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Volcanic gases can be harmful to health, vegetation and infrastructure.

Magma contains dissolved gases, which provide the driving force that causes most volcanic eruptions. As magma rises towards the surface and pressure decreases, gases are released from the liquid portion of the magma (melt) and continue to travel upward and are eventually released into the atmosphere. Large eruptions can release enormous amounts of gas in a short time. The [1991 eruption of Mt. Pinatubo](#) is thought to have injected more than 250 megatons of gas into the upper atmosphere on a single day. However, even if magma never reaches the surface, gases can often escape continuously into the atmosphere from the soil, volcanic [vents](#), [fumaroles](#), and hydrothermal systems.



By far the most abundant volcanic gas is water vapor, which is harmless. However, significant amounts of carbon dioxide, sulfur dioxide, hydrogen sulfide and hydrogen halides can also be emitted from volcanoes. Depending on their concentrations, these gases are all potentially hazardous to people, animals, agriculture, and property.

Carbon dioxide (CO₂) trapped in low-lying areas can be lethal to people and animals.

Carbon dioxide constitutes approximately 0.04% of the air in the Earth's atmosphere. In an average year, volcanoes release between about 180 and 440 million tonnes of carbon dioxide. When this colorless, odorless gas is emitted from volcanoes, it typically becomes diluted to low concentrations very quickly and is not life threatening. However, because cold carbon dioxide gas is heavier than air it can flow into in low-lying areas where it can reach much higher concentrations in certain, very stable atmospheric conditions. This can pose serious risks to people and animals. Breathing air with more than 3% CO₂ can quickly lead to headaches, dizziness, increased heart rate and difficulty breathing. At mixing ratios exceeding about 15%, carbon dioxide quickly causes unconsciousness and death.

In volcanic or other areas where CO₂ emissions occur, it is important to avoid small depressions and low areas that might be CO₂ traps. The boundary between healthy air and lethal gas can be extremely sharp; even a single step upslope may be adequate to escape death. In 2006, [three ski patrol members were killed at Mammoth Mountain ski resort](#) after falling into a snow depression surrounding a volcanic fumarole and filled with cool



Carbon dioxide gas can collect in low-lying volcanic areas, posing a lethal risk to humans and animals. A burning torch lowered into a CO₂ pocket (top) causes the flame to go out (bottom).

CO₂ gas. High concentrations of CO₂ gas in soils can also damage or destroy vegetation, as is visible in several areas on [Mammoth Mountain](#).

In addition to their direct hazard, volcanic CO₂ emissions also have the capacity to affect the global climate, but scientific studies indicate that the average global volcanic output is insignificant when compared to emissions from human activity.

Sulfur dioxide (SO₂) is irritating to eyes, skin and respiratory system.

Sulfur dioxide is a colorless gas with a pungent odor that irritates skin and the tissues and mucous membranes of the eyes, nose, and throat. SO₂ emissions can cause acid rain and air pollution downwind of a volcano—at Kilauea volcano in Hawaii, high concentrations of sulfur dioxide produce [volcanic smog \(VOG\)](#) causing persistent health problems for downwind populations. During very large eruptions, SO₂ can be injected to altitudes of greater than 10km into the stratosphere. Here, SO₂ is converted to sulfate aerosols which reflect sunlight and therefore have a cooling effect on the Earth's climate. They also have a role in ozone depletion, as many of the reactions that destroy ozone occur on the surface of such aerosols.

Please see our discussion of [volcanic gases and climate change](#) for additional information.

Hydrogen sulfide (H₂S) is very toxic in high concentrations.

Hydrogen sulfide is a colorless, flammable gas with a strong, offensive odor. It is sometimes referred to as sewer gas. Interestingly, the human nose is more sensitive to H₂S than any gas monitoring instrument we have today: air mixtures with as little as 0.000001% H₂S are associated with a rotten egg smell.

Unfortunately, however, our sense of smell

is not a reliable alarm - at mixing ratios above about 0.01%, H₂S becomes odorless and very toxic, causing irritation of the upper respiratory tract and, during long exposure, pulmonary edema. Exposure to 500 ppm can cause a human to fall unconscious in 5 minutes and die in an hour or less.

Hydrogen halides (HF, HCl, HBr) are strong, toxic acids.

When magma ascends close to the surface, volcanoes can emit the halogens fluorine, chlorine and bromine in the form of hydrogen halides (HF, HCl and HBr). These species are all strong acids and have high solubility; therefore they rapidly dissolve in water droplets within volcanic plumes or the atmosphere where they can potentially cause acid rain. In an [ash](#)-producing eruption, ash particles are also often coated with hydrogen halides. Once deposited, these coated ash particles can poison drinking water supplies, agricultural crops, and grazing land.



Volcanic Smog (vog) is produced from SO₂ gas and is a hazard in Hawaii. Scientists monitor SO₂ emission rates at Kilauea volcano.



Gas Plume during the 1984 eruption of Mauna Loa, Hawaii blocks out the sun.