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Catastrophes

The world's most deadly volcanoes

The most fateful and tragic explosions of rock, lava, ash and gas

Presented by
Jane Palmer

Last August, in southern Iceland, the flanks of the volcano Bardarbunga ripped open and fountains of lava spouted skyward. Molten rock oozed downhill making its way toward the sea. The eruption has now come to an end but the volcano continues to pump gases into the atmosphere. Scientists are still monitoring it closely.

“Bardarbunga has really, for the first time, seriously showed its power,” says Pall Einarsson, a geophysicist at the University of Iceland. But, for now, the eruption has followed what Einarsson describes as the “best case scenario.” Aside from the occasional air pollution affecting eastern Icelanders, its impacts have been minimal and it bears little resemblance the granddaddy of Icelandic volcanoes: Laki.


When Bardarbunga blew its top (Credit: Arctic Images/Alamy)

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Laki’s eruption started in 1783 and, for eight long months, it spewed lava and noxious gases. The sulphur dioxide created acid rain that decimated Iceland’s vegetation, and fluorine gas settled on the grass eventually killing sixty percent of the livestock. **More than a fifth of the Icelandic population, approximately 10,000 people, died from famine or disease**.

But Laki’s devastation spread well beyond the ‘island of fire and ice.’ The sulphurous haze quickly reached Europe, **damaging crops and blocking out the sun’s rays**, leading to cooler temperatures. Even in Alaska, the **summertime temperatures were 4 Celsius less than the norm and Russian traders noted a population decrease in the Inuit**.

Although the ultimate death toll from Laki might be near impossible to estimate, the volcano definitely earns its place amongst the world’s deadliest. It’s a list that includes Indonesia’s Tambora volcano, which erupted in 1815, and Columbia’s Ruiz volcano, which claimed the lives of local Columbians as recently as 30 years ago.

Each volcano wields its force differently (Credit: Tui De Roy/NPL)

None of these volcanoes wielded their force in quite the same way, and nearly all took their victims by surprise. Does that mean that, with the science of volcanology now being able to predict when a volcano erupts, that deadly volcanoes are a thing of the past?

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Economists at Saxo Bank don't think so. Listed in their **'Outrageous Predictions' for 2015** was that an eruption of Bardarbunga would cloud the skies over Europe and call for a doubling of food prices. Although the bank's predictions are typically for unlikely events, several previous predictions have unfortunately come true.

If Bardarbunga, which lies partly under a glacier, had erupted under the ice, it would have sent plumes of gritty ash into the sky and furious floods across the mainland. "But what happened was a very peaceful lava eruption on an ice-free part of the country, where it could not possibly do any harm," Einarsson says.

But in the decades to come, will Iceland, and the world, remain so fortunate?

Forces of Fire and Flood

On April 5 1815, a some 4000 metre high volcano, Mount Tambora, on the island of Sumbuwa in Indonesia, burst into life so loudly that **soldiers hundreds of miles away in Java thought they'd heard cannon fire** and dispatched troops to repel invaders.


The Mount Tambora volcano, photographed by NASA from space (Credit: PF-(space1)/Alamy)

The Mount Tambora volcano, photographed by NASA from space (Credit: PF-(space1)/Alamy)

Then, five days later, the real fireworks began: Tambora propelled plumes of smoke and ash thousands of metres into the skies. "Big billowing pillars, or columns, of ash and gas, hot gas, shoot up above such a volcano to huge heights, up to 30,000 feet or so," says Jon Davidson, an earth sciences professor at Durham University in the UK.

Tambora ejected about 150 cubic kilometres of ash, some of which settled as far as 1,300 km away. In central Java and Kalimantan, 900 km (550 miles) from the eruption, **one centimetre of ash fell**.

It was the most powerful volcano recorded in modern times - a 7 on the volcanic explosivity index (VEI-7).
The collapse of the eruption column produced numerous burning pyroclastic flows - high-density mixtures of burning rock fragments and hot gases - that descended downslope at great speed. "If those columns collapse, and we know they do continuously while the volcano is erupting, they are deadly because they are very, very quick," Davidson says. "You can't outrun them."


Hot ash is major cause of volcanic destruction (Enrique Lopez-Tapia/NPL)

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Decimating all the villages in their path, the fiery flows plunged into the ocean where the hot-cold mix sent further explosions of ash soaring into the atmosphere. Ash smothered buildings and crops and contaminated the water. Whereas the pyroclastic flows and volcanic bombs killed almost 10,000 people, an estimated 82,000 more died indirectly from starvation and disease.

> *It was a potent mix of magma and seawater that made the eruption so explosive. And that blew the island to pieces*

And Tambora's deadly tendrils spread far afield. Its sulphurous emissions caused acid particles to spread around the globe, triggering a global cooling. The year was known as a **"Year Without a**

Summer," one that led to major food shortages across the Northern Hemisphere. Beyond the fatalities from hunger, the cold also claimed lives. In America, the year earned the nickname **'eighteen hundred and froze to death,'** and frozen crops spurred many farmers to strike West in search of warmer temperatures.

Less than 60 years later, another Indonesian volcano shook the world, but this time its strike was sure and swift: within one day, more than 36,000 people died. On August 26, 1883, Krakatoa, which lay 1,400 km west of Tambora, jetted out a white cloud of ash and pumice. As the volcano hurled its innards into the air, its underground chamber emptied and, eventually, with nothing to support it, the cavity's rock roof collapsed. Water then gushed onto the magma - a mixture of molten and semi-molten rock and dissolved gases - and such a cataclysmic eruption ensued that i**t was heard more than 7,000 kilometres** away in Sri Lanka.


Volcanoes remain active in Indonesia (Credit: Jurgen Freund/NPL)

Volcanoes remain active in Indonesia (Credit: Jurgen Freund/NPL)

"It was a potent mix of magma and seawater that made the eruption so explosive,' says Davidson, "and that blew the island to pieces."'

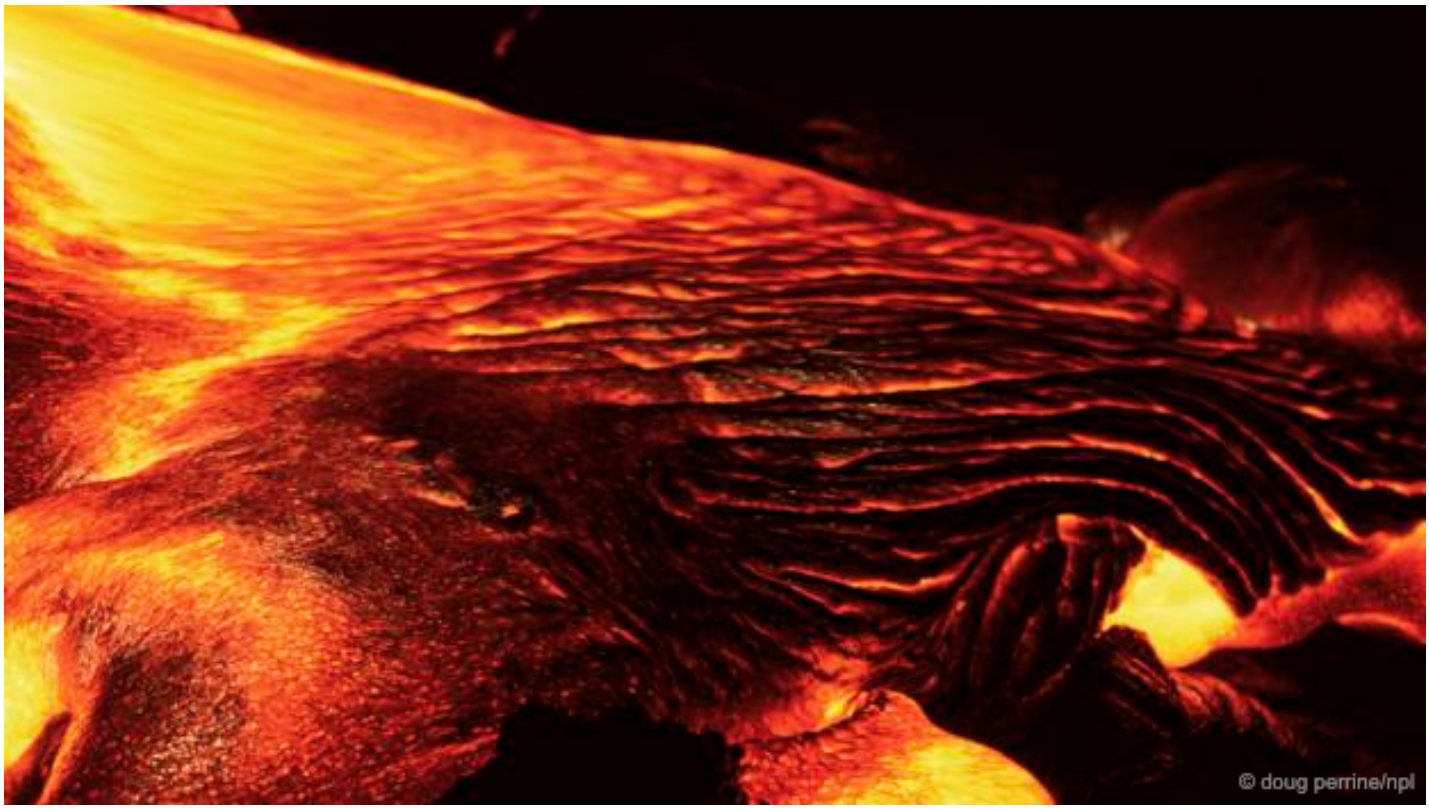
The volcano then collapsed to 250 metres beneath sea level, and two-thirds of the island followed it. Most of the casualties, however, were on neighbouring islands. Following the first eruption, tsunami after tsunami hit the shores of Sumatra, Java and the adjacent islands obliterating villages and coastal communities. And, in similar circumstances to the aftermath of Tambora, sun blocking gases caused global temperatures to fall by as much as 1.2 Celsius.

"Even though it wasn't as big as an eruption as Tambora, I think Krakatoa had a bigger effect," says Davidson. When it comes to being deadly, size isn't everything, he points out.

Small but Deadly

A veritable monster of volcanoes, the ice-capped Nevado del Ruiz covers more than 200 square kilometres in central Columbia, stretching 65 kilometres from east to west. But when it came to life in 1985, it issued a mere murmur, an eruption that only registered a 3 on the Volcanic Explosivity index. Not enough to worry the residents of the town of Armero, 40 kilometres away.

"People live a long way from the summit because the volcano is so large," says Don Swanson, a volcanologist at the Hawaii Volcano Observatory. "So the threat doesn't seem as immediate as it might be around a smaller, more conical shaped volcano."



Lava flows can trigger other, more deadly effects (Credit: Doug Perrine/NPL)

On eruption, the volcano's heart ejected a molten mass of rocks and gas, which in itself didn't impact the town. But the heated material melted the glacier and **sent a mixture of ice and water careering down the hillsides at 50 kilometres an hour**. These landslides picked up ash, rocks and volcanic material to form lahars - volcanically induced debris flows - which coursed into the major rivers at the base of the volcano.

"One river charged through the small town, and basically demolished it," Davidson says. In Armero, the lahar killed more than 20,000 of its almost 29,000 inhabitants. Scientists had warned the government that mudslides could destroy the towns, but the inhabitants didn't evacuate.

"And this is the real tragedy of the Ruiz situation. The lahar, of course, would have destroyed the town but people could have escaped with their lives," Swanson says. "This was a small, manageable event - it was a very small eruption."

Ruiz was the second deadliest volcanic disaster of the 20th century, surpassed only by the 1902 eruption of Mount Pelée on the island of Martinique. But only one notch higher on the explosivity index than Ruiz, Mount Pelée claimed 28,000 lives shortly after erupting.

1902 eruption of Mount Pelée on Martinique (Credit: Mary Evans Picture Library / Alamy)

1902 eruption of Mount Pelée on Martinique (Credit: Mary Evans Picture Library / Alamy)

When the volcano blew its top, on the morning of May 8, its lava dome collapsed to send a fireball of gas, steam, dust and pumice shooting down the hillside. This pyroclastic flow, thanks to the incandescent gas, is also known as an nuée ardente - a glowing cloud. Travelling at more than 160 km/h (100 m/ph), **it struck the town of St Pierre at 8:02am** and immediately suffocated and burnt its inhabitants. Only three survived, including Auguste Ciparis, the sole occupant of the city's dungeon.

“It's just coincidence whether or not those pyroclastic density currents head towards an area of dense population,” Davidson says. “It could have gone down the north side, in which case nobody probably would have even heard about the eruption.”

What’s simmering?

For years after the Krakatoa volcano sank spectacularly into the ocean, peace reigned in the surrounding area. But then, in 1927, **Javanense fishermen saw steam and debris bubbling away in the water**. Soon after, Anak Karakatoa - 'Child of Krakatoa' - began to rise above the sea.

This ‘enfant horribilis’ has since erupted quite frequently to reach a height of about 300 metres, but Davidson doubts that another massive Krakatoa eruption will happen again soon. Currently, there is simply not enough magma in the volcano’s chamber to fuel such an explosion, he says.

An erupting volcano has extraordinary power (Credit: Wild Wonders of Europe/Grunewa/NPL)

Should another large volcanic eruption hit Indonesia, however, the casualties could be huge, as millions of people live in places prone to flooding. “The most dangerous volcanoes are, of course, those that are in the densely populated areas,” Swanson says.

If pressed to name the potential most deadly volcano of the future, both Davidson and Swanson concur: “Vesuvius is one that I think would probably be at, or very close to, the top of every volcanologist's list,” Swanson says.

Vesuvius, perhaps the most famed volcano worldwide, decimated the town of Pompeii and Herculaneum when it exploded in 79 A.D. Now more than 600,000 people live near its base in what is termed the **“red zone”** - the 12-kilometre radius where people would stand little chance of survival if the volcano explodes again.

But in the battle of man against the immortal, science is proving an invaluable weapon. Volcanologists at the Vesuvius Observatory now monitor the volcano constantly to anticipate future eruptions. “Then you'll have an opportunity to make decisions which can potentially move the population out of the way, “ Davidson says.

An eruption of Vesuvius, Italy, April 1906 (Credit: The Print Collector/Alamy)

By mapping back through time to previous eruptions and analysing them, scientists can now begin to determine the nature and timing of future eruptions, Davidson says. “The more we study the

volcanoes, the more familiar they become in the sense that they have, just like people, certain characteristics," Davidson says.

But that doesn't necessarily mean that deadly volcanoes are simply a phenomenon of the past.

There are many volcanoes that haven't erupted in living memory, and aren't being monitored, Davidson says. "And because we've never seen it, we don't really know what we're looking for," he adds.

When Mount Pinatubo erupted in 1991, for example, few scientists had been monitoring it - its last eruption had been some 400-500 years earlier. Although many people fled the region after scientists' warnings, 847 still perished.

An Icelandic volcano explodes, May 2010 (Credit: Erlend Haarberg/NPL)

And what of the Icelandic volcanoes? As Laki has already demonstrated, these volcanoes wield their own brand of deadliness, spreading noxious gases to the nearby densely populated European countries. Icelandic volcanoes will always give plenty of warning, however, and scientists can monitor air quality so that governments can take the necessary precautions, Davidson says.

Still, scientists will watch closely, should Bardabunga make another move. Einarsson remains cautiously optimistic. It was the biggest eruption for 200 years, he says, but still the damage was minimal.

So even though Bardarbunga certainly had the potential to create a catastrophe along the lines of the Laki disaster, “It would really be quite far-fetched to assume that now,” Einarsson says.

Let’s just hope it stays that way.

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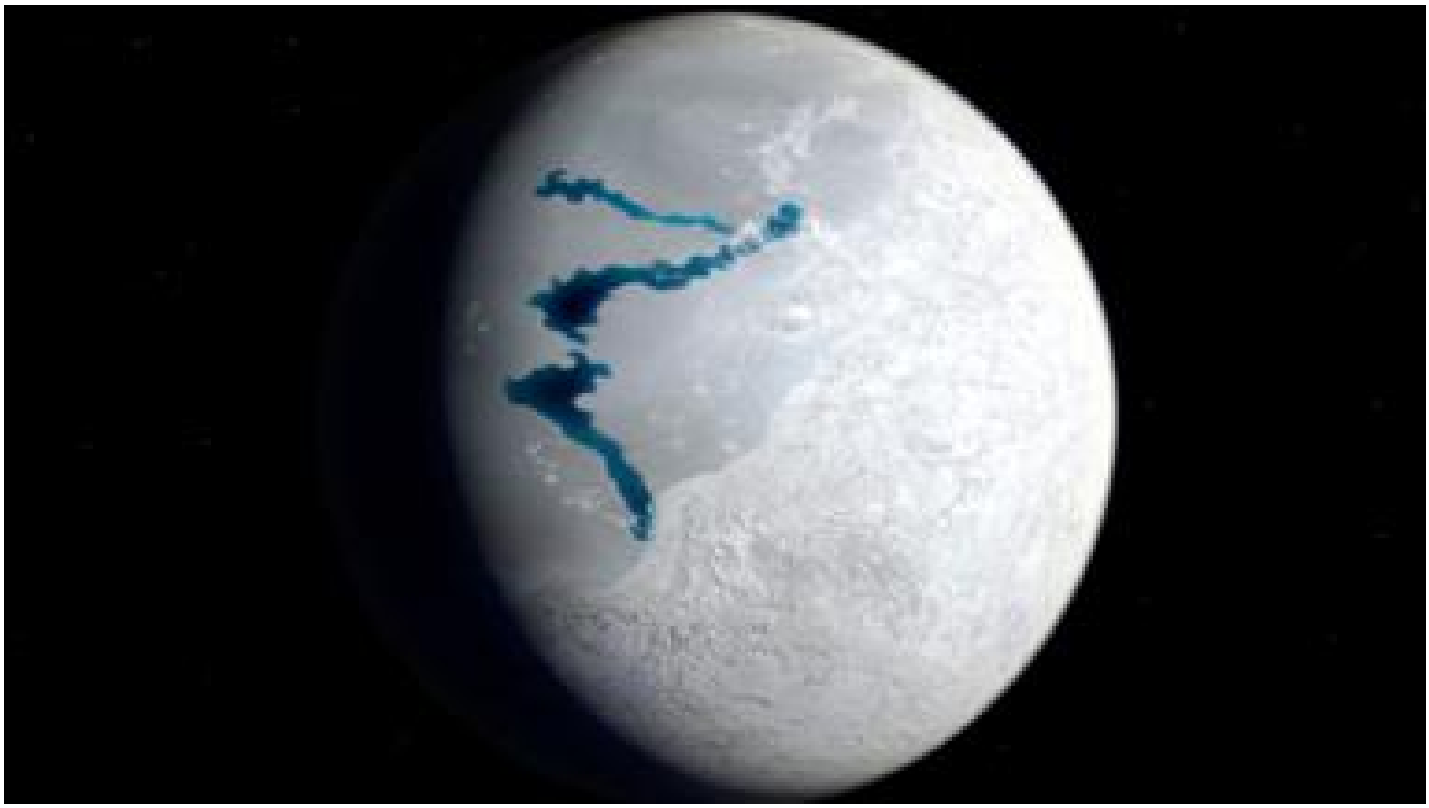

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