How Do Volcanoes Change The Earth's Surface? - Complete Guide

The question 'How **do volcanoes change the earth's surface**?' is quite common in academic circles and is also asked by people curious about spontaneous physical events that affect the earth.

Volcanoes change the earth's surface through the formation of beneficial igneous rocks, mountains, and islands; and devastating phenomena like erosions, landslides, floods, and tsunamis.

This post will help you understand the process of volcanic eruption and the sequence of events that result in the evolution of the physical geography of an area.

Volcanic Eruption

The temperature far beneath the earth's surface is extremely high. Some rocks melt under this intense heat, become thick, and start flowing as magma. This magma is lighter than the surrounding solid rocks and thus rises above them.

When the tectonic plates beneath the earth moves, they can crack the earth's surface. The molten magma then erupts through this opening to the earth's surface.

This eruption can either be violent; destroying the environment or insidious; hardly noticeable.

How Do Volcanoes Change The Earth's Surface?

There are so many factors that contribute to significant changes on the earth's surface. But, how do volcanoes change earth's surface?

Change #1: Topography (Igneous Rock Formation)

We have established that during a volcanic eruption, cracks develop on the surface of the earth. This allows hot lava, gasses, and ashes to surface.

While most volcanic eruptions are spectacular with hot molten magma being shot high in the air, some can be unremarkable with slow expulsion of ashes and hot lava.

The erupted hot lava stays on the surface of the earth. Same for the molten magma. **When they remain on the surface for long enough, they eventually cool down to form hard igneous rocks.** This cooling process either takes place on the surface or on the crustal layer.

The igneous rocks formed from this eruption and cooling process are described as volcanic rocks.

Fun fact: the earth's moon is made of igneous rocks.

Change #2: Formation of Mountains

Mountains formed from volcanic eruptions are termed volcanic mountains. Other types like **fault-block mountains, plateau mountains, and fold mountains** form by the elevation of the earth's crust.

However, **volcanic mountains form from the eruption, cooling, and solidification of molten rock, often known as magma, on the earth's surface.**

First, the earth's crust ruptures or cracks, then the molten magma previously trapped within it escapes to the surface through this opening and condensation then takes place. This entire process is known as volcanic activity.

Volcanic mountains are not only formed from magma though. Gases and volcanic ash released alongside the magma condense along the vent where they contribute to both the mountain mass and composition.

Types of Volcanic Mountains - Based on Shape and Composition

- **Stratovolcano or Composite volcano:** notable examples include Mount Rainier and Mount Fiji.
- **Cinder Cone Volcanic Mountain**: they are steep, conical, and made up of glassy cinders. E.g. Mauna Kea and Mauna Loa in the United States.

Various types of volcanic mountains can be formed on both land like the **Cascade Range in Washington and seas like the Hawaiian Islands.** This process that results in the accumulation of volcanic matter forms mountains on land and islands on the seas and oceans.

While this process of volcanic rock formation appears to be simple and straightforward, it takes place over **thousands** of years and is often initiated by the movement of the tectonic plates.

It is interesting to know that volcanic mountains are also formed on other planets in the solar system and are far more massive than the ones on earth.

Note: when molten rock is held below the earth's crust, it is known as magma. When it reaches the earth's surface, it is then referred to as lava.

Fun fact: some of the most popular volcanic mountains include Mount Fiji, Mount Kea, and Mount Saint Helens.

Change #3: Soil Formation and Soil Erosion

In addition to the formation of rocks, mountains, and batholiths, volcanic eruptions also form a type of soil called volcanic soil. They are formed from the weathering or breakdown of products of volcanic eruptions like molten rock and volcanic ashes. They are found in places with different types of climates.

The chemical and physical properties of this soil are similar to those of poorly formed crystalline and non-crystalline minerals. **The soil composition is further modified by accumulated organic matter from dead plants and animals.**

Along with limestone, this soil contributes the greatest quantity of groundwater to estuaries and coastal areas. This is because the cracks and cavities in its substratum make it porous.

Tip: Volcanic soils are fertile enough to support crop farming as a source of livelihood for millions of people.

How do volcanoes cause erosion?

This takes place either **directly or indirectly.** Volcanic eruptions sometimes occur with fiery violence and shake up the earth's surface with great force. This loosens the bond between the soil and the rocks that maintains the soil structure. Both soil erosion and leaching of soil nutrients then ensue.

It can also indirectly result in other forms of erosion. After compromising the integrity of the soil structure, wind and running water from rainfall can then easily erode it.

Volcanoes can result in soil formation, soil erosion, or both.

Fun fact: Volcanic ash can destroy farm crops in the short term but over time it enriches the soil with potash making it fertile for cultivation.

Change #4: Landslides and Lahars

Landslides are huge masses of rocks (which are either dry or wet) and soil that slides from height with great speed under the influence of gravitational force. Imagine a type of rainfall, only that this time around rocks fall instead of rain.

They either appear as avalanches or rockfalls. While falling, they break down into particles of different sizes.

Landslides often originate from volcanic cones. This is because the cones are weakened by the erupting magma, located at the volcano's apex, and are steep.

A Lahar is formed when a landslide becomes very massive and contains enough water and smooth particles like clay. They can travel at a terrifying speed of 200km/hr despite their huge mass. They originate from the slopes of a volcano. Lahar is a word of Indonesian origin and is also known as debris flows or volcanic mudflows.

In addition to lahars, landslides can also cause **tsunamis**. Sliding debris from an active volcano can crash into a nearby sea, shake up its floor and generate a tsunami that can cross to the opposite shore to wreck lives and properties.

If rocks and avalanches debris from a landslide are thick enough, they form dams across tributary streams and form new lakes. **The lakes eventually drain downwards to cause floods downstream.**

Fun fact: On May 18, 1980, a landslide occurred on Mount St. Helen and reached a speed of 80 m/s and had a mass of 2.5km^3.

Change #5: Batholith Formation

While igneous rocks are formed from the cooling of lava on the surface, batholiths are formed from the cooling of hot molten magma in deeper layers of the earth's crust. Some portions of the erupting magma get trapped while still within the earth's crust, cool, and form large domes.

These domes have significant granite components. Some denudational forces erode the earth's surface covering these domes, which then become batholiths.

Batholiths are extensive and can sometimes cover a wide landmass of up to 100 kmsq. They are also known as plutonic rocks and are mostly comprised of diorite, granite, and quartz.

Fun fact: Bartholiths intrude across mountain folds and are elongated across the axis of the mountain with the wildest diameter.

Change #6: Emission of Greenhouse Gases

When volcanoes erupt, they release greenhouse gases into the atmosphere. Some of those gases include carbon dioxide, methane gas, nitrous oxide, and even water vapor.

The role these greenhouse gases play in heating and depleting the ozone layer is well known. They absorb energy from the sun in the form of radiation, then they emit the trapped heat into the earth.

The ozone layer shields the earth from the direct effect of sunlight, and when these harmful gases wear them off, global warming ensues. This increased warming is significantly responsible for the melting of glacial ice, rising sea levels, and massive flooding.

While the number of gases specifically released from volcanic eruptions might not be large enough to trigger natural disasters on its own, its combination with industrial wastes can do so.

During the course of the earth’s history, massive volcanic eruptions triggered the melting of glacial ice in the Arctic, which not only changed the climate but the physical properties of the surrounding regions.

Are there significant changes?

This changed the type of vegetation that could grow there. **Species of herbivores that couldn’t adapt became extinct and got replaced**. Same for the carnivores, as they needed to evolve new physical structures to be able to hunt the new species of herbivores.
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While the volcanic eruptions were abrupt, the chain of events by which the released gases resulted in climate and physical changes on the earth’s surface was long. Tens of thousands of years.

Fun fact: Gases are not the only products released by active volcanoes. Lava and ash are also major pollutants that cause harm to the earth’s surface in the long run.

Other changes volcanoes cause on the earth's surface that are worth mentioning are **deforestation and desertification**. Erupted lava destroys the vegetation across its part killing animals and destroying their habitats.

Deforestation then predisposes the area to desert encroachment.

Final Words

This post has explained **how volcanic eruptions change the earth's surface.** Cracks in the earth's crust create an opening for molten rock to escape to the surface of the earth. They then cool and then change the look of the surrounding areas.

The result can either be positive or negative. The rock formed, the mountains, the hills, and the islands are beneficial to human existence.

The landslides, global warming, soil erosion, and flooding wreak immense havoc and cause humanitarian crises. So from your own understanding, how do volcanoes change the earth's surface?