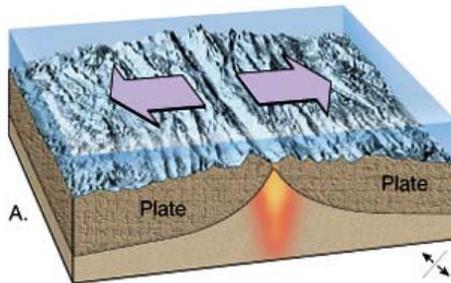


Plate Boundary Types

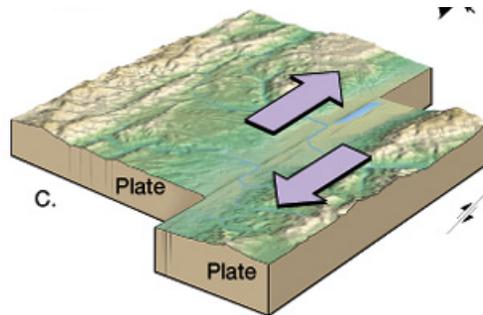
- **Converging plate boundary:**  $\rightarrow \leftarrow$   
(come together)



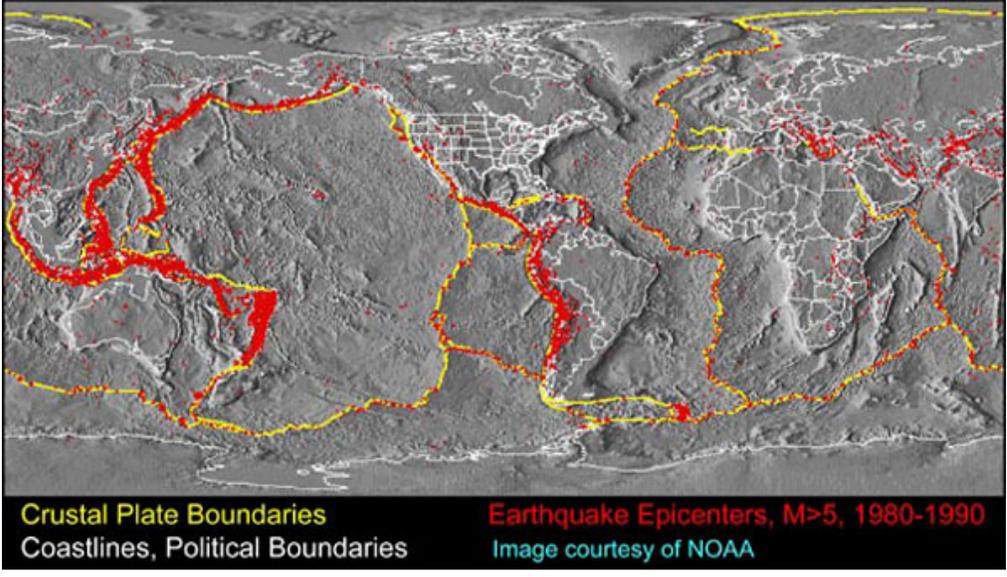
- **Diverging plate boundary:**  $\leftarrow \rightarrow$   
(move apart)



- **Transform plate boundary:**  $\updownarrow$   
(slide past each other)



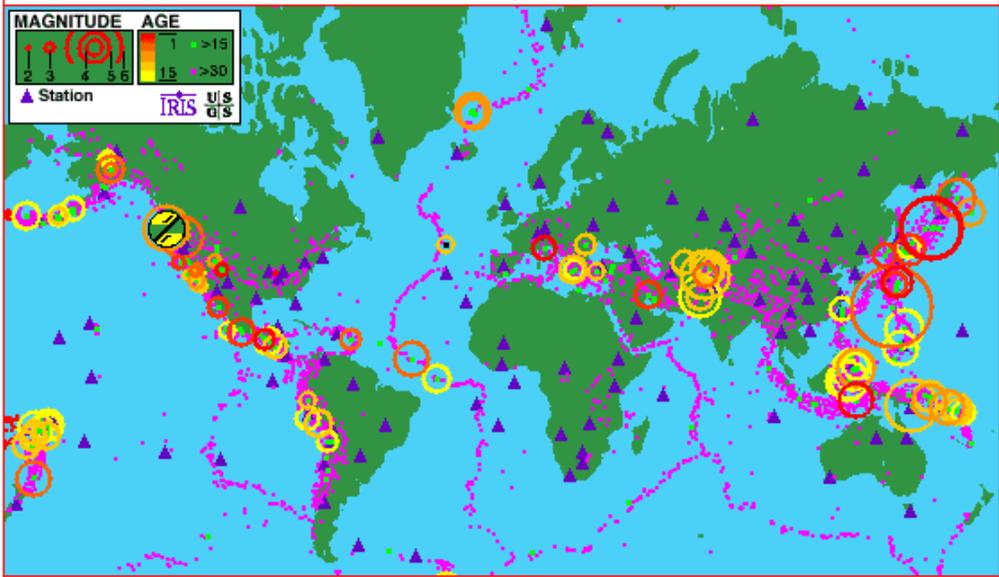
- Most mountains can be found along **plate boundaries**.
- Most earthquakes " " " " "
- Most volcanoes " " " " "



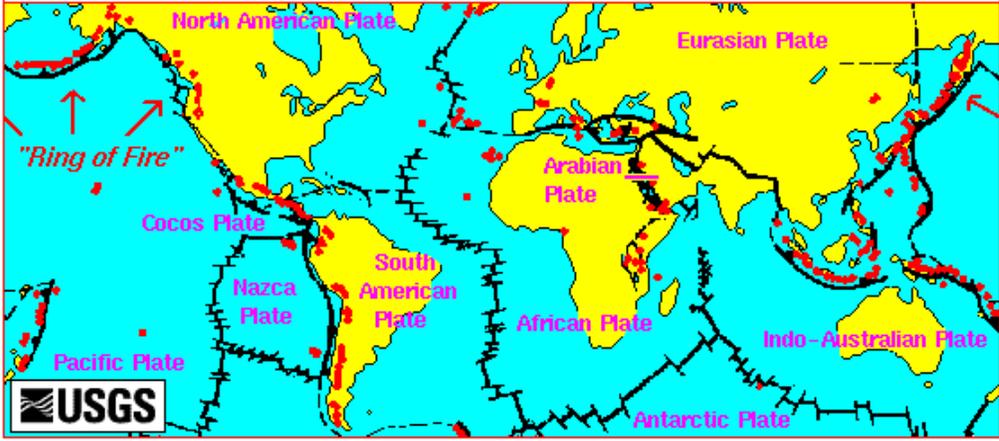
Crustal Plate Boundaries  
Coastlines, Political Boundaries

Earthquake Epicenters, M>5, 1980-1990  
Image courtesy of NOAA

### Earthquakes, Active Volcanoes, and Plate Tectonics



**TOP:** World-wide earthquakes on July 7, 1999, and past 5 years, demonstrating how earthquakes define boundaries of tectonic plates. Data from NEIC. Chart from IRIS Consortium, USGS, U.Colorado, Reel Illusions, Inc., and U.Washington. Chart modified for web use. Purple triangles are seismic stations, green/yellow "ball" is 5.1 event of July 3, 1999. **BOTTOM:** World-wide active volcanoes (red circles), tectonic plates, and the "Ring of Fire". Chart modified from Tilling, Heliker, and Wright, 1987, and Hamilton, 1976. -- Topinka, USGS/CVZ, 1999



USGS