

# Iceland's most active volcano is likely headed for another eruption

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A photo taken approximately 3 hours after a large explosive eruption commenced at Grímsvötn in May 2011. The plume is approximately 20km high. Credit: [Ólafur Sigurjónsson](#)

Glacial volcanoes sound like an oxymoron. But Iceland's Vatnajökull ice cap, Europe's largest by volume, covers many active volcanoes, including

the country's most frequently erupting one, Grímsvötn. Nine years after its last eruption in 2011, which closed Icelandic airspace, [Grímsvötn appears poised](#) for yet another, according to the Icelandic Meteorological Office's (IMO).

A [Grímsvötn](#) eruption—occurring roughly every 5-10 years—blasts through the glacial ice enclosing the volcano and the magma-ice interactions create a stunning explosion. "The lava melts the ice, it flashes into steam. There is a tremendous amount of energy being released in split seconds," Ronni Grapenthin, a geophysicist at the University of Alaska, described to GlacierHub. Grímsvötn is also infamous as the source of the seven-month long Laki fissure eruption in 1783, which caused a famine that claimed 20 percent of Iceland's population and [lowered Northern Hemisphere temperatures](#) by an estimated 1°C.

While scientists are fairly certain another eruption is coming, forecasting the timing, magnitude and nature of eruptions is challenging because "each volcano is different and they behave differently, and you can have different behavior from one eruption to the other," said Sigrun Hreinsdottir, a geodetic scientist at GNS Science in New Zealand. However, because Grímsvötn erupts so frequently, scientists see patterns that suggest another eruption is imminent. "Currently we have a state of the volcano which is very similar to the pre-eruptive conditions before 2011 and 2004 [eruptions]," Benedikt Ofeigsson, a geoscientist at the IMO, told GlacierHub.



Close-up view of the eruptive crater in the 1998 eruption of Grímsvötn. Credit: [Oddur Sigurðsson](#)

A team of scientists spanning Alaska to Iceland to New Zealand is carefully monitoring Grímsvötn. A high-precision GPS on the ground measures volcanic [deformation](#)—the movement of the ground—in real time. As magma flows into the volcano from below, the ground expands outwards from the magma chamber, like a balloon. According to Ofeigsson, Grímsvötn is "pretty much inflated to the same point as prior to 2011 [eruption] so it's showing all the signs of an eruption well within the next month or year."

An additional piece of information suggests an impending Grímsvötn

eruption: gas measurements. When magma nears the surface, the gases originally dissolved in the magma escape. "It's a lot like opening a soda bottle. When you release the pressure, the gases come out," said Terry Plank, a volcanologist at Columbia University's Lamont-Doherty Earth Observatory. Since 2012, the IMO has periodically made gas measurements at Grímsvötn, but in early June, they "measured very high concentrations of SO<sub>2</sub>, CO<sub>2</sub> and H<sub>2</sub>," which Ofeiggson noted are unusual for Iceland. These measurements indicate that an eruption is near because the magma is just below the surface.

Because Grímsvötn is completely covered by a glacier, it also has a subglacial lake—a lake that lies entirely below the ice. The heat from the volcano melts the ice immediately above it, and, as a result, a lake forms underneath in the caldera or crater. Periodically, the volume of water exceeds the capacity of the caldera, so a [glacial outburst flood](#) or jökulhlaup occurs, in which hundreds of square kilometers can flood. According to Ofeiggson "the lake [is] pretty full, so we also expect a jökulhlaup from Grímsvötn this summer."



Grímsvötn caldera wall (Mt Grímsfjall) in June 2011. Credit: [Anna Líndal](#)

"When the volcano is ready to erupt, the eruption can be triggered by the flood," Ofeigsson added. Grímsvötn has "a hair-trigger sensitivity to pressure," so the pressure release from the removal of the lake water can start the eruption, explained Dave McGarvie, a volcanologist at Lancaster University. Therefore, for the first time, scientists are monitoring Grímsvötn's subglacial lake level in real time. Because jökulhlaups triggered many past Grímsvötn eruptions, including in 2004, scientists expect the next eruption will also follow the flood.

Despite the short window of warning—and Grímsvötn's history of devastating eruptions—the next eruption is not expected to be bad. Every 150-200 years, Grímsvötn has a large eruption. Since the last big one was in 2011, scientists expect the upcoming eruption to be fairly small. McGarvie added that "most of [the eruption] in fact is contained within the glacier." Because of the "magma-water interactions," the ash is "pretty sticky;" it mostly falls within 40 km of the vent, hardly reaching inhabited areas. A jökulhlaup could be more damaging, but because they occur every 3 to 4 years, Iceland is well prepared for them. Bridges swept away by the 1996 Grímsvötn jökulhlaup were rebuilt to withstand flood waters, and roads in the south will close during the flood. Iceland will also have time to prepare, as the flood water must travel over 40 km under Vatnajökull first, McGarvie explained.

In spite of scientists' confidence that Grímsvötn will erupt soon, monitoring data is limited because the volcano is covered in ice. "As opposed to other volcanoes, we can't really see as much as we would like to," Grapenthin said. GPS instruments must be placed on bedrock because ice "flows much faster than the volcano deforms," and there is only one site at Grímsvötn with solid bedrock.



The flow channel of a subglacial outburst flood, triggered by the Gjálp eruption in 1996, draining the lake. Credit: [Oddur Sigurðsson](#)

However, the addition of gas measurements and real time monitoring of Grímsvötn's lake and deformation could pave the way for scientists to precisely forecast future volcanic eruptions. "If you could get more types of instruments prior to an eruption, you will understand maybe what the pre-eruptive signals are," Hreinsdottir said. With multiple Grímsvötn eruptions during one scientist's lifespan, knowledge from one eruption can be applied to the next one.

Regardless of how tame Grímsvötn's next eruption may be, it will surely be a dramatic sight. McGarvie told GlacierHub: "I went up to the eruption site in 2011, a couple months after the eruption ended, and you

could see these spectacular circular crevasses, fractures in the upper surface of the ice, as the ice gently, but persistently moves back into the eruption site to fill this hole basically caused by the [eruption](#)."

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