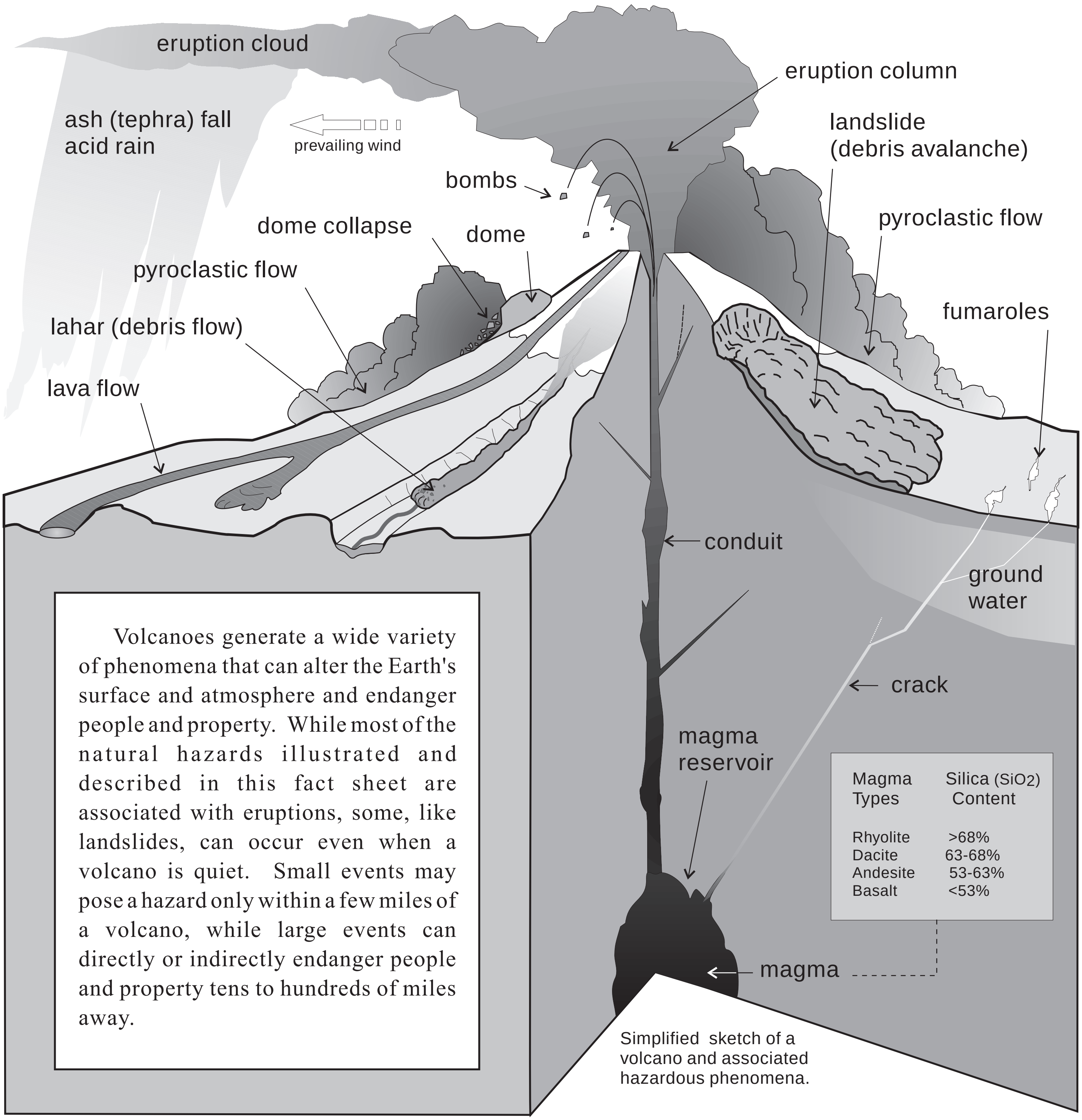
VOLCANO HAZARDS FACT SHEET
U.S. Department of the Interior
U. S. Geological Survey

Hazardous Phenomena at Volcanoes



Volcanoes generate a wide variety of phenomena that can alter the Earth's surface and atmosphere and endanger people and property. While most of the natural hazards illustrated and described in this fact sheet are associated with eruptions, some, like landslides, can occur even when a volcano is quiet. Small events may pose a hazard only within a few miles of a volcano, while large events can directly or indirectly endanger people and property tens to hundreds of miles away.

Simplified sketch of a volcano and associated hazardous phenomena.

ERUPTION COLUMNS AND CLOUDS

An explosive eruption blasts molten and solid rock fragments (**tephra**) into the air with tremendous force. The largest fragments (**bombs**) fall back to the ground near the vent, usually within 2 miles. The smallest rock fragments (**ash**) continue rising into the air, forming a huge, billowing **eruption column**. Volcanic ash is composed of fragments of rock, minerals, and glass that are less than 2 millimeters (0.08 inch) in diameter.

Eruption columns can be enormous in size and grow rapidly, reaching more than 12 miles above a volcano in less than 30 minutes. Once in the air, the volcanic ash and gas form an **eruption cloud**. Eruption clouds pose a serious hazard to aviation. During the past 15 years about 80 commercial jets have been damaged by inadvertently flying into ash, and several have nearly crashed. Large eruption clouds can travel hundreds of miles downwind from a volcano, resulting in **ash fall** over enormous areas. Ash from the May 18, 1980, eruption of Mount St. Helens was deposited over 22,000 square miles of the western United States. With increasing distance downwind from a volcano, the ash particles become smaller and the thickness of the resulting layer decreases. Minor ashfall can be a nuisance to people and damage crops, electronics, and machinery; heavy ashfall can collapse buildings.

PYROCLASTIC FLOWS High-speed avalanches of hot ash, rock fragments, and gas move down the sides of a volcano during explosive eruptions or when the steep edge of a dome breaks apart and collapses. These **pyroclastic flows**, which can reach 1500o F and move at 100-150 miles per hour, are capable of knocking down and burning everything in their paths. A more energetic and dilute mixture of searing gas and rock fragments is called a pyroclastic surge. Surges move easily up and over ridges; flows tend to follow valleys.

The May 18, 1980 eruption of Mount St. Helens generated a horizontally directed series of explosions that formed a lateral blast. This blast destroyed an area of 230 square miles. Trees 6 feet in diameter were mowed down like blades of grass as far as 15 miles from the volcano. The blast exhibited characteristics of both pyroclastic flows and surges.

LAVA FLOWS AND DOMES

Molten rock **(magma**) that pours or oozes onto the Earth's surface is called **lava**. The higher a lava's silica content, the more viscous it becomes. For example, low-silica basalt lava can form fast-moving (10-30 miles per hour), narrow lava streams or spread out in broad sheets up to several miles wide. Between 1983 and 1993, basalt lava flows erupted at Kilauea Volcano in Hawaii destroyed nearly 200 houses and severed the coast highway along the volcano's south flank.

In contrast, higher-silica andesite and dacite lava flows tend to be thick, move slowly, and travel short distances from a vent. Dacite and rhyolite lava flows often form mound-shaped features called **domes**. Between 1980 and 1986, Mount St. Helens built a lava dome about 1,000 feet high and 3,500 feet in diameter.

LAHARS (DEBRIS FLOWS OR MUDFLOWS) **Lahars** are mixtures of water, rock, sand, and mud that rush down valleys leading away from a volcano. They can travel over 50 miles downstream, commonly reaching speeds between 20 and 40 miles per hour. Sometimes they contain so much rock debris (60-90% by weight) that they look like fast-moving rivers of wet concrete. Close to the volcano they have the strength to rip huge boulders, trees, and houses from the ground and carry them downvalley. Further downstream they simply entomb everything in mud. Historically, lahars have been one of the most deadly volcanic hazards.

Lahars can form in a variety of ways, either during an eruption or when a volcano is quiet. Some examples include the following: (1) rapid release of water from the breakout of a summit crater lake; (2) generation of water by melting snow and ice, especially when a pyroclastic flow erodes a glacier; (3) flooding following intense rainfall; and (4) transformation of a volcanic landslide into a lahar as it travels downstream.

VOLCANIC LANDSLIDES (DEBRIS AVALANCHES) A **landslide** is a rapid downslope movement of rock, snow, and ice. Landslides range in size from small movements of loose debris on the surface of a volcano to massive failures of the entire summit or flanks of a volcano. Volcanic landslides are not always associated with eruptions; heavy rainfall or a large regional earthquake can trigger a landslide on steep slopes. Volcanoes are susceptible to landslides because they are composed of layers of weak, fragmented, volcanic rocks that tower above the surrounding terrane. Furthermore, some of these rocks have been altered to soft, slippery, clay minerals by hot, acidic ground water inside the volcano. At least five large landslides swept down the slopes of Mount Rainier during the past 6,000 years. The largest volcanic landslide in historical time occurred at Mount St. Helens on May 18, 1980.

VOLCANIC GASES Volcanoes emit gases during eruptions. Even when a volcano is not erupting, cracks in the ground allow gases to vent to the surface through **fumaroles**. The most common volcanic gases are water vapor (90%), carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen. Sulfur dioxide gas can react with water droplets in the atmosphere downwind and fall as acid rain, causing corrosion and adversely affecting vegetation. Carbon dioxide is heavier than air and tends to collect in depressions, where on occasion it can accumulate in lethal concentrations and cause people and animals to suffocate. Sometimes, toxic concentrations of fluorine are adsorbed onto ash and ingested by livestock or leached into domestic water supplies.

Large eruptions inject sulfur dioxide gas into the stratosphere, where it combines with water to form an aerosol of sulfuric acid. By reflecting solar radiation, the sulfur aerosols can lower Earth.s average surface temperature by a few degrees Fahrenheit. These aerosols also hasten ozone destruction by altering chlorine and nitrogen chemical species in the stratosphere.

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