Module 3, Investigation 3: Plate Tectonics

Introduction

Welcome!

You have seen evidence for shifts in the positions of continents. You gave seen evidence for expansion of the ocean basins. But what actually causes these things to occur?

Now you will examine what is happening below Earth's surface to cause these shifts._ You will need to refer to your notes on volcanoes, earthquakes, and Earth's structure to see the whole picture.

Check your Google Earth settings!

1. Turn off all Layers except **Borders** and **Labels**.
2. Select Tools > Options > 3D View > Units of Measurement > select **Meters, Kilometers**.
3. Select Tools, > Options > 3D View > Terrain Quality > check "Show terrain" > enter **2** for **Elevation Exaggeration**.
4. Select Tools > Options > 3D View > Show Lat/Long > check **Decimal Degrees**.
5. Select Tools > Options > Touring > check "**Show balloon when waiting at features**".

Folder 1: Plate Geography and Structure

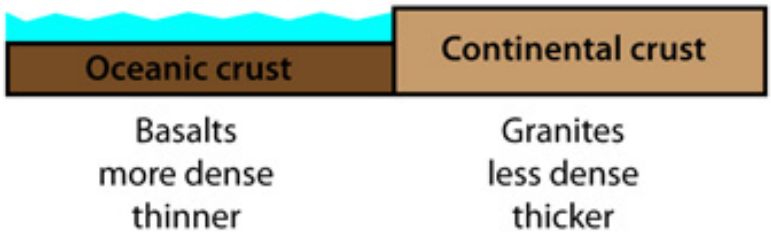
What is a Tectonic Plate?

The entire Earth's surface is divided into pieces called "lithospheric" or "tectonic plates" and the movement of these plates over geologic time is called "plate tectonics".

There are seven or eight "major" plates, depending on how they are defined, and numerous minor plates. Turn on your *Plate Geography* folder to see the names and locations of the various plates. Note that the plates are typically named for the continent that occurs on them, but most plates include both land and ocean portions.

The plates include two layers, the upper mantle below and crust above. The thickness of the plates depends on their age. In the last investigation, you saw how new oceanic lithosphere is constantly being formed at the mid-ocean ridges. In the ocean, plates are often less than 15 km thick, while on the older land masses, plates can be more than 200 km thick.

Another important difference between the two types of plates is that oceanic crust is denser than continental crust. This is because oceanic crust is made of basalt, which has a higher proportion of dense minerals such as magnesium, while continental crust is granitic, which has a higher percentage of less dense minerals such as aluminum. Why is this so important? You will soon see!



Some important differences between oceanic and continental plates.

Folder 2: Rates of Plate Movement

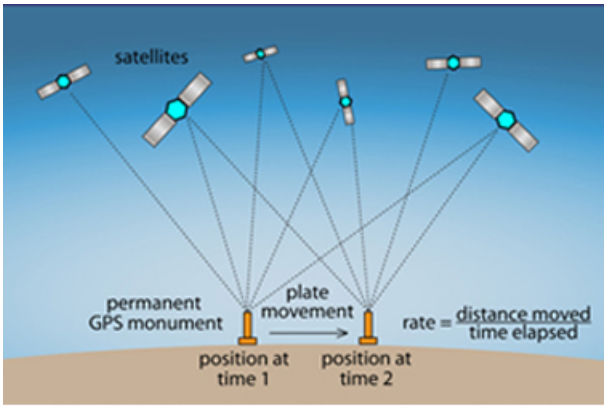
How Fast do Tectonic Plates Move?

Scientists keep track of which direction the plates are moving in and how fast they are moving. To do this they use the global positioning system (GPS).

This system includes 24 satellites that orbit Earth each day. The satellites are used to locate many very sensitive GPS receivers that are housed in permanent "GPS monuments".

Changes in the locations of these GPS monuments over time show the rate and direction of plate movement.

A permanent GPS monument.
Photo credit: Canadian Geologic Survey



How the direction and rate of plate movements are determined using permanent GPS monuments. At least 4 satellites are required to get an accurate location of a monument.

Folder 3: Driving Forces

What Causes the Plates to Move?

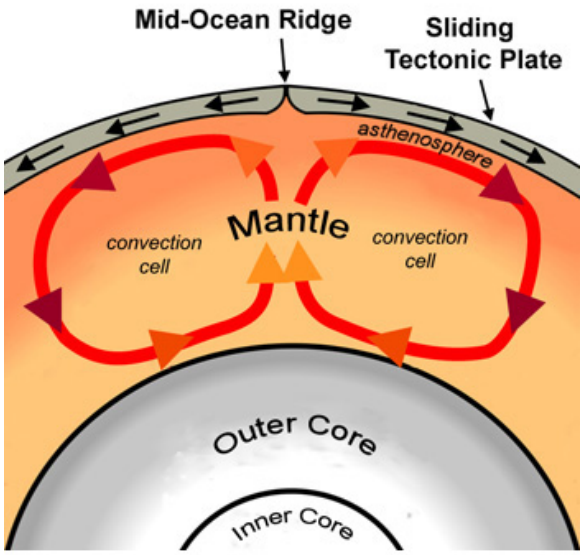
You already know something about Earth's structure that is key to making plates move. Can you think of what it is? If not, review your notes from "Exploring Earth's Interior". There you found that the asthenosphere is a relatively soft layer between the lithosphere and upper

mantle. In fact, the asthenosphere acts as a kind of lubricating layer. The tectonic plates "float" above it.

You also learned that the outer core is liquid and that the inner core is solid and metallic. Metals in Earth's core produce heat through radioactive decay. This heat is carried through toward Earth's surface by convection currents in the outer core and mantle. The currents move hot material to the surface and cool material downward.

Many scientists believe that the convection currents in the mantle act like conveyor belts that pull the plates above them along. This process is shown in the simple diagram below. However, mathematical models are far more complex.

View the animation here to see for yourself.



Simplified diagram of convection cells in the mantle, which cause the tectonic plates to be dragged along.

Folder 4: Plate Interactions

Living on the Edge

There are three types of plate boundaries. Colliding plates are called "convergent". Separating plates are called "divergent". Plates sliding past each other are called "transform". To view each type of boundary, click the play button below and hover your mouse over each label in the diagram. Then click on the labels to learn more about each type of boundary.

[Plate Interactions Animation]

Folder 5: Mystery Tour

Mystery Tour

Now that you know what happens at the different types of plate boundaries, let's see if you can identify them "in the field". You will visit several locations and determine what type of boundary is shown. Before you begin, turn on the Volcanoes and Earthquakes layers under the Gallery folder in the Layers panel. These layers contain important clues!

Good Luck!