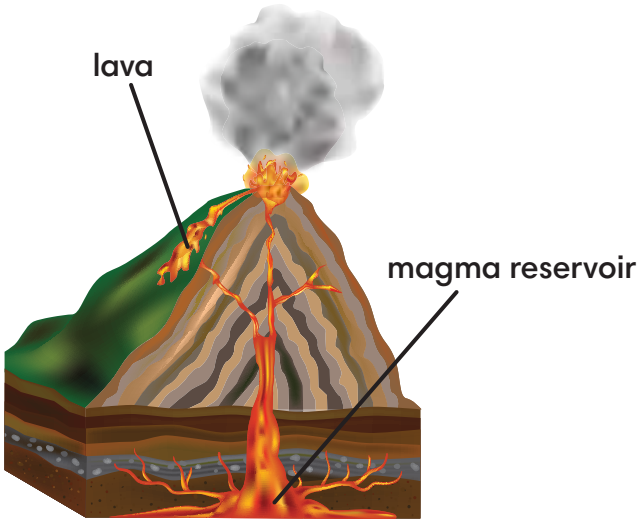
IMPORTANT TERMS

magma Rock that is molten (in liquid form due to heating). When magma reaches the surface, it is called *lava*.

magma reservoir An underground pool that is filled with molten rock (magma); also known as a **magma chamber**.

lava Magma (molten rock) that is erupting/has erupted above ground. Lava is hot! Hawaiian lava has an average temperature of about 1100°C (2012°F).

- **lava flow** Lava moving along the ground (or underwater).
- **lava lake** A pool of lava that forms in a volcanic crater or caldera.



magma reservoir and lava


lava


lava lake

eruption (volcanic) Occurs when gases, ash, rocks, and/or lava break out of Earth's surface.

- **explosive eruption** An eruption in which trapped gases blast apart sticky lava. This creates debris and causes ash clouds that can reach high into the sky.
- **effusive eruption** An eruption in which runny lava flows steadily and often slowly downhill.
- **flank eruption** An eruption from the side (flank) of a volcano rather than from the summit. Flank eruptions are common in the rift zones of shield volcanoes.

explosive eruptions

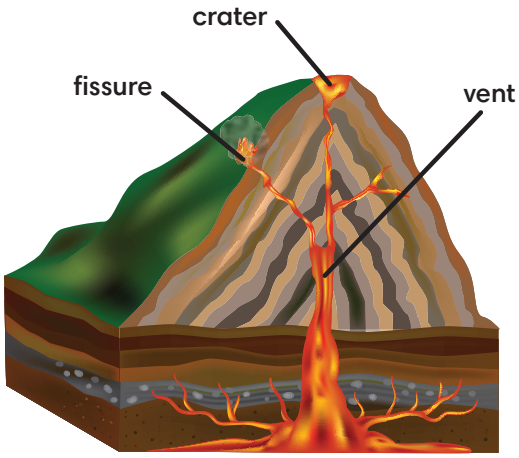
effusive eruption

flank eruption (effusive)

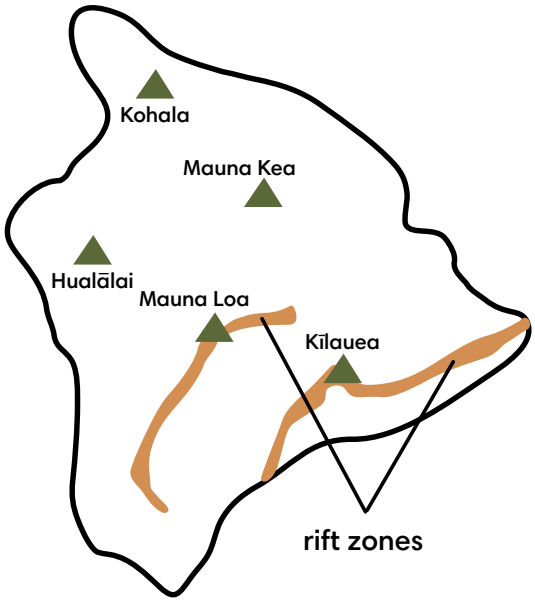
fissure A long crack or break in the ground from which volcanic gases, ash, rocks, and/or lava erupts.

rift zone An area along the side of a volcano where the land is splitting apart. Fissures often form in these areas. Rift zones are common in shield volcanoes.

vent An opening in a volcano that carries magma up to the summit crater or to a fissure.



vent, fissure, and crater



rift zones


fissure

caldera A large, steep-sided pit on a volcano. It is formed when the summit (highest point) collapses because magma has drained away or lava has erupted from it. Calderas are found on many dormant volcanoes. Sometimes, however, a caldera can have an active crater inside it.

crater A pit with openings for volcanic activities like lava flow and eruption of ashes. Craters are smaller than calderas and are generally circular.


caldera

crater within a caldera

tephra Ash and lava fragments that are thrown into the air during a volcanic eruption.

- **volcanic bomb** (or **projectile**) A piece of tephra that measures over 64 mm.
- **volcanic ash** A piece of tephra that measures less than 2 mm.


eruption of tephra

volcanic bomb

volcanic ash

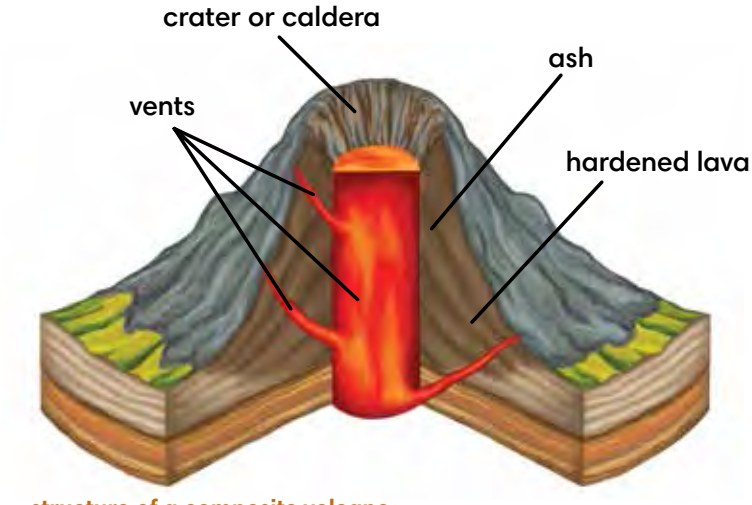
WHAT IS A COMPOSITE VOLCANO?

A **composite volcano** is the tallest and steepest type of volcano. It has the shape and size of a mountain.

On a composite volcano, thick and sticky lava erupts from a central vent. The eruptions are often explosive. Flank eruptions can also occur.

Composite volcanoes are formed of layers of hardened lava and ash. Most have a summit crater, which can become a caldera after a large explosion and collapse.

Another word for a composite volcano is **stratovolcano**.



structure of a composite volcano

Mount Fuji, Japan

Volcán Arenal, Costa Rica

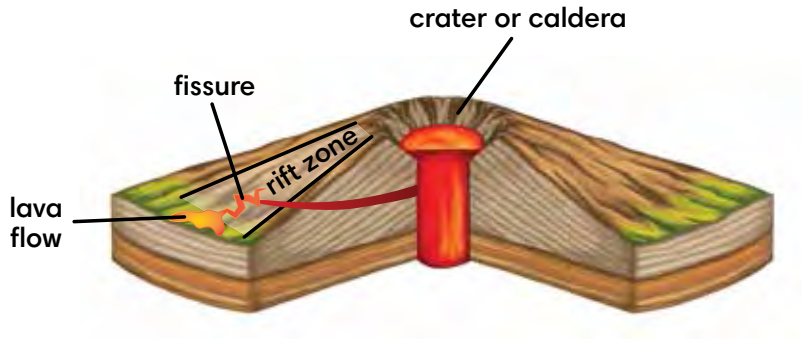
WHAT IS A SHIELD VOLCANO?

A **shield volcano** is the largest and widest type of volcano. It is less steep than other volcanoes. The name "shield" comes from the broad shape, which looks like a warrior's shield.

A shield volcano often has effusive eruptions of runny lava. However, explosive eruptions can also occur. Eruptions often occur from fissures in rift zones.

Shield volcanoes build up over time from lava flows that pour in all directions. When this occurs in the ocean, the hardened lava can form an island.

A large eruption on a shield volcano can form a caldera.



structure of a shield volcano

Galápagos Islands, Ecuador

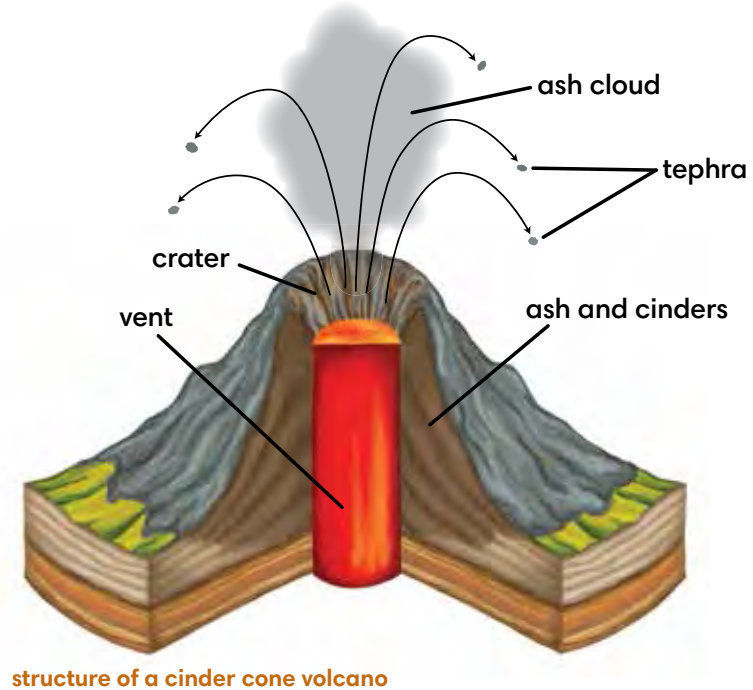
WHAT IS A CINDER CONE VOLCANO?

A **cinder cone volcano** is the simplest form of volcano.

Cinder cones are relatively small. They rarely rise more than 300 m above their surroundings.

Cinder cones have explosive eruptions of gas, lava, and ash from a single vent. These lumps of lava cool into cinders and pile up with ash to create a cone shape with a crater at the top.

Cinder cones often form on or near larger volcanoes (shield or composite volcanoes).



structure of a cinder cone volcano

cinder cone, Lassen Volcanic National Park, CA

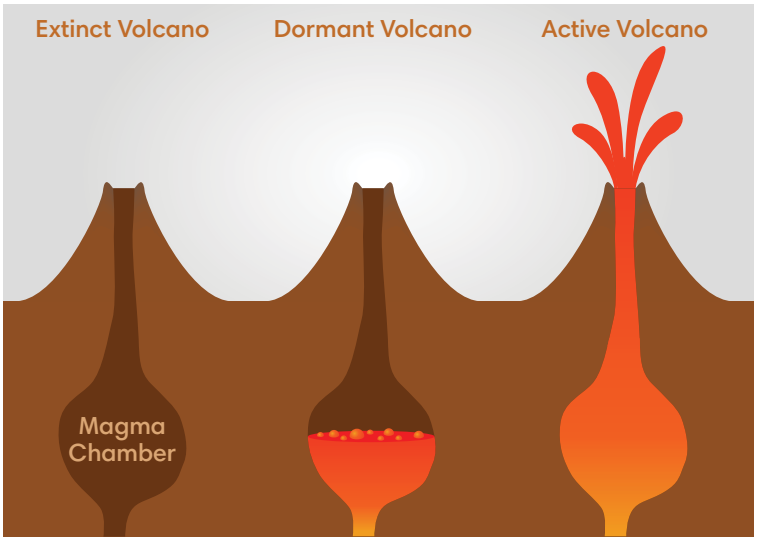
cinder cones within Haleakalā National Park, Hawai'i

HOW CAN YOU TELL WHETHER A VOLCANO IS ACTIVE, DORMANT, OR EXTINCT?

Most scientists call a volcano **active** if it has erupted in the last 10,000 years.

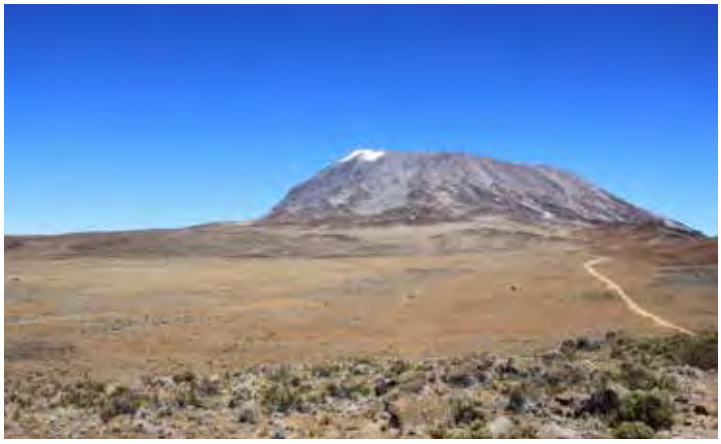
If a volcano has not erupted very recently but is expected to erupt again, then it is called **dormant**. A dormant volcano is a kind of active volcano. It still holds magma beneath it.

A volcano is called **extinct** if scientists think it will never erupt again. Most extinct volcanoes show no evidence of an eruption within the last 10,000 years. An extinct volcano is cut off from any supply of magma.



extinct, dormant, and active volcanoes


Glass House Mountains, Australia: extinct volcanoes


Kibo peak, Kilimanjaro, Tanzania: a dormant volcano


Mayon, Philippines: an active volcano

The ground is swelling!

How and why do scientists monitor deformation at volcanoes?

Deformation refers to changes to the ground surface on a volcano. These changes are caused by magma moving underground. The changes may appear as swelling (inflation) or sinking (deflation).

Inflation occurs when a magma reservoir fills. The reservoir swells and pushes the ground above it up and out, tilting the ground away. This often happens before an eruption. **Deflation** happens after magma erupts or as it moves away underground. This causes the ground to sink down.

These changes can usually only be measured with sensitive instruments. A Global Positioning System (GPS) receiver is an instrument that uses satellite signals to determine its location. Scientists set up GPS stations with receivers on volcanoes and measure the changes in their locations. They also measure changes in the distances between stations. An increase in distance between these GPS stations can mean that inflation is occurring.

Scientists monitor deformation because these changes can offer signs that a volcano may erupt soon.

inflation on Mount Saint Helens prior to an eruption in 1980

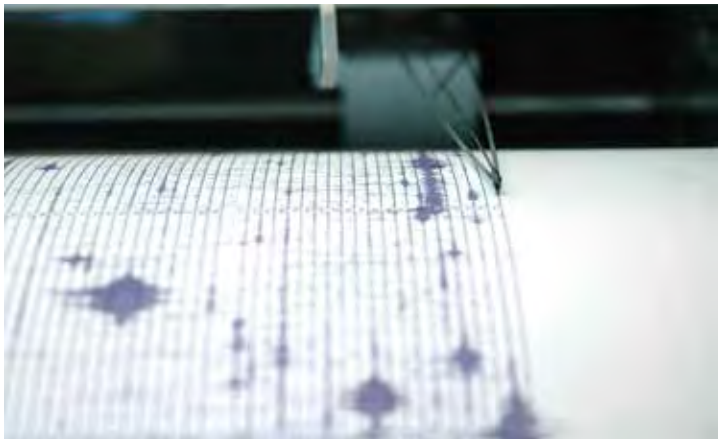
setting up a portable GPS receiver on a Hawaiian volcano

GPS receiver at North Rim Station, Newberry Volcano, Oregon

The ground is shaking!

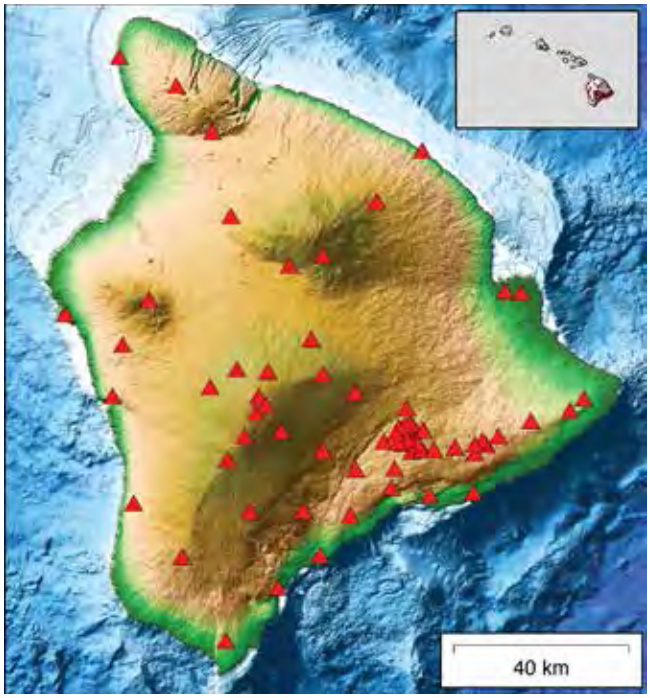
How and why do scientists monitor earthquakes around volcanoes?

Volcanic activity can sometimes cause earthquakes. Most of these earthquakes are too small for people to feel directly. However, scientists can use instruments called **seismographs** to detect them. Lots of small earthquakes near a volcano can provide warning signs that magma is cracking rocks and rising up through the cracks. When the magma is closer to the ground surface, the volcano may erupt soon.



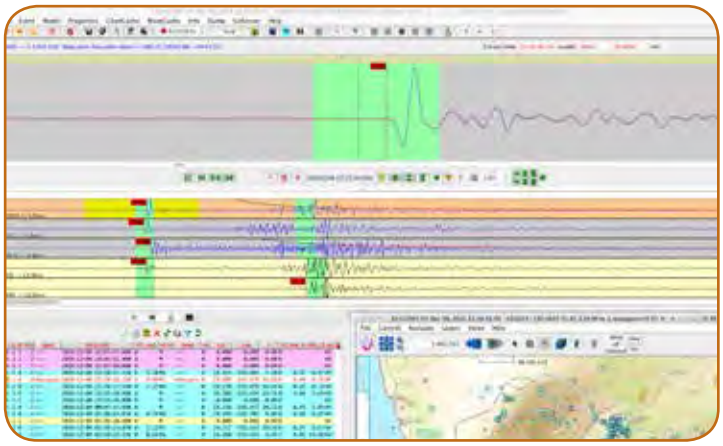
seismograph recording

earthquake monitoring station on Vesuvius



earthquake monitoring stations (red triangles) on the island of Hawai'i and across the state of Hawaii (inset)

Source: U.S. Geological Survey



screenshot from Hawai'i Volcano Observatory's earthquake monitoring software

Source: U.S. Geological Survey

Eew, that smell!

How and why do scientists measure sulfur dioxide concentrations around volcanoes?

Sulfur dioxide is a colorless gas with a nasty, sharp smell. It is produced by active volcanoes. Scientists use instruments called **spectrometers** to measure and monitor the amount of sulfur dioxide released by a volcano.

Changes in the amount of gases released can help scientists predict an upcoming eruption. These changes can also give clues about the amount of magma supplying an eruption. Volcanoes release more sulfur dioxide when magma comes near the surface.

Sulfur dioxide is toxic if it is inhaled. It can cause irritation of the nose and throat, as well as coughing and shortness of breath. Wind can carry the gas from its source to other areas nearby.

Scientists and public health officials recommend that people stay indoors and avoid exercise when levels of sulfur dioxide are high. Anyone with breathing or heart problems should leave the area.

measuring volcanic gases with a spectrometer at Kīlauea Volcano, Hawai'i

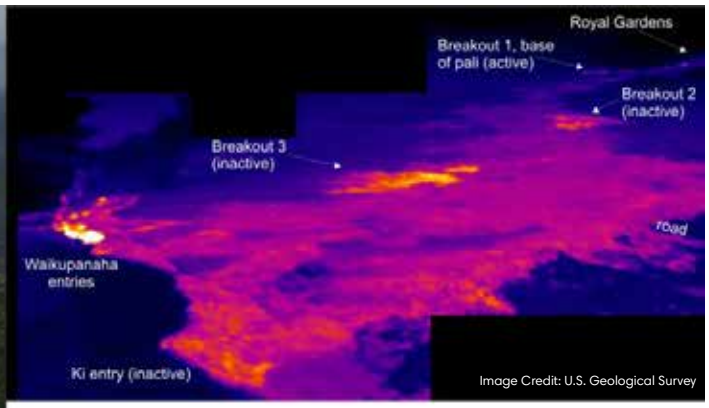
sampling gases at Augustine Volcano, Alaska

It's hot down there!

How does surface temperature help scientists predict changes in volcanic activity?

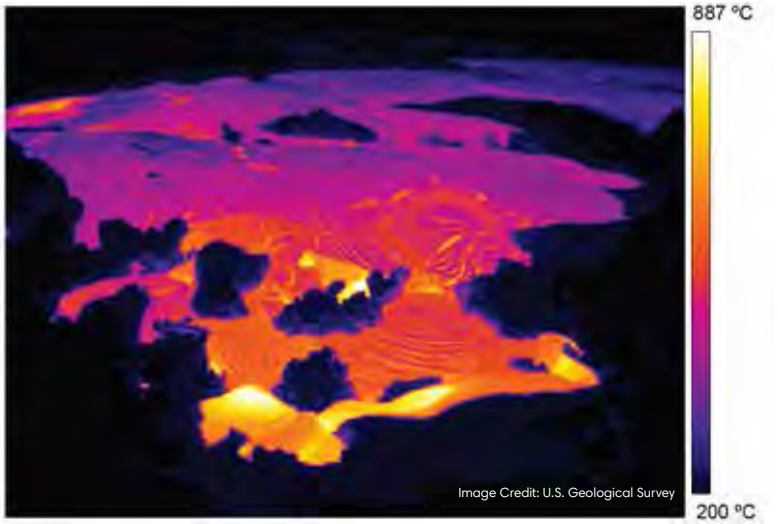
Anyone who lives near an active volcano will want to know if they are in the path of an eruption. Scientists use a method called **thermal imaging** to locate volcanic hazards. Thermal imaging uses special cameras or sensors that allow scientists to measure temperatures from a distance. The cameras/sensors create thermal images that use colors to show hot and cold areas. These images help scientists track **lava flows** and predict new eruptions.

lava flow reaching the coast



thermal image of the same area, showing areas of lava movement

lava flow



thermal image of a lava flow

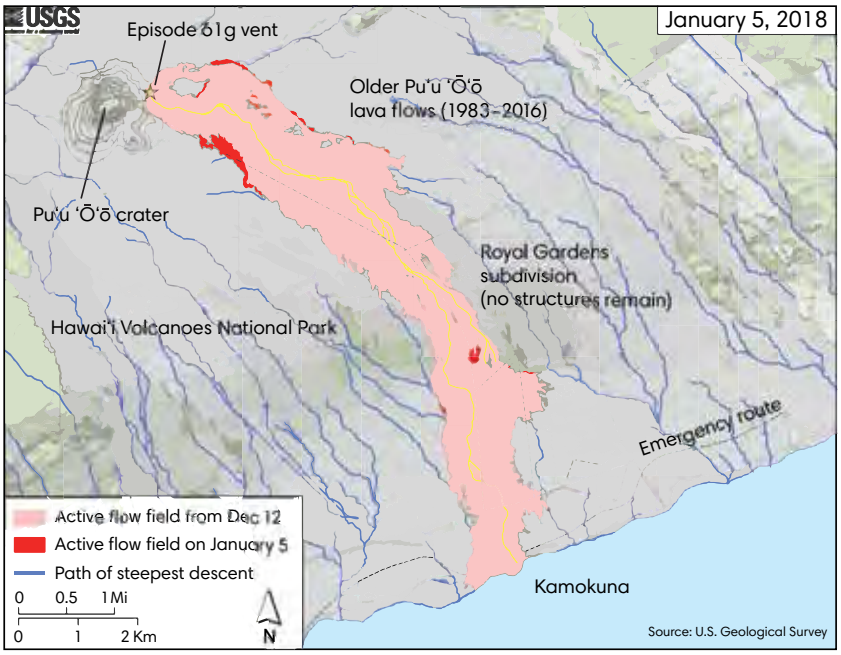
Get out of the way!

How can scientists predict where lava will flow?

When **magma** rises to the surface above a volcano, the hot, molten rock is called **lava**. In order to warn people where they might be in danger, scientists work to predict where the lava will flow.

Lava can sometimes flow from long **fissures**, or cracks in the ground, on a volcano's flanks. When lava erupts along a fissure, it may produce "curtains of fire." These rows of lava fountains often reach a few tens of meters in height and dwindle down after a few days.

Lava that spills from a **crater** or fissure will flow downhill. **Lava flows** are likely to follow the paths of steepest descent (where the ground slopes down the steepest). Once lava begins to flow, anyone living on the downhill side of its path will be alerted and evacuated. Roads, parks, and nearby areas at risk will be closed to the public.



map of lava flows and paths of steepest descent from Kīlauea's East Rift Zone in January 2018

area closure signs near a lava flow

a lava flow pours downhill from a fissure

It's gonna explode!

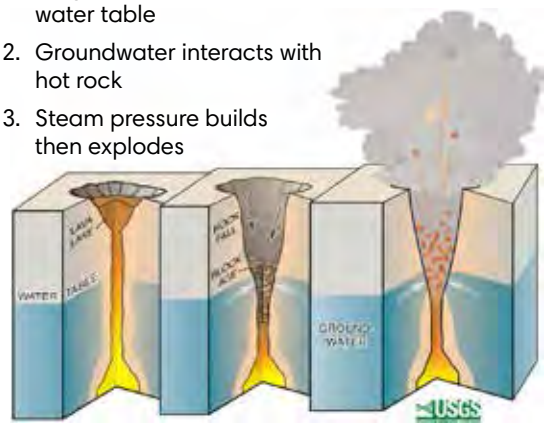
How can the lava lake provide clues about an eruption?

There are different types of volcanic eruptions. When a shield volcano erupts, the lava usually oozes slowly downhill. However, explosions can also occur. This can happen when a **lava lake** drops down below the water table underground. The water turns into steam, which builds up pressure until the rocks around it explode. Scientists monitor the levels of magma and groundwater in order to predict explosive eruptions.

Explosive eruptions blast **tephra**, or ash and lava fragments, into the air. Falling rocks called **volcanic bombs** can pose dangers to people close by. Ash can damage buildings, crops, and vehicles. It can endanger airplane flights and cause health problems when breathed in. Scientists try to predict eruptions to help people avoid these dangers.

Explosive eruptions can occur when:

1. Magma column drops below water table
2. Groundwater interacts with hot rock
3. Steam pressure builds then explodes



explosive eruption process

Source: U.S. Geological Survey

volcanic bombs from explosive eruptions littering the area near a volcanic crater

houses covered in ash from a volcanic eruption

A drop in the level of the lava lake can give scientists another clue. It may mean that magma is moving somewhere else underground. Another eruption might happen nearby.