

Student Name:

Grade:

# Physical Geology 101 Lab #5 The Origin and Nature of Volcanoes

**I. Introduction & Purpose:** The purpose of this lab is to learn about the nature and origin of volcanoes, which includes using the Internet and an interactive computer program. The following aspects of volcanoes will be studied in this lab: the origin, composition and movement of lavas; the factors that cause eruptions; the types of volcanic eruptions; the types of volcanic edifices, and volcanic hazards. You will learn why volcanoes erupt, how they erupt, the methods that volcanologists use to predict volcanic eruptions and their associated volcanic hazards. You will also get to simulate your own volcanic eruptions.

**Internet Resources:** Use the following Internet resources to gather the needed data for this lab:

- 1) [SDSU Geology Department - How Volcanoes Work](http://www.geology.sdsu.edu/how_volcanoes_work): [www.geology.sdsu.edu/how\\_volcanoes\\_work](http://www.geology.sdsu.edu/how_volcanoes_work)
- 2) [USGS Volcano Publication by Robert Tilling](http://pubs.usgs.gov/gip/volc/cover2.html): <http://pubs.usgs.gov/gip/volc/cover2.html>
- 3) [USGS - Volcanic Hazards](http://volcanoes.usgs.gov/hazards/index.php): <http://volcanoes.usgs.gov/hazards/index.php>
- 4) [Erupt3 Volcano Eruption Simulation Program](http://www.ees1.lanl.gov/Wohletz/Erupt-New.htm): <http://www.ees1.lanl.gov/Wohletz/Erupt-New.htm>

## PRELAB SECTION – Parts II through IX need to be completed before the lab meeting.

### II. Tectonic Connection [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Volcano\\_tectonic.html](http://www.geology.sdsu.edu/how_volcanoes_work/Volcano_tectonic.html)

A. List the three *tectonic environments* where most active volcanoes are found.

- 1) \_\_\_\_\_ 2) \_\_\_\_\_ 3) \_\_\_\_\_

B. List the two major tectonic processes at plate boundaries that generate magmas and volcanism.

- 1) \_\_\_\_\_ occurs at divergent boundaries.  
 2) \_\_\_\_\_ occurs at convergent boundaries.

### III. Magmas and Lavas [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Controls.html](http://www.geology.sdsu.edu/how_volcanoes_work/Controls.html)

A. List the four magma types and their respective silica contents and resultant volcanic rock that forms from them.

	<u>Magma Type</u>	<u>SiO<sub>2</sub> Content</u>	<u>Resultant Volcanic Rock</u>
1)	_____	_____	_____
2)	_____	_____	_____
3)	_____	_____	_____
4)	_____	_____	_____

### IV. Volcanic Eruptions

- 1) [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Controls.html](http://www.geology.sdsu.edu/how_volcanoes_work/Controls.html)
- 2) [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Variability.html](http://www.geology.sdsu.edu/how_volcanoes_work/Variability.html)

A. List the three primary physiochemical factors that control the eruptive nature of lava.

- 1) \_\_\_\_\_ 2) \_\_\_\_\_ 3) \_\_\_\_\_

B. **Question:** What is the relationship between lava temperature and viscosity?

C. Question: Which factor above provides the driving force for explosive eruptions? \_\_\_\_\_

D. Define "**vesiculation**" and explain why it is so important to a volcanic eruption.

E. Question: What is the name of the scheme used for estimating the magnitude of historic eruptions?

Answer: \_\_\_\_\_.

F. Question: What are the criteria used for establishing the **VEI** for a given historic eruption?

1) \_\_\_\_\_ 2) \_\_\_\_\_ 3) \_\_\_\_\_ 4) \_\_\_\_\_ 5) \_\_\_\_\_

G. Briefly explain the relationship between the **height of eruption column** and **explosiveness**.

*The greater the eruption explosiveness, the \_\_\_\_\_ the height of the eruption column.*

H. Briefly define/explain the **magma column** and its **exsolution surface** inside a magma chamber.

I. Briefly define/explain the **eruption column**, and its underlying **fragmentation surface** that separates it from the magma column below.

## V. VOLCANIC LANDFORMS <http://pubs.usgs.gov/gip/volc/types.html>

A. List the four **main volcano types** with a brief description of shape, composition and eruption type.

<u>Volcano Type</u>	<u>Shape</u>	<u>Lava Comp</u>	<u>Eruption Type</u>
1) _____	_____	_____	_____
2) _____	_____	_____	_____
3) _____	_____	_____	_____
4) _____	_____	_____	_____

B. Question: What is the difference between an **active**, **dormant**, and **extinct** volcano?

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C. Question: What is a **caldera**, and how does it form?

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D. Question: What is a **lava dome**, and how does it form?

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**VI. ERUPTION PRODUCTS** [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Products.html](http://www.geology.sdsu.edu/how_volcanoes_work/Products.html)

A. List the five primary **products of volcanic eruptions**.

- 1) \_\_\_\_\_ 2) \_\_\_\_\_ 3) \_\_\_\_\_ 4) \_\_\_\_\_ 5) \_\_\_\_\_

B. **Question:** List some of the differences between a typical basaltic lava and a andesitic or rhyolitic lava?

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C. **Question:** What is the difference between a'a lava and pahoehoe lava found in Hawaiian eruptions?

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D. **Question:** List the three general types of tephra. Give a brief description for each.

<u>Tephra Type</u>	<u>Brief Description</u>
1) _____	_____
2) _____	_____
3) _____	_____

**VII. ERUPTION TYPES** [http://www.geology.sdsu.edu/how\\_volcanoes\\_work/Eruption\\_types.html](http://www.geology.sdsu.edu/how_volcanoes_work/Eruption_types.html)

A. List the six **main volcano eruption types** with a brief description of its associated lava type, volcano type, and explosivity index.

<u>Eruption Type</u>	<u>Lava Type</u>	<u>Volcano Type</u>	<u>Explosivity Index</u>
1) _____	_____	_____	_____
2) _____	_____	_____	_____
3) _____	_____	_____	_____
4) _____	_____	_____	_____
5) _____	_____	_____	_____
6) _____	_____	_____	_____

B. List the differences and similarities between a **Hawaiian** eruption and a **Fissure** eruption.

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C. List the differences and similarities between a **Hawaiian** eruption and a **Strombolian** eruption.

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D. List the differences and similarities between a **Strombolian** eruption and a **Vulcanian** eruption.

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E. How are **Plinian** eruptions different from all the other above types of eruptions?

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**VIII. TYPES OF VOLCANIC HAZARDS** <http://volcanoes.usgs.gov/hazards/index.php>

A. List the six principle **types of volcanic hazards**, including a brief description of it, and the reasons that make it a dangerous hazard.

<u>Hazard Type</u>	<u>Brief Description</u>	<u>Hazard Factors</u>
1) _____	_____	_____
2) _____	_____	_____
3) _____	_____	_____
4) _____	_____	_____
5) _____	_____	_____
6) _____	_____	_____

B. Question: Which of the above **volcanic hazards** do you think is the most dangerous? Why?

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**IX. VOLCANO MONITORING** <http://volcanoes.usgs.gov/activity/methods/index.php>

A. List the six principle **types of volcano monitoring techniques**, including a brief description of it, and its usefulness in monitoring changes in a volcano.

<u>Monitoring Method</u>	<u>Brief Description</u>	<u>Usefulness</u>
1) _____	_____	_____
2) _____	_____	_____
3) _____	_____	_____
4) _____	_____	_____
5) _____	_____	_____
6) _____	_____	_____

## X. VOLCANIC ERUPTION SIMULATIONS – ERUPT3

**Overview:** This part of the volcano lab involves the use of a computer program to graphically simulate various volcanic eruption types. You will simulate Hawaiian, Strombolian, Vulcanian, and Plinian eruptions.

**Directions:** Run the **ERUPT3** interactive computer program to simulate each of the six types of volcanic eruption types that you have researched in **Part V.** of this worksheet. The instructor will guide you through the initial **ERUPT3** computer program steps that it takes to get you going. Once that you are ready to begin, you then choose 1) the type of volcanic eruption you want. Then go ahead and run your eruption simulation over the specified time span. Record your eruption settings and eruption observations, including filling out the data spreadsheet, sketching a cross-section drawing of your resultant volcanic landform and its ash column (like doing a screen capture). Be sure to have the "View Legend" feature turned on (that will let you see what types of eruption products your volcano made). The volcano characteristics are found in different parts of the bottom menu information. Finally note: Use the information you collected from your Prelab Parts II through IX.

### A. HAWAIIAN ERUPTION SIMULATION

#### 1) ERUPTION PARAMETERS

<u>Eruption Type</u>	<u>Scale</u>	<u>Extrusion rate</u>	<u>Strength</u>	<u>Elapsed Time</u>
_____	<u>Medium</u>	<u>Fast</u>	<u>Default</u>	<u>1000 years</u>

#### 2) RESULTANT ERUPTION CHARACTERISTICS:

<u>Volcano Type</u>	<u>Volcano Dimensions</u>	<u>Volcano Volume</u>	<u>VEI</u>
_____	_____ km wide; _____ km tall	_____ cubic Km	_____

Eruption Products: \_\_\_\_\_ Worst Hazard: \_\_\_\_\_

#### 3) VOLCANO LANDFORM SKETCH (cross-section):

4) ERUPTION NOTES: \_\_\_\_\_

### B. STROMBOLIAN ERUPTION SIMULATION

#### 1) ERUPTION PARAMETERS

<u>Eruption Type</u>	<u>Scale</u>	<u>Extrusion rate</u>	<u>Strength</u>	<u>Elapsed Time</u>
_____	<u>Medium</u>	<u>Fast</u>	<u>1.00</u>	<u>5 years</u>

#### 2) RESULTANT ERUPTION CHARACTERISTICS:

<u>Volcano Type</u>	<u>Volcano Dimensions</u>	<u>Eruption Volume</u>	<u>VEI</u>
_____	_____ km wide; _____ km tall	_____ cubic Km	_____

Eruption Products: \_\_\_\_\_ Worst Hazard: \_\_\_\_\_

#### 3) Volcano Landform Sketch (cross-section):

4) ERUPTION NOTES: \_\_\_\_\_

### C. VULCANIAN/SURTSEYAN ERUPTION SIMULATION

#### 1) ERUPTION PARAMETERS:

<u>Eruption Type</u>	<u>Scale</u>	<u>Extrusion rate</u>	<u>Strength</u>	<u>Total Elapsed Time</u>
_____	<u>Medium</u>	<u>Fast</u>	<u>0.80</u>	<u>60 days</u>

#### 2) RESULTANT ERUPTION CHARACTERISTICS:

<u>Volcano Type</u>	<u>Volcano Dimensions</u>	<u>Eruption Volume</u>	<u>VEI</u>
_____	_____ km wide; _____ km tall	_____ cubic Km	_____

Eruption Products: \_\_\_\_\_ Worst Hazards: \_\_\_\_\_

#### 3) VOLCANO LANDFORM SKETCH (cross-section):

4) ERUPTION NOTES: \_\_\_\_\_

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### D. PELEAN ERUPTION SIMULATION

#### 1) ERUPTION PARAMETERS

<u>Eruption Type</u>	<u>Scale</u>	<u>Extrusion rate</u>	<u>Strength</u>	<u>Elapsed Time</u>
_____	<u>Medium</u>	<u>Fast</u>	<u>1.00</u>	<u>500 years</u>

#### 2) RESULTANT ERUPTION CHARACTERISTICS:

<u>Volcano Type</u>	<u>Volcano Dimensions</u>	<u>Eruption Volume</u>	<u>VEI</u>
_____	_____ km wide; _____ km tall	_____ cubic Km	_____

Eruption Products: \_\_\_\_\_ Worst Hazard: \_\_\_\_\_

#### 3) VOLCANO LANDFORM SKETCH (cross-section):

4) ERUPTION NOTES: \_\_\_\_\_

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## E. PLINIAN ERUPTION SIMULATION

### 1) ERUPTION PARAMETERS

<u>Eruption Type</u>	<u>Scale</u>	<u>Extrusion rate</u>	<u>Strength</u>	<u>Elapsed Time</u>
_____	<u>Large</u>	<u>Fast</u>	<u>1.00</u>	<u>60 days</u>

### 2) RESULTANT ERUPTION CHARACTERISTICS:

<u>Volcano Type</u>	<u>Volcano Dimensions</u>	<u>Eruption Volume</u>	<u>VEI</u>
_____	_____ km wide; _____ km tall	_____ cubic Km	_____

Eruption Products: \_\_\_\_\_ Worst Hazards: \_\_\_\_\_

### 3) VOLCANO LANDFORM SKETCH (cross-section):

4) ERUPTION NOTES: \_\_\_\_\_

## G. COMPARE AND CONTRAST THE MAJOR TYPES OF SIMULATED VOLCANIC ERUPTIONS

Question 1) Which eruption type(s) created a **shield**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

Question 2) Which eruption type(s) created a **stratovolcano**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

Question 3) Which eruption type had the **highest VEI**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

Question 4) Which eruption type had the **lowest VEI**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

Question 7) Which eruption had the **largest ash column**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

Question 8) Which eruption had the **smallest ash column**? \_\_\_\_\_ Why? \_\_\_\_\_

\_\_\_\_\_

## **XI. POST VOLCANO LAB REFLECTION**

**Directions:** Write a 120 word minimum reflection of the lab activity, explaining its purpose, the methods used, the results obtained, and a brief personal reflection of what you enjoyed and learned about doing this lab (3 points possible). Answer the following 3-point question reflection set on a separate sheet of paper:

- 1) *What was the purpose of this lab? What did you actually discover and learn during this lab?*
- 2) *What did you enjoy most about this lab? Also, what was challenging or thought-provoking?*
- 3) *What are your constructive comments about the design and execution of this lab? What's good? What's bad? Offer suggestions for making the lab better.*