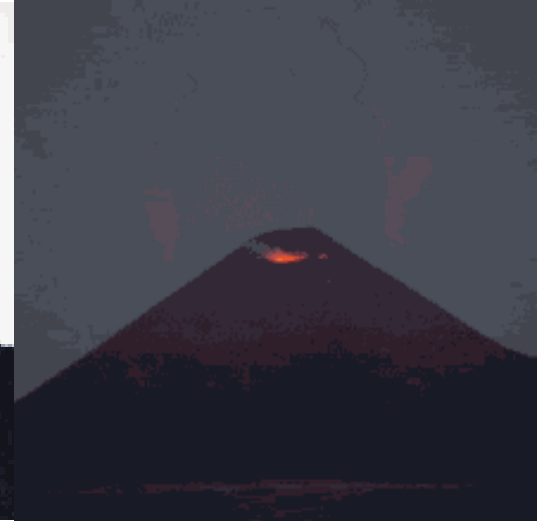


VOLCANO



*Dr R Jegankumar
Professor and Head
Department of Geography, BDI*

A **volcano** is a vent or a fissure in the crust from which **lava** (molten rock), **ash**, **gases**, **rock fragments** erupt from a magma chamber below the surface.

Volcanism is the phenomenon of eruption of molten rock, **pyroclastics** and **volcanic gases** to the surface through a vent.

Volcanism : Volcanism refers to **processes** where magma, gases, and volcanic materials rise from the Earth's interior to the surface. Driven mainly by tectonic plate movement, it occurs at divergent boundaries, subduction zones, and hotspots. When magma erupts, it appears as lava, which cools to form igneous rocks. Volcanoes are surface expressions of volcanism including shield volcanoes, stratovolcanoes, and cinder cones, each with unique eruption styles.

Volcanology is the scientific study of volcanoes, lava, magma, and related geological phenomena

Causes of Volcanism

- There is a **huge temperature difference** between the inner layers and the outer layers of the earth due to the differential amount of radioactivity.
- This temperature difference gives rise to **convective currents** in the mantle.
- The convection currents in the mantle **create convergent and divergent boundaries** (**weak zones**).
- At the divergent boundary, molten, semi-molten and sometimes gaseous material appears on earth at the first available opportunity.
- The earthquakes here may expose fault zones through which magma may escape (**fissure type volcano**).
- **At the convergent boundary, the subduction of denser plate creates magma at high pressure which will escape to the surface in the form of violent eruptions.**

Material ejected from a volcano

The materials released from volcanic eruptions are divided into three categories.

1. **Gases and Water Vapor:** During volcanic eruptions, a large amount of gases is released, with 60-90% consisting of **water vapor**. Other gases include: Sulfur dioxide (SO_2), Nitrogen (N_2), Ammonium chloride (NH_4Cl) Carbon dioxide (CO_2), among others.
2. **Fragmented Materials:** Along with gases, solid materials, fine dust particles, and ash, as well as large chunks of rock, are expelled during eruptions. These fragments vary in size, from a few inches to several feet in diameter.
 - **Types of Volcanic Fragments:**
 - **Lapilli** – Pebble or walnut-sized fragments.
 - **Volcanic Ash** – Very fine particles of dust and ash.
 - **Volcanic Bombs** – Large, solid rock fragments.
 - **Volcanic Breccia** – When small, angular lava fragments stick together, forming solidified volcanic rock.
3. **Lava material-** When the material coming out of a volcano is in the form of liquid or fluid, it is called 'lava'.

1. **Acidic Lava (Felsic Lava)**

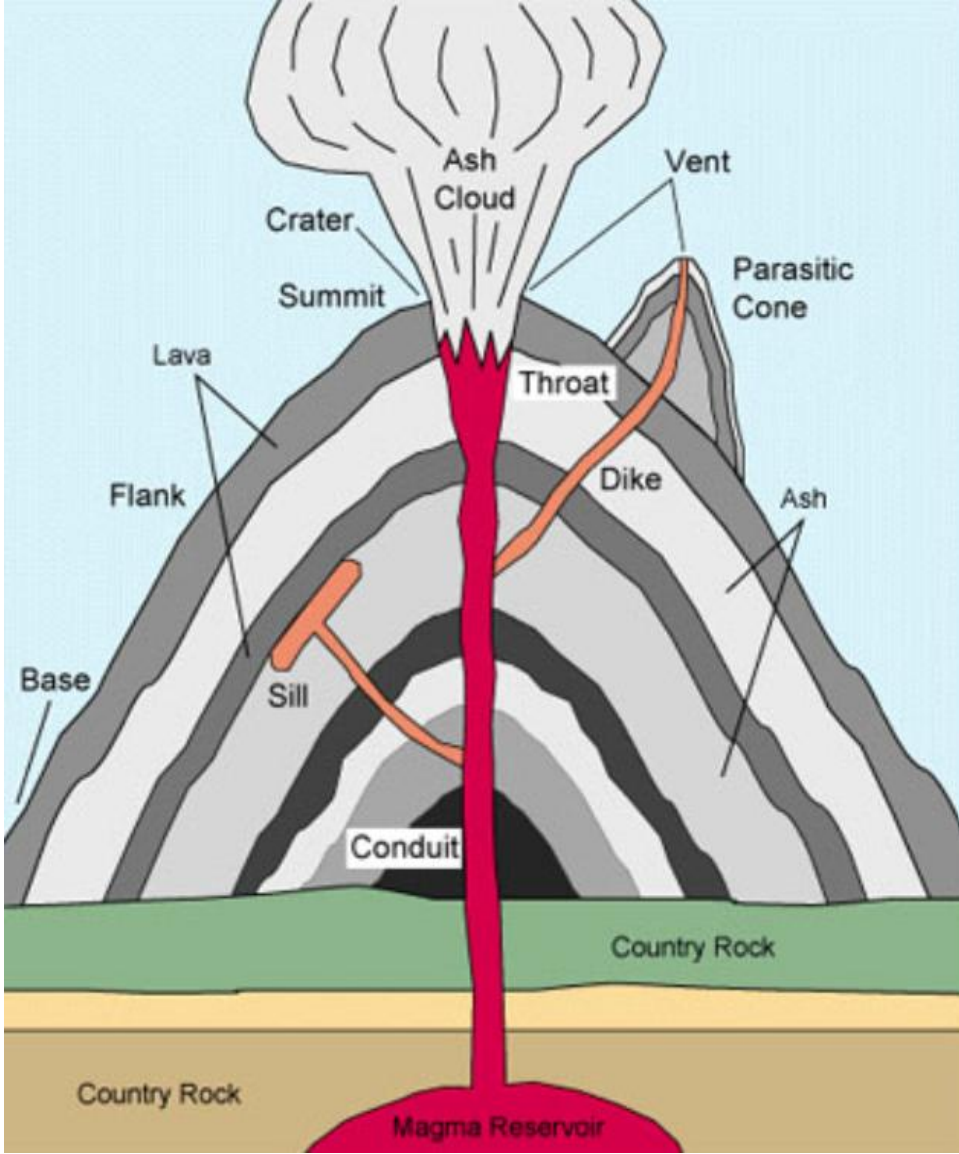
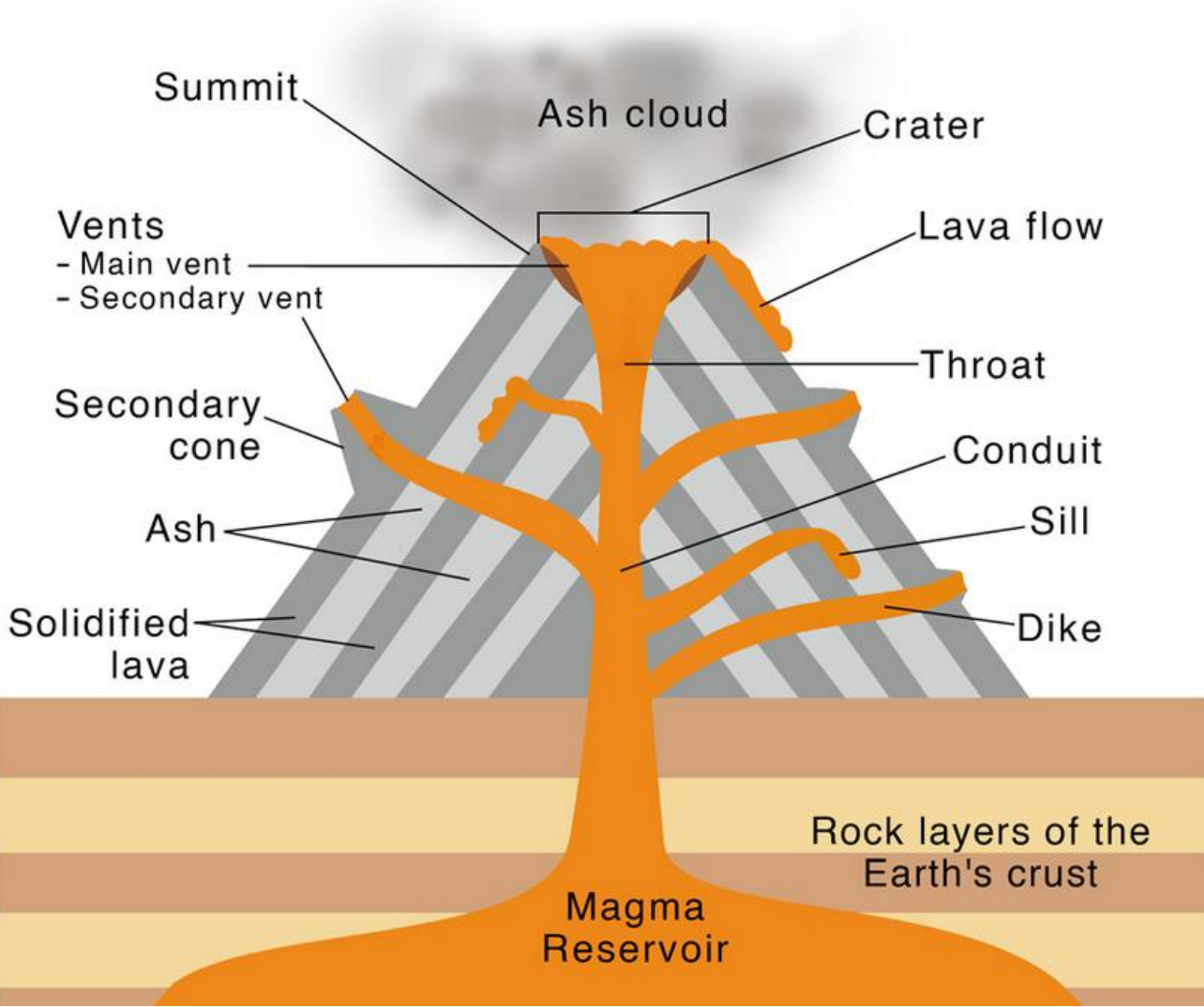
- Highly viscous and thick.
- Yellow in color and lightweight.
- Melts at a high temperature.
- Contains a high amount of silica.
- Usually erupts explosively and forms tall, conical volcanoes.
- Example: Rhyolite

2. Basic Lava (Mafic Lava)

- Thin and fluid in molten form.
- Dark-colored, black, and heavier.
- Melts at a lower temperature.
- Spreads quickly over the surface due to low viscosity.
- Contains less silica and solidifies rapidly.
- Erupts with less explosion, forming plateaus or plains.
- Example: Basalt

Note – Andesite Lava – Intermediate between acidic and basic lava, neither too acidic nor too alkaline.

Parts of Volcano



The material ejected from a volcano comes out through a natural channel called a “**Volcanic Pipe.**” The opening through which lava emerges onto the surface is known as a "**Volcanic Vent.**"

When this vent expands, it forms a "**Volcanic Crater.**"

As the erupted material accumulates around the volcanic vent, it gradually builds a cone-shaped mountain, known as a "**Volcanic Mountain.**"

When lava escapes from secondary vents on the sides of the main volcanic pipe, it forms small cone-like structures called "**Secondary Cones.**"

Classification of Volcanoes

Bases

Frequency of eruption

1. Active
2. dormant
3. Extinct

Pattern of eruption

centrally explosive

1. Hawaiian
2. Stromboli
3. Vulcanian
4. Vesuvius
5. Peelian

fissured eruption

Topography

1. Shield Volcano
2. Composite volcano
3. Caldera Volcano
4. Basaltic flow field volcanoes
5. Mid-ocean ridge volcanism

Location

1. tectonic boundary
2. Hot-Spot Volcanism

1. Active volcano -

- When lava, gas and fragmented material keep coming out continuously from a volcano, it is called an 'active volcano'.

Etna, Stromboli of Sicily Island [Italy], Barren Island [Andaman Nicobar], Erebus [Antarctic], Mauna Loa [Hawaiian Islands], Mayon [Philippines] are its major examples.

Note -

- The area around Stromboli volcano remains illuminated due to the continuous emission of gases. That is why it is called the 'Lighthouse of the Mediterranean Sea'.
- **Cotopaxi volcano** is the world's highest active volcano. (Height 5879 m.)

2. Dormant Volcano -

- Volcanoes that have not erupted for a long time but still have the possibility of erupting are called dormant volcanoes. • **Vesuvius (Italy), Krakatoa (Indonesia), Fujiyama (Japan), Narcondam [Andaman Nicobar]** are its major examples.

3. Extinct volcano -

- Such volcanoes in which the eruption has completely stopped and there is no possibility of eruption in future are called dormant volcanoes.
- Due to water filling in the mouth of these volcanoes, a crater lake is formed.
- **Koh Sultan and Demvand (Iran), Mount Popa (Myanmar), Kilimanjaro [Tanzania], Aconcagua [Argentina], Chimborazo [Ecuador]** are examples.

Based on eruption

Volcanic eruption occurs in two forms.

1. When a lot of lava, gas and fragmented material comes out of the surface in the form of an explosion through holes and pipes.
2. When the intensity of the gas decreases, liquids come out of the surface quietly through cracks.

On the basis of the above mentioned forms, volcanoes are classified into two parts

1. Volcanoes with central eruptions

2. Volcanoes with surface or fissure eruptions

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1. Central eruption volcano

- ❖ • Eruptions occur through a narrow volcanic pipe leading to an opening (vent).
- ❖ • When lava contains a high amount of gas and there is a decrease in pressure from above, the gases and lava rapidly rise with great force.
- ❖ • This intense pressure breaks through weak zones of the Earth's crust, releasing lava onto the surface with a loud explosion.
- ❖ • Due to the high intensity of gases, volcanic material is ejected high into the sky, forming thick, dark clouds of vapor, gas, and smoke.
- ❖ • After some time, fragmented material and lava fall back to the ground like rain.
- ❖ • The liquid lava accumulates around the vent, forming a volcanic cone or dome.
- ❖ • Due to violent explosions, these volcanoes are highly destructive

2. Fissure eruption volcano

- ❖ • Volcanoes with such eruptions are rarely found on Earth.
- ❖ • Eruptions occur through long cracks (fissures) rather than a central vent.
- ❖ • Lava is alkaline and flows out slowly and calmly with minimal explosion.
- ❖ • Due to its fluid nature, lava spreads over vast areas instead of forming a volcanic cone or mountain.
- ❖ • Instead of mountains, these eruptions create lava plains and lava plateaus.
- ❖ • Columbia Plateau of USA, Parana Plateau of Brazil and Deccan Trap of India, Drakensberg Plateau of South Africa are its main examples.

Types of Volcanic Eruptions

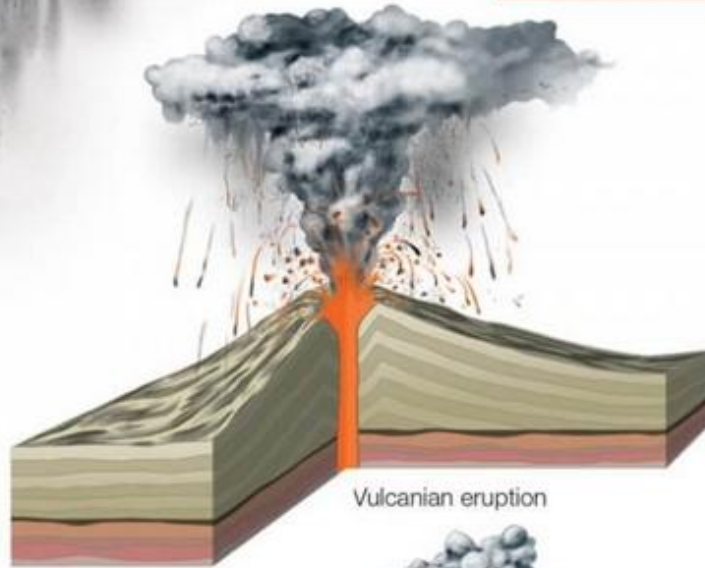
Types of volcanic eruptions depend on various factors such as **chemistry of magma, temperature, viscosity, volume, presence of groundwater, and water and gas content.**

Following are the different types of volcanic eruptions

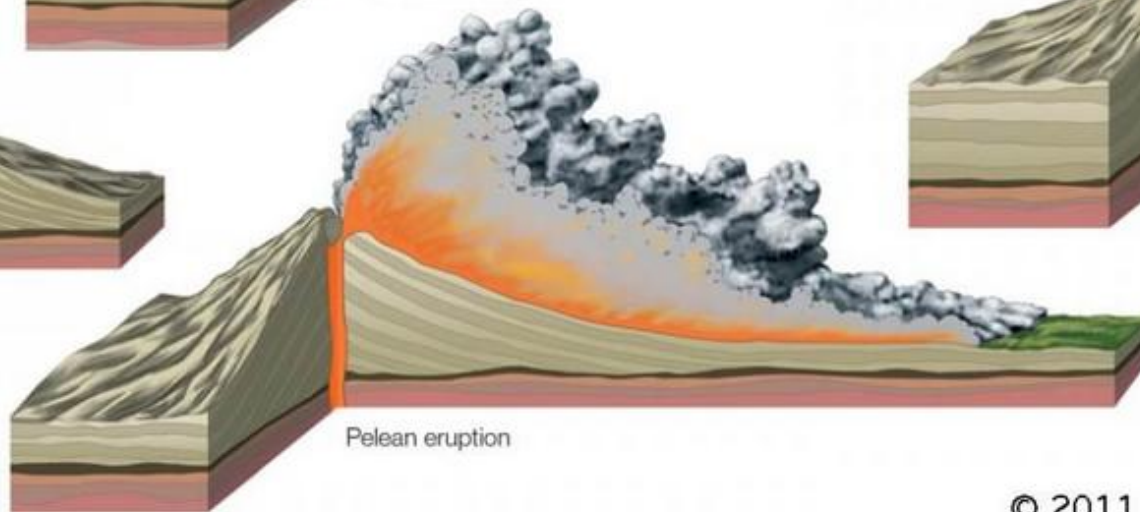
- ❖ **Hydrothermal eruption:** These eruptions include ash and not magma. They are driven by the heat caused in hydrothermal systems.
- ❖ **Phreatic eruption:** This is driven when the heat of the magma interacts with the water. These eruptions do not include magma and only ash.
- ❖ **Phreatomagmatic eruption:** This eruption takes place when there is the interaction between the newly formed magma and water.
- ❖ **Strombolian and Hawaiian eruption:** Hawaiian eruption has fire fountains while the Strombolian eruption has explosions due to lava fragments.
- ❖ **Vulcanian eruption:** These eruptions last for a short period of time and can reach up to a height of 20 km.
- ❖ **Subplinian and Plinian eruptions:** Subplinian eruptions reach up to 20 km height, while Plinian eruptions reach up to 20-35 km.



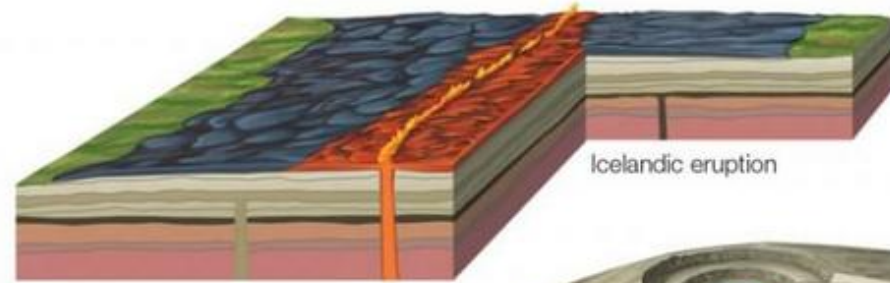
Plinian eruption



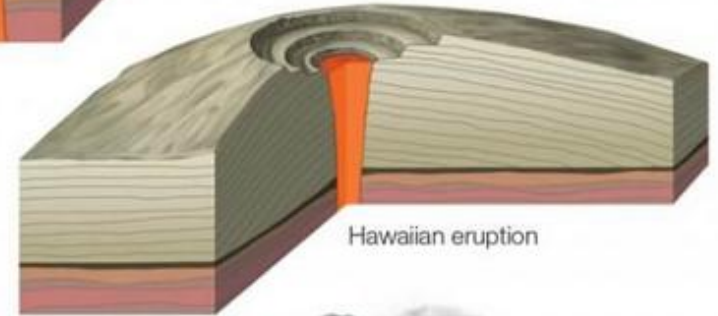
Vulcanian eruption



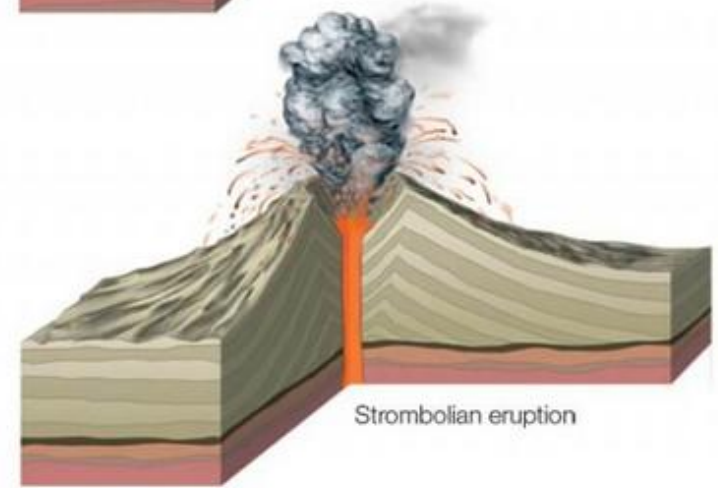
Pelean eruption



Icelandic eruption



Hawaiian eruption

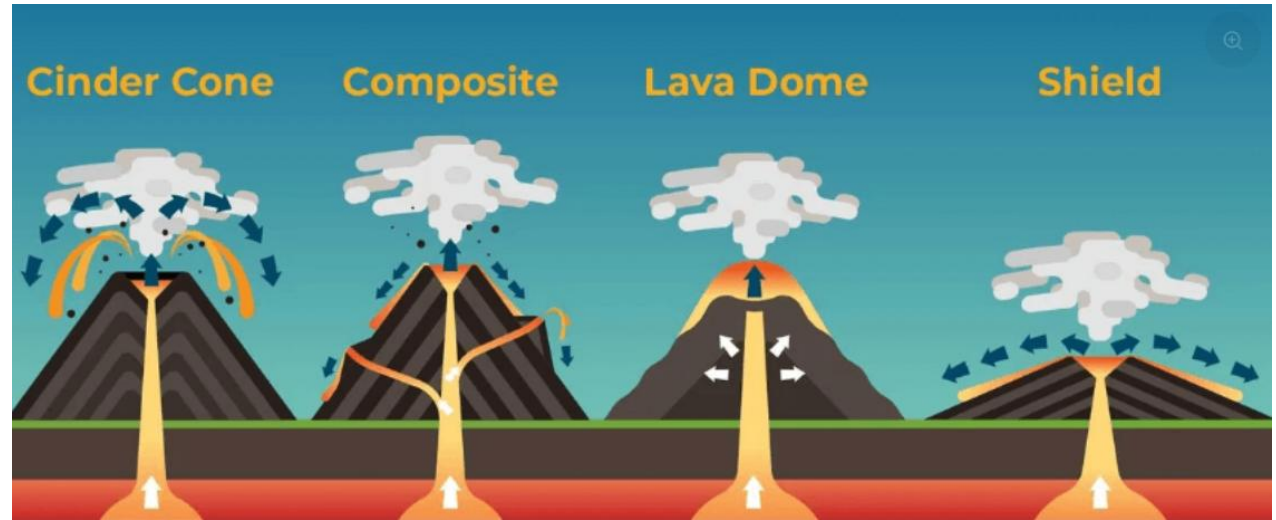


Strombolian eruption

Types of Volcanoes

Volcanoes are grouped into four types:

- ❖ **Cinder cones**
- ❖ **Composite volcanoes**
- ❖ **Shield volcanoes**
- ❖ **Lava volcanoes**



Cinder Cones

- Cinder cones are circular or oval cones made up of small fragments of lava from a single vent that have been blown up. Cinder cones result from eruptions of mostly small pieces of scoria and pyroclastics that build up around the vent.
- Most cinder cones erupt only once. Cinder cones may form as flank vents on larger volcanoes, or occur on their own.

Composite Volcano

- Composite volcanoes are steep-sided volcanoes composed of many layers of volcanic rocks, usually made from high-viscosity lava, ash and rock debris. These types of volcanoes are tall conical mountains composed of lava flows and other ejecta in alternate layers, the strata that give rise to the name.
- Composite volcanoes are made of cinders, ash, and lava. Cinders and ash pile on top of each other, lava flows on top of the ash, where it cools and hardens, and then the process repeats.

Shield Volcano

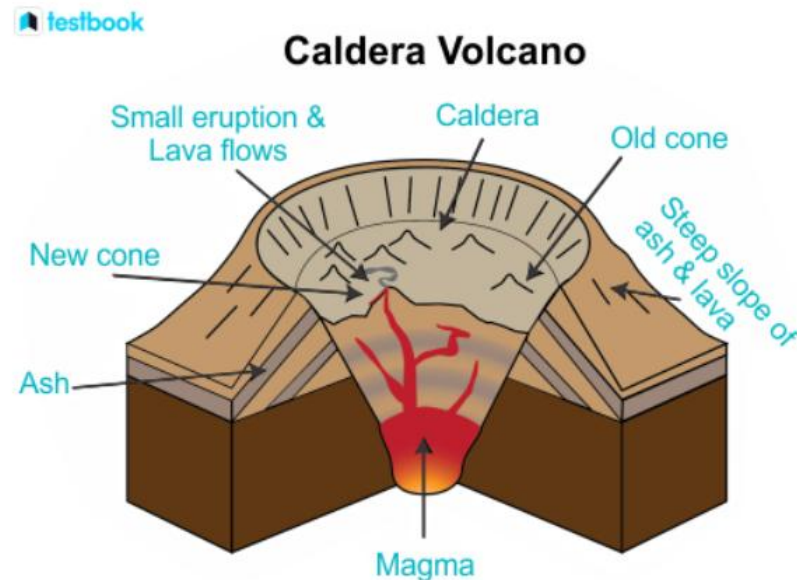
- Shield volcanoes are volcanoes shaped like a bowl or shield in the middle with long gentle slopes made by basaltic lava flows. These are formed by the eruption of low-viscosity lava that can flow a great distance from a vent.
- They generally do not explode catastrophically. Since low-viscosity magma is typically low in silica, shield volcanoes are more common in oceanic than continental settings. The Hawaiian volcanic chain is a series of shield cones, and they are common in Iceland, as well.

Lava Domes

- Lava domes are formed when erupting lava is too thick to flow and makes a steep-sided mound as the lava piles up near the volcanic vent. They are built by slow eruptions of highly viscous lava.
- They are sometimes formed within the crater of a previous volcanic eruption. Like a composite volcano, they can produce violent, explosive eruptions, but their lava generally does not flow far from the originating vent.

Calderas

- Calderas are large, circular depressions that form when a volcano's magma chamber partially or completely empties during an eruption.
- They can be several kilometers in diameter and are often associated with powerful eruptions.
- **Example:** Yellowstone National Park in the United States is situated within a massive caldera formed by the collapse of a supervolcano during a cataclysmic eruption over 600,000 years ago



What is a Caldera?

A caldera is formed when a volcano erupts and collapses inward, resulting in a depression on the Earth's surface. This depression, known as the caldera, remains a reservoir after the collapse. The term "caldera" derives from the Spanish word for cauldron or kettle, which describes its shape. While calderas share some similarities with craters, their origin, shape, and size can differ significantly, making them distinct geological features.

Largest Caldera in the World

- The Apolaki Caldera is the world's biggest caldera, with a diameter of 150 kilometers.
- The biggest caldera on Earth, "Apolaki Caldera," is located within the Benham Rise.
- Jenny Anne Barretto, a Filipina marine geophysicist, and her team discovered it in 2019.

Caldera Volcano Examples

- Yellowstone Caldera:** The largest caldera in the world. It was formed by a massive eruption 640,000 years ago.
- Toba Caldera:** The second largest caldera in the world. It was formed by a massive eruption 74,000 years ago that may have caused a global climate change.
- Krakatoa Caldera:** Formed by a massive eruption in 1883 that caused a tsunami. It was heard over 3,000 kilometers away.
- Caldera de Taburiente:** A caldera on the island of La Palma that is home to a number of volcanic cones.
- Mauna Loa Caldera:** A caldera on the island of Hawaii that is home to the largest volcano on Earth.

Volcanism Distribution

The volcanoes are divided into the following areas:

Ring of Fire: Most active belt, with 75% of active volcanoes (Japan, Indonesia, US West Coast)

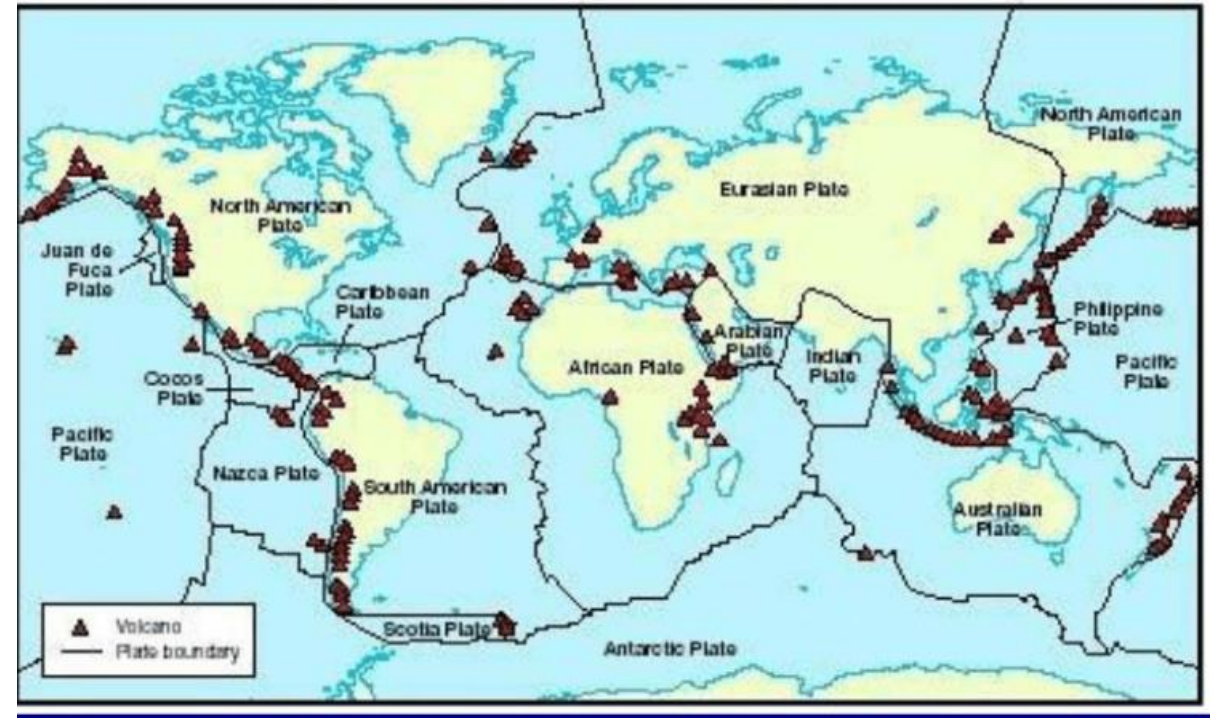
Mid-Ocean Ridges: Continuous volcanic activity along ocean ridges (Mid-Atlantic Ridge).

Hotspots: Intraplate volcanism forming islands (Hawaii, Iceland, Yellowstone).

Continental Boundaries: Tectonic collisions or separations drive volcanism (Himalayan region)

Rift Zones: Regions like East African Rift allow magma upwelling

Subduction Zones: Converging plates create explosive volcanoes (Mount Fuji, St. Helens)



Volcanoes in India

- ❖ There are no volcanoes in the Himalayan and Peninsular region in India.
- ❖ **India's sole active volcano is Barren Island in Andaman and Nicobar Islands which erupted in 1803, 1891, 1995, 2005 and 2017.**
- ❖ **The other volcano is Narcondam which lies 150 km north-east of Barren Island. It is believed to be extinct.**

Thank You