Volcanoes

Of all the earth processes, volcanic activity is certainly among the most powerful. By means of volcanic activity, people are able to witness the active transfer of earth materials and the active re-formation of the earth's surface. By means of volcanic activity, people are able to get some idea of the tremendous heat and pressure that exist within the earth's crust, where the heat is great enough to melt rock and the pressure is great enough to blow the top off a mountain. History contains accounts of over five hundred major volcanic eruptions and thousands of minor eruptions.

Task 1*: Fill in the gaps in the text about Krakatau.*

Task 2: *Prepare the explanation of the underlined words in the part you will be told.*
Check the correct pronunciation in the dictionary.

History of some main eruptions

Mount Mazama

The Cascade Mountains of the northwestern United States have been the site of much volcanic activity. Of all the volcanoes in the Cascade Range (which extends from northern California to Canada), the one that may have had the largest eruption was probably Mount Mazama in southern Oregon.

Prior to its eruption about 6600 years ago, Mount Mazama had a height of over 1800 meters. During that eruption, 49 cubic km of mostly ash and pumice were blown into the air and extruded (forced or pushed) out and down the sides, spreading over 896 000 square km. Beneath the mountain, the magma chamber that had been emptying during the eruption became even larger as the remaining magma drained back into the depths of the earth. The mountaintop collapsed into the empty magma chamber, leaving a large circular depression 916 m in diameter. See Fig. 10-2. Through eruption and collapse, Mount Mazama lost 70 cubic km of its top. The remaining **rim** now rises only 450 m above the surrounding countryside. This type of a collapsed volcanic crater is called a **caldera**. Three small volcanic cones were later formed in the floor of the collapsed crater. Water has since accumulated to a depth of about 610 m inside the caldera. The area is known today as Crater Lake National Park. See Fig. 10-3.

Mount Vesuvius

A seventeen-year-old young man by the name of Pliny has provided us with an eyewitness account of the eruption of Mount Vesuvius on August 24, A. D. 79. The eruption of Mount Vesuvius took place across the bay from present-day Naples. In that A. D. 79 eruption, three towns were buried under more than 18 m of heated mud and ash. About ten percent of the population of the three towns was killed during the eruption.

Krakatau

In 1883, a volcanic mountain erupted on Krakatau, a small island …….. Java and Sumatra in present-day Indonesia. The noise from the eruption was heard as far away …… Australia. The force of the eruption …….. off much of the mountain and created a large …… (a modern example of what probably happened to Mount Mazama 5600 years earlier).
The eruption also produced a ……. dust cloud that circled the earth at ……
of over twenty-seven kilometers. For three years following the eruption, the volcanic dust cloud caused the solar radiation level in Europe to be ten percent …… average.
The dust cloud also provided years of spectaculars …….. all over the earth.

Clue: altitudes as below between blew caldera huge sunsets

Mount Pelée

In 1902, on the island of Martinique in the West Indies, Mount Pelée erupted. The eruption did not come out of the top of the volcanic mountain because the top was plugged with volcanic rock from a previous eruption. Instead, the eruption broke through a weakened side of the volcano. Hot ash, cinders, gas, and rock rubble roared down the slope toward the seaport of St. Pierre at a speed of nearly 90 km per hour. Mount Pele's eruption killed 28 000 people. Only two people survived. One of the two survivors was a prisoner in a dungeon, and the other was in his basement at the time of the eruption.

Mount Lassen

In 1914, another period of volcanic activity took place in the Cascade Mountains. A **lateral eruption** (an eruption from the side of the mountain) took place on Mount Lassen, located in northern California. Mount Lassen´s eruptive period lasted from 1914 to 1921. An ash cloud rose over 9000m. Several centimeters of volcanic ash accumulated on the streets of Reno, Nevada, 216 km away. The lateral eruption extended for several kilometers away from the mountain and involved lava that spilled down the sides of the mountain, melted snow, and created floods filled with large volcanic boulders.

Parícutin

In February, 1943, a volcano named Parícutin began as a small opening in a farmer´s field in Mexico. At first, Parícutin was a curiosity that drew visitors and attracted scientific interest. As the volcanic material grew into a mountain, however, the farmer had to abandon the farm. In time, people in nearby towns had to leave their homes because the entire area became filled with ashes and lava. Parícutin was no longer a curiosity. It had destroyed two towns and the surrounding countryside. In one town, only the top of a church steeple showed above the thick lava deposits.

Mount St. Helens

In May, 1980, an eruption of Mount St. Helens in the state of Washington set off huge ash falls, mudslides, and floods. More than six people were killed, and property damage was set at 2.7 billion dollars.

In one large explosion, the upper 400 m (about 4 cubic km) of Mount St. Helens blew away. Much of the explosion propelled broken rock, ash, and mud laterally down the side of the mountain, scorching and smothering the land and every living thing in its path. The debris filled in valleys and created dams. As a result, the level of Spirit Lake near the base of Mount St. Helens is about 115 m higher than it was before the eruption. The blast from the eruption stripped trees of limbs and laid the trees over onto the ground. From high in the air, the ground appeared covered with matchsticks. But these matchsticks represented nearly 590 square km of formerly thickly forested land. See fig 10-5.

Mount St. Helens has had a long history of activity. Four hundred years ago, volcanic activity reshaped the cone into one of the most **symmetrically shaped cones** in the world. Between 1831 and 1957, the mountain was again active with minor eruptions. However, even though the volcano had been intermittently active, the 1980 eruption was unexpectedly violent. An area of over 400 square km of the Mount St. Helens region has been designated a **National Volcanic Monument** and attracts many visitors. The bleak landscape has an eerie quality and is a reminder of the awesome power and death-dealing nature of volcanoes.

Loss of life and property is common with volcanic eruptions. But even with all the dangers, people often repopulate devastated landscapes. The slopes of Mount Vesuvius, for example, have people living there today.

Tasks

Write the key words for the following answers to these questions.

2. How do volcanic eruptions in inhabited areas affect people?

3. How far into the atmosphere can volcanic eruptions reach? Give an example.

4. Do you know which famous volcano in the Philippines erupted on June 15th, 1991?

5. What do you know about major volcanic eruptions in the last 20 years?

Prepare a presentation on a history of a particular volcano, if you choose this topic as a credit task.

Watch the video "Caldera - Yellowstone" and fill in the missing words.

Yellowstone is the current ……. of magmatic activity produced as the continental ……..
of North America moves over a stationery …….. **hotspot**. Magma accumulates at the ……..
of the crust where it begins to crystallize, …… a change in composition and physical
……. Less dense magma …… to the middle level of the continental crust
forming …….. **magma chambers**. Cooling and crystallization …… the water
content of the …….. magma …….. the water pressure becomes greater than the
…….. of overlying rocks and a massive eruption ……. As the magma chamber ……, the
weight of …….. rocks causes them to collapse into the vacated …….. forming a
large **caldera**.

……. clouds from the three most …….. eruptions of Yellowstone covered much of the
western United States. Ash fell over an area …….. northward to Canada, ……
to the Mississippi river, ……../ to the Pacific Ocean and southward to Mexico. ……
interaction of the prevailing wind at the time of the eruptions …….. the extent of ash
……. A line of older calderas extending to the southwest of Yellowstone ……..
the site of ancient eruptions as the North American …….. passed …….. the long-lived hot spot.

Watch the video "Hawaii" and answer these questions.

1. What is the cause of volcanic activity on Hawaiian Islands? -

2. Are all Hawaiian Islands active? - Compare their activity with St. Helens. -
3. What does molten lava form when it reaches the sea? -
4. What are the advantages and disadvantages of Hawaiian volcanic activities for scientists?

Why some eruptions are so violent

Volcanic activity includes all earth processes in which molten rock, gases, or fragments of solid material come out of a **vent**, which is an opening in the earth's crust. (As you may recall, molten rock below the surface of the earth is called magma; molten rock on the surface of the earth is called lava.) Sometimes the lava or fragments spread out almost flat. Sometimes the volcanic material from the vent builds up to form a mountain. Either the vent or the mountain is known as a volcano.

Volcanic material is hot. Gases and lava may reach 1200°C. The source of heat within the earth can be from several different earth processes. One source would be heat left over from when the earth was first formed. A second source of heat would be from the friction of rocks bending or sliding past other rocks deep within the earth. A third source is radioactive elements found within the earth that undergo spontaneous change and release heat. Other sources such as chemical reactions associated with the forming and re-forming of differed minerals may contribute minor amounts of heat.

One of the concerns of people has been the violent nature volcanoes. The Valley of 10,000 Smokes in Alaska was at one time a volcanic mountain Mount Katmai. In 1912, Mount Katmai exploded, leaving a huge valley with thousands of fumaroles. A **fumarole** is a volcanic vent or opening that gases and smoke come out of.

What causes some eruptions, like Mount Katmai and Mount St. Helens, to be violent and others, like those of Hawaii or Iceland, to be relatively quiet? Usually three variables account for the differences in violence.

1. The first factor is the viscosity of the lava. **Viscosity** is a measure of how easily a liquid flows. Volcanoes with a highly viscous lava (in other words, with lava that flows very slowly) often tend to have more violent eruptions.
2. The second factor is the water content of the lava. The presence of superheated steam tends to make the eruption more violent.
3. The third factor is the chemical composition of the lava. If the chemical composition is similar to the continental rock type granite (over 60% silica), then the eruption tends to be more violent. If the lava has the chemical composition of basalt (40^{C}c silica), as in oceanic crustal rocks, then the eruption tends to be less explosive.

Check yourself

1. What earth processes are considered volcanic activities?
2. List the three major sources of heat that contribute to the heat in the earth.
3. How hot are volcanic gases and molten rock?
4. Which three variables account for the differences in violence?
5. How and when was the Valley of the 10,000 Smokes, Alaska formed? (Fig. 10-6)

Volcanic landforms

Volcanic eruptions can develop into three different types of volcanic mountains, depending on the nature of the volcanic material.

A **shield cone** is a volcanic mountain that is built almost entirely of lava flow. The slopes of a shield cone volcano are very gentle and rounded like a warrior's shield. The islands of Iceland and the Hawaiian Islands are examples of shield cones. The island of Hawaii is a shield cone volcano that rises from the ocean floor. That volcano is more than 10 km high from its base on the ocean bottom to its highest point above the sea.

A **cinder cone** is a volcanic mountain that is built entirely of volcanic cinders and ashes. Cinder cones are small (usually less than 450 m high) and have steep sides.

The slopes of such a volcano have an average angle between 30° and 40°.

Examples of cinder cones are the volcanic cones of Paricutin in Mexico, Cerro Negro in Nicaragua, and Wizard Island in Crater Lake, Oregon.

A **composite cone**, or a **stratovolcano**, is built of alternate layers of solidified lava and pyroclastic material - a super-hot avalanche of rock and ash that engulfs everything in its path in dense ash. Large rocks thrown out during the eruption – **bombs** - crush and set fire to anything they hit. Ash and toxic gases, including sulphur dioxide, create an eruption cloud, which pollutes the atmosphere over a large area and can contribute to acid rain.

Mud flows can be swift, silent and lethal, engulfing homes many kilometres away from the volcano. Composite cones are beautifully symmetrical and can reach 4 km in height.

The gentle slopes near the base are generally lava flows. The steeper parts of a composite cone contain larger percentages of cinders and ash.

Mount Fuji in Japan and Mount Shasta in California are two examples of composite cone volcanoes. Mount St. Helens had a more symmetrical shape before its last eruption.

Some volcanic activity does not produce a cone. Sometimes the lava flows from a **fissure**, which is a long crack in the ground. Thick buildups of horizontal layers of basalt, called **plateau basalts,** may form as a result of lava flows from fissures in the ground. Much of eastern Washington and Oregon and parts of Idaho are covered by plateau basalts. In India, the Deccan plateau basalts cover more than 500 000 square kilometers. In South America, the Parana plateau basalts of Brazil and Paraguay cover more than 750 000 square kilometers.

Check yourself

1. List examples of three types of volcanic mountains.
2. What are the relative sizes of the three types of volcanic mountains?

3. How do plateau basalts form? *Watch the video in the syllabus.*

4. List three examples of areas of plateau basalts, and indicate their size.
5. What is the origin of the word volcano?
6. Do the listening test on the types of volcanic mountains as your homework.

Homework Listening Comprehension (videos in the syllabus in IS)

also available in ROPOT with the key

SHIELD VOLCANOES

1. How big are individual eruptions?
2. How long does a cone form?
3. What material forms eruptions?
4. a) Where are the best known shield cones?
   b) Are they commonly found on islands?
5. When can you see clouds of gas?
6. What gave the name to this type of a volcano?

CINDER CONES

1. What is the viscosity of magma?
2. What is its gas content?
3. What forms the mixture blasting into the air?
4. How steep is the forming slope?
5. What happens with the smaller ash?
6. How does the explosiveness change over years?
7. How long does most of the cinder cone eruptions last?
8. Give an example:
9. How does the area round the volcano change after short time?
10. What causes the change?

STRATO VOLCANOES (COMPOSITE CONES)

1. What are they formed by?
2. How long do they form?
3. What is the volume of individual eruptions?
4. What viscosity do the magmas have?
5. What do magmas rich in gas do?
6. What are lava flows produced by?
7. Which are the most dangerous eruptions?
8. Give an example:

Where volcanoes occur

Volcanic activity is more likely to occur in certain regions of the earth than in others. Two regions of volcanic activity are the Circum-Pacific Ring of Fire and the mid-ocean ridge.

around curve curve edges entire form includes parallel relationship the the

The Circum-Pacific Ring of Fire. Many volcanoes are located around the Pacific Ocean. This …….. group of volcanoes makes up what is called the **Circum-Pacific Ring of Fire**. The Latin word *circum* means …….. A glance at Figure 10-8 will show you why this group of volcanoes is called a ring. The Circum-Pacific Ring of Fire ……. the volcanic mountains near the …… of North America, Central America, and South America. It also includes the volcanic islands that are found in the North and West Pacific. These volcanic islands form …….. -shaped groups called **island arcs**. The Mariana Islands and Japan in the West Pacific and …….. Aleutian Islands in the North Pacific are examples of island arcs. The Aleutians …….. south and west from Alaska and …….. the southern boundary of the Bering Sea.
There is a …….. between the volcanoes of the Circum-Pacific Ring of Fire and **trenches** in the Pacific Ocean. Along the ocean bottom, volcanoes of the Circum-Pacific Ring of Fire are found near trenches. The volcanoes of the Aleutian Islands, for example, are along the Aleutian Trench, which is 3700 km long and 7.7 km deep. On the continent of South America, the volcanoes of the Andes Mountains are …… to the Peru-Chile Trench. In Central America, the volcanoes are near …….. Middle America Trench.

The mid-ocean ridge. Much volcanic activity takes place along the mid-ocean ridge. The **mid-ocean ridge** is a system of tall, rugged, submerged mountains that form the single most dominant feature of the ocean bottoms. As shown in Figure 8-9 (page 380), the mid-ocean ridge extends down the center of the Atlantic Ocean, around the tip of Africa, and into the Indian Ocean. In the Indian Ocean, the mid-ocean ridge splits into a **Y** shape. One part of the **Y** extends northward toward the Gulf of Aden where it splits into a Red Sea branch and an African rift system branch. The other part extends southeastward—passing south of Australia, across the southern Pacific Ocean, and up toward Central America. Active volcanoes are found along many parts of this mid-ocean ridge system. Although most of the volcanic activity along the ridge is below the ocean's surface, some volcanic mountains form islands like Iceland and the Azores in the Atlantic Ocean.

Tasks

1. Describe the Circum-Pacific Ring of Fire. Name some volcanoes located there. (Figure 10-8)

2. Describe the mid-ocean ridge and its volcanic nature. (Pictures)

3. What do the Japanese Islands and the Aleutian Islands have in common?

4. Explain relationship between the volcanoes of The Circum-Pacific Ring of Fire and the trenches in the Pacific Ocean.

Watch the video "Iceland" and complete the tasks. Note the key words during the first listening and complete whole sentences during further listening.

1. ***Note the key words during the first listening and complete whole sentences during further listening.***

   What happened in November 1963?
   clue: volcano - sea level
   magma +cold water =>
   gases + atmosphere =>

   Volcanic activity built a …….. which rose above sea level.
   The …….. of hot magma and cold sea water produced dense clouds of ……..
   and ejection of …….. in ballistic trajectories.
   Hot volcanic …… interacting with the colder …….. produces meteorological phenomena like …… and ……

2. What is **Surtsey**?
   - a new island which was born after nine months as a result of this activity.

3. True or false? Its growth could not be documented as the scientists could not reach the island.

4. Was the eruption on an inhabited island of **Heimaey** expected a decade later?
   Describe what happened. How long was the volcano active?
   -

5. What did the residents do when they came back?

Adapted from Fariel, R. - Hinds, R. - Berey, D.: Earth Science, Addison-Wesley 1987

English for Geology, Věra Hranáčová, 2012

Videos from Plummer, Ch. - McGeary, D. - Carlson, D.: Physical Geology: Earth Revealed, The McGraw-Hill Companies 2001 University Textbook.