

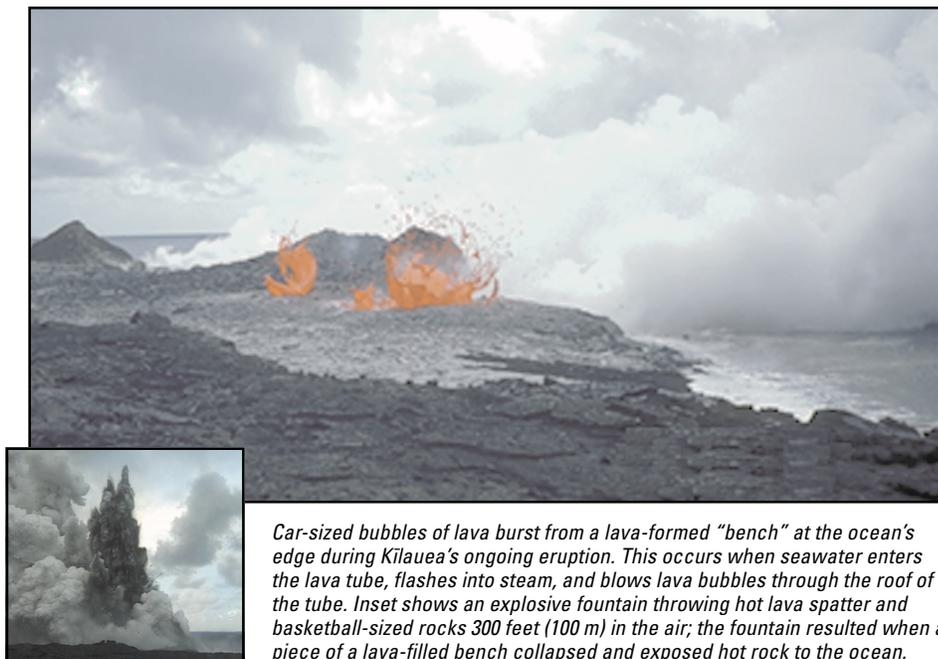
Viewing Hawai'i's Lava Safely—Common Sense is Not Enough

The Hawaiian Islands have four historically active volcanoes, but Kīlauea Volcano on the Island of Hawai'i is the only one currently erupting. Eruptions of these volcanoes are noted for their approachable flows of molten lava, but they also undergo many changes that can be rapid, unpredictable, and life threatening. Without knowledge of Hawai'i's volcanic landscapes and the processes that form them, visitors can easily find themselves in danger. Understanding volcano hazards and taking the right equipment are keys to safely exploring volcanic landscapes.

**PLEASE READ CAREFULLY—
YOUR LIFE MAY DEPEND ON IT**

Hawai'i has four historically active volcanoes—Haleakalā on Maui and Mauna Loa, Hualalai, and Kīlauea on the Island of Hawai'i. Only Kīlauea is currently erupting. This eruption started in 1983, when spectacular lava fountaining began at a new vent, named Pu'u Ō'ō, high on the volcano's east rift zone. Most of this eruption's activities have occurred within Hawai'i Volcanoes National Park. Although surface flows have been common in the eruption, most lava from the vent flows concealed in lava tubes until it reaches the ocean.

The process of lava entering the ocean shows how the Hawaiian Islands have been built. Seeing rock in its bright molten state and watching new land being formed have



Car-sized bubbles of lava burst from a lava-formed "bench" at the ocean's edge during Kīlauea's ongoing eruption. This occurs when seawater enters the lava tube, flashes into steam, and blows lava bubbles through the roof of the tube. Inset shows an explosive fountain throwing hot lava spatter and basketball-sized rocks 300 feet (100 m) in the air; the fountain resulted when a piece of a lava-filled bench collapsed and exposed hot rock to the ocean.

fascinated and inspired everyone lucky enough to experience it. Seeing lava for the first time is captivating. Unfortunately, it often lures the viewer closer into potentially dangerous situations.

When hot lava enters the ocean, it bursts into pieces, building new land at the water's edge from the fragmental material. This pile of rubble is then covered with a veneer of lava flows, forming a "bench" that gives a false impression of solid ground.

Without experience drawn from years of watching the behavior of Hawai'i's volcanoes, casual visitors cannot know all the hazards and may easily underestimate them. Warning signs cannot always be posted near hazardous areas, because the positions of

lava flows and lava tubes change frequently.

The information in this fact sheet has been gathered mostly from experiences of Earth scientists working at the U.S. Geological Survey's Hawaiian Volcano Observatory (HVO) on Kīlauea. Heeding its lessons can help you safely enjoy visiting Hawai'i's volcanoes and might save your life.

What are the volcanic hazards facing you?

- Bench collapse can kill
- Tephra jets & littoral fountains hurl hot lava
- Steam blasts toss rocks
- Acid fumes and glass particles can irritate eyes and lungs
- Scalding waves burn

Plus, be prepared for personal hazards such as:

- Dehydration
- Heat stroke
- Sunburn & sunstroke
- Sprains & abrasions
- Getting lost in the dark

COMMON SENSE IS NOT ENOUGH—EDUCATE YOURSELF TO THE HAZARDS!

Every week, the spectacular interaction between hot lava and cool seawater draws thousands of people to Kīlauea's south shore. By knowing what's going on and by taking the right gear you can safely experience this fantastic display. Remember, this is an ever-changing terrain subject to unpredictable behavior.

In the event of a strong earthquake, which may cause a tsunami (seismic sea wave or "tidal" wave), run for high ground immediately.

New Land, Shoreline Collapse, and Explosions

When visiting ocean entry sites of lava:

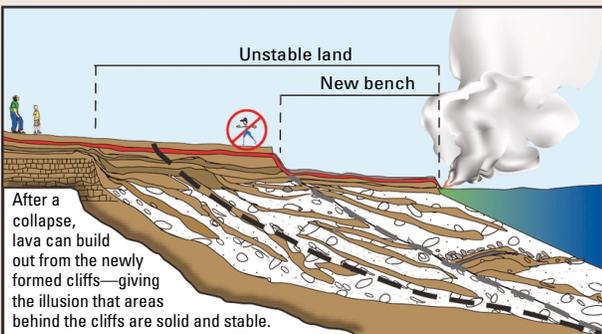
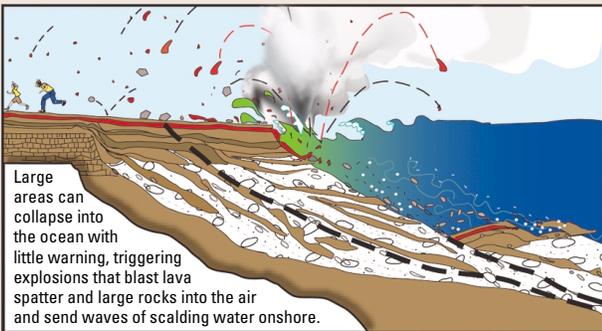
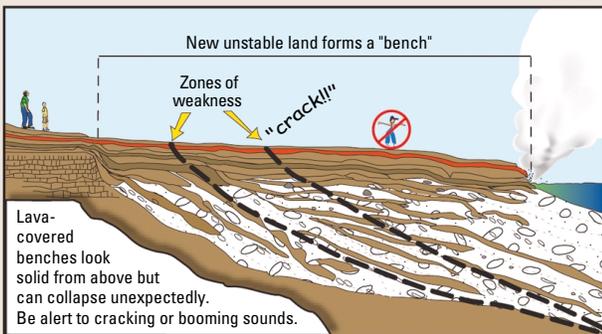
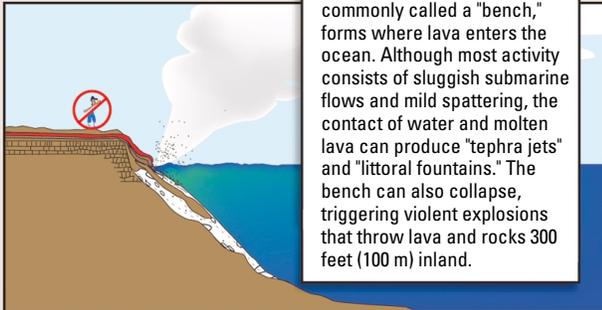
Stay well back from the edges of steep cliffs! They break off frequently, and if you fall in the ocean, you cannot climb back up and may be burned by hot, acidic water.

Do not go on the "benches" built by lava entering the sea! Bench collapses have killed people.

Move inland quickly if you hear unusual noises! These may indicate that the ground is about to collapse.

Do not go near the water! It may be extremely hot, and you could be severely scalded by unexpected waves.

FORMATION OF BENCH AND UNSTABLE LAND

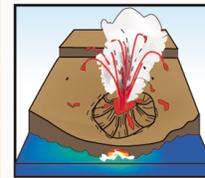
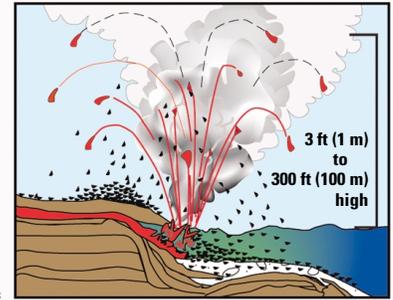


What is a tephra jet?

When waves splash onto molten lava, they "explode" in a cloud of steam, hot water, and tephra (molten splatter, tiny glass fragments, and long glass filaments known as "Pele's hair") called a "tephra jet."

A tephra jet is the most common type

of explosion a visitor is likely to witness when an active lava tube opens to the sea.

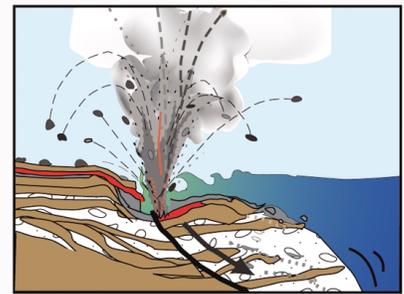


A "littoral fountain" (left) produces bursts of molten lava and steam from a lava tube at or below sea level. As water enters the 2,120°F (1,160°C) lava tube, it immediately flashes to steam. The resulting explosions of molten lava and bombs and smaller tephra pieces can reach higher than 300 feet (100 m) and build a steep cone on the lava bench.

What causes the steam blasts?

Collapse of a lava bench exposes hot, newly solidified lava flows to sea water. The water heats to steam and can trigger a type of explosion called a steam blast. Visitors standing anywhere near a bench or on cliffs formed by a previous bench collapse can be hit by ballistic projectiles.

In 1993, a lava bench at a Kilauea ocean-entry site collapsed, triggering a violent steam explosion. A person standing on the bench died, and twelve others who were nearby needed medical attention after being hit by flying rocks.



Avoid "flying rocks"!

This rock was thrown more than 30 feet (10 m) inland by a steam blast.

Stay at least 100 yards (100 m) from the ocean entry



Scalding Water, Steam Plume, and Bad Air

Is the water hot near ocean entry sites of lava?

In November 2000, two visitors who had ventured too close to an ocean entry site of lava were found dead, apparently scalded by acid-laced steam on the lava bench. Six years earlier, two people standing near the water's edge by a lava entry site were severely scalded by a sudden wave and had to be hospitalized.

When hot lava touches the ocean, it heats the surface water to temperatures capable of causing third-degree burns. Sudden releases of hot, acidic steam can occur unexpectedly on a lava bench because of bench collapse or high waves. Visitors should therefore stay off the bench to avoid being scalded by hot water or burned by acid steam.

Why are steam plumes considered a hazard?

Avoid walking under plumes of "laze" (lava haze) formed when hot lava flows into seawater and makes it boil. Chloride and hydrogen from the water combine to form hydrochloric acid in the plumes. When onshore winds blow clouds of laze inland, "acid rain" can fall on the land and people

below. Acid rain has a pH between 1.5 and 3.5 (pure water has a neutral pH of 7) and has the corrosive power of battery acid. Plumes of laze also contain tiny glass fragments that can irritate eyes and, in rare cases, cause permanent damage.



Onshore winds can blow the steam plume caused by lava entering the ocean into the path of hikers, creating a "whiteout." This plume hides deep cracks in the middle ground of the photograph.

What is a "whiteout"?

Onshore winds can blow steam plumes onto the land, causing visibility to be limited. This can be disorienting and could cause you to walk into risky areas. Move away from a whiteout when the winds shift. Heavy rain can also produce dense fog that limits visibility.

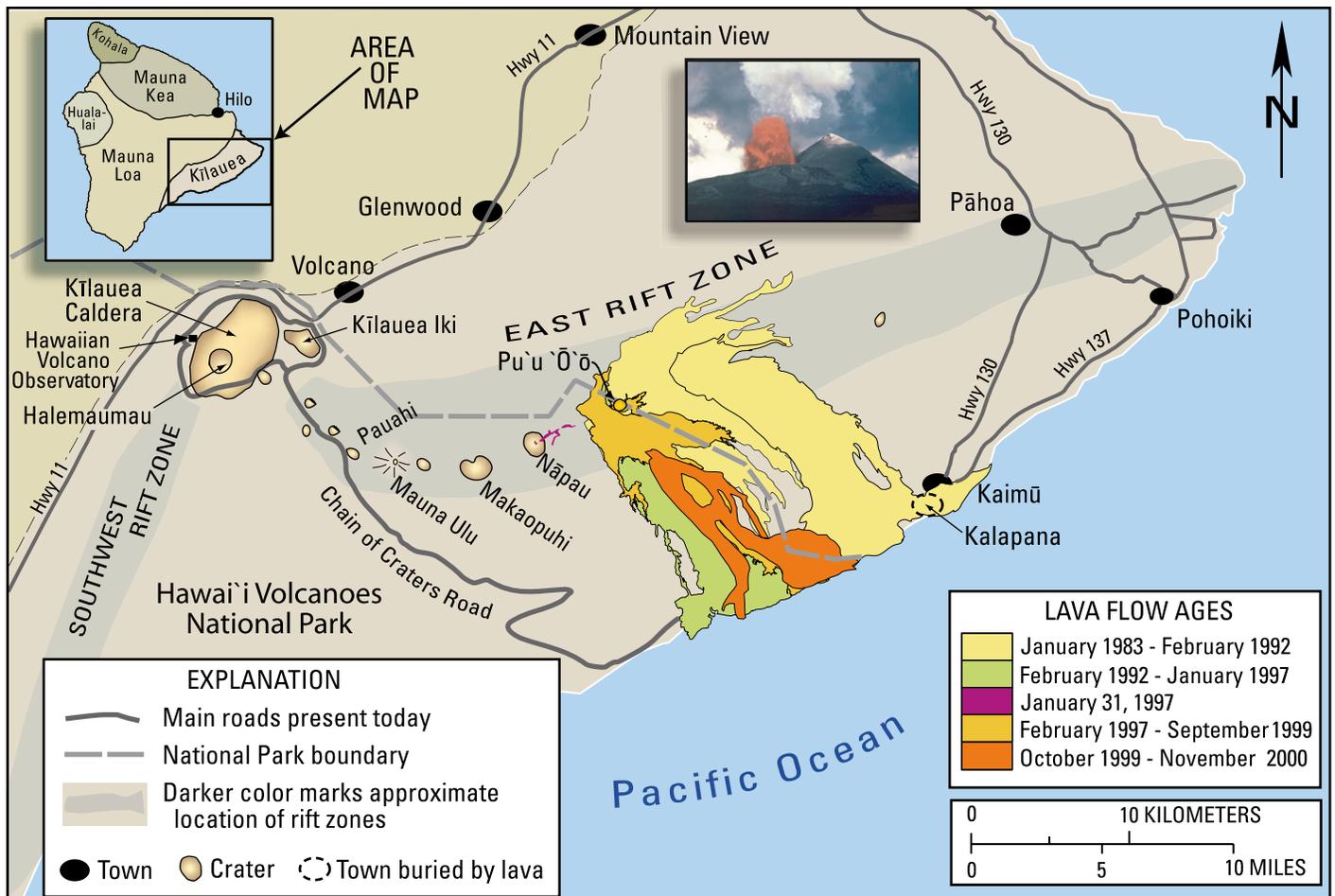
What is "vog" and who is at risk breathing it?

"Vog" (volcanic smog) is the visible haze that forms when irritating sulfur dioxide and other volcanic gases combine and interact chemically with oxygen, moisture, dust, and sunlight. Currently Kilauea emits about 2,000 tons of sulfur dioxide each day, mainly from the still-open vent at Pu'u 'Ō'ō.

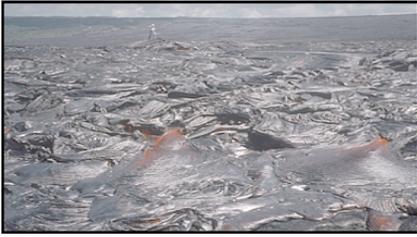
In Hawai'i, trade winds commonly disperse volcanic gases, so that their concentration is not generally hazardous. However, sulfur dioxide fumes can be concentrated near ground cracks along, and down-wind from, lava tubes.

Exposure to concentrated sulfur dioxide fumes puts all people at risk, but particularly those with breathing problems (such as asthma and chronic obstructive pulmonary disease) and heart difficulties, pregnant women, infants, and young children. If sulfur fumes begin to cause physical distress, you should leave the area!

The current eruption of Kilauea, which began in 1983 at Pu'u 'Ō'ō on the volcano's east rift zone, has covered many square miles with lava flows and added new land along the Island of Hawai'i's south coast. Inset shows a 1986 high-fountaining event at Pu'u 'Ō'ō. Such fountaining built a cone 835 ft (255 m) high, but the cone has lost much of its top because of collapses since 1986.



Stay Alert and Stay Alive—Plan Ahead Before Going To the Lava Flows



Typical irregular surface of "pāhoehoe" lava. Red glowing areas in the foreground show that this flow is still active.

How long does it take to walk across cooled lava flows?

The hummocky surfaces of cooled "pāhoehoe" lava flows are unlike anything most people have walked on. Because of their surface irregularities, you should allow twice the time you think the walk might take. If a park ranger tells you it is 3 miles (5 km) to where you are going, consider it the equivalent of walking 5 to 6 miles (8-10 km) on a smoother surface. Don't forget that if the return trip is uphill, it will be much harder and take longer!

I am only going for a few hours. Why do I need a flashlight?

Many people who walk out just for a day hike get caught in the dark. This can happen because they didn't estimate their speed properly, or they were engrossed in the scenery and didn't pay attention to the time. Remember that darkness falls more quickly near the equator than in temperate locales—when the sun sets, there is less than an hour of twilight left.

What is a "skylight"?



A scientist from the Hawaiian Volcano Observatory probes into a lava tube through a "skylight" near the coast. Lava in the tube has a temperature of about 2,120°F (1,160°C). The steam plume in the background is created by lava from this tube entering the ocean.

Large volumes of lava commonly move in lava tubes beneath the congealed surface of recent flows. "Skylights" form when the roof of a lava tube collapses, revealing the molten lava flowing beneath. It is important to stand well back from these holes, which form where the roof of the tube is thin and the ground unstable.

What do I need to take with me when I visit the lava-flow field?

Shown below are the items that park rangers advise taking when visiting lava-flow fields. They are arranged from the essential ("very important") items at the top to recommended items at the bottom. If you drive down Chain of Craters Road to reach Kīlauea's lava-flow field, purchase any needed items before you leave, as there are no services available at the end of the road.



Isn't some of this equipment unnecessary?

Most injuries at Hawai'i's volcanoes are not directly due to the eruptions. Intense sunlight and high temperatures can lead to severe dehydration, heat exhaustion, and sunstroke. Take sunscreen and a hat and drink more water than you think you need—if you feel thirsty you are already dehydrated! Air temperatures near lava flows can exceed 120°F (49°C), depending on cloud cover and wind conditions. At higher elevations, wind and rain can chill you and lead to hypothermia (low body temperature).

Injuries from falls are common. It is easy to break through a thin, overhang-

ing crust of lava or trip on a crack and fall on the abrasive, glassy surface of a lava flow. HVO scientists always wear long pants, sturdy boots, and sometimes gloves when working near lava flows—never shorts and slippers!

Lava Flows

Be alert when walking downslope from a moving lava flow. Make sure that you have an escape route planned to prevent getting caught between two advancing flows.

Before trying to visit Kīlauea's lava-flow field, check with park rangers for current conditions there and for the best approach route. Park rangers do not recommend attempting the hike to the coast if you are unprepared or uninformed. The area is remote, has no shade or water source, and is seldom patrolled.

By informing the public about hazards in Hawai'i Volcanoes National Park, the U.S. Geological Survey (USGS) and the National Park Service are helping visitors safely enjoy the park's attractions. The work of scientists at HVO is only part of USGS efforts to understand volcanoes and help protect people's lives and property from volcano hazards in all of the volcanic regions of the United States, including Hawai'i, Alaska, Wyoming, California, and the Pacific Northwest.

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<http://hvo.wr.usgs.gov/>
For current volcanic activity:
<http://hvo.wr.usgs.gov/kilauea/update/>
See also *Living on Active Volcanoes—The Island of Hawai'i* (USGS Fact Sheet 074-97) and *Volcanic Air Pollution—A Hazard in Hawai'i* (USGS Fact Sheet 169-97)

This Fact Sheet and any updates to it are available online at:
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