

Reading: Volcanoes and Gases

As early as the 1850s, scientists realized that gases play a key role in forcing magma to the Earth's surface and causing explosive volcanic eruptions. Many different gases can dissolve in molten rock in the same way that carbon dioxide can dissolve in water. The amount of gas that can dissolve in magma increases with pressure. As magma rises toward the Earth's surface, pressure decreases, reducing the solubility of the gases, causing them to come out of the magma to form bubbles. (Think of the carbon dioxide coming out of your soda after you open the can.) The bubbles expand as they rise due to a continued decrease in pressure as the gases rise toward the surface. At the surface pressure, the bubbles expand enormously in volume, producing a foam of magma that provides the driving force for volcanic eruptions, similar to spraying soda out of a shaken bottle.

Volcanic gases have been collected by courageous volcanologists and analyzed to determine their composition. Water vapor ($\text{H}_2\text{O}_{\text{gas}}$) and carbon dioxide (CO_2) are the most common ingredients in volcanic gases. Next in abundance is sulfur (S) in the form of either sulfur dioxide (SO_2) or hydrogen sulfide (H_2S), chlorine (Cl), and fluorine (F). Other gases present in smaller amounts are nitrogen (N_2), hydrogen (H_2), carbon monoxide (CO), along with trace amounts of other gases. Every eruption releases enormous amounts of these gases from deep in the earth.



The abundance of gases varies considerably from volcano to volcano depending on the type of eruption and magma. Water vapor is consistently the most abundant volcanic gas, normally comprising more than 60% of total emissions. Carbon dioxide typically accounts for 10 to 40% of emissions.

Adapted from several sources:

- From Understanding Earth (3rd Edition) by Press, F. and Siever, R.
- https://en.wikipedia.org/wiki/Volcanic_gas
- Chapter 7 Volatiles in Magma of the *Encyclopedia of Volcanoes* 2015