

Name: _____

Date: _____

Reading: Why do earthquakes happen in specific patterns around the world?

We looked at earthquake data around the world at different locations and noticed that earthquakes seem to happen in patterns or lines or clusters in different parts of the world. Although most earthquakes happen along mountain ranges and some occur in the middle of the ocean, we also saw that some earthquakes happen at other spots. In your assigned locations, you might have noticed similar and different landforms and satellite imagery as compared to what other groups shared about their site locations.

There have been earthquakes occurring on Earth for many, many millions of years. Over time, scientists have had many different ideas for the cause of earthquakes, but some of these ideas were not supported by evidence. For example, some thought that living things under the ground caused earthquakes, while others thought the winds around the Earth caused the earthquakes. As scientists began recording data about what the land looked like after an earthquake, it was determined that neither idea could be supported with evidence.

Have you ever felt the ground move where you live? What do you think caused the ground to move?

In addition to noticing the ground shaking and moving, scientists began noticing that these earth movements led to sudden changes in the Earth's surfaces. In 1822, Maria Graham, a travel writer, was in Valparaiso, Chile and wrote about some of her noticings during an earthquake:

Excerpts from Maria Graham's 'Journal of a residence in Chile, during the year 1822; and a voyage from Chile to Brazil, in 1823', London, 1824

November 20th, 1822.

'At a quarter past ten , the house received a violent shock, with a noise like the explosion of a mine. I sat still. until, the vibration still increasing, the chimneys fell, and I saw the walls of the house open. We jumped down to the ground, and were scarcely there when the motion of the earth changed from a quick vibration to a rolling like that of a ship at sea. The shock lasted three minutes. Never shall I forget the horrible sensation of that night. I observed that the furniture in the different rooms... Had all been moved in the same direction, and found that direction to be north-west and south-east.

Mr Cruikshank has ridden over from old Quintero: he tells us that there are large rents along the sea shore; and during the night the sea seems to have receded in an extraordinary manner, and especially in Quintero Bay. I see from the hill, rocks above the water that never were exposed before.

On the night of the nineteenth, during the first great shock, the sea in Valparaiso bay rose suddenly, and as suddenly retired in an extraordinary manner, and in about a quarter of an hour seemed to recover its equilibrium; but the whole shore is more exposed and the rocks are about four feet higher out of the water than before.'

December 9th, 1822.

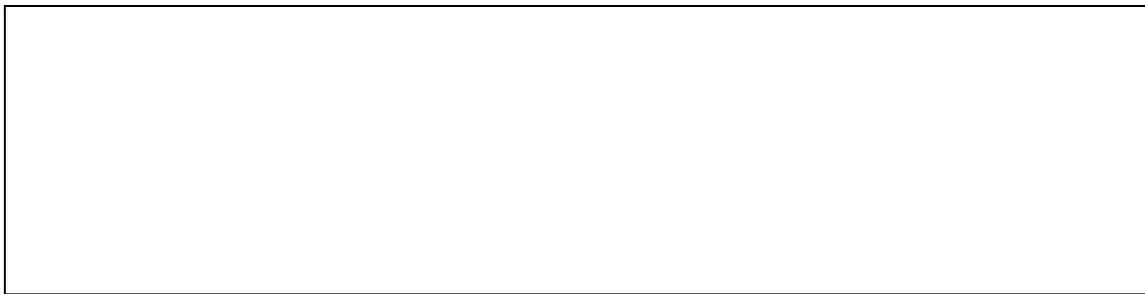
'in the evening I had a pleasant walk to the beach with Lord Cochrane; we went chiefly for the purpose of tracing the effects of the earthquake along the rocks. On the beach, though it is high water, many rocks with beds of muscles remain dry, and the fish are dead; which proves that the beach is raised about four feet at the Herradura. Above these recent shells, beds of older ones may be traced at various heights along the shore; and such are found near the summits of some of the loftiest hills in Chile.'

Ms. Graham's account of this experience led scientists, such as Charles Darwin, to begin collecting more data about how earthquakes affected the Earth's surface.

Scientists observed coastlines being elevated significantly higher after an earthquake, large crevices in the land, and exposed seafloor. Scientists noticed that when gunpowder was used, the ground shook and things on the ground moved or fell over. So a few thought it would be interesting to try using gunpowder underground to simulate things underground shaking and moving. They would drill a hole into the Earth and put gunpowder into the hole. When the gunpowder was ignited, they saw it caused the ground to move in vibration patterns out from the location the gunpowder was ignited. At the time, they also had a machine to collect data about the movement of the earth. Scientists would use this machine to record how the land

moved and how long it took to happen. They found vibrations can travel through solid material, like rock, and have characteristic patterns for how things move at the surface!! These vibrations are called *seismic waves*. These patterns found from using the gunpowder investigation resulted in patterns similar to what is observed during earthquakes.

When scientists studied these earthquake patterns, they noticed that they seemed to happen near areas where the solid ground broke and shifted. This got them thinking about how other solids crack, such as a ceramic dinner plate. Have you ever seen an object break that appeared pretty solid?

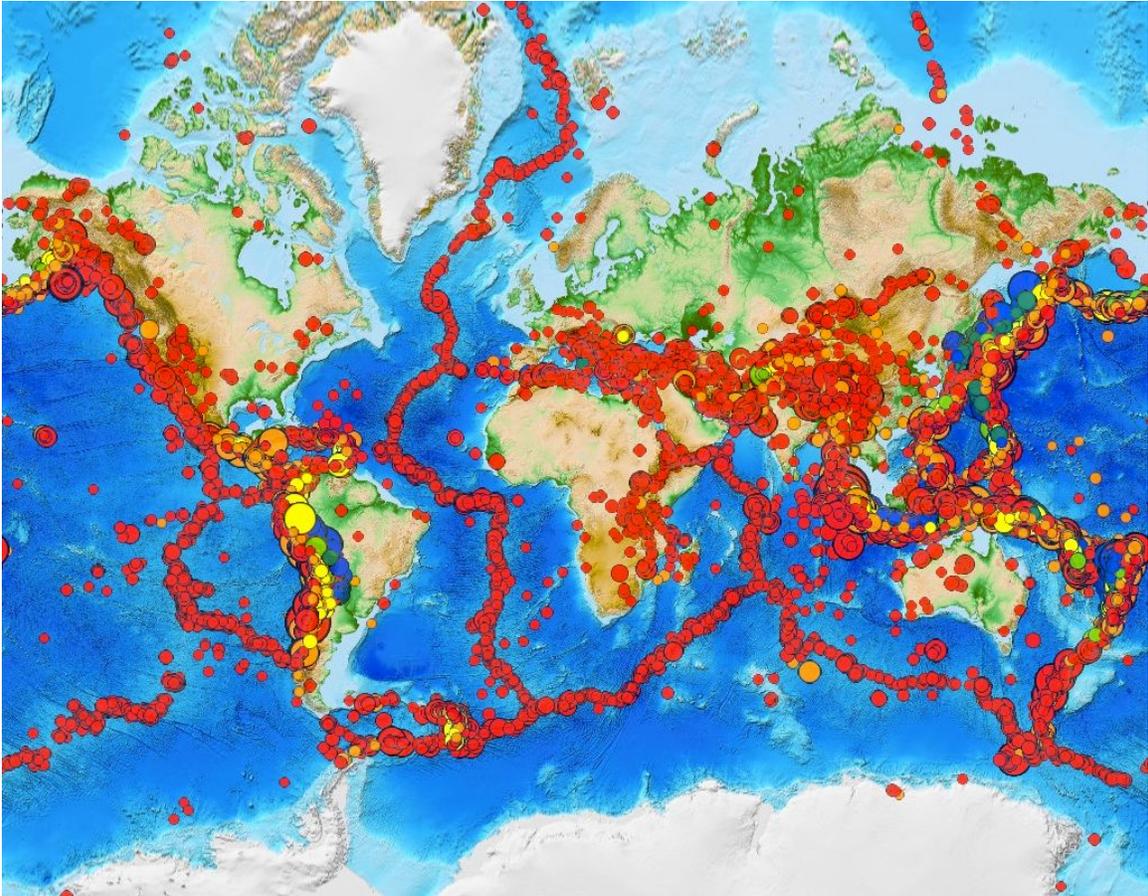


This led scientists to wonder how something as solid as the ground on Earth could move like it does during an earthquake and break and/or move apart. They assumed that this might be happening at the same places where the patterns of earthquakes seem to occur and then the rest of the land appears continuous and solid or unbroken.

As data was collected over time about where earthquakes occurred around the Earth and how the land was changed after an earthquake occurred, scientists determined that the surface of the Earth, called the *crust*, was not one solid continuous piece of rock, like was originally thought. They began picturing it like the image of the broken ceramic plate above. Because of this image, scientists named these different pieces of Earth's surface, *plates*. Scientists today are not in agreement on how many plates there are, but most agree that there are 9 major plates. They debate on how big of a piece of land makes a plate because there isn't enough earthquake data to clearly identify all of the boundaries between plates. In some places, it is difficult to know how to define the edges or boundaries of the plates. Think back to our broken ceramic plate - there were some really large pieces, but then there were also a lot of little chips. This is how scientists use their data they have collected to map out where these different plates are located. Where the plates touch each other, or are contact, is called the plate boundary. One cause of an earthquake is when these plate boundaries move against each other.

Let's look back at our map. Where do you see some evidence of where the larger plate boundaries could be?

1. Mark on the map below using a black marker or colored pencil where larger plates are found.
2. Use a different color to mark where you think some of the smaller plates might be found.



Sources:

Maria Graham's journal entries obtained from: <https://trowelblazers.com/aria-graham/>