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Not My Fault: Steamed about volcanos

Lori Dengler/For the Times-Standard
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I want to clear up two misconceptions you may have gotten from last week's column about the December 9th eruption in New Zealand. First, that this volcano only produces small steam/gas explosions (phreatic) and second, that all phreatic eruptions are small.

Whakaari/White Island may look small at the surface. The 800 acres surface expression is only the tip of the volcano. From the sea floor, it is over 5,200 feet high and only about 20 percent is above the surface. Geologists have found a complex eruptive history of lava flows, domes and ash/tephra. The eruptions of the past century have been small. But GNS, the New Zealand agency responsible for monitoring geologic hazards, notes there is magma beneath the cone and there is a small but real chance it could produce a much larger eruption, affecting coastal communities around the Bay of Plenty and possibly producing a tsunami.

Volcanologists use the Volcanic Explosivity Index (VEI) to describe how large and how explosive an eruption is. It ranges from 0 (lava flows, no explosions or fountains) to 8 (catastrophic explosions reaching the stratosphere). Hawaiian eruptions tend to be in the 0 to 1 range. The eruption of Mt. St. Helens in 1980 was a 5. The most explosive eruption in written historic times was the 1815 eruption of Tambora in Indonesia, a 7 on the VEI scale. The Taupo eruption 26,500 years ago (about 100 miles SW of Whakaari/White Island) is likely the world's most recent VEI-8 eruption. The December 9th eruption ranks somewhere between 2 – 3.

Phreatic eruptions are common and occur in volcanic systems all around the world and many are small, in the VEI 1 to 3 range. Last week's eruption was likely driven by the slow degassing of the magma body beneath the volcano. Some of the gas gets trapped in subsurface pockets and suddenly becomes unstable and bursts to the surface, blasting existing rock and debris with it. But phreatic eruptions can also be powered by any water nearby such as lakes, seawater or ground water coming into sudden contact with the extremely hot rock near the magma body and when this happens, very large eruptions can occur.

One of the largest eruptions in written historic times may have been largely driven by an explosive steam blast. In late August of 1883, much of the island of Krakatau (Krakatoa), blew into the atmosphere in what is arguably the loudest explosion ever recorded, the sound circling the earth four times and rated 6 on the VEI scale. Australia's Bureau of Meteorology released a report in 2012 estimating the energy released in the explosion was the equivalent to 200 megatons of TNT, about four times greater than the largest nuclear bomb ever tested. Most volcanologists believe that the sudden contact of seawater with the magma body played a major role in the explosion.

Steam is also likely to have played a large role in New Zealand's worst volcano disaster, the 1886 eruption of Tarawera on the North Island that claimed at least 120 lives. I became fascinated with Tarawera in 2002 while spending time in the country. What drew my attention were the Pink (Te Otukapuarangi) and White Terraces (Te Tarat), or rather the destruction of them in the eruption.

The Pink and White Terraces were a geologic marvel touted by the fledgling New Zealand tourist industry of the mid-nineteenth century as the 8th natural wonder of the world. Cascading mineral-rich geothermal waters down the sides of Mt. Tarawera deposited silica in the form of chalcedony, creating a series of stepped ponds, the water eventually entering Lake Rotomahana. The White Terraces, the larger of the two, covered 20 acres with 50 terraced pools, each level stepping down a few feet. The waters were hottest at the top and visitors could choose their preferred temperature. There are several similar places in the world today such as Badab-e Surt in Iran and Pamukkale in Turkey (formed by deposition of carbonates), but the Pink and White Terraces were unique and likely one the largest silica sinter deposits on earth when they existed.

The idyllic world of the terraces was shattered in June of 1886 with a series of earthquakes, large enough to be felt by residents. What happened next is a bit of a chicken and egg story. Magma may have reached the surface and contacted lake waters which instantly flashed to steam or the water made contact with the hot rock, flashing to steam and enabling the magma to erupt as well. Either way, it is an example of a phreatomagmatic eruption – one that involves both steam/gas and primary molten rock. The steam greatly amplified what would have been a more placid eruption had only the basaltic magma been involved. The explosion was heard in Christchurch over

400 miles away. The eruption rates 5 on the VEI scale, comparable to 1980 Mt. St. Helens.

It was deadly for the Maori villages which were quickly buried beneath volcanic debris. In an instant the Pink and White Terraces were gone, destroyed or covered in the blast and ultimately water. Lake Rotomahana became ten times larger and 100 feet higher. In 2002 we took a boat ride across the lake and I imagined those glorious terraces many feet below us. Tarawera still bears the scars of the 1886 eruption, the thick ash deposits still preventing vegetation regrowth and a deep cleft along the mountain ridge where the fissures exploded.

Note: Note, the death toll from the December 9th eruption has reached 18. GNS summary of hazards at Whakaari/White Island
https://www.gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/New-Zealand-Volcanoes/Volcano-Geology-and-Hazards/White-Island-Geology ,
a description of the 1886 Tarawera eruption is at https://www.wired.com/2011/02/the-1886-eruption-of-mt-tarawera-new-zealand/

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