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Iceland a hot spot of volcanic activity

By Faye Flam

Inquirer Staff Writer

In 1783, a dense, murky fog settled over Paris, darkening the daytime skies for weeks on end, a phenomenon that excited the curiosity of Benjamin Franklin while he was in France to sign the Treaty of Paris.

Franklin wrote a paper describing the cooling effect of the haze and theorizing that it had blown over from an Icelandic volcano.

He was right: That year much of Europe was blanketed by sulfur particles from Laki, an erupting crack in the ground that spewed enough poison gas to wipe out about a quarter of Iceland's population and kill people as far away as the British Isles.

If the past is any indication, Iceland will bring forth stronger and more dangerous eruptions than Eyjafjallajokull, which last week disrupted air travel by sending an ash cloud of tiny glass shards over Europe.

(Some scientists have come to abbreviate the volcano as E15, for the 15 letters that follow the E).

If not for the flight delays, said Jeffery Karson, a geology professor at Syracuse University, "this is just one little volcano that we'd hardly pay attention to. There are lots more and they could start erupting at any time."

Globally, killer volcanoes hundreds of times the size of E15 erupt every few decades. The last was Pinatubo in the Philippines in 1991.

Every few tens of thousands of years, Earth's seething interior brings forth a "megavolcano," covering continents with ash and plunging the planet into nuclear-winter-like conditions. The most recent was in Indonesia 74,000 years ago.

With today's dependence on air travel, even the weakest eruptions can wreak havoc.

In the short term, E15 could sputter on for months. The last time this particular volcano erupted, in 1821, it lasted a year and a half, said Michael Sheridan, a volcanologist at the

University of Buffalo. On those previous occasions it also set off a more powerful neighboring volcano, Katla. "That doesn't bode well for the present," Sheridan said.

An eruption at Katla could loft material into the stratosphere, where it would influence global weather.

Iceland has been erupting for as long as 55 million years, said Syracuse's Karson. That's because it sits on top of a cauldron of underground activity. Many miles below the ground is a "hot spot" - a mysterious disturbance deep in Earth's mantle.

No one knows exactly what produces these hot spots, which can persist for millions of years, sending up narrow plumes of searing magma that punch holes through the Earth's crust.

Other hot spots lurk under Hawaii and Yellowstone.

Iceland also sits on a north-south seam in the Earth, a spreading center where tectonic plates are pulling apart and magma is filling the gap.

Because all this activity has been churning under Iceland for so long, there's been time for many types of magma to evolve, said Stephen Self, a volcanologist who works for the Nuclear Regulatory Commission in Maryland.

Some magmas have more explosive power than others because they contain more dissolved carbon dioxide, sulfur dioxide, and other gases, scientists say. At some point as magma rises, decreasing pressure allows the gases to bubble out, much as they do in a newly opened bottle of champagne.

In addition, thinner magmas tend to flow and thicker ones tend to explode. In thick magmas, the gases can bubble out of solution suddenly, turning the molten rock into froth.

The ash that's been hovering over Europe actually came from the edges of burst bubbles, said John Eichelberger, who heads the Volcano Hazards Program for the U.S. Geological Survey.

Once magma bursts out of the ground, he said, the bubble edges cool too fast to solidify into any kind of crystal structure. Instead they become glass, which retains some liquid-like properties.

Many of Iceland's volcanoes, including E15, get extra power from the glaciers that cover them. The erupting magma acts like a blowtorch, melting and then vaporizing the ice. That amplifies the power of the eruptions in what's called a "fuel-coolant interaction," Self said.

Iceland also has a lot of fluorine, which contributed to the deadly effects of 1783's Laki eruption. Fluorine-laced gas killed people as far away as England and led to a surge in chronic illness. Fluoridosis killed between half and three-quarters of Iceland's farm animals.

The eruption also released many times more sulfur dioxide than E15, leading to the long-lasting haze over Europe and freakish cold in Europe and North America.

On the bright side, people are getting better at forecasting eruptions, USGS' Eichelberger said. They have made big strides in the last decades, thanks to advances in radar and GPS. By

measuring swelling in parts of the ground, the Icelanders forecast an E15 eruption a year ago.

Closer to the eruption, small earthquakes prompted the evacuation of the few people who lived in the remote area around E15.

Now, however, the scientists can't say whether E15 will continue to die down or start erupting again.

One thing they do know is that E15's emissions so far won't cause any large-scale climate change because they haven't been lofted high enough. Other eruptions, such as Pinatubo in 1991, sent ash and sulfur dioxide into the stratosphere, where it circled the planet, causing dramatic sunsets and a drop of 1 degree Fahrenheit in global temperatures.

Volcanoes have led to global cooling and then, later, global warming. The cooling comes from sulfur particles that form sulfuric acid droplets in the atmosphere. The particles are just the right size to block sunlight. That's what is thought to have led to the famous "year without a summer" in 1816 after a powerful eruption of the volcano Tambora in Indonesia.

Over the last 1,000 years, volcanoes have been the major natural driver of climate, said Alan Robock, a climatologist at Rutgers University.

Recent observations of the sun show it doesn't vary in brightness nearly enough to compete with the much more striking effects of volcanic gases on Earth climate, he said.

Changes in global temperatures over the course of the last millennium track with volcanic activity, he said. The fewer active volcanoes, the higher the temperature. That connection stops in the 20th century, when temperatures began to rise dramatically despite several major eruptions, he said.

Volcanoes also cause global warming - but that happens later, over longer time scales, said Caspar Ammann, a climatologist with the National Center for Atmospheric Research in Colorado. That's because they emit carbon dioxide, which hangs in the atmosphere long after the sulfur particles rain back down.

In the 100,000-some-odd years that modern humans have existed, there's been one megavolcano, Toba, which erupted in Indonesia about 74,000 years ago. Its ash covered much of India and Pakistan and parts of China.

Robock, who has done some modeling of the atmospheric effects of Toba, said the temperature probably plunged around 20 degrees Fahrenheit below normal for several decades, and the murky daytime sky would have barely outshone the night.

We've been lucky in recent times that no major volcanoes have gone off in densely populated areas, NRC's Self said. But barring the end of the world from some other near-term catastrophe, it's pretty much inevitable.

Contact staff writer Faye Flam

at 215-854-4977 or fflam@phillynews.com.

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