Plate Tectonic Theory

- The theory of plate tectonics is one of the great advances in the twentieth century.

  In the 1960's, **scientists such as Alfred Wegener** proposed the **"continental drift theory"**, and

  Tuzo Wilson put forth the idea that, "**Earth consisted of several different fragments called plates, instead of being made up of one static, rigid, solid layer**."

  This revolutionized the way scientists think of Earth today.

Reference:
Tarbuck and Lutgens
Pages 525-526, 23
CD 805-809, 818-820

- **Tectonic Plate**

  a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.

  Plate size varies from a few hundred to thousands of kilometers across, the Pacific and Antarctic are among the largest.

- These massive slabs seem to float because of their composition.

  Continental Crust (Thickness: 30-100 km) is composed of Granitic rocks which are made of lighter minerals (Felsic) and are less dense than:

  Oceanic Crust (Thickness: 5-10 km) which is composed of Basaltic Rocks which are made of denser minerals (Mafic)

- *In the late 1960's scientific studies of the ocean floor led to the development of a theory that better explained the idea of a mobile Earth, This theory was called the Plate Tectonic Theory.*
- *A Canadian geologist named Tuzo Wilson was the person to proposed the Plate Tectonic Theory.*

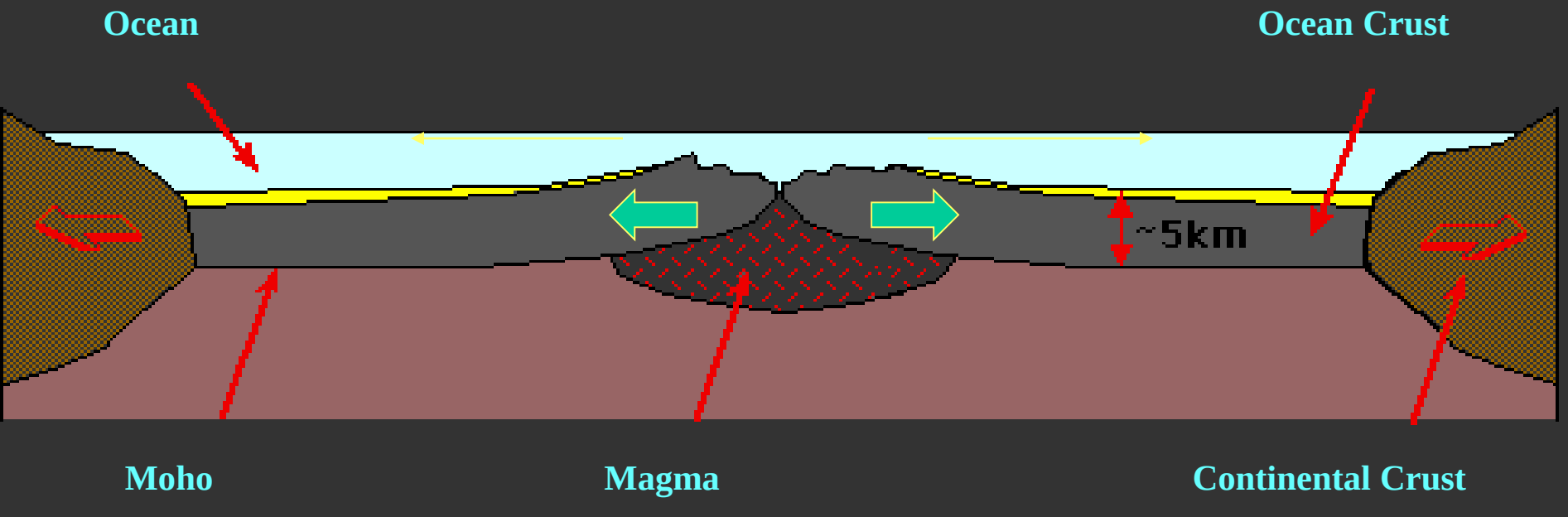
Theory of Plate Tectonics States:

- "Earth's crust is divided into approximately 20 rigid slabs called tectonic plates."
- These tectonic plates are in continuous slow motion relative to each other which occurs along one of three types of boundaries bordering each plate."

Three Types of Plate Boundaries Include:

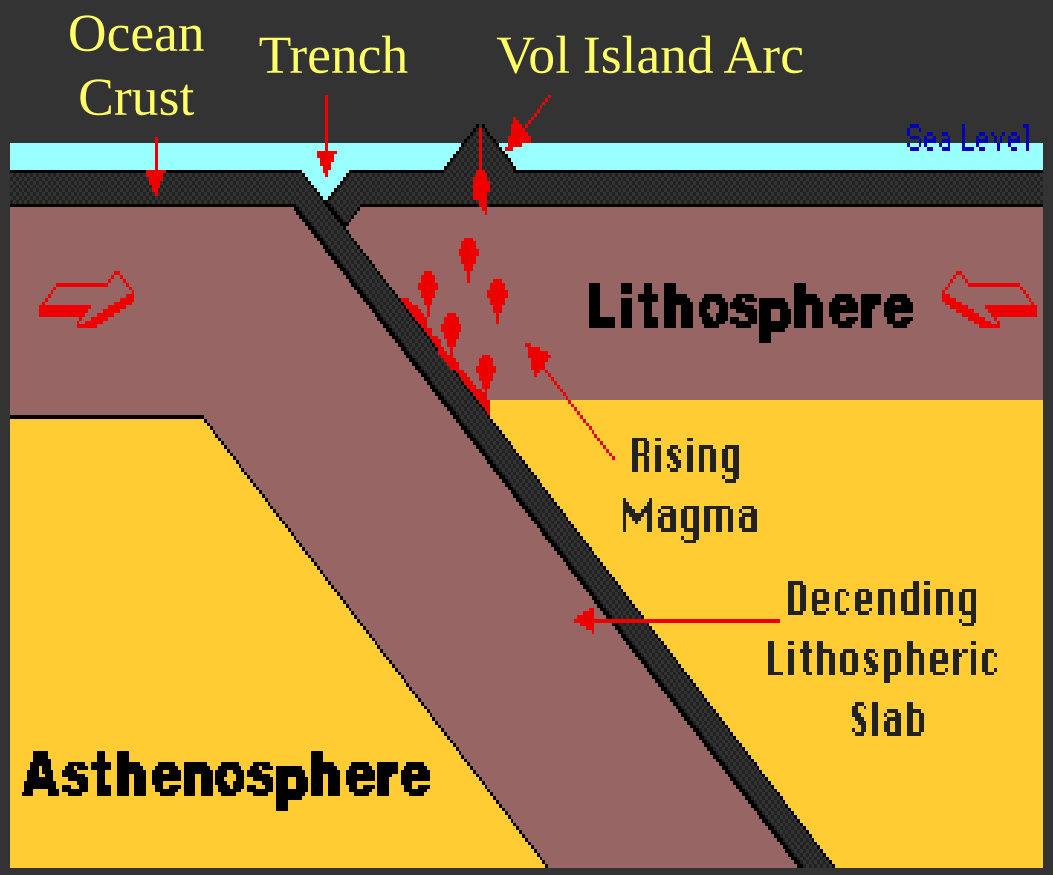
1) **Divergent Boundary**

- Plates move apart, resulting in upwelling of molten material from the mantle to create new ocean floor.
- Features on the ocean floor called Ridges, show this form of plate movement.
- Tensional forces cause the plates to move apart.



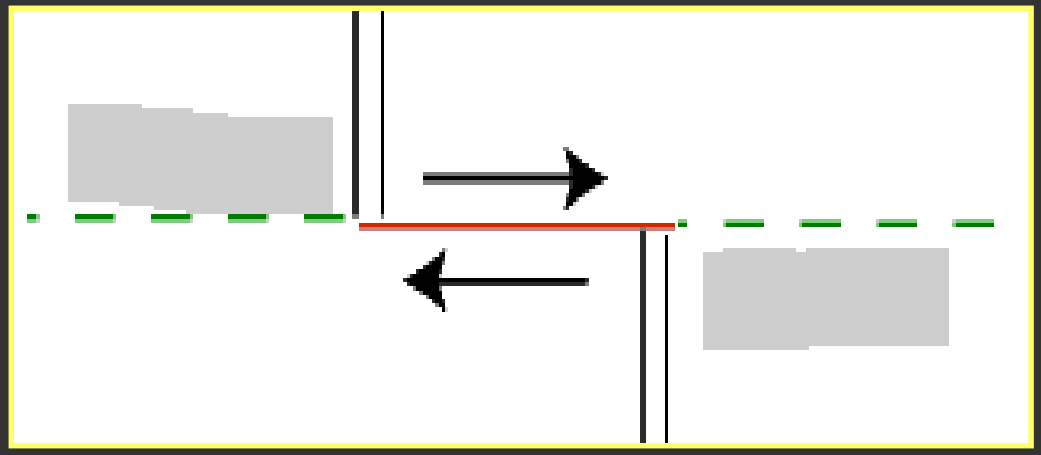
2) Convergent Boundary

- Plates move together, causing one slab of lithosphere to be consumed into the mantle as it descends beneath the overriding plate.
- Features called ocean trenches are formed at these boundaries. Lithosphere is destroyed at these boundaries.
- Compressional forces cause the plates to move together.



3) Transform Boundary

- Plates move past each other in opposite directions. Lithosphere is not created or destroyed at these boundaries.
- No vertical movement. For example, San Andreas Fault.
- Shearing forces cause the plates to move past one another.



Birds Eye View or Top View

Plate Tectonic Theory - Evidence:

1) Earthquakes and Volcanoes
2) Polar wandering
3) Magnetic Reversals and Seafloor Spreading
4) Ocean Drilling and Heat Flow
5) Hot Spots

Special Scientists

Frank Taylor	1910 – Explained the formation of the Himalayan Mountains by moving continents (no evidence given).
Alfred Wegener	1915 – Proposed the theory of continental drift (evidence given, but no mechanism provided).
Alexander DuToit	1937 – Proposed that Earth's continents would fit more closely together at the continental margins.
Arthur Holmes	1950s – Proposed the existence of a mechanism for movement; mantle convection.
Harry Hess and Robert Deitz	1960s – Proposed the theory of seafloor spreading.
Fredrick Vine and Drummond Matthews	1963 – Proposed the idea of magnetic reversals as evidence to support the theory of seafloor spreading.
J. Tuzo Wilson	1965 - Proposed the existence of "plates" on Earth's surface as a result of mapping the world's volcanoes and earthquakes. He also proposed the existence of transform faults along plate boundaries; and that stationary hotspots in Earth's mantle caused volcanism within plates.
Xavier Le Pichon and Dan McKenzie	1970s – Proposed the theory of plate tectonics

Sample Problem

Using Plate Tectonics, explain why the Hawaiian Islands vary in age and amount of volcanic activity.

Answer:

The Hawaiian Island chain formed as a result of the Pacific plate moving over a hot spot located in the mantle beneath the pacific ocean. The oldest volcanic islands are located the farthest from the hot spot and has little to no volcanic activity. Whereas the closer you get to the hot spot, the younger the volcanic islands are and the greater the amount of volcanic activity. For example, the island of Hawaii is presently positioned directly above the hot spot and experiences volcanic activity on a regular basis.