Plate Tectonics

Overview: I will explain the definition and my understanding of the theory, its driving mechanisms, and plate boundaries and how they explain some intense geologic activity on Earth.

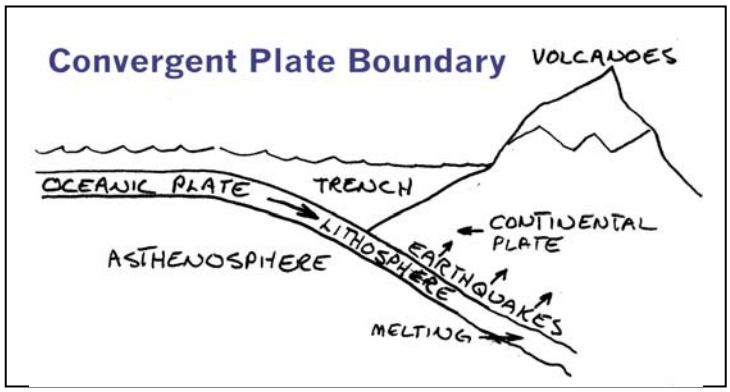
Definition: It is the idea that the earth surface (Lithosphere) is divided into several large plates that move slowly over the asthenosphere, which is the outer most part of the Earths mantle. These plates change in size and position relative to one another.

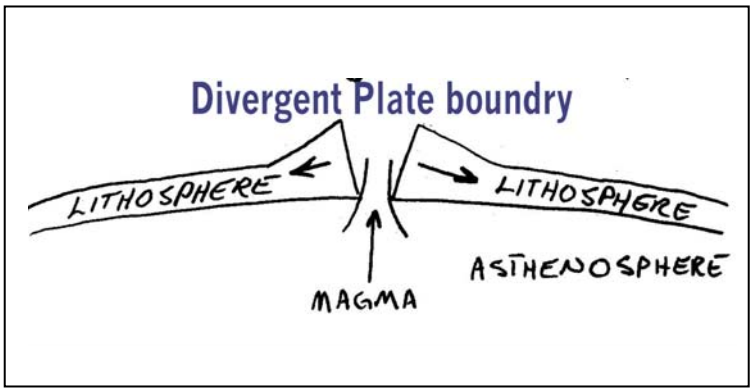
Theory: The concept of Plate Tectonics was born in the late 1960s by combining two preexisting ideas----continental drift and sea-floor spreading. Continental drift (first proposed in ~1910 by Alfred Wegener) is the idea that the continents are moving freely over the earth's surface, changing their position relative to one another. Sea-floor spreading being the idea that sea floor forms at the crest of the mid oceanic ridge, then moves horizontally away from the ridge crest toward an oceanic trench. 200 million years ago the continents were all together in one super continent called Pangaea. We know this because maps show that the continents can be made to fit together like a puzzle. We also know that matching glacial striations and fossils were found in Africa, South America and Australia in the same kind of rock.

Supporting Data: Various lines of reasoning support plate tectonic theory. They include: fossil data (similar fossils exist on both sides of the Atlantic Ocean that couldn't have been transported by any other means than tectonic, such as fossil ferns); rock data (similar rocks of the same type and the same age exist on both sides of the Atlantic – driven apart from where they formed by plate motion); glacial evidence (striations, or scratches, in bedrock produced by glacial activity can only be adequately explained by plate motions); paleomagnetic data (rocks on the sea floor preserve magnetic patterns - evidence of the earth's magnetic field strength and direction when they were formed); puzzle-like fit of the continents noticed by Wegener and others before him; satellite imagery and Global Positioning System (GPS) data are the latest data to confirm tectonic theory by measuring plate motions in absolute terms and real time.

Driving Mechanisms The plates move due to the movement of heat called convection under the surface of the Earth. The plates are composed of blocks of the Earths crust (lithosphere) that are riding on a plastic like substance called asthenosphere There are three types of plate movement.

1. Convergent; The plates are moving towards each other and are hitting head on. When two continental plates hit they rise up and form high places on earth like the Himalayas. When oceanic plates hit they are pulled down (subducted) and are recycled into the Earths mantel and form low places on Earth like the Mariana's trench. When an oceanic plate hits a continental plate the oceanic plate being colder and therefore denser dives below the continental plate and is recycled. As the plate is being melted it can resurface and form volcanoes in the area. These areas are called subduction zones and the plates rubbing together can also cause earthquakes.
2. Divergent; Two plates moving away from one another. This is where the plates are spreading away from each other and can occur in the middle of the ocean, or in the middle of a continent. When this happens in the ocean it's called sea floor spreading and a good example of this is the Mid Atlantic Ridge. Magma rises from the asthenosphere as the two plates are spreading apart. As it cools it sinks toward trenches to be subducted by another plate. The proof being that the spreading centers have the youngest rocks and the oldest rocks can be found at the subduction zones. Boundaries such as these have shallow earthquakes and many volcanoes.
3. Transform; the plates are sliding horizontally past each other. A good example of this is the San Andreas Fault in California where the plates are moving opposite each other. Many earthquakes occur when energy is unleashed as the two plates unlock. The most famous being the 1906 earthquake in San Francisco and the Loma Prieta earthquake in 1989. This type of boundary produces many earthquakes, but no volcanoes.





Significance: It seems important to study plate tectonic theory in order to assess the types of damages and loss of life caused by the hazards imposed by plate motions. Earthquakes and resultant hazards (ground motion, liquefaction, landslides, tsunamis) can wreak havoc on humans and other life forms. Volcanoes, similarly, do the same with their hazards (ash fallout, pyroclastic flows, tsunamis, earthquakes, landslides, lave flows, gas emissions). Concentration of geologic resources, such as oil, natural gas, and minerals is related to plate tectonics. We utilize minerals and fossil fuels every day of our lives; finding these resources is important for maintaining our current standard of living.

Conclusion In general, plate tectonics is a result of heat flow from within the Earth. The mantle moves due to convection, causing the overriding, rigid plates to move as well, resulting in three types of plate motion: 1) convergent; 2) divergent; and 3) transform motion. Most geological phenomena can be explained by plate tectonic theory: earthquakes, volcanoes, mountains, trenches, and even ore distribution. It is the overarching theory in geology.