

20B Volcanoes

How are volcanoes and plate boundaries related?

Mount St. Helens in Washington State erupted violently in 1980, sending ash and dust high into Earth's atmosphere. The winds in the atmosphere blew this ash and dust around the world. All active volcanoes erupt and release material like lava, ash, and dust that is very hot and therefore dangerous. Some volcanoes, such as Mount St. Helens, are especially dangerous because of the sudden, violently explosive nature of their eruptions. Other volcanoes, such as Mauna Loa in Hawaii, are less explosive. Less explosive volcanoes spew lava fountains and streams of melted rock, but in a gentler manner. In this investigation, you will discover key differences between gentle and explosive volcanoes and will discover a pattern in their geographic distribution.

Materials

- Bathymetric map
- Red and blue markers
- Ruler (to help plot latitude and longitude points)

1 The Volcanic Explosivity Index

The *Richter scale* has been used by geologists for more than 50 years to measure the strength of an earthquake. The Richter scale is a number scale that describes the magnitude of an earthquake. Geologists have also used a number scale that describes volcanic eruptions. This number scale is called the Volcanic Explosivity Index, or VEI. The higher the VEI, the more explosive or violent the eruption of a volcano. Explosive eruptions are associated with high plumes of lava and ash escaping from the top of the volcano, such as Mount St. Helens. Volcanoes with low VEI numbers have gentle eruptions. The plumes of these eruptions are not very high and not as much lava is released when the volcano erupts, such as Kilauea in Hawaii. Table 1 provides a list of volcanoes and their VEI ratings.

Table 1: Examples of volcanoes and VEI ratings

VEI	Plume height	Volume (m ³)	Average time interval between eruptions	Example
0	<100 m	≥ 1000	one day	Kilauea
1	100–1000 m	≥ 10,000	one day	Stromboli
2	1–5 km	≥ 1,000,000	one week	Galeras, 1992
3	3–15 km	≥ 10,000,000	one year	Ruiz, 1985
4	10–25 km	≥ 100,000,000	≥ 10 years	Galunggung, 1982
5	> 25 km	≥ 1,000,000,000	≥ 100 years	Mount St. Helens, 1981
6	> 25 km	≥ 10,000,000,000	≥ 100 years	Krakatoa, 1883
7	> 25 km	≥ 100,000,000,000	≥ 1,000 years	Tambora, 1815
8	> 25 km	≥ 1,000,000,000,000	≥ 10,000 years	Toba, 71,000 years ago

- a. What is the relationship between the VEI and the average time interval between eruptions?
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- b. The plume height is the height the erupted material rises from a volcano. What is the relationship between the plume height and the VEI?
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- c. What rating does Kilauea in Hawaii have on the VEI? What rating does Mount St. Helens in Washington state have on the VEI?
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2 Connecting volcanoes to plate boundaries

- Table 2 provides the position by latitude (Lat) and longitude (Long) for eight volcanoes represented by two-letter symbols. The volcanoes in the left-hand group are known to erupt violently. The right-hand group volcanoes are known as gentle or less violent.
- Plot the locations of all volcanoes on your bathymetric map.
- Represent each volcano with its two-letter symbol. Represent violent volcanoes with a red marker and gentle volcanoes with a blue marker.

Table 2: Locations of volcanoes

	Violent volcanoes		Gentle (less violent) volcanoes
PN	<i>Lat 15.1° N, Long 120.4° E</i>	MA	<i>Lat 19.5° N, Long 155.5° W</i>
KR	<i>Lat 16.7° S, Long 105.4° E</i>	FE	<i>Lat 0.4 S, Long 91.6 W</i>
KA	<i>Lat 58.3° N, Long 155.0° W</i>	ER	<i>Lat 13.6° N, Long 40.7° E</i>
BE	<i>Lat 56.1° N, Long 160.7° E</i>	PT	<i>Lat 21.2° S, Long 55.7° E</i>

- a. How do the locations of the two kinds of volcanoes relate to the locations of plate boundaries?
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- b. Volcanoes that form near convergent plate boundaries release magma that is viscous. Viscous magma is very thick and gases become trapped inside, building up pressure over time. What types of volcanoes are located near convergent plate boundaries?

- c. Near divergent plate boundaries the magma in volcanoes is not viscous. Magma that is not viscous is not as thick and does not contain as much gas. This causes the magma to flow more easily, causing less pressure to build in the magma before it flows out as lava. What types of volcanoes are located near divergent plate boundaries?

3 Connecting the location of volcanoes to volcanic rock

Table 3 provides information about the magma composition and the type of volcano that you plotted in Part 2. Study the table, and using your map, think about how the magma composition relates to a volcano’s location.

Table 3: Type of volcano and magma composition

Volcano	Type	VEI	Volcanic Rock (Magma composition)
Pinatubo (PN)	composite	6	rhyolite
Krakatoa (KR)	composite	.7	rhyolite/andesite
Katmai (KA)	complex composite	3	andesite
Bezymianny (BE)	complex composite	2	andesite
Mauna Loa (MA)	shield	0	basalt
Fernandina (FE)	shield	2	basalt
Erta Ale (ER)	shield	2	basalt
Piton de la Fournais (PT)	shield	1	basalt

- a. What type of volcanic rock is associated with more explosive eruptions (higher VEI)?
 What type of volcanic rock is associated with less explosive eruptions (lower VEI)?
