Volcanic Processes

Grade Level: 3–6

Learner Objectives:

Students will:

- **Recognize the scope of geologic processes that occur at Cascade volcanoes**
- **Identify volcanic processes seen in photographs**
- **Understand that, during an eruption, volcanic processes often occur simultaneously or sequentially.**

Setting: **Classroom**

Timeframe: **40 minutes**

Materials:

- **Copies of *"Volcanic Processes"* student page**
- **Nine graphics illustrating *"Common Volcanic Processes at Cascade Volcanoes"* (computer projection, transparencies, or paper copies to students)**
- **Library or Internet access**

USGS science for a changing world

NATIONAL PARK SERVICE

Living with a Volcano in Your Backyard–An Educator's Guide with Emphasis on Mount Rainier

Prepared in collaboration with the National Park Service

U.S. Department of the Interior
U.S. Geological Survey

General Information Product 19

Overview

Students learn about volcanic processes at Cascade volcanoes as they view the graphics provided, research processes further and write results on a student page. As an optional activity, students prepare a booklet or computer presentation about each process with an emphasis on process interaction. This activity is offered as an alternative to the **Understanding Volcanic Hazards** video that may be unavailable or inappropriate for your students.

Vocabulary: **Blocks, bombs, crater, debris flow, earthquake, eruption, eruption cloud, explosive eruption, fractures, fumarole, hydrothermal alteration, lahar, landslide, lava, lava dome, lava flow, magma, pyroclastic flow, tephra, volcano, volcanic ash, volcanic gas**

Skills: **application, interpretation, inference**

Benchmarks:

See benchmarks in Introduction.

Activity last modified: November 21, 2014

Teacher Background

Background information about volcanic processes can be found in the teacher pages that follow.

Procedure

Volcanic Processes

The term volcanic processes refers to eruptive and noneruptive activities that take place on volcanoes. Students viewing photos individually may get the faulty impression that volcanic events occur in isolation. During an eruption, volcanic processes often occur simultaneously or sequentially, as explained in the descriptions below. Keep in mind that one of the objectives for this activity is this recognition of volcanic processes occuring in a sequence rather than in isolation.

1. Display the individual graphics, one through nine and for end review, repeat graphic one. Convey the written information to students by paraphrasing, reading, or providing the pages to the students. Alternatively, make copies of each graphic and distribute it to groups, or at stations around the classroom.

2. Distribute the "***Volcano Processes***" student page. Students should work in small groups to research processes further and write definitions and descriptions beside each graphic.

3. Discuss the information learned in student research. Emphasize the wide range of geologic processes that occur on Cascade volcanoes; identification of volcanic processes seen in photographs; and knowledge that, during an eruption, volcanic processes often occur simultaneously or sequentially.

Adaptations

- Older students can perform an Internet or library search for information about these processes. Students then create a volcano book, collage, or computer presentation with text, definitions, and additional graphics.

Extensions

- Students conduct Internet research to discover where these processes are observed at volcanic eruptions today. Instruct students to write a report about the progression of volcanic processes noted by observers over the course of an eruption. For a list of eruptions in progress, visit the Web site for Smithsonian Global Volcanism. The address is found at **Internet Resources**.

Assessment

Use the "***Volcanic Processes***" student page as a learning tool, and your discussion as an assessment of students' knowledge about important volcanic processes. After completing this activity, students should be able to recognize the scope of geologic processes that occur on Cascade volcanoes; identify volcanic processes seen in photographs; and understand that during an eruption, volcanic processes often occur simultaneously or sequentially.

References

Harris, S.L., 2005, Fire mountains of the west—the Cascade and Mono Lake volcanoes: Missoula, Mont., Mountain Press Publishing Company, 454 p.

Kennedi, C.A., Brantley, S.R., Hendley J.W., II, and Stauffer, P.H., 2000, Volcanic ash fall—a "hard rain" of abrasive particles: U.S. Geological Survey Fact Sheet 027–00 (revised April 2002), 2 p.

Myers, B., Brantley, S.R., Stauffer, P.H., and Hendley J.W., II, 1998, What are volcano hazards? (revised July 2004): U.S. Geological Survey Fact Sheet 002–97, 2 p.

Myers, B., and Driedger, C., 2008, Geologic hazards at volcanoes: U.S. Geological Survey General Information Product 64, poster.

Refer to **Internet Resources Page** for a list of resources available as a supplement to this activity.

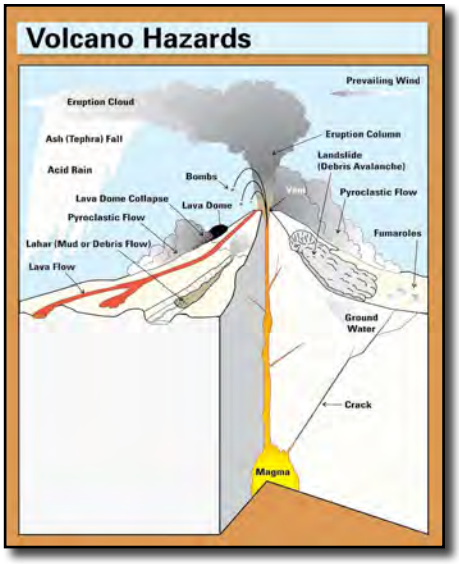
Photo Credits

Graphic 1. USGS, after Myers, B., and Driedger C., 2008, Geologic Hazards at Volcanoes, General Information Product 64, poster.
Graphic 2. Photo by Jack Whitnall, May 18, 1980.
Graphic 3. Photo by Christina Heliker, USGS, January 26, 1988.
Graphic 4. Photo by Hugo Moreno, Servecío National de Geologiá y Mineriá, Chile.
Graphic 5. Photo by Willie Scott, USGS, 1995.
Graphic 6. Photo by Richard Janda, USGS,1985.
Graphic 7. Photo by Toni Venzin.
Graphic 8. Photo by Kevin Scott, USGS, March 25, 1999.
Graphic 9. Photo by Steve Brantley, USGS.

Teacher Page

Common Volcanic Processes at Cascade Volcanoes

Graphic 1—Overview



Common sequences of events at stratovolcanoes:

Before an ***eruption*** begins, rising ***magma*** opens cracks ***(fractures)*** in rocks beneath the ***volcano***, commonly causing ***earthquakes***, deformation of the land surface and gas release. During the onset of an ***explosive eruption***, ***volcanic gases*** in the magma expand and break magma into tiny pieces called ***tephra***. After many of the gases have dispersed in the atmosphere, a more fluid ***lava*** pool within the crater rises and flows over the ***crater*** lip as a ***lava flow***. The ensuing lava flows sometimes break apart on steep volcanic terrain as avalanches of hot rock and gases. These ***pyroclastic flows*** (sometimes called hot ash flows), melt snow and ice, providing the water for ***debris flows*** and ***lahars*** (large debris flows). Pyroclastic flows also originate from the collapse of eruption columns-the dark column of ash, steam, and other gases that rises above an explosively erupting volcano. Rocks that have been weakened by hot acidic groundwater ***(hydrothermal alteration)*** become more susceptible to collapse as a ***landslide***. Volcanoes can also erupt nonexplosively, without tephra. Where lava is too viscous to flow, it forms a dome-shaped feature commonly called a ***lava dome***.

Graphic 2—Tephra—Volcanic ash fall from Mount St. Helens darkens Yakima, Washington, at noon on May 18, 1980

Explosive eruptions blast fragments of rock high into the air. Large fragments fall to the ground near to the volcano, while small fragments create large ***eruption clouds*** capable of traveling thousands of kilometers (miles) from the volcano. ***Volcanic ash*** clouds are usually nontoxic but have the capability to disrupt peoples' lives for long periods. Heavy ash fall can collapse buildings, and even minor ash fall reduces visibility and can damage crops, electronics, and machinery. Aircraft that fly into a volcanic ash cloud are at great risk of engine failure.

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Common Volcanic Processes at Cascade Volcanoes-continued

Graphic 3—Tephra—Volcanic blocks and bombs at Kilauea Volcano, Hawaii

A volcanic ***block*** is a solid rock fragment greater than 64 millimeters (2.5 inches) in diameter that was ejected from a volcano during an explosive eruption. Blocks commonly consist of solidified pieces of old lava flows that were part of a volcano's cone.

By comparison, semi-solid rock can be aerodynamically shaped into a variety of forms called volcanic ***bombs***.

Graphic 4—Lava flow on Villarica Volcano in Chile

Lava is molten rock that pours or oozes onto the planet surface. Lava flows cool and harden faster on the outside (within minutes), than on the inside, where cooling continues for days to years.

Graphic 5—Pyroclastic flow on Montserrat Volcano in the Caribbean

Pyroclastic flows are avalanches of hot lava fragments and volcanic gases formed by the collapse of ash clouds and lava domes and flows. These flows rush down the mountain at speeds up to a few hundred kilometers (miles) per hour. They destroy everything in their path by impact, incineration, asphyxiation, or burial. Nothing will survive in the path of a pyroclastic flow.

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Common Volcanic Processes at Cascade Volcanoes-continued

Graphic 6—Lahar at Armero, Colombia

The word lahar is an Indonesian term that describes a mixture of rock, mud, and water that rushes down the slopes of a volcano and its river valleys for many miles away from the volcano and at speeds of up to 60 kilometers per hour (40 miles per hour). Lahars and their scaled-down versions, known as debris flows, once witnessed, are never forgotten. The ground shakes and rumbles in a way similar to that of an approaching train. Dust plumes rise into the air above the flow front and small pebbles splash skyward. These flows look and behave like a river of wet flowing concrete and are tan to gray in color.

During volcanic eruptions on snow or glacier-clad volcanoes, hot rocks melt the snow and ice to produce large amounts of meltwater that can entrain loose rock and make a lahar. The enormous snow and ice packs on the slopes of Cascade volcanoes are a particular threat. Approximately 4.4 cubic kilometers (1cubic mile) of ice and perennial snow (snow that remains from year to year) cover the slopes of Mount Rainier. That is as much as on all the other Cascade volcanoes combined! Catastrophic landslides also can trigger lahars.

The above photo of Armero, Colombia, illustrates the devastation caused by lahars triggered by the November 13, 1985, eruption of the snow and ice-capped Nevado del Ruiz volcano in Colombia. This lahar traveled at an average velocity of more than 30 kilometers (20 miles) per hour, so the people in the nearby city of Armero had more than two hours to climb to the safety of higher ground on nearby valley walls. However, they had not been advised on evacuation procedures or warned of the lahar's approach. More than 20,000 people perished as they slept, while lahars swept through and buried much of the city.

Teacher Page

Common Volcanic Processes at Cascade Volcanoes-continued

Graphic 7—Debris flow in Tren, Canton of Grissons, Switzerland

At Mount Rainier, small flows of water, mud and rock debris that stay within park boundaries are know locally as debris flows. Flows that travel beyond park boundaries are classified as lahars. Debris flows commonly occur during noneruptive times, especially during periods of intense rainfall or snowmelt, as opposed to lahars, which are generally caused by eruption or landslide activity.

Graphic 8—Landslide at Casita Volcano in Nicaragua

A landslide, or debris avalanche, is a rapid downhill movement of rock and overlying material. Volcano landslides can be small movements of loose debris on the surface of a volcano or massive collapses of the entire summit or sides of a volcano. Steep-sided volcanoes can be especially vulnerable to landslides, since they are built partially of layers of loose volcanic rock fragments, which break free and move downhill. Landslides on volcano slopes are triggered when eruptions, heavy rainfall, or large earthquakes occur.

Graphic 9—Hydrothermal Alteration Weakens Lava Rock at Mount Rainier, Washington

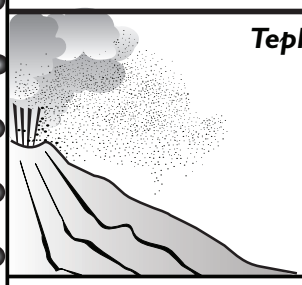
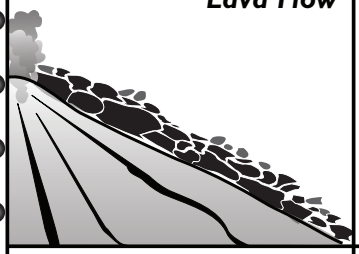
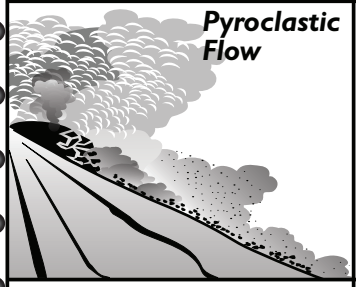
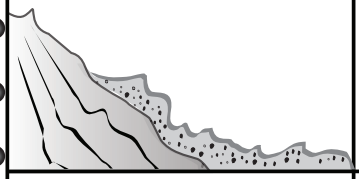
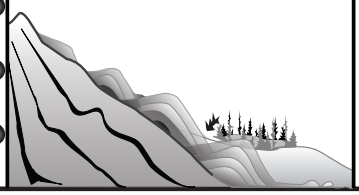
Some rocks on volcanoes have been altered to soft, slippery clay minerals because of exposure to circulating hot, acidic ground water, a process called hydrothermal alteration. Entire portions of a volcano can be left susceptible to collapse through landslides. Altered rock is often visible in the vicinity of ***fumaroles,*** or steam vents on the volcano's surface.

Student Page

Name _____

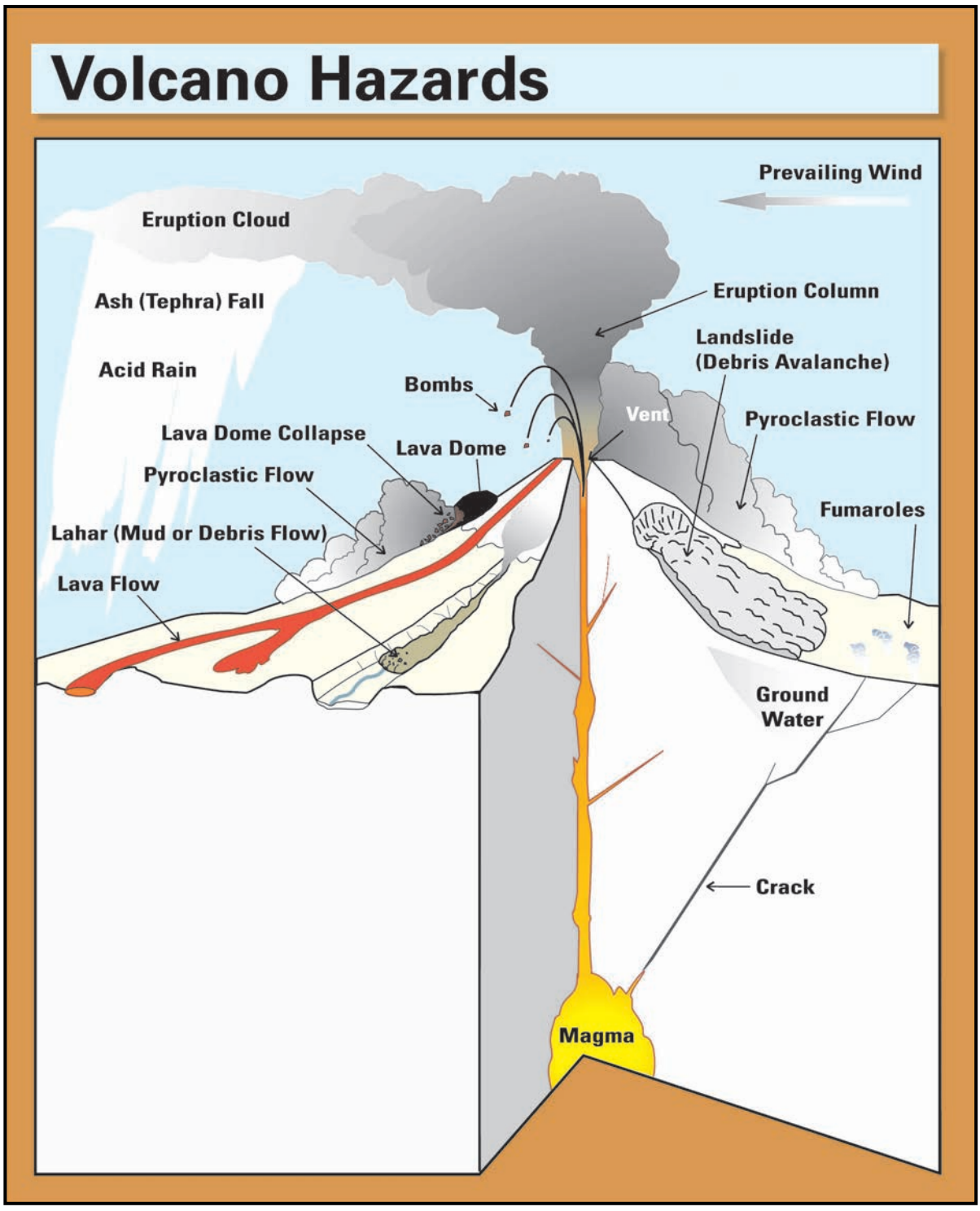
Volcanic Processes

Instructions: *Learn more about each of the volcanic processes listed below. Write definitions and descriptions beside each graphic.*

Volcanic Processes	Definitions and Descriptions
Tephra 	
Lava Flow 	
Pyroclastic Flow 	
Lahar or debris flow 	
Landslide 	

Graphic Page

Volcanic Processes—Graphic 1



Volcanic Processes—Graphic 2—Tephra—Volcanic ash fall from Mount St. Helens darkens Yakima, Washington, at noon on May 18, 1980

Photo by Jack Whitnall

Graphic Page

Volcanic Processes—Graphic 3—Tephra—Volcanic blocks and bombs at Kilauea Volcano, Hawaii

Photo by Christina Heliker, USGS

Volcanic Processes—Graphic 4—Lava flow on Villarica Volcano in Chile

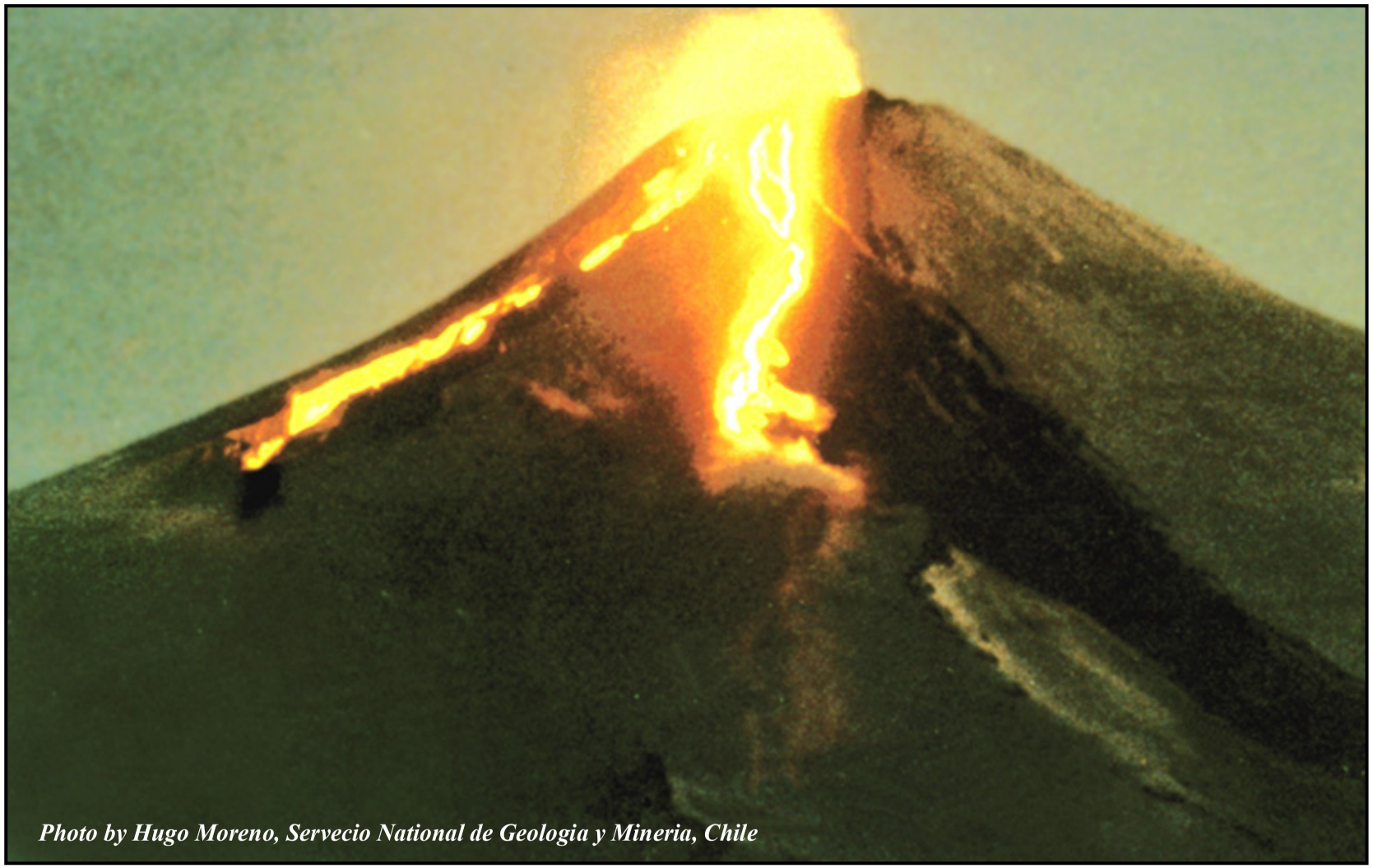


Photo by Hugo Moreno, Servecio National de Geologia y Mineria, Chile

Volcanic Processes—Graphic 5—Pyroclastic flow on Montserrat Volcano in the Caribbean

Photo by Willie Scott, USGS

Volcanic Processes—Graphic 6—Lahar at Armero, Colombia

Photo by Richard Janda in 1985, USGS

Volcanic Processes—Graphic 7—Debris flow in Tren, Canton of Grissons, Switzerland

Photo by Toni Venzin

Volcanic Processes—Graphic 8—Landslide at Casita Volcano in Nicaragua

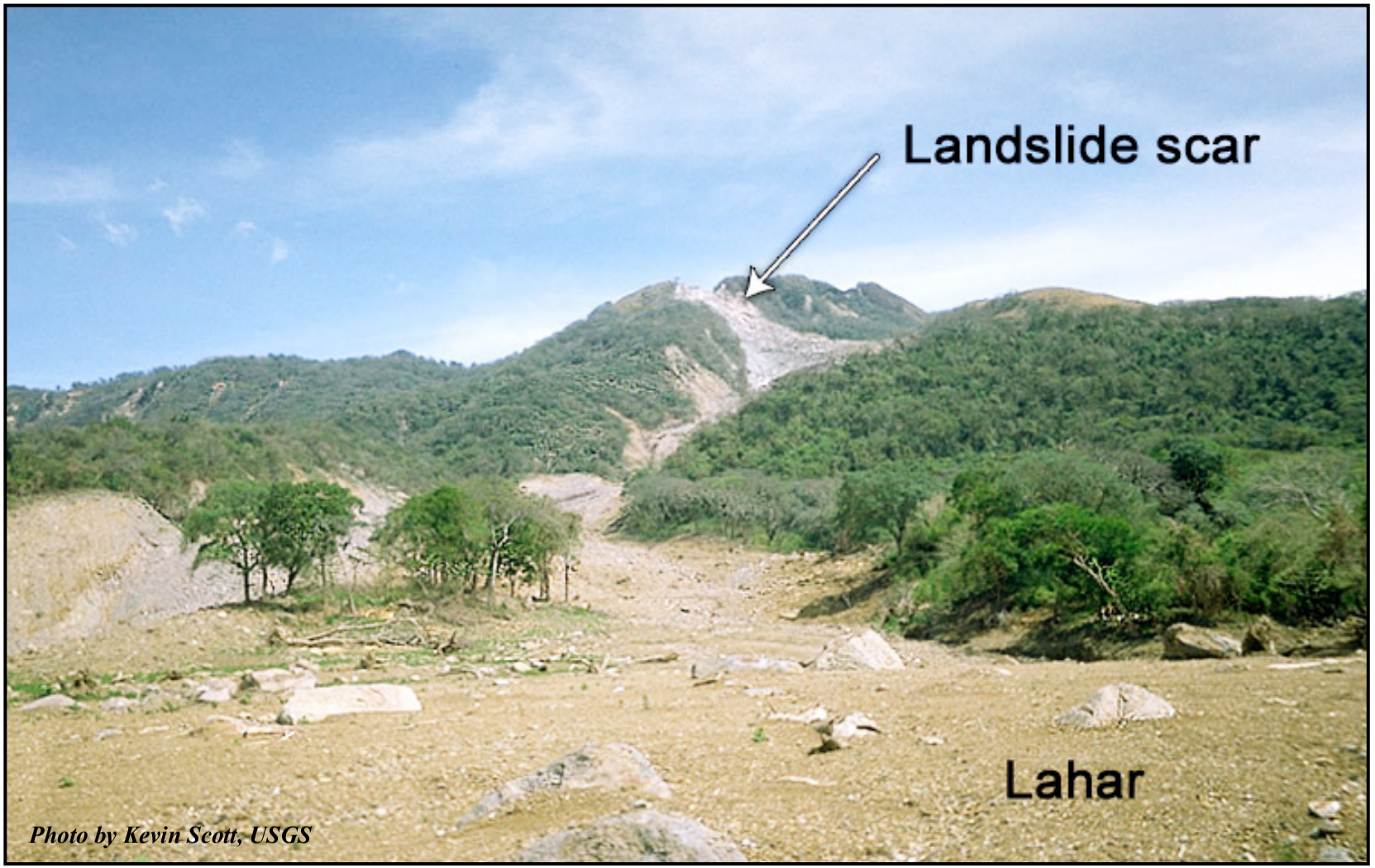


Photo by Kevin Scott, USGS

Volcanic Processes—Graphic 9—Hydrothermal Alteration Weakens Lava Rock at Mount Rainier, Washington

Photo by Steve Brantley, USGS