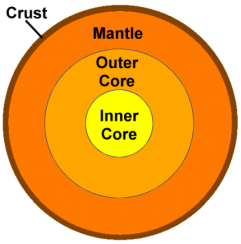
Name: _____ Teacher: _____

6.ESS2.3 Puzzling About the Past

Formative Assessment Task: Evidence of the Past

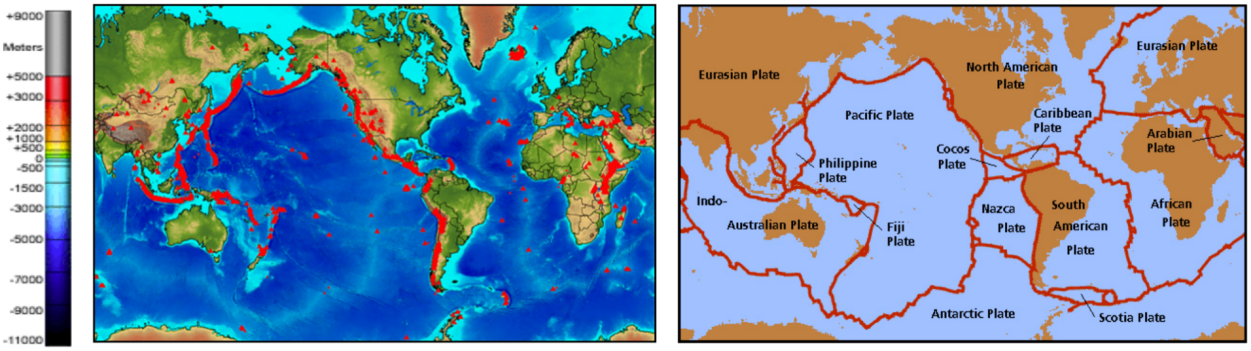


Scientists learn about Earth's past and future by studying fossils, rock formations, and the shape and movement of continents. After gathering large quantities of evidence, geoscientists have created a theory known as Plate Tectonics. This theory states that Earth's outer crust is divided into separate rocky plates that slowly and constantly glide over the softer rock in the mantle below. This movement causes changes on the surface of the Earth over millions of years.

One way scientists have gathered evidence to support this theory is by studying patterns in the location of volcanoes. A volcano forms when hot, liquefied rock (magma) deep in Earth's mantle rises through cracks or weaknesses in Earth's crust. These cracks occur due to the movement of the plates that make up Earth's crust. When the magma reaches the surface as a volcanic eruption, it cools to form new crust.

Task 1

Compare the two diagrams below. The diagram on the left indicates the location of Earth's active volcanoes (shown in red). The colors on the map indicate crust height above and below sea level. The diagram on the right shows the plates and their boundaries that have been determined by scientists.



1. What patterns do you notice linking the volcano locations and plate boundaries?

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2. Moving plates can collide with, move away from, or slide past one another as they move over the mantle. Look closely at the area where the Pacific Plate is located. Based on what you know about how volcanoes form, make a claim about which direction you think the Pacific Plate is moving. Use evidence from the maps above to help support your claim.

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3. There are some volcano locations on the map that cannot be explained by plate collisions. According to the map on the left, in what types of areas are these volcanoes generally found?

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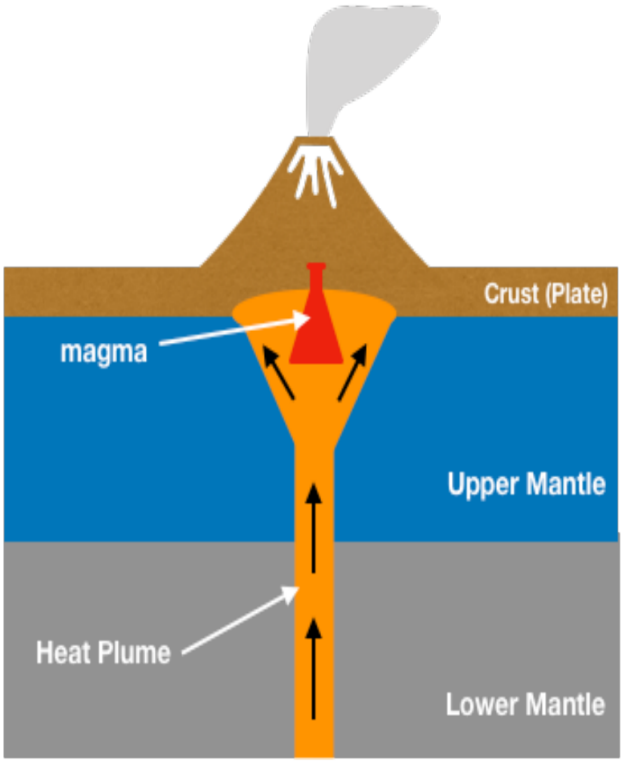
Task 2

Scientists have found a phenomenon related to plate movement that explains why some volcanoes are not found at plate boundaries. Many volcanoes occur at what are known as "hotspots." These are areas beneath the crust where heat rises from deep within the mantle and forms a heat plume, which rises to the top of the mantle. From here, the extreme heat melts mantle rock into liquid magma just under Earth's crust, which rises through cracks in the crust, forming a volcano. This is unique because the plume is in the mantle and remains in place. The hotspot does not move with the plate above it (diagram on the right).

This can occur under oceanic plates or continental (land) plates. When it occurs under the ocean, an island can form if the volcano builds to the ocean's surface.



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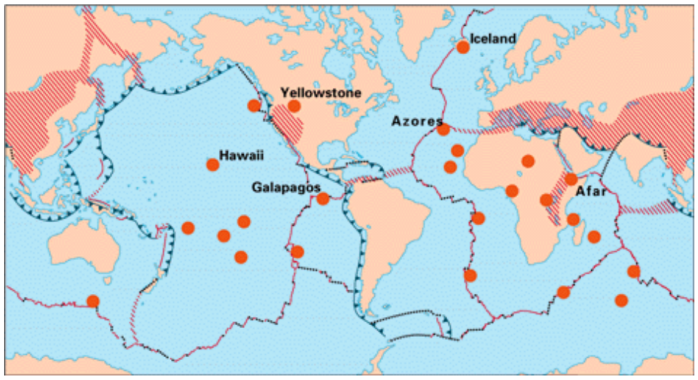
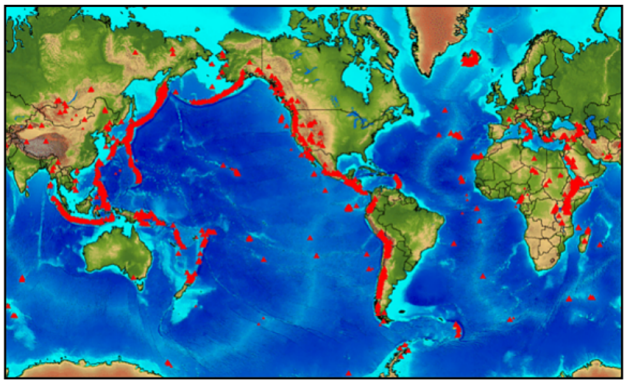
Location of Hotspots on Earth



Location of Active Volcanoes on Earth



4. The map on the left shows the location of major hotspots under the Earth's surface. How do the patterns in this new information provide further evidence for the location of volcanoes that do not occur on plate boundaries?

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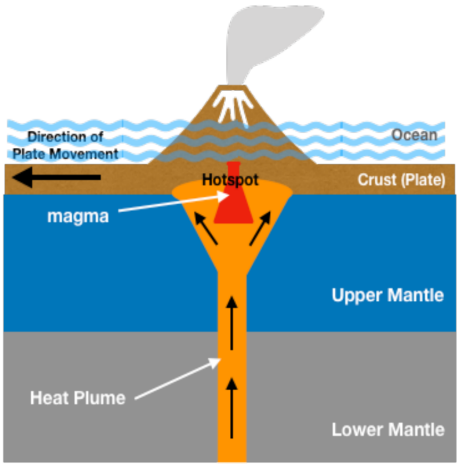
5. Hotspots remain stationary in relation to the plate above them. Imagine that the plate in the previous diagram is moving very slowly in the direction shown on the diagram to the right. Furthermore, imagine that the hotspot is under oceanic crust. Make a claim about what the landform(s) above water might look like after millions of years of plate movement. Refer to the diagram to describe how you think this might happen.



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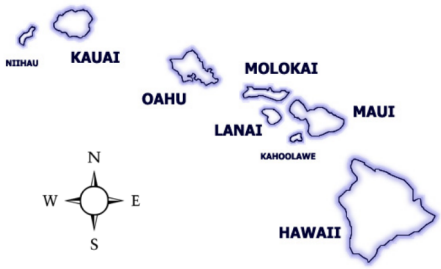
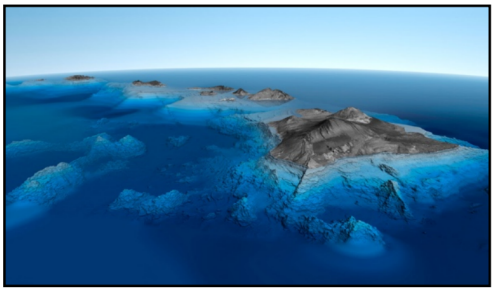
The Hawaiian Islands are volcanic islands formed over a hotspot.





Scientists have used radioactive isotopes to determine the ages of rocks on the Hawaiian Islands. The table on the right shows age ranges of volcanic rock found on different islands.

Island	Age (in years)
Kauai	3.8 – 5.6 million
Oahu	2.2 – 3.3 million
Molokai	1.3 – 1.8 million
Maui	0.1 - 1 million
Hawaii	0 - 0.8 million

6. Use the information in the table and your ideas from question #5 to explain why you think the islands are arranged in a chain instead of being one huge island.

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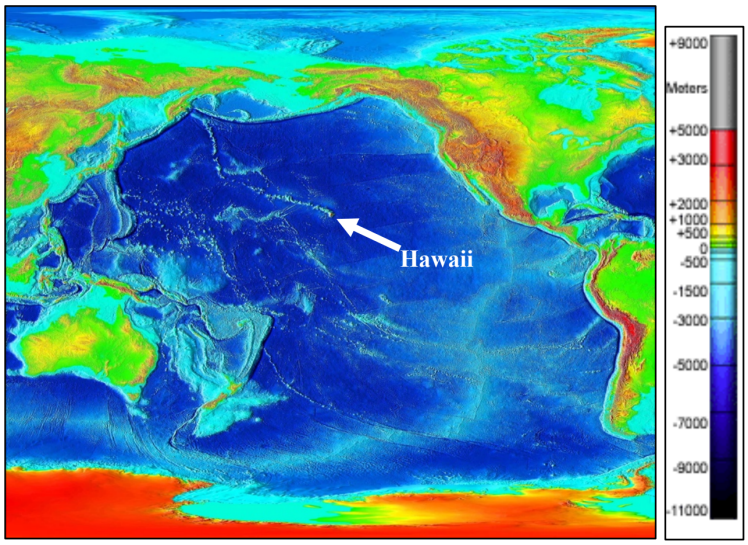
Task 3

The map on the right shows an enhanced view of crust height in meters (above and below sea level) and the location of Hawaii in the Pacific Ocean. Notice the patterns of other islands on the Pacific Plate and underwater mountain features. Review the maps of plate boundaries and hotspots you have seen here.



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7. What additional evidence can you see in the enhanced map that provides more proof of the movement of the Pacific Plate?

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8. Look back at your claim in question #2.

- If you still think your claim is correct, describe additional evidence from Tasks 2 and 3 that supports your original claim.
- If you feel your original claim was incorrect, describe how you would change it and what evidence from Tasks 2 and 3 helped you decide on this change.

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Graphics sources:

- *https://www.researchgate.net/figure/The-rings-of-fire-distribution-of-active-volcanoes-around-the-world_fig1_269723657*
- *http://www.geo.cornell.edu/hawaii/220/PRI/PRI_PT_hotspot.html*
- *https://www.hawaii-guide.com/content/posts/hawaii_geology_and_geography*
- *https://commons.wikimedia.org/wiki/File:Pacific_elevation.jpg*

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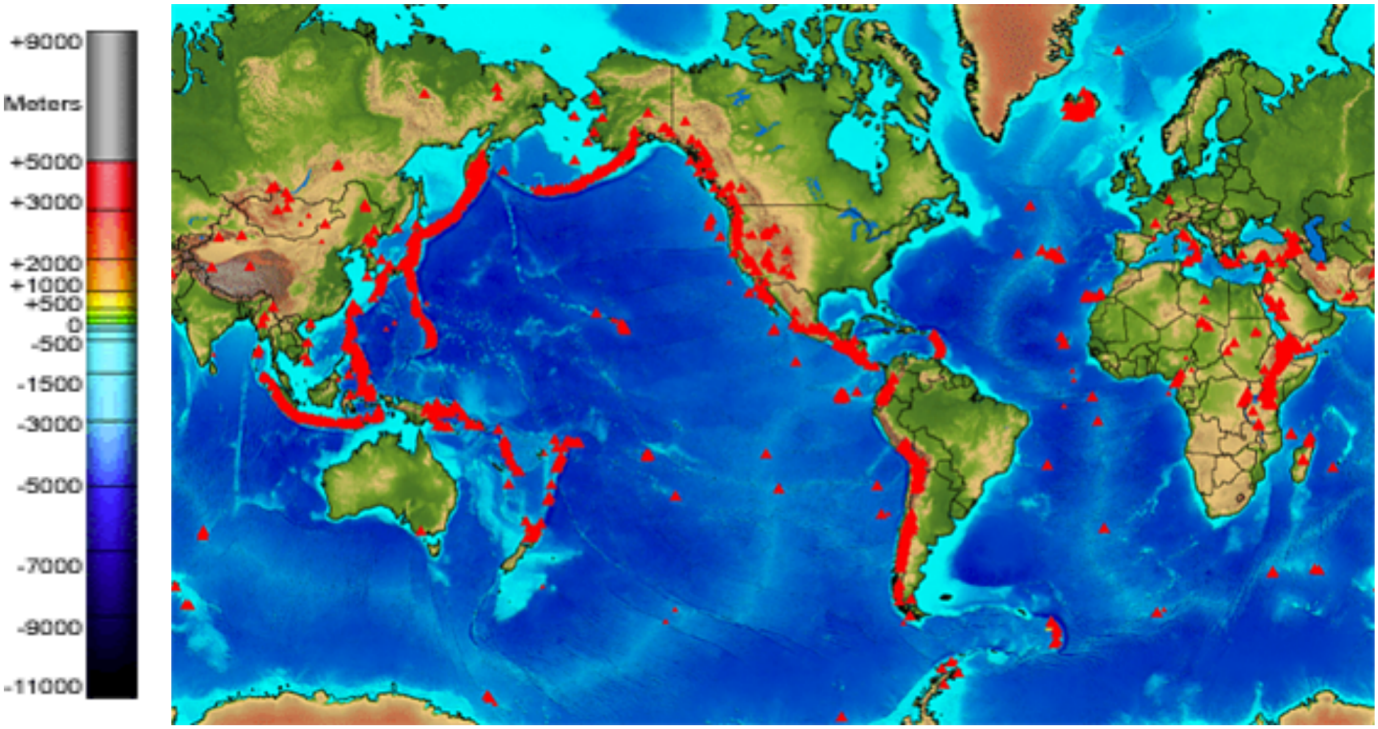
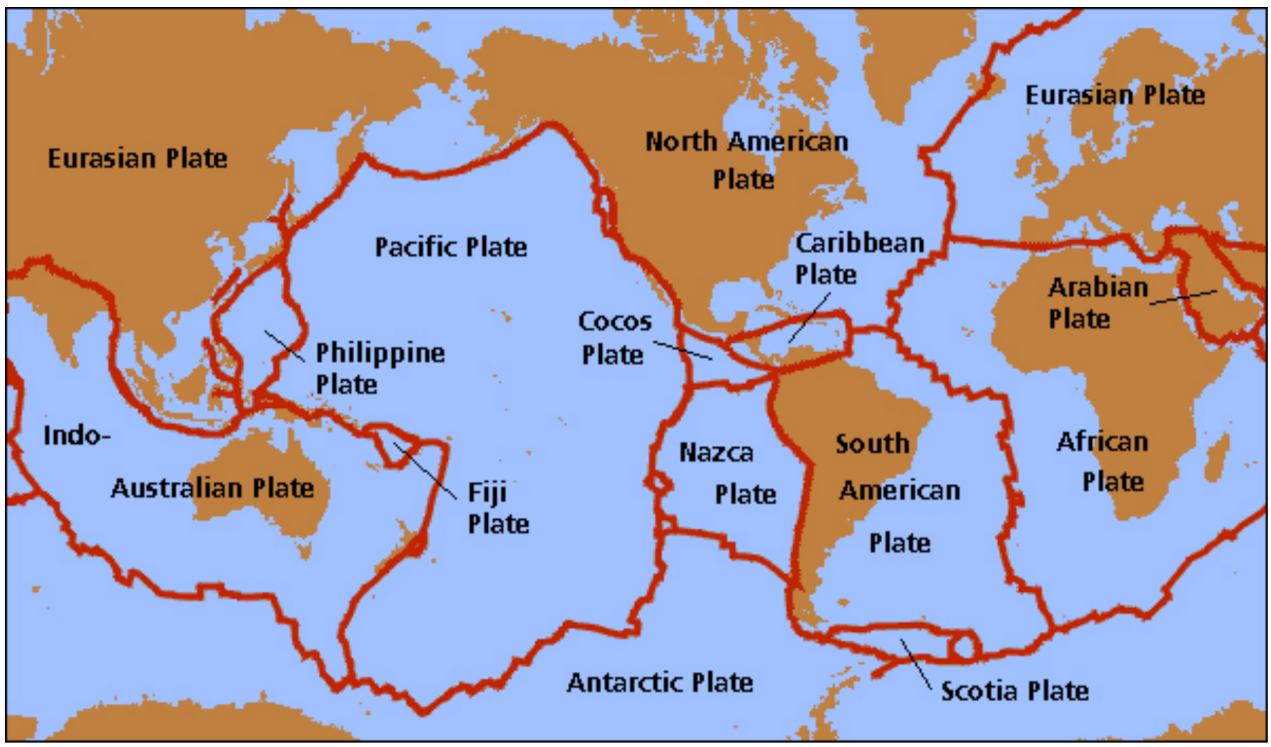
Images for Display During Assessment



Source: https://www.aegweb.org/?page=Volcanoes



Source: http://www.geog.ucsb.edu/~dylan/mtpe/geosphere/topics/pt/plate_tectonics.html

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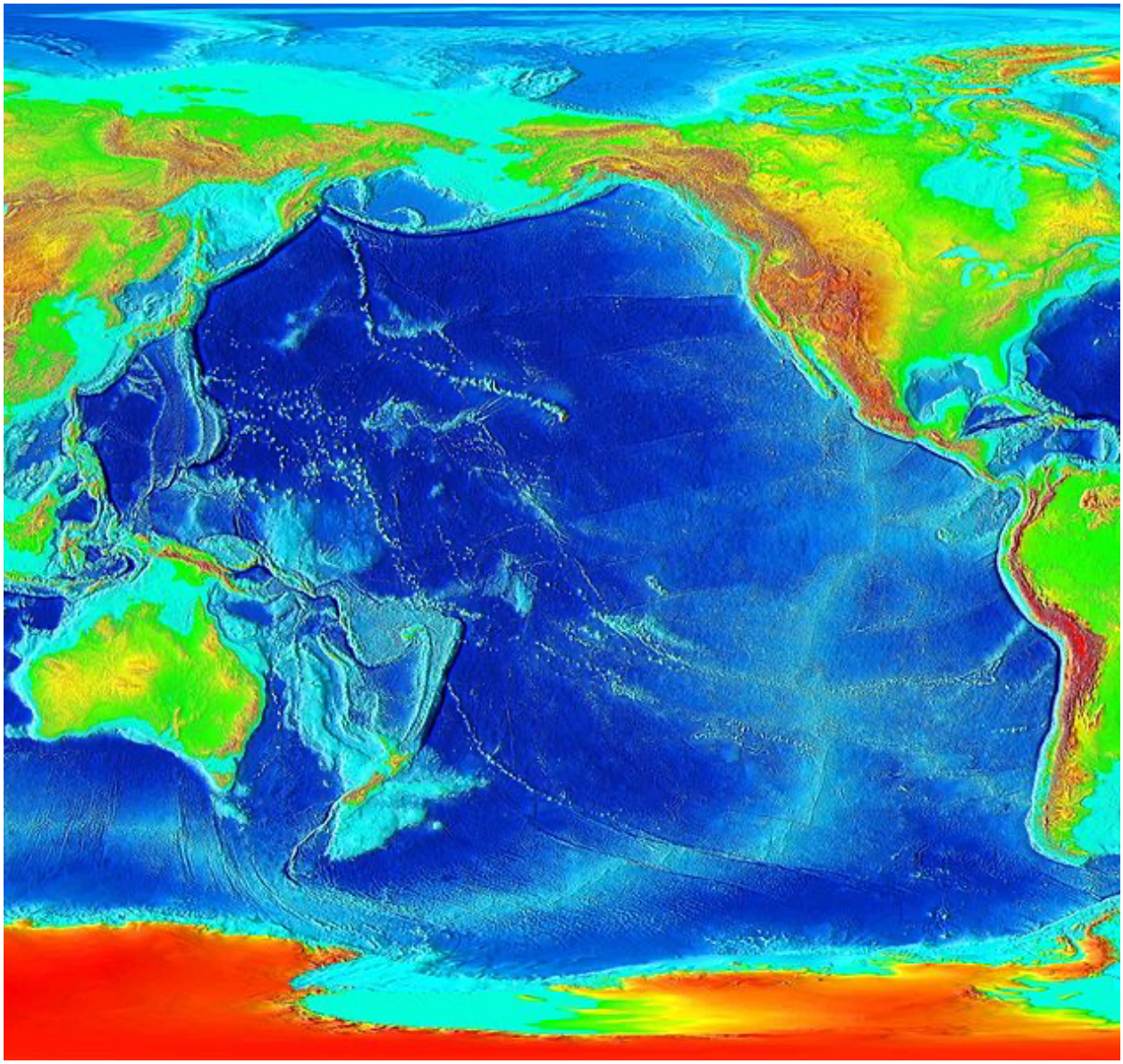

Source: https://commons.wikimedia.org/wiki/File:Pacific_elevation.jpg

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