

A California volcano once obliterated a forest and propelled ash 280 miles. Experts say it offers a warning

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Lassen Peak had been rumbling for days. Glowing hot rocks bounded down the slopes. Lava was welling up into a freshly created crater.

Then, on this day 103 years ago, it exploded in a way California would never forget. It created a gigantic mushroom cloud that reached an altitude of 30,000 feet, could be seen as far away as Eureka and Sacramento and sent [volcanic ash](#) as far away as 280 miles, reaching Elko, Nev.

It was the first volcanic [eruption](#) in the contiguous 48 states since the founding of the United States, and the last until Mount St. Helens erupted on May 18, 1980.

And it was a reminder not only of how California is threatened by earthquakes, but how volcanoes are a part of life in a state that sits in the Ring of Fire. As the world focuses on the volcanic show in Hawaii, the Lassen Peak eruption offers a lesson of the threat closer to home.

"California is not just earthquake country. It is also volcano country," said Margaret Mangan, the scientist in charge of the U.S. Geological Survey's California Volcano Observatory. There have been 10 eruptions in California over the last 1,000 years, and in any given year the chance of a major [volcanic eruption](#) in the state is about the same as the risk of a major earthquake on the San Andreas fault.

"Our nearly forgotten hazard is our volcanoes," state geologist John Parrish once said.

Including the Lassen Volcanic Center, there are eight volcanic regions considered worth watching for future eruptions in California, according to the USGS, from the far north of the state to near the Mexican border. Most have been confirmed to have partly molten rock underneath them.

Some of California's most scenic wilderness spots are threatened by volcanic activity. More than 190,000 Californians live within a volcano hazard zone; among them are people who live or work in the Long Valley region, home to Mammoth Lakes in Mono County, a favorite destination of skiers from Southern California, and areas in the shadow of Mount Shasta, such as the towns of Mount Shasta and Weed. Those cities are close enough to volcanoes that they may be in harm's way in the next eruption, Mangan said.

Volcanoes in the Lassen, Shasta and Long Valley areas are capable of producing [pyroclastic flows](#) or surges when they do erupt—fast-moving flows of hot ash, rock and gas sweeping down the sides of mountains, of the type that killed 57 people when Mount St. Helens erupted in 1980.

Most of the volcanoes are far from California's largest cities and several produce heat that's used to generate electricity in what are the world's most productive geothermal power plants, such as the Salton Buttes 160 miles southeast of Los Angeles and the Clear Lake Volcanic Field 85 miles north of San Francisco, which powers the Geysers steam field.

But volcanic eruptions could have lasting repercussions that could affect all of California. Volcanic ash could bring down jetliners and disrupt hundreds of flights daily passing through Northern California or the Mammoth Mountain area. In 2010, the eruption of Iceland's Eyjafjallajökull volcano forced the cancellation of 100,000 flights in a

single week.

Volcanic ash, when wet, is conductive and can disrupt high-voltage lines that supply electricity to millions of California homes. Ash could disrupt travel on Interstate 5, the main route between California and Oregon, masking windshields and making roads slippery, even impassable. And it could contaminate water supplies to much of the state; California's largest reservoirs are close to the Shasta and Lassen volcanoes.

If there's any good news, it's that major volcanic activity is usually accompanied by some warning signs, and scientists have become much better at forecasting major events before they happen, enabling authorities to sound warnings to reduce the chance of deaths.

"We aim to make that number zero," said USGS volcano scientist Wendy Stovall.

Volcano scientists have done well so far at forecasting hazards associated with Kilauea volcano on Hawaii's Big Island in recent weeks. After a lava-containing crater collapsed, scientists tracked a pattern of earthquakes eastward, suggesting magma was on the move and would eventually come to the surface. It did so in the neighborhood of Leilani Estates, about 25 miles east of the volcano's summit, where lava has destroyed dozens of structures. Scientists also correctly forecast the steam-driven explosions at the summit.

Volcano science has come a long way since the deadly 1980 eruption of Mount St. Helens, which is the most active volcano in the Pacific Northwest and is in a remote part of Washington state. Those who died generally had been within 15 miles of the volcano. There were signs that magma was moving underneath the volcano in the months before the eruption, but how it unfolded caught scientists by surprise.

Instead of from the top, the eruption occurred from the side of the volcano—sending magma pressurized with gas erupting out horizontally instead of vertically, said Seth Moran, scientist in charge of the USGS Cascades Volcano Observatory. Because the initial direction of the pyroclastic flow was aimed horizontally, it traveled much farther on land from the summit than had been anticipated, and killed people who were beyond a zone of evacuation. Such pyroclastic flows are so hot they will burn flesh and sear lungs; too much ash can also make it hard to breathe.

California's volcanoes were more prolific in prehistoric times. About 760,000 years ago, a super eruption occurred at what is now known as the Long Valley Caldera, erupting an astonishing 140 cubic miles of magma, covering much of east-central California in glowing hot ash and blowing ash as far away as Nebraska. (Mount St. Helens, by contrast, erupted only 0.05 cubic miles of material.) There is no sign that there is enough magma underneath Long Valley to cause another super eruption, Stovall said.

An eruption can be preceded by months of volcanic instability. At Lassen, where the magma is usually very viscous—kind of like a crystalline mush—new magma began lifting up to the surface in 1914, rejuvenating the stagnant magma beneath the volcano, said USGS volcano scientist Mike Clynne. Initially, the magma caused groundwater to heat up, producing steam-fueled explosions, eventually blasting out a crater at Lassen Peak.

It would take about a year for magma to come up to the surface.

By May 15, 1915, viscous lava started pooling up and filling up the crater. That had the effect of plugging up a hole at the volcano, and pressurized gas started collecting underneath it. On May 19, there was an explosion that threw blocks of hot rock down the slopes of the snow-covered volcano, Clynne said, triggering a half-mile-wide avalanche of

rock and snow. As the snow melted, it turned into a debris flow downstream for about 9 miles.

After two days of quiet, the big eruption finally came. On May 22, new magma ascended from below, this time far more quickly, and exploded from the summit, causing a huge mushroom cloud eruption—similar to the kind that Pliny the Elder saw when Mount Vesuvius exploded in the year 79.

A pyroclastic flow was sent flying down the northeast flank of the volcano, creating a zone now known as the Devastated Area. The flow knocked trees down and destroyed everything in its path—3 square miles of wilderness was obliterated. The pyroclastic flow melted snow and sent a volcanic debris flow—called a lahar—raging down for 15 miles down Lost Creek, and fueled floodwaters to hit Hat Creek.

Steam explosions would continue through 1917.

In the grand scheme, Lassen's eruption was small, relatively speaking; Mount St. Helens' eruption in 1980 was 30 times bigger, Clynne said.

Sometimes it's not the pyroclastic flows that prove so deadly; sometimes it's the ice and snow quickly melting during the eruption that pose the greatest threat. The 1985 eruption of Nevado del Ruiz in Colombia killed 25,000 people—but was so deadly only because the melting water triggered mudflows. "They didn't know it was coming. It happened at night," Clynne said.

In the eruption of Indonesia's remote Krakatau volcano in 1883, it was the top of the mountain caving in that triggered a tsunami that struck Java and Sumatra islands, killing as many as 36,000 people.

Ongoing monitoring of volcanoes is critical to forecasting when

something is amiss, Mangan said in a recent public lecture. USGS scientists detected such a problem in 2008, when a cluster of earthquakes suggested instability on the tiny island that's home to Kasatochi volcano in Alaska, and where employees of the U.S. Fish and Wildlife Service were located.

An order went out to evacuate as there was nowhere to hide on that island. "And about 10 hours later, the [volcano](#) erupted," Mangan said. "The island was coated in pyroclastic flows and ash. And lives were saved."

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