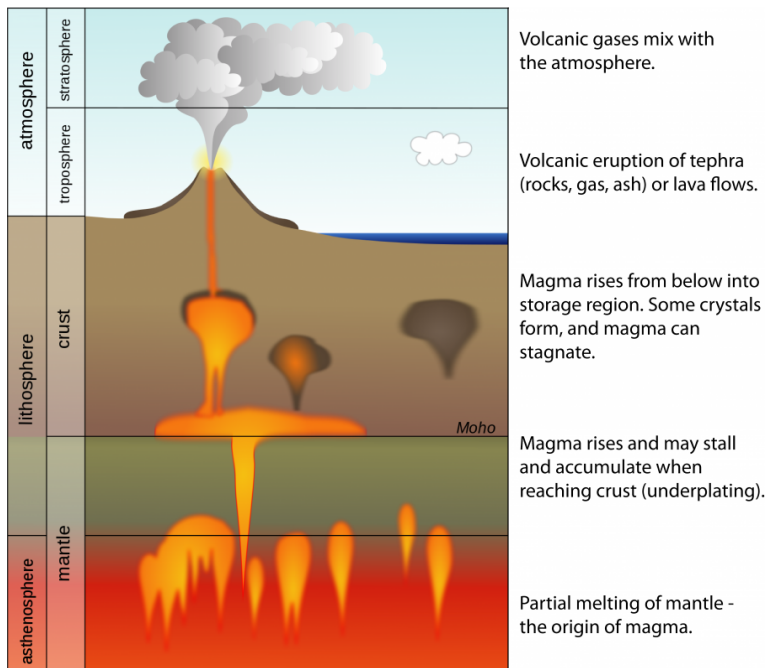


Volcanoes

Volcanoes are openings, or vents where lava, tephra (small rocks), and steam erupt on to the Earth's surface. The vent may be visible as a small bowl shaped depression at the summit of a cone or shield-shaped mountain. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location. [1]

How



Molten rock below the surface of the Earth that rises in volcanic vents is known as magma, but after it erupts from a volcano it is called lava. Magma is made of molten rock, crystals, and dissolved gas—imagine an unopened bottle of soda with grains of sand inside. After cooling, liquid magma may form crystals of various minerals until it becomes completely solid and forms an igneous or magmatic rock.

Originating many tens of miles beneath the ground, magma is lighter than surrounding solid rock and is driven towards Earth's surface by buoyancy, and by pressure from gas within it. Magma forces its way upward and may ultimately break through weak areas in

the Earth's crust. [1]

Magma can form and rise from depths of 100 to 200 km (60 to 120 miles)! As the rising magma moves slowly up through the crust, two things may occur to modify the composition of the magma. (1) Crystallization of olivine and pyroxene minerals from the basalt can leave the residual melt enriched in silica and depleted in magnesium, iron, and calcium--a process called "fractional crystallization". (2) Basaltic magmas have enough excess heat to partially melt the continental host rocks through which they are ascending and can melt more silica rich rocks from continental crust, for example, and reincorporate more felsic compositions into the overall melt--a process called "partial melting". Because continental rocks are generally higher in silica, potassium, and sodium than are oceanic rocks, this process of assimilation and mixing can also play an important role in producing the wide range of compositions that occur in rocks from volcanoes. [2]

Types!

Cinder Cone



Cinder cones are the simplest type of volcano. They are made of small pieces of solid lava, called cinder, that are erupted from a vent. The powerful blast throws molten rocks, ash, and gas into the air. The rocks cool quickly in the air and fall to the earth to break into small pieces of bubbly cinder that pile up around the vent. They accumulate as a small cinder cone that can be as high as a thousand feet above the surrounding ground.

SP Crater and lava flow (dark area to right of cinder cone) in the northern part of San Francisco Volcanic Field, Arizona.

Composite Volcano (Stratovolcano)

Mount Mageik volcano viewed from the Valley of Ten Thousand Smokes, Katmai National Park and Preserve, Alaska. Mageik's broad summit consists of at least four separate structures.

Some of the Earth's grandest mountains are composite volcanoes—stratovolcanoes. They are usually tall with steep even sides and are made out of repeating layers of lava flows, volcanic ash, cinders, blocks, and volcanic bombs. Ojos del Salado in Chile is the tallest composite volcano on Earth with a summit elevation (height above sea level) of 22,615 feet; the tallest in the U.S. is Mount Rainier in Washington State with a summit elevation of 14,410 feet.



Shield Volcano



Shield-volcano Mauna Kea viewed from the northern slope of Mauna Loa (cinder cones in the foreground) shows off its broad shield shape. The bumps on its profile are large cinder cones.

Shield volcanoes are built almost entirely of fluid lava flows. Lava pours out of vents in all directions, either from the summit (top) or along two to three rift zones (fractures) that radiate out from the summit like spokes on a bicycle wheel. As lava flows overlap one another, they construct a broad, gently sloping dome shape. Shield volcanoes build up slowly by the growth of thousands of lava flows that spread widely over great distances, and then cool as thin sheets. On Earth, some of the most massive volcanoes are shield volcanoes. In northern California and Oregon, many shield volcanoes are up to 3 or 4 miles wide and as tall as 1,500 to 2,000 feet. The

Hawaiian Islands are made of a chain of shield volcanoes including Kilauea and the world's largest active volcano, Mauna Loa.

Lava Dome

Lava dome at Novarupta, Valley of Ten Thousand Smokes, Katmai Alaska, was erupted in 1912.

Lava domes are technically lava flows, but they contain lava that is too thick to flow away from the vent. Lava squeezes out of the vent and accumulates as a giant pile over and around the vent. Some domes form pointed spines, while others appear as a giant muffin, as opening flower petals, or as steep-sided stubby flows or tongues. Lava domes often grow within craters or upon the flanks of large steep-sided composite volcanoes.



As fresh magma fills the inside, the cooler and harder outer surface shatters and spills hot rock and gases down the mountainside. [1]

"hot-spot," volcanoes.

A hot spot is believed to be related to the rising of a deep-mantle plume, which is caused by very slow convection of highly viscous material in the Earth's mantle. As hot but solid mantle rock moves upward, partial melting may occur from the lowering of its pressure-dependent melting temperature. Where a lithospheric plate moves over a hot spot, a chain of volcanic islands may be created. As the plate moves, the older volcanoes are transported away from the magma source and become extinct. The younger, active volcanoes are clustered at the end of the chain over the hot spot. It is not known how a volcanic hot spot maintains its position for millions of years while a plate passes over it. Hawaiian volcanoes are the best examples of hot-spot volcanoes. The five volcanoes that form the island of Hawaii at the southeast end of the Hawaiian chain are all less than one million years old. Two of these, Kilauea and Mauna Loa, are two of the most active volcanoes in the world. Northwestward along the Hawaiian chain each island is progressively older. The extinct volcano or volcanoes that formed the island of Kauai are about five million years old.

The two most common types of volcanoes are explosive: stratovolcanoes, and effusive: shield volcanoes. Explosive: strato volcanoes often erupt basalt, andesite, dacite, and rhyolite, with andesite being the predominant rock type. Effusive: shield volcanoes are most commonly associated with basaltic eruptions and sometimes bi-modal (basalt and rhyolite) eruptions. [2]

Some Interesting History!

In 1785 Scottish farmer and naturalist, James Hutton known as the founder of modern geology, found granite penetrating metaphoric schists, in a way which indicated that the granite had been molten at one time. He concluded that granite formed from cooling of molten rock, not precipitation out of water as

Identifying Plate Boundaries, by Alyssa Abbey, Mike Phillips, Liang Zeng. *In Development from EER2020 "Creating Inquiry Labs" Workshop, August 2020 (Group 15 PlateTectsF2F).*

others at the time believed. The idea that the granite coils have been molten and it's penetrating relationship with the schist lead him to determine that the granite must be younger than the schists.

Over time others slowly latched onto the idea of molten rock and linked lava and magma from below the Earth's surface (the mantle) with formation of various rock types.

Then, in 1929 British geologist Arthur Holmes used the idea that as magma is heated it tends to rise and then it cools and sinks again creating a sort of convection cell. He proposed that convection in the mantle was the force driving continental drift. Although his ideas were not taken seriously at the time, Holmes's mantle convection hypothesis later gained support.

Where?

There are about 1,500 potentially active volcanoes worldwide, not counting the volcanoes under the oceans. About 500 of these have erupted in the past 100 years. Many of these are located around the Pacific Ocean in what is known as the "Ring of Fire." In the U.S., volcanoes along the west coast and in Alaska (Aleutian volcanic chain) are part of the Ring of Fire, while Yellowstone and Hawaiian volcanoes form over a "hot spot." [1]

The volcanoes on the western and northern margin of the Pacific Ocean (New Zealand, New Guinea, Mariana Islands, Japan, Kamchatka, and the Aleutian Islands) are all strato volcanoes. Where as most of the shield volcanoes are largely hidden along the submarine crest of the East Pacific Rise and the Pacific-Antarctic Ridge at depths of 2 to 3 km (1.2 to 1.9 miles) below sea level.

References

[1] https://volcanoes.usgs.gov/vhp/about_volcanoes.html accessed August 1, 2020

[2] <https://www.britannica.com/science/volcano/Volcanoes-related-to-plate-boundaries> accessed July 20, 2020