

Volcanism: UPSC Geography Notes

Volcanism is the phenomenon of eruption of molten rock (magma) onto the surface of the Earth or a solid-surface planet, where lava, and volcanic gases erupt through a break in the surface called a vent.

Volcanism on Earth

On Earth, volcanism happens in many different geologic settings. Most of these are associated with the boundaries of the enormous rigid plates that make up the crust and upper mantle. The majority of active terrestrial volcanoes (roughly 80 percent) and related phenomena occur where two tectonic plates converge and one overrides the other, forcing it down into the mantle to be reabsorbed.

A second major site of active volcanism is along the axis of the oceanic ridge system, where the plates move apart on both sides of the ridge and magma wells up from the mantle, creating a new ocean floor along the trailing edges of both plates. Virtually all of this volcanic activity occurs underwater. In a few places the oceanic ridges are sufficiently elevated above the deep seafloor that they emerge from the ocean, and subaerial volcanism occurs.

How does the process of Volcanism take place

Magma from the mantle or lower crust rises through its crust towards the surface. If magma reaches the surface, its behavior depends on the viscosity of the molten constituent rock. Viscous (thick) magma produces volcanoes characterised by explosive eruptions, while non-viscous (runny) magma produce volcanoes characterised by effusive eruptions pouring large amounts of lava onto the surface.

There are instances where magma will solidify and cool without coming in contact with the surface. In such cases the magma will cool down and will be solidified into ingenious mass crystallines within the crust to form an igneous intrusion. As magma cools the chemicals in the crystals formed are effectively removed from the main mix of the magma, so the chemical content of the remaining magma evolves as it solidifies slowly. Fresh unevolved magma injections can remobilise more evolved magmas, allowing eruptions from more viscous magmas.

In a nutshell, volcanism can be defined as an igneous activity which includes the following :

1. Formation of Magma
2. Upward movement of Magma

3. Ejection on the surface
4. Cooling and Solidification.

Intrusive and Extrusive Volcanism

As per the movement of magma, volcanism can be classified into both intrusive and active volcanism.

Intrusive Volcanism

Intrusive volcanism is when magma is forced into the rocks that make up the Earth's crust. When it cools and becomes solid while still underground, different features called plutons are formed. The rock formed is intrusive igneous rock.

These plutons will be exposed at the surface of land when the overlying rocks are removed after a long time of denudation (laid bare by erosion).

The cooling and solidification of magma can happen both inside the earth and over the surface of the earth. In the process the following types of magma-based landforms are created inside of the earth:

1. **Batholiths:** A formation of large scale magma that has been solidified at the base of a mountain.
2. **Laccoliths:** A small scale magma that pushes the overlying layers of rocks to form a dome shaped structure.
3. **Lapoliths:** It is a small scale magma cooled near the earth's surface that lies horizontally to the existing rocks.
4. **Phacoliths:** A phacolith is a pluton of igneous rock parallel to the bedding plane or foliation of folded country rock.
5. **Sills/Sheets:** Is a small scale magma cooled near the earth's surface that lies horizontally to the existing rocks.
6. **Dikes:** Is a small scale magma cooled within the earth's crust that stands vertically to the existing rocks.

Extrusive Volcanism:

The molten magma under great pressure forces its way through the fissure of underground rocks and reaches the Earth's surface. The formation as a result of this volcanic movement forms an "igneous extrusion".

The examples of extrusive landforms (forming over the surface) are :

1. **Caldera:** A caldera is a large cauldron-like hollow that forms shortly after the emptying of a magma chamber/reservoir in a volcanic eruption. When it is filled with water it is called a 'caldera lake'.

2. **Composite cones:** Composite cones are large volcanic mountain formed by solidified lava on the surface.
3. **Geysers:** A geyser is a vent in Earth's surface that periodically ejects a column of hot water and steam.
4. **Hot springs:** A hot spring, otherwise known as geothermal spring is a spring produced by the emergence of geothermally heated groundwater that rises from the Earth's crust.

It may be noted that since the lava flows to a larger area to form plateaus, it consists of a larger consistency of liquid in it while the volcanic mountains are formed due to an explosion. This explosion has a greater carrying force for the solids to eject onto the surface. Thus the mountain landscape formed due to a volcanic explosion contains more solids.