



Name: _____

Laboratory Section: _____

Date: _____

Score/Grade: _____

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LAB EXERCISE

Plate Tectonics: Faulting and Volcanism

Lab Exercise and Activities

SECTION 1

The San Andreas Fault

- How many kilometers separate Pinnacles and southern portion of the Neenach formation? What is the average speed of movement of this section of the San Andreas fault over the past 23 million years, in centimeters per year?

300 km. 1.3 cm/yr.

- The average rate of motion across the San Andreas fault zone during the past 3 million years is 5.6 cm/yr. How far apart are San Francisco and Palm Springs, in kilometers? How many million years will pass until they are sister cities across a new bay?

700 km. 12.5 my.

The 1906 San Francisco earthquake resulted in a maximum 8.5 m (28 ft) of movement along the San Andreas Fault around Point Reyes.

- How many years of stress were relieved by the 1906 earthquake, if the speed of movement has been 5.6 cm/yr?

151 years

- If that section of the fault has not moved since 1906, how many centimeters of stress have accumulated, assuming a speed of movement of 5.6 cm/yr?

604.8 cm or 6 m.

SECTION 2

Volcanoes

- Calculate the relief for each volcano by subtracting the lower elevation on the transect line from the higher elevation. Enter the relief into **Table 20.1**.
- Calculate the length along each transect between the contour lines you used to measure the relief, using the scale bar. You can also calculate the length of each transect by measuring the transect with a ruler and using the written scale to convert it to feet. Enter the length into Table 20.1.
- Calculate the slope in percentage by dividing the relief by the length. Enter the slope into Table 20.1.

TABLE 20.1 Volcano type

Figure	Relief	Length	Slope
A	400'	685'	58%
B	7000'	20,800'	33.6%
C	4000'	27,500'	14.5%

- Compare the results you recorded in Table 20.1 with **Table 20.2**. The three volcanoes in this section are the Cinder Cone at Lassen Volcanic National Monument in California; Mauna Kea, a shield volcano on the Big Island of Hawai'i; and Mount Shasta, a composite volcano in California.

TABLE 20.2 Volcano type

Volcano Type	Slope and Relief	Tectonic Setting	Eruptive Behavior
Shield volcano	2°–10° (3%–18%), up to 10 km	Hot spot, rifting	Effusive
Cinder cone	34° (67%), up to 300 m	Hot spot, rifting	Lava fountain
Composite	Up to 30° (57%), over 4 km	Subduction	Explosive

- Which volcano is shown in Figure 20.3a? Explain your conclusion. Which tectonic setting is the source of its magma? What are the types of materials produced during eruptions and the hazards associated with these volcanoes?

Cinder Cone, 54% slope, 400' relief. Caused by rifting.

- Which volcano is shown in **Figure 20.3b**? Explain your conclusion. Which tectonic setting is the source of its magma? What are the types of materials produced during eruptions and the hazards associated with these volcanoes?

Mount Shasta, 8000' relief. Subduction.

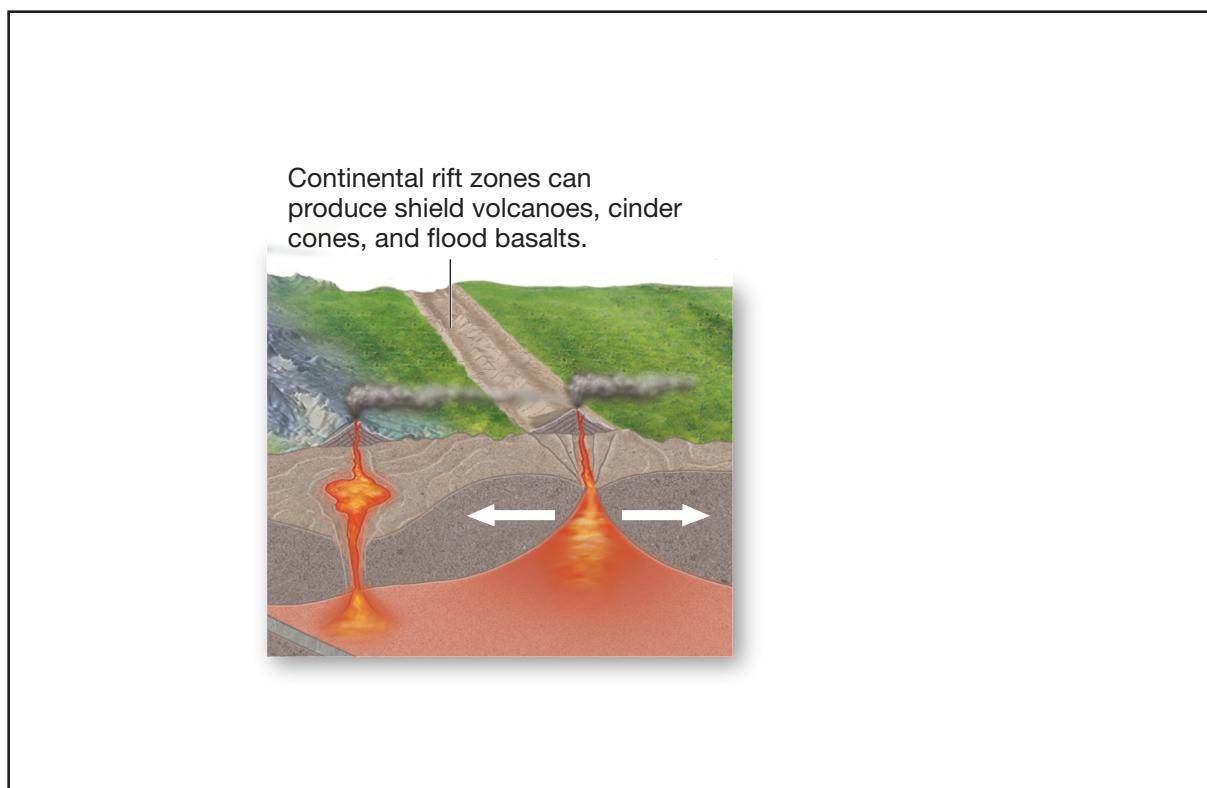
7. Which volcano is shown in **Figure 20.3c**? Explain your conclusion. Which tectonic setting is the source of its magma? What are the types of materials produced during eruptions and the hazards associated with these volcanoes?

Mauna Kea, 14% slope, 10,000' relief as measured, but over 13,000' relief just from sea level to the summit. Hot spot.

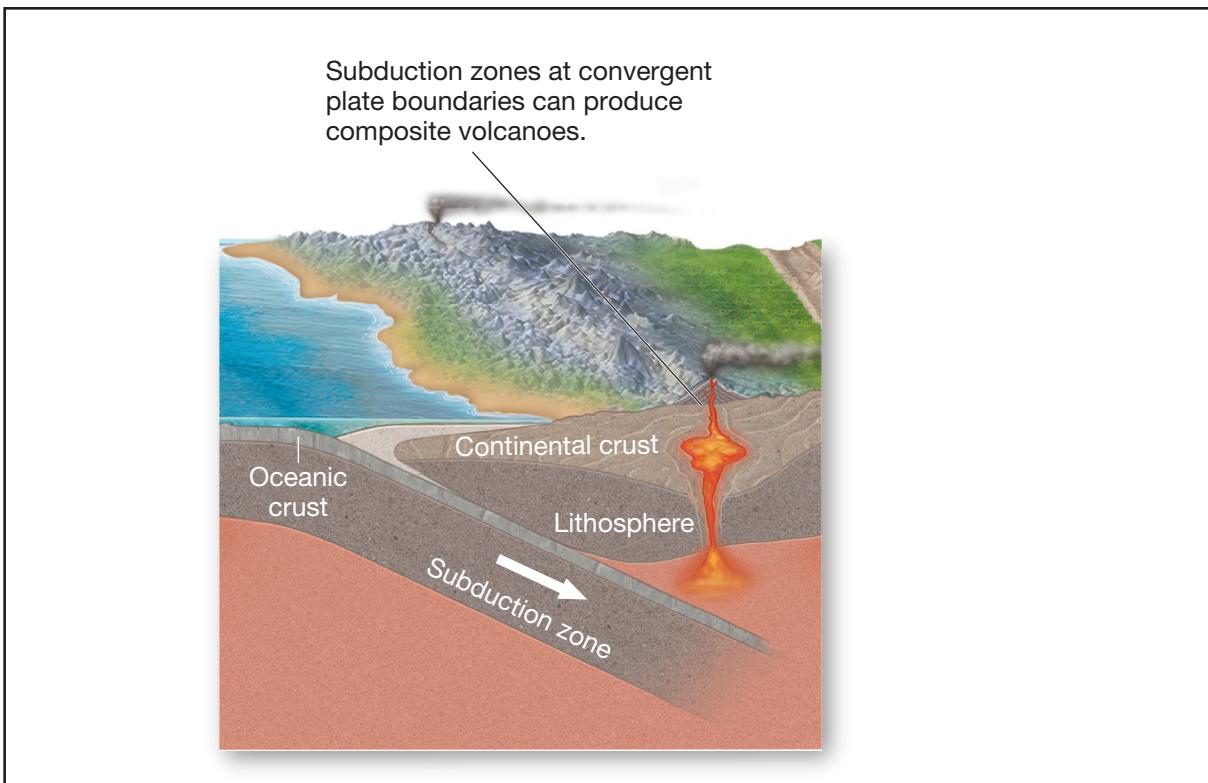
8. Which volcano is composed of the most fluid lava? The least fluid lava? Explain.

Mauna Kea is composed of the most fluid lava because of its low angle slopes. The Cinder Cone looks like it should have the least fluid lava, but it is composed of ash. Mount Shasta has the least fluid lava.

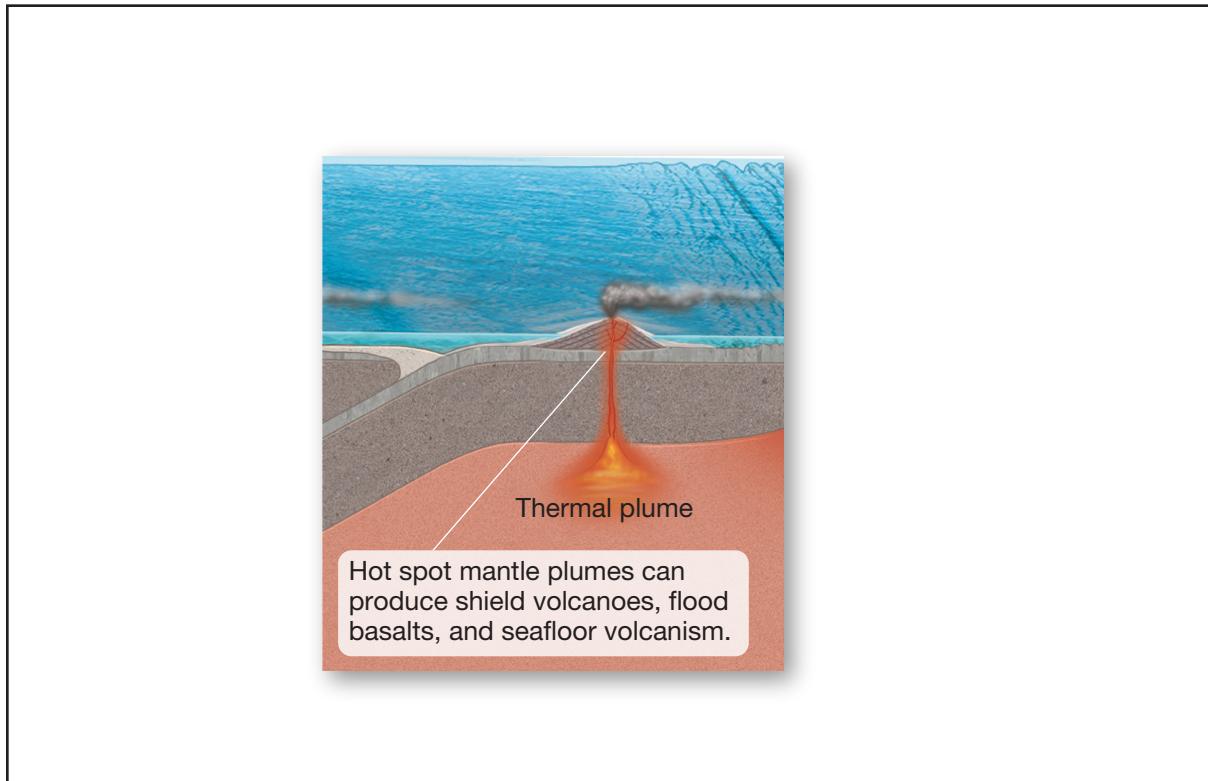
9. In the boxes in Figures 20.5a, 20.5b, and 20.5c, draw an artistic rendering of a cross section of the tectonic situation that has created each of these volcanoes. For example, you could include a side view of tectonic rifting if one of the volcanoes had been made of flood basalt flows or a hot spot if one of the volcanoes were a shield volcano.



▲ **Figure 20.5a** Setting for volcano in Figure 20.3a



▲ **Figure 20.5b** Setting for volcano in Figure 20.3b



▲ **Figure 20.5c** Setting for volcano in Figure 20.3c

SECTION 3

Kīlauea Caldera in Hawai‘i

1. What is the scale of this map?

1:24,000

What is the contour interval?

20 ft.

2. What are the north-south length and east-west width of Kīlauea Crater?

in miles:

2.46 mi north-south, 1.99 mi east-west

in kilometers:

3.96 km north-south, 3.2 km east-west

3. What is the vertical relief (the difference between the highest and lowest elevations) between the volcano observatory at Uwekahuna Bluff on the rim of the crater and the floor of the crater at the 3524-foot bench mark? Note the tick marks on the contour lines.

496'

4. Within the crater is a “fire pit” named Halemaumau. This pit has varied in size during eruptions. What is the relief from the rim of Halemaumau to the 3412-foot benchmark on the floor of the pit?

220'

5. Record the dated lava flows noted on the map in the Kīlauea Crater, from oldest to youngest:

1885, 1894, 1919, 1921, 1954, 1959, 1971, 1974.

6. Describe how the appearance of the most recent lava flows compares to the older lava flows. What processes have caused this difference.

The more recent lava flows are darker in color. This is due to chemical weathering processes.

7. If you wanted to see the floor of Halema’uma'u when it was molten lava, when should you have been there?

1974

8. What signs of recent volcanic activity do you see in Figure 20.7?

Steam and volcanic gases

SECTION 4

Shiprock Volcanic Neck

- Based only on the appearance of the surrounding landscape, does Shiprock appear to be composed of different rock or similar rock materials than surrounding rocks? Note the observations that led you to your opinion.

Different materials respond to weathering and erosion at different rates, so we see slopes and cliffs and a variety of forms.

- Is Shiprock an intrusive igneous feature or an extrusive igneous feature? Explain.

An intrusive feature of magma hardening (cooling) in the neck of a volcanic feature, subsequently exposed by weathering and erosion to stand starkly in the desert plain that surrounds. The radiating volcanic dikes are also intrusive features, forming below the surface to later be exposed by denudation processes.

- What is the relief from the top of Shiprock to the ground at the base of Shiprock?

Around 1000'

- What is the relief from the top of the west dike to the ground at the base of that dike? What is the relief from the highest part of the south dike to the ground at the base of that dike?

Around 180', 200'

- Describe the endogenic and exogenic processes, including physical and chemical weathering, that produced this volcanic formation.

Physical weathering and erosion, whereas this is a dry, desert landscape, water is the main erosional agent in episodic patterns of intensity. Chemical weathering occurs as physical elements act on the basalt and break it down.

- Even though northwestern New Mexico is a desert, do you see any indication of water at work as an agent of erosion and transportation? Explain your observations from the aerial imagery.

See the fluvial dissection of the landscape by water.