

I. Plate Tectonics

A. Earthquakes and Plates

1. Earthquakes are concentrated in narrow belts around the Earth
 - Earthquakes = shaking of ground caused by shock released during sudden breaking of the lithosphere.
2. Stresses are focused where these Earthquakes occur
 - These stresses cause the Earthquakes
3. **Point:**
 - a. Lithosphere is broken into ~ 20 'plates'.
 - b. These plates are in motion,
 - c. Interacting at their edges producing stresses that result in Earthquakes!

B. Stresses:

1. Lines on map = orientation of principle compressive stress (shortening/squeezing)
2. Orientation of stresses are different at different boundaries
 - e.g.: Pacific rim = compression perpendicular to boundary vs. Iceland where compression is parallel to boundary.
3. **Point:** Stresses and Plate Boundaries
 - a. Stresses produced by motion of plates
 - b. Different stress orientations implies different relative motions of plates.
 - c. So, we can see that boundaries can be classified by the different stress orientations, or different relative plate motions

C. Theory of Plate Tectonics = Point above – lithospheric plates are in motion and interact at edges.

II. Types of Plate Boundaries

A. Three types of relative plate motion

1. Move toward, move away, slide past
2. So, there are three types of plate boundaries

B. Divergent Boundaries: plates move away from each other.

1. Lithosphere Pulled apart
 - a. Thins vertically (e.g. silly putty or milky way bar)
 - b. Asthenosphere rises, melting resulting in Volcanoes on the surface
2. This process results in
 - a. Rifting of continents to linear seas (e.g., AFAR to Red Sea)
 - b. Continues to opening of ocean basins (Process of Seafloor Spreading)

C. Convergent Boundaries: Plates come together.

1. Two types of Convergent Boundaries depending on the converging plates
 - a. Subduction Zones (Type one) – where one or both of the plates is oceanic
 - b. Collision Zones – both plates are continental
2. Subduction zones: e.g., Aleutians, Cascades
 - a. Oceanic plate or slab sinks under the other plate (process called subduction)
 - b. Marked by a deep oceanic trench where the plate is sinking
 - c. Sinking slab is heated and squeezed
 - i. This drives fluids from the slab that cause melting of the asthenosphere
 - ii. Resulting in volcanic arc on the surface
3. Collision zones: e.g., Himalaya
 - a. Two continents collide
 - b. Produces huge mountains build from two continental masses
4. Note that subduction eventually will lead to collision causing subduction to stop.

D. Transform Boundaries: Plates slide past each other (e.g. San Andreas)

1. Transform plate boundaries are huge faults (San Andreas, Anatolian etc.)
 - large devastating Earthquakes are generated along these faults
2. They link the two other types of boundaries – see the tectonic map
 - very common in the oceans

III. Hot Spots

A. Note: not all volcanoes are located on plate boundaries.

- Those that are within plates are called Hot Spot volcanoes

B. Cause of Hot Spots = mantle plumes

1. Anomalously hot mantle rises through mesosphere and asthenosphere

2. Melts at base of lithosphere producing volcano on the surface

C. Hot Spot Tracks

1. Lithospheric plate continues to move over the hot spot

a. New volcanoes grow as older ones die out.

b. This produces a trail of extinct volcanoes leading to an active volcano

c. Example: Hawaiian island chain, Yellowstone Hot Spot

2. Hot spot tracks give velocities of plate motion!

a. Velocity = distance divided by time

b. Distance = length of the volcanic chain

c. Time = Age of the extinct volcanoes

d. Plate velocities range from ~0 (Africa) to > 18 cm/year for parts of Pacific plate