

Volcanic Eruptions and Threats to Respiratory Health

In early May 2018, Kīlauea volcano became increasingly active, posing an increase in threat to respiratory health. The emission of gases such as sulfur dioxide from Kīlauea produces large amounts of respirable acid particles as the gases react with water vapor and sunlight, resulting in a visible haze called “vog”. Additionally, the lava lake at Kīlauea’s summit crater has fallen, leading to explosions of “ash” that have reached as high up as 30,000 feet above sea level. Finally, lava entering the Pacific Ocean boils sea water to dryness, creating thick clouds of “laze” that is filled with hydrochloric acid and tiny shards of glass. Depending on your location and wind direction and speed, vog, ash, and laze can reach hazardous levels of air pollution that are toxic to humans. This fact sheet serves to inform you of potential adverse health effects following exposure to these airborne products of volcanic activity. This outdoor air quality issue is relevant to other locations worldwide at risk for volcanic activity.



U.S. Geological Survey

What is vog and what are the symptoms following exposure?

Vog is a cloudy air mixture of sulfur dioxide gas (SO₂), water vapor (H₂O), carbon dioxide (CO₂), sulfate particles and volcanic ash. Human exposure may lead to respiratory symptoms, particularly among those with a history of pre-existing conditions such as:

- Obstructive airway diseases (e.g. asthma, bronchitis, bronchiectasis and chronic obstructive pulmonary disease—COPD)
- Cardiovascular diseases
- Extremes of age (infants and elderly)
- Pregnancy

People with known airway reactivity (such as asthma or COPD) may develop bronchospasm (tightening of airway muscles) that causes symptoms such as shortness of breath, wheezing, cough, and inflammation in the airways leading to swelling and mucus production, even with limited vog exposure. At high exposures, anyone (even healthy people with no lung disease) may develop breathing problems. Sustained levels of exposure have been associated with an increased risk of needing emergency room care. People, especially those at higher risk (listed above) should follow the health advisories listed in the Air Quality Index for particle pollution produced by the

Environmental Protection Agency (Figure 1). For example, the Air Quality Index for Kona (about 40 miles or 64 km) northwest of the summit was at “orange” level on May 20th, 2018, and therefore was unhealthy for older individuals or those with pre-existing heart or lung disease.

Figure 1. Air Quality Index for Particle Pollution

Air Quality Index	Health Advisory
Good (Green) 0–50	None
Moderate (Yellow) 51–100	Unusually sensitive people should consider reducing prolonged or heavy exertion.
Unhealthy for Sensitive Groups (Orange) 101–150	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
Unhealthy (Red) 151–200	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
Very Unhealthy (Purple) 201–300	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.

Adapted from the Environmental Protection Agency (EPA) Air Quality Index (AQI)
@ <https://airnow.gov/index.cfm?action=aqibasics.aqi>

In addition to the Air Quality Index, keeping track of wind conditions is important as winds carry vog to different areas further from the volcano. Vog and wind forecasts are available to the public online (<https://vog.ivhhn.org/vog-and-wind-forecasts>).

People can reduce vog exposure by taking the following measures:

- Seek the local wind and weather pattern.
- Avoid strenuous outdoor activities in areas with increased vog conditions.
- Close windows and doors, and remain indoors or upwind of the vog source.
- Use air conditioning and HEPA filters. In the same way that air conditioning removes water vapor, it will remove sulfate particles. A HEPA (PM_{2.5}) filter provides additional protection.
- Shelter in pollution-free areas.
- Be careful to reduce other sources of indoor air pollution such as tobacco smoke, dust, animal dander, and mold.

For vog, sheltering in such places or leaving a high SO₂ or vogy area is more effective than masks or respirators which require special fitting or cannisters to effectively remove gases and respirable particles, and may add to the work of breathing for those with pre-existing lung disease.

If you are exposed to vog and are having symptoms, contact your healthcare providers right away and get away from further vog exposure. Treatment of symptoms often includes staying hydrated and (for those who have been diagnosed with asthma or COPD) using a rescue bronchodilator inhaler as prescribed. A short course of oral steroids, to reduce airway inflammation, could be considered by your healthcare provider.

What about ash?

Ash is defined as fragments that are ≤ 2 millimeters in size. Kīlauea has low viscosity basaltic magma and does not usually erupt significant amounts of ash. However, in the time since the lava lake at the summit of Kīlauea started to drain, there



have been remarkable explosions of gas and ash reaching as high as 30,000 feet above sea level. From that height, smaller ash particles can drift downwind and fall miles away. The ash particles are generally not breathed into the lungs. Nevertheless, ash can deposit in the eyes, nose, mouth, and throat, causing discomfort and irritation.

Eye protection and simple masks can reduce deposition of particles the size of pollens or hair. N95 masks can block smaller particles but can also clog if pollution is high, limiting breathing. Neither will remove sulfur dioxide gas.

What is laze?

Laze is formed when molten lava flows into the ocean and boils seawater. This creates large amounts of steam filled with



Lava flows reaching the ocean on Hawaii's Big Island on May 20th, 2018 creating a cloud of laze.

hydrochloric acid and glass shards, making it very noxious to inhale. Irritation of mucosal surfaces including the skin, eyes, and airways can lead to shortness of breath. Two deaths have been reported

in individuals with high levels of exposure near a laze cloud in 2000. Laze is confined to very localized areas, off limits to sightseers on foot or on boat.

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Rx Action Steps

- ✓ Monitor wind and air quality to know when air pollution will be a health risk in your location (www.airnow.gov)
- ✓ Keep your indoor air free of contaminants. Close windows and doors and do not smoke
- ✓ Avoid strenuous outdoor activity
- ✓ Remain indoors if air quality is a health risk
- ✓ Consider recirculating indoor air using an air conditioner, or air purifier with a HEPA (PM_{2.5}) filter
- ✓ Seek medical advice immediately if respiratory symptoms persist despite getting out of the vog, staying hydrated, and (for those with a respiratory diagnosis) taking your prescribed medications

References and Additional Resources:

Frequently Asked Questions on Vog from Kīlauea Volcano

- <https://vog.ivhhn.org/FAQ.pdf>

American Lung Association: Volcanic Ash

- <http://www.lung.org/our-initiatives/healthy-air/outdoor/emergencies-and-natural-disasters/volcanic-ash.html>

Centers for Disease Control and Prevention

- <https://www.cdc.gov/disasters/volcanoes/pdf/aftereruption.pdf>

AirNow: Particle Pollution and Your Health

- https://airnow.gov/index.cfm?action=particle_health.index

Air Purifier Information

- <https://vog.ivhhn.org/air-purifier-information>

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