



# Plate type effect on volcanoes

from the Esri GeoInquiries™ collection for Earth Science

Target audience – Earth Science learners

Time required – 15 minutes

<b>Activity</b>	Investigate how properties of volcanoes are influenced by the crust and plate boundaries nearest them.
<b>Science Standards</b>	NGSS:MS-ESS3-1 – Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are result of past and current geoscience processes.
<b>Learning Outcomes</b>	<ul style="list-style-type: none"><li>• Students will describe how magma is generated at plate boundaries and hot spots.</li><li>• Students will determine how melted crust involved in the creation of the volcano influence volcano properties.</li></ul>

Map URL: <http://esriurl.com/earthgeoinquiry8>



## Engage

### Deep dish or cracker thin, is the earth’s crust all the same?

- Click the link above to launch the map.
- Click the pin on the Pacific Coast.
- Click the image in the pop-up to see more detail.
- ? What is this ocean’s average depth? *[It is ~ -15,000 feet, or ~ -3 miles.]*
- ? What is the continent’s average elevation? *[It is ~2,500 feet, or ~½ mile.]*
- On the map, it appears that there are generally two types of the earth’s crust.
- ? If the earth’s crust were two types of ships floating on a sea of molten upper mantle, why would one ship sink so much lower in the liquid mantle than the other? *[The ocean bottom consists of different denser material, which sinks deeper into the exterior of the planet.]*



## Explore

### How else are the earth’s two crusts different?

- Volcanoes form when melted crust (magma) cools at the surface (lava). Stickier, viscous, or slower-flowing lava piles up steeply before solidifying. More easily flowing, less viscous lava spreads out broadly before cooling.
- Click the button, Bookmarks. Select Mount Rainier. Click the arrow icon.
- ? What does Mount Rainier’s shape imply about the runniness of the lava? *[It is piled high because of sticky (more viscous) lava.]*
- ? Which type of crust was melted for this volcano to form? *[This crust was continental, consisting of granite and high in silicate.]*
- Click the button, Bookmarks. Select Mauna Loa, Click the arrow.
- ? What does the volcano’s shape imply about the runniness of its lava? *[The very broad peak suggests runny or low-viscosity lava.]*



## Explain

### How are other sticky solutions similar to lava?

- Think of lava like a sugar solution. Higher sugar content is more viscous and slower flowing.
- ? How would the shape of a freshly poured puddle of juice compare to puddles of syrup or honey? *[Juice is thin and runny, making a broad puddle; syrup is thicker and makes a small peak where poured; and honey is thickest, with a steeper, higher peak when first poured.]*
- In a volcano, the amount of silicate acts like sugar in solution. Ocean plates have little silicate, while continental crust is rich in silicate. Like honey, continental volcanoes are steeper and more localized.

more ►

## Elaborate

### Does each plate type create its own distinct pattern of volcanoes?

- Click the Default Extent button (between Zoom In and Zoom Out buttons, upper-left corner of map).
- With the Details button underlined, click the button, Show Contents of Map (Content).
- Turn on the two layers, Plate Boundaries and Global Volcanoes.
- Click different plate boundaries to see summary graphs of the types of volcanoes that occur within 250 miles.
- ? Which boundary type has the most volcanoes? [*Convergent boundaries generate more melted rock when grinding neighboring plates under.*]
- ? Which has the highest percentage of shield volcanoes (the portion in white)? [*Divergent plates along ocean crust create runnier (less viscous) magma, forming shield volcanoes if erupting at a point or fissure volcanoes if erupting along a line.*]
- ? Which boundary type has a higher percentage of cinder cone formation? [*Transform boundaries do not create as much magma as convergent or divergent boundaries that generally form the larger composite volcanoes.*]

## Evaluate

### Why do many oceans have their own ridges?

- ? Where do volcanoes form near convergent boundaries? Why? (Zoom in for more detail.) [*Volcanoes form off to one side of a boundary. The crust on the other side of the boundary must run deep enough under a volcano's plate to melt.*]
- Pan to a divergent boundary (e.g. Chile or Aleutian Islands).
- ? Is the same true for divergent boundaries? [*No. Divergent volcanoes occur directly over rising hot convection currents from the earth's core, melting the crust into volcanoes (points) or fissures (longer lines).*]
- ? What happens to a continent over a divergent boundary? [*It would split the continent, and after enough time, it would be centered in the ocean.*]

## ENLARGE POP-UP IMAGES

- Click the Pop-up symbol.
- Click the image in the pop-up.

## BOOKMARK

- At the top of the map, click the Bookmarks button.
- Choose your bookmark; the map will take you there.

## Next Steps

**DID YOU KNOW?** ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://www.esri.com/schools>.

### THEN TRY THIS...

- Learn more about a volcano in the middle of a plate. Explore the storymap, Kilauea: Fountains of Fire. <http://esriurl.com/GEO18612B>
- To analyze volcanic data further, access the advanced GeoInquiry on this topic. <http://esriurl.com/earthGeoInquiries>

## TEXT REFERENCES

This GIS map has been cross-referenced to material in the volcanoes sections of chapters from middle-school texts.

- *Earth Science by Glencoe McGraw Hill – Chapter 12*
- *Earth Science by Prentice Hall – Chapter 7*
- *Earth Science by McDougal Littell – Chapter 3*
- *Earth Science by Tarbuck and Lutgens – Chapter 8*