

## Plate Tectonics

As solid as the earth may seem, there are always parts of its crust that are moving at an incredibly slow rate. Since the 1940s and 1950s, steady advancement in technology has allowed geologists to better understand the movement of the earth's plates and how these plates work.

The surface of the earth is made up of several crustal plates. Think of a massive puzzle. Instead of little cardboard cutouts, the puzzle pieces are gigantic slabs of rock that cover the earth. This "puzzle" sits right on top of the mantle's fluid and extremely hot layer, which is made up of several elements, the most prevalent being oxygen, silicon, and magnesium. The crust is divided into two types: oceanic crust and continental crust. As you can guess, the oceanic crust is composed of the pieces that cover the ocean floor, and the continental crust forms our continents.

### Oceanic Crust

You may think that the ocean floor is stationary, meaning it doesn't move. However, that's not the case at all. The ocean floor is always moving, though at a very slow rate. In the past, geologists have mapped the ocean floor. By doing so, they discovered a large mountain range that lies underwater in between continents. This mountain range is called the *mid-oceanic ridge*.

As we learned before, the mantle is found directly underneath crustal plates. Since the mantle is made of very hot material, we find "convection currents" within this layer of the earth. Hot material at the deepest part of the mantle rises, then cools once it reaches the surface, then sinks back into the mantle, only to be reheated and rise again, repeating the cycle. Convection currents in the mantle cause the oceanic ridges to rise and form mountains. This is where many scientists say new crust is being generated. The hot magma from the mantle rises up between tectonic plates and spreads outward. So, as this happens, the earth's crust moves very slowly, carrying the continents with it. How slowly? Scientists measure the "spreading rate" in units of millimeters per year, with the faster rates measuring about 80 to 120 millimeters per year.

### Types of Boundaries

Convergent boundaries are points at which tectonic plates move into one another. This can result in the formation of mountain ranges (like the Himalayas) as continental plates push against one another. Or it can result in something called subduction, where one plate rises over another as they collide, and the other sinks underneath. This also can form a mountain range, just in a different process. The plate that slowly slips underneath the other plate then melts in the mantle.

Divergent boundaries, on the other hand, are boundaries at which plates are pushed away from one another. These occur both in the ocean and on land. In the ocean, hot magma from within the earth rises out from deep-sea trenches where the plates are pushed farther away from each other. On land, plates are pulled apart as part of a chain reaction beginning with the movements happening in the ocean. The Great Rift Valley in Africa is an example of this. If the plates continue to be pulled apart there, eastern Africa can split from the continent to form a new landmass. But that won't take place for millions of years since the process happens so slowly.

The last type is a transform boundary, one that involves plates sliding against each other. The San Andreas Fault in California is an example of this. The motion of tectonic plates sliding against one another can sometimes cause earthquakes, some quite large and devastating. Transform boundaries are also called strike-slip faults due to the motion they make. This type of relatively fast plate movement that causes earthquakes is the only one we can really feel. Since the other plate shifts are so slow and gradual, we don't feel them.

### **Pangaea**

Scientists have discovered that our continents were not always the same shape or in the locations they are in now. Our continents have changed and drifted closer together or farther apart over the course of billions of years. The most recent time when all the continents were part of the same landmass happened about 300 million years ago. Scientists have named this huge landmass Pangaea, calling it a "super-continent." It existed when dinosaurs roamed our planet. Seventy million years later, Pangaea started to shift apart. When this happened, it broke into two pieces: Laurasia and Gondwana. Laurasia later broke up into Eurasia and North America, while Gondwana separated into Australia, South America, Africa, and Antarctica to make our earth look like it does today. And since our continents are still drifting, it is very possible that we will have another super-continent hundreds of millions of years from now.

What information supports all of this? If you look closely at a map of the earth, you can kind of see where the continents possibly used to fit together. South America looks like it could slide right into Africa and the two would fit together. So scientists began to speculate. But it wasn't enough to assume our continents were once a single landmass just because they look like they could fit together. Therefore, scientists began looking at fossils on different continents. They found similar fossils on Australia and southern Asia. They also found that there were very similar types of rock on the western coast of Africa and the eastern coast of South America. The support lay in the fossils of the animals and plants on the different continents. We can only wonder what the earth will look like in another hundred million years!

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

1. What are the two types of crust on the earth's surface?

- A) continental and silicon
- B) transform and oceanic
- C) oceanic and continental
- D) divergent and convergent

2. What does the author compare the earth's surface to?

- A) dinner plates
- B) a massive puzzle
- C) the ocean
- D) an earthquake

3. Crustal movements can be dangerous to humans.

What evidence from the text supports this conclusion?

- A) Plate movement at transform boundaries can sometimes cause earthquakes, some quite large and devastating.
- B) Plate movement at convergent boundaries can result in the formation of mountain ranges like the Himalayas.
- C) The spreading rate of some continents can reach 120 millimeters per year.
- D) As solid as the earth may seem, there are always parts of its crust moving at incredibly slow rates.

4. Crustal movements in one location can affect locations far away.

What evidence from the text supports this conclusion?

- A) Steady advancement in technology has allowed geologists to better understand plate tectonics.
- B) The mantle is made up of elements like oxygen, silicon, and magnesium.
- C) Geologists mapped the ocean floor and discovered the mid-oceanic ridge.
- D) Divergent boundaries in the ocean create a chain reaction that pulls plates apart on land.

5. What is the main idea of this text?

- A) Pangaea was a "super-continent" that existed about 300 million years ago.
- B) Plate tectonics cause the earth's surface to shift and change in various ways.
- C) Scientists discovered similar fossil types and rock types on different continents.
- D) Crustal movements create convergent, divergent, and transform boundaries.

**6.** Read this sentence from the text.

“As you can guess, the oceanic crust is composed of the pieces that cover the ocean floor, and the continental crust forms our continents.”

As used in the text, what does the word "composed" mean?

- A) studied
- B) divided
- C) made up
- D) shifted

**7.** Choose the answer that best completes the sentence.

The continents are slowly but constantly changing in location. \_\_\_\_\_, the continents used to form a single landmass called Pangaea but gradually drifted apart.

- A) For example
- B) Currently
- C) Including
- D) Above all

**8.** What are convection currents?

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**9.** How do convection currents help form underwater mountains?

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**10.** Explain two ways in which changes on the earth's surface are connected to changes below the earth's surface.

Support your answer with evidence from the text.

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