

## **VULCANICITY**

### **What is vulcanicity?**

Vulcanicity is the process through which gases and molten rock are either extruded (poured) on the earth's surface or intruded (forced) into the earth's crust.

Molten rock material (magma) that are injected into the crust are called intrusive material (intrusive rock) and the features formed are called intrusive features.

Molten rock material (lava) that are poured out into the surface are called extrusive material (extrusive rock) and the features formed are called extrusive features.

Magma is the molten rock originating from the upper plastic layer of the mantle. When it gets to the surface and loses its gases, it is known as lava.

### **Materials ejected when a volcano erupts**

Three different types of materials may erupt from an active volcano. These materials are:

**Lava** - Lava is magma that breaks the surface and erupts from a volcano. If the magma is very fluid, it flows rapidly down the volcano's slopes. Lava that is more sticky and less fluid moves slower.

**Tephra, or pyroclastic material**, is made of rock fragments formed by explosive shattering of sticky magma. The best-known tephra materials include:

**pumice** - Light-colored, frothy volcanic rock, formed by the expansion of gas in erupting lava.

**Cinders** - Cinders are vesicular (having small cell or cavity) lava fragments 1 centimeter or larger in diameter

**Volcanic ash** - Fine particles of pulverized rock blown from an explosion vent. Measuring less than 1/10 inch in diameter. The finest ash is called volcanic dust and is made up of particles that are less than 0.06 mm (0.002 in) in diameter.

**Volcanic bombs** - A volcanic bomb is a mass of molten rock (tephra) larger than 64 mm (2.5 inches) in diameter, formed when a volcano ejects viscous fragments of lava during an eruption. Some bombs can be the size of a small car.

**Gases** - primarily in the form of steam, are released from volcanoes during eruptions. All eruptions, explosive or non-explosive, are accompanied by the release of volcanic gas. Most volcanic gases predominantly consist of water vapor (steam), with carbon dioxide and sulfur dioxide also chlorine and fluorine gases.

### **Types of Volcanoes**

**Active**: This is a volcano that has erupted within the last 500 years and still shows signs of activity.

**Dormant**: This is a volcano that has not erupted within the last 500 years but still shows signs of activity such as hot springs. An example is Mt. Kilimanjaro.

**Extinct**: This is a volcano that has not erupted within the last 500 years and shows no signs of activity. An example is Mt. Kenya.

### **Types of lava**

<b>Basic lava</b>	<b>Acidic lava</b>
Contain small amount of silica	Contain large amount of silica
Highly fluid	Highly viscous/ sticky
Low melting point	High melting point
Fast flowing	Slow flowing
Travel long distances	Seldom travel far
Build gently sloping cones	Build steep sided cones
Quiet and without much explosive activity	Explosive volcanic activity

### **What is volcano?**

A volcano is an opening, or rupture, in the Earth's surface or crust, which allows hot molten rock, ash and gases to escape from deep below the surface.

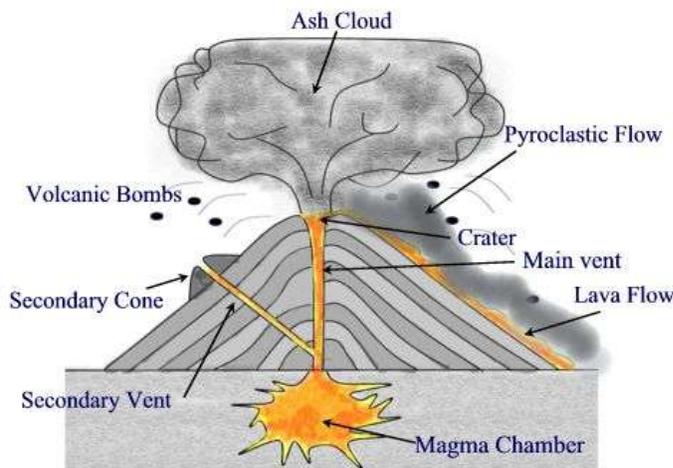
Volcanic activity tend to form mountains or features like mountains over a period of time.

A volcano is typical conical in appearance with a funnel-shaped depression at the top called a **crater**. The structure is built up when lava and pyroclastic material

is solidified around a vent.

In the lower part of the crater is the **vent** also called a **conduit** or **pipe**, through which volcanic material are ejected. The shape of the volcano depend on the type of the material ejected

When the main vent is blocked, lava may issue from the sides to form conelets or parasitic cones or secondary cones.



**Main Features of a Volcano**

**Ash clouds** - is created when volcanic ash is propelled into the atmosphere during an eruption.

**Secondary cones** also called parasitic cones or conelets.

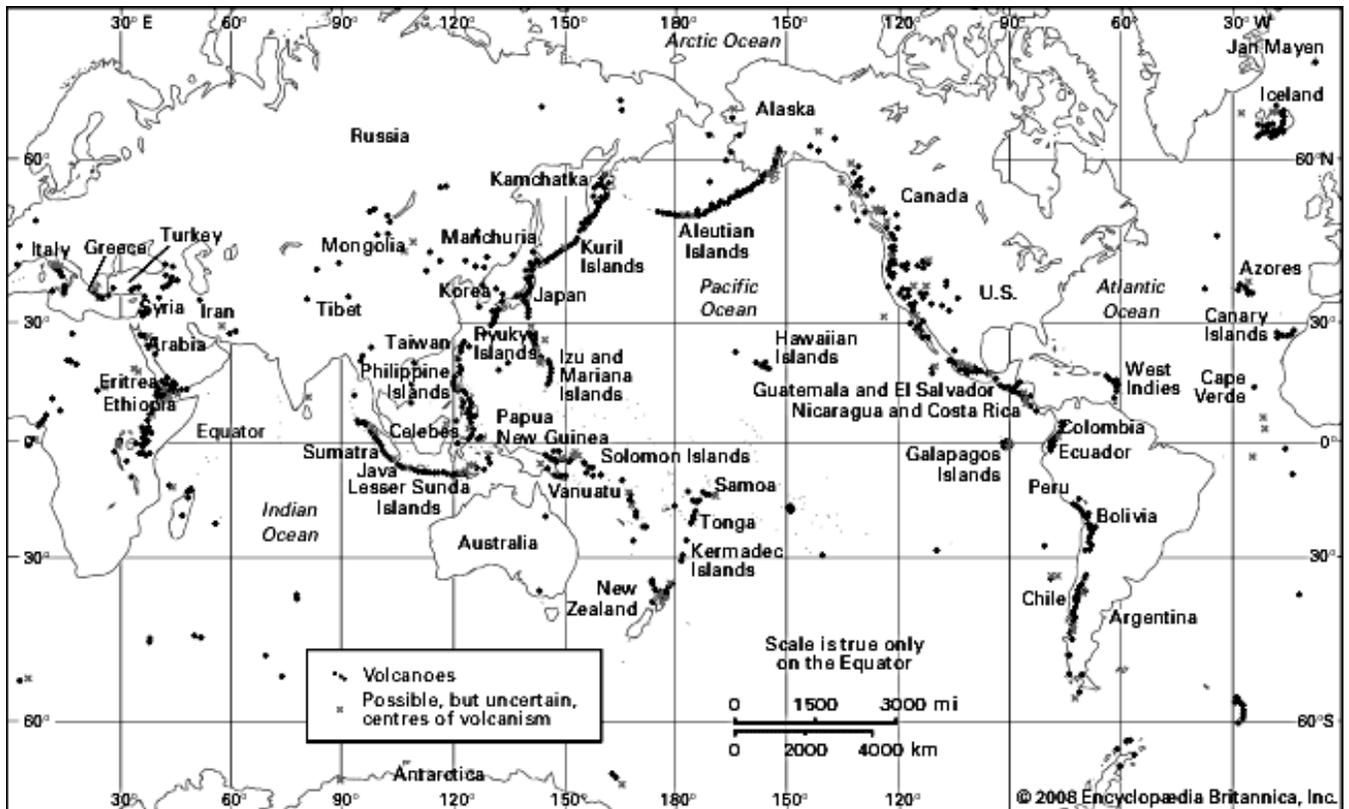
**Main vent** also called pipe or conduits.

**Distribution of volcanoes**

Volcanic zones occur along the edges of tectonic plates that form the Earth's crust, for example, near the margins of continents lining the Pacific seaboard and the western side of North, Central and South America. About 75% of volcanoes are situated in a circle around the Pacific Ocean, known as the Pacific Ring of Fire. This belt coincides with the young fold mountains of western North and South America and the Pacific

basin.

Some are located in and around the Mediterranean Sea, for example, Mount Etna in Sicily, Vesuvius and Stromboli. Volcanic islands form insular arcs such as part of the Pacific Ring of Fire, from the Kuril islands north of Japan, to the East Indies: others form an insular arc, as in the Caribbean. Volcanoes are also found near the rift valley zones.



**Why volcanoes cluster along narrow mountain belts?**

Volcanoes cluster in these zones because this is where folding and fracturing of the crust provide channel ways for the escape of magma to the surface. These areas are located along plate margins. The eruption of molten rocks which is heated by its downward movement, form the volcanoes.

**Features formed by intrusive volcanic activity**

The features formed by intrusive volcanic activities result from the intrusion of molten magma into the crust. The form (shape) the features take depends on how fluid or how sticky the magma is. Fluid magma flows as a thin sheet while viscous magma solidifies rapidly.

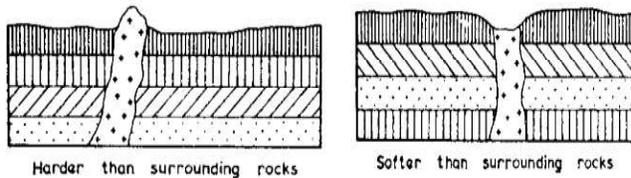
The main intrusive features are:

1. **Dyke** - a mass of vertical or highly inclined intrusive rock that cuts across layers of sedimentary rocks.

They are formed when magma forces its way through a fissure, crack or fault where it cools and solidifies.

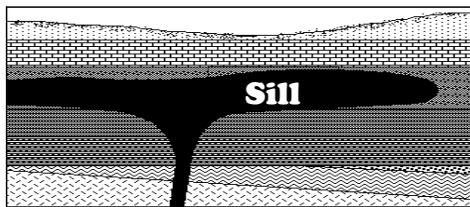
When affected by denudation a dyke may stand up as a ridge the dyke is more resistant than its surrounding or be worn away to form a depression.

N.B - *Intrusive rock, that is, molten rock that solidifies in the crust.*



2. **Sill** - these are intrusions of igneous rocks formed between bedding planes of rocks.

They are formed when magma forces its way between layers of sedimentary rock where it cools and solidifies. Sills can be of any thickness and extends over many square km.

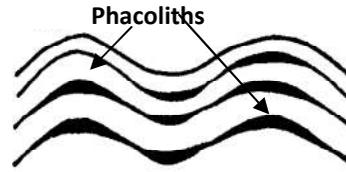


3. **Laccolith** - these are domes or lens of igneous rocks which have been injected between two layer of sedimentary rock.

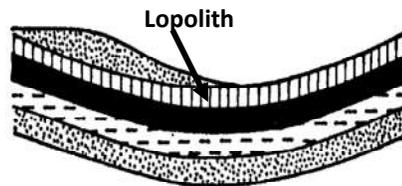
They are formed when magma forces its way between two layer of sedimentary rock causing the upper surface of the rocks to arch up into a dome. Well formed laccoliths have flat bottoms and a irregular upper surface. They are sometimes eroded to form hills or mountains.



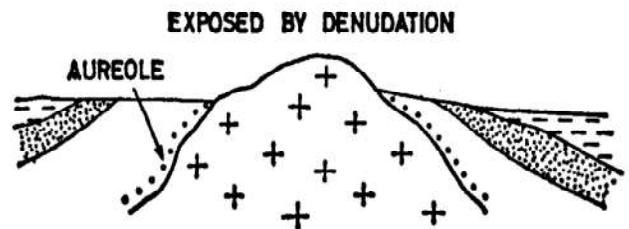
4. **Phacolith** - these are lens-shaped mass of igneous rock which are formed on top of anticlines or the bottom of synclines in folded strata.



5. **Lopolith** - a basin-shaped body of igneous rock formed by the penetration of magma between existing layers of rock



6. **Batholith** - a very large igneous intrusion extending to an unknown depth in the earth's crust. Batholiths are usually composed of coarse-grained rocks (e.g., granite or quartz diorite) and often have an irregular shape, with side walls that incline steeply.



**Features formed by extrusive volcanic activity**

Materials ejected onto the earth's crust may form a number of features or landforms. The shape of the landforms depend on the nature of the material ejected. These landforms includes:

- Ash cone volcano** - A volcanic cone built primarily of unconsolidated ash .

They are formed by the interaction between magma and water, such as those occurring in the open ocean. The interaction between magma and water, along with expanding steam produce the ejection of ash. The ash that falls after an eruption forms an ash cone.

Examples of ash cone volcano: An example of a tuff cone is Diamond Head and Kapoho Cone (Hawaii)

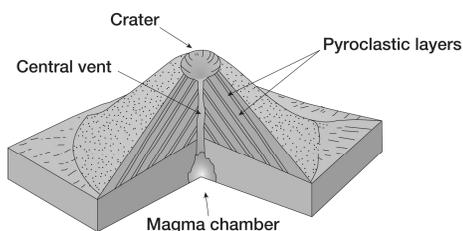


N.B. Unconsolidated means - loosely arranged

**2. Cinder cone volcano** - A cinder cone or scoria cone is a steep conical hill of volcanic debris (tephra) that accumulates around a volcanic vent.

The volcano forms when volcanic debris pile up around the vent to form a circular or oval cone. Cinders are melted volcanic rock that has cooled and formed pebble-sized pieces when it is thrown out, into the air. Cinder Cone volcanoes are the most common volcano.

Examples of cinder cone volcano: Paricutin (Mexico), Cerro Negro (Nicaragua), Wizard Island (Crater Lake, Oregon)



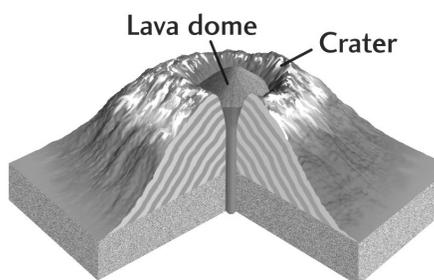
(a) Cinder cone  
Copyright © 2005 Pearson Prentice Hall, Inc.

**Dome volcano/acidic lava dome/silicic lava dome** - Volcanic domes are rounded, steep-sided mounds built by very viscous magma.

The height of these volcanoes is greater than the width of the base. The volcano is now built by further addition of lava from the inside and the earlier form layers (top layers) are heaved up.

Some of the more viscous lava is squeezed out to form a spine or plug.

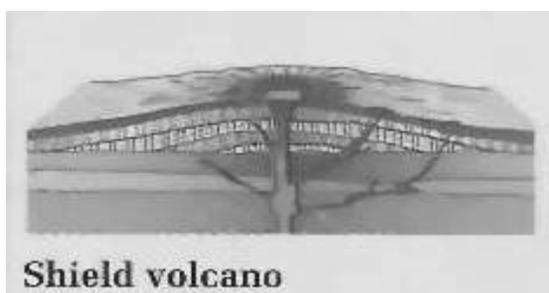
Examples of dome volcano: Unzen Volcano (Japan), Mount Hood (Oregon), Soufriere Hills Volcano (Montserrat)



**Shield volcano/basaltic lava volcano/basic lava cone** - A shield volcano is a wide volcano with shallowly-sloping sides.

A shield volcano have a broad profile is built up over time by flow after flow of relatively fluid basaltic lava issuing from vents or fissures on the surface of the volcano. Many of the largest volcanoes on Earth are shield volcanoes.

Examples of shield volcano: Mauna Loa and Kilauea (Hawaii), Etna (Sicily), Erta Ale (Ethiopia)



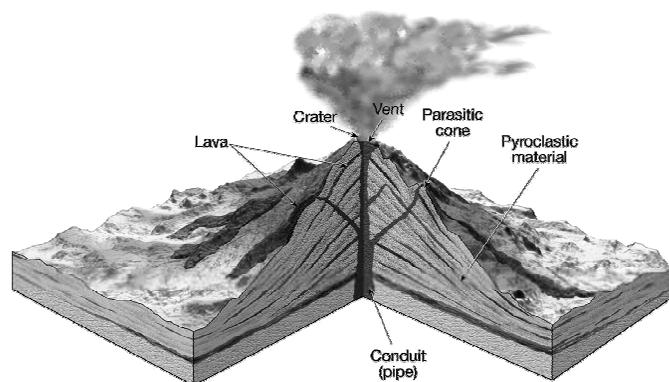
**5. Composite or strato volcano** - A strato volcano, also called a composite volcano, is a tall, conical volcano composed of many layers of volcanic material.

These volcanoes are characterized by a steep profile and periodic, explosive eruptions.

Composite volcanoes are constructed from multiple eruptions, sometimes recurring over hundreds of thousands of years, sometimes over a few hundred.

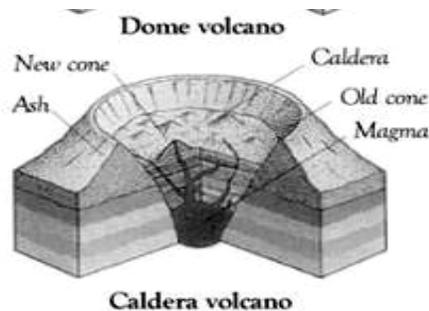
Lava issued sideways from the main vent to form dykes which strengthened the cone. Sometimes active conelets known as parasitic or secondary cone are formed on the sides of the main of the main volcano.

Examples of composite volcano: Mount St. Helens and Mount Rainier (Washington State, USA), Mount Vesuvius (Italy), Mayon Volcano (Luzon Island, Philippines), Mount Fuji (Japan) Mount Cotopaxi (Ecuador), Mount Shasta (California), Mount Hood (Oregon, USA)

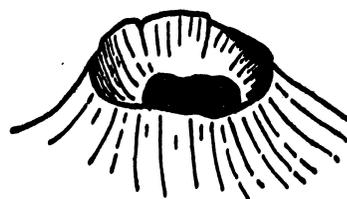


**6. Caldera** - a large volcanic crater, especially one formed by a major eruption leading to the collapse of the mouth of the volcano.

A caldera is formed by the emptying of the magma chamber beneath the volcano, as the result of a large volcanic eruption.



**7. Crater lake** is formed when water collects in the crater of a volcano or in a caldera.



Examples of caldera: Gran Etang (Grenada), Crater Lake (Oregon, USA), Aniakchak Caldera (Alaska)

## **Minor volcanic forms**

**Hot Springs or thermal springs** - A hot spring is a spring that is produced by the emergence of heated groundwater from the earth's crust.

The water issuing from a hot spring is heated by geothermal heat, i.e., heat from the Earth's interior. If water percolates/seeps deeply enough into the crust, it will be heated as it comes into contact with hot rocks. The water from hot springs is heated in this manner.

**Geyser** - is a type of hot spring that erupts periodically, ejecting a column of hot water and steam into the air.

**Fumaroles** - A fumarole is an opening in Earth's crust which emits steam and gases such as carbon dioxide, sulfur dioxide, hydrochloric acid, and hydrogen sulfide.

**Solfatara** - A natural volcanic steam vent that continues to give off steam and certain gases, principally sulfurous gases.

## **Positive Effects of volcanic activity**

Volcanic eruptions can have a devastating effect on people and the environment.

However, unlike earthquakes, volcanoes can also have a positive impact on an area. These positive impacts can help to explain why people choose to live near volcano.

1. Volcanic or igneous rocks are valuable for their minerals, for example, nickel, copper and gold in the Pakaraima region in Guyana.
2. Weathered lava produces good farming soil. Rich volcanic soils also support dense populations
3. Hot springs are used as a source of energy for domestic use. Some spas or hot springs are used for health purposes,
4. Geothermal electrical energy in Iceland is produced from hot springs and steam.
5. Volcanic features are major tourist attractions
6. Mud rich in black iron sulphide is used in soap manufacturing in Dominica. Dominica also exports pumice, which is a volcanic rock.

## **Negative Effects of volcanic activity**

1. Many lives can be lost as a result of a volcanic eruption.
2. If the ash and mud from a volcanic eruption mix with rain water or melting snow, fast moving mudflows are created. These flows are called lahars.
3. Lava flows and lahars can destroy settlements and clear areas of woodland or agriculture.
4. Human and natural landscapes can be destroyed and changed forever.

## **Exercise**

1. Name three features formed within a volcano.
2. Draw a labeled diagram of a typical volcano
3. Identify the types of material ejected from a volcano.
4. Name three differences between basic lava and acidic lava?
5. Name two differences between a shield volcano and a composite volcano.
6. List three types of volcanic activity that can cause pollution to the environment.
7. Explain each of these terms.
  - i lahar
  - ii pyroclast
  - iii nuée ardente
8. State three measures which can be taken to minimise the impact of volcanic disasters.
9. Explain how a crater lake is formed.
10. Name two intrusive volcanic features
  1. A volcano is

1. A mountain or hill formed around a crack in the earth's crust.
  - (a) A mountain with a jagged peak.
  - (b) A mountain or hill with a flat top.
2. The hot rock under the earth's surface is called
  - (a) Lava
  - (b) Magma
  - (c) Dormant
3. The hot rock that flows down the sides of the volcano is
  - (a) Lava
  - (b) Magma
  - (c) Dormant
4. The opening in the top of a volcano is a
  - (a) Dormant
  - (b) Magma
  - (c) Crater
5. All volcanoes erupt all of the time
  - (a) True
  - (b) False
6. Volcanoes erupt because of
  - (a) The pressure in the earth forcing the hot rock through a crack.
  - (b) An earthquake happening nearby
  - (c) The earth getting overheated.

1. All the solid material that a volcano ejects are known as \_\_\_\_\_
2. Name four solid materials that a volcano ejects \_\_\_\_\_
3. Lava that contain much silica are called \_\_\_\_\_ lava
4. Lava that are poor in silica are \_\_\_\_\_ lava
5. A volcano is a \_\_\_\_\_
6. The funnel-shaped depression at the top of the volcano is called \_\_\_\_\_
7. The central hole in a volcano through which lava is ejected is called \_\_\_\_\_

Answer true or false

1. Fluid lava flow as a thin sheet \_\_\_\_\_
2. Viscous lava form dome-shaped masses \_\_\_\_\_
3. An intrusion of igneous rock which form between layers of sedimentary rock is called a dyke \_\_\_\_\_
4. A vertical wall of igneous rock which cuts across bedding planes of sedimentary rocks is called a \_\_\_\_\_
5. The small volcanoes formed at the side of the main volcanic cone are called \_\_\_\_\_
6. Volcanoes that have not erupted since historic time are said to be \_\_\_\_\_
7. Volcanoes that erupt frequently are said to be \_\_\_\_\_
8. A volcano that has been quiet for a long time, but still has signs it may erupt again is said to be \_\_\_\_\_
9. A massive intrusion of igneous rock extending over any square km is called a \_\_\_\_\_
10. An intrusion of igneous rock that spread along bedding planes forcing up the strata in to a dome is called a \_\_\_\_\_
11. An elongated dome of igneous rock formed beneath an anticline and along a syncline \_\_\_\_\_
12. A large intrusion which sags downward in the centre forming a saucer-shaped depression is called a \_\_\_\_\_
13. Three basic types of volcanic cones are \_\_\_\_\_
14. Volcanoes formed from ash and cinder a are called \_\_\_\_\_
15. Volcanoes formed from acidic lava/silicic lava are called \_\_\_\_\_
16. Volcanoes formed from basic lava or basaltic lava are called \_\_\_\_\_
17. Volcanoes formed by alternating layers of ash and cinder and lava are called \_\_\_\_\_
18. What is a volcanic spine/plug \_\_\_\_\_

1. What is a caldera, how is it formed \_\_\_\_\_
2. What is a crater lake and how is it formed \_\_\_\_\_
3. What is a hot spring and how is it formed \_\_\_\_\_
4. What is a geyser? \_\_\_\_\_
5. How are fumaroles formed? \_\_\_\_\_
6. How solfatara formed \_\_\_\_\_
7. What are some of the advantages of volcanic eruptions \_\_\_\_\_
8. What are some disadvantages of volcanic eruptions \_\_\_\_\_
9. Name the volcanically active area in the Caribbean \_\_\_\_\_