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Not My Fault: Big Eruptions Past and Present

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Last week was front stage for tsunami. Now volcanoes get equal time. The annual meeting of the American Geophysical Union was held last week in Chicago and volcanic eruptions were featured prominently.

Volcanic eruptions are far more common than most people think. At any given time, there are roughly 50 volcanoes in some state of eruptive activity or volcanic unrest. And that doesn't even count the nearly continuous oozing of lava from segments of the oceanic ridge system that go undetected and unnoticed.

Visit https://volcano.si.edu/reports_weekly.cfm to view Smithsonian/USGS Weekly Volcanic Activity Reports for a quick overview of what volcanoes currently doing. Some on the list have only recently stirred while others have been erupting for a long time. Over the last month, every continent except Antarctica and Australia are included. The longest ongoing eruption is Dukono on Halmahera Island in Indonesia. The current eruption began in 1933 and has continued with small explosions and gas emissions ever since.

In contrast to Dukon's nearly continuous small to moderate eruptions was a recent listing of Taupo in New Zealand. Taupo is a large volcanic complex that is marked today by a large lake in the center of the North Island. Seemingly serene, the lake occupies the caldera formed about 65,000 years ago in one of history's largest documented eruptions. Taupo has been quiet for roughly 1800 years.

Taupo has yet to produce any new volcanic products, but an increase in earthquake activity beneath the lake has raised concerns. Last September New Zealand's GNS Science Institute raised the volcanic alert to level 1 at Taupo for the first time. Level 1 is roughly equivalent to the USGS Advisory or Yellow alert and means that there is increasing unrest in the form of earthquakes, gas emissions, or ground surface deformation.

Last month's magnitude 5.7 earthquake right beneath Lake Taupo increased the concern. Nearly 700 aftershock have been recorded since the November 30th tremor. The shaking apparently triggered a landslide in the lake resulting in a tsunami that caused some damage. GNS is careful to note that the current unrest is not necessarily going to lead to an eruption, but it is a sign that shifting is going on in the vicinity of the magma chamber.

Taupo is an example of a volcano that rarely erupts but when it does, those eruptions can be very big and very explosive. Eruptions span a broad range of behavior and potential hazard. At one end are the effusive volcanoes, ones that produce lava flows that travel down slopes. Like Hawaii and Iceland, these volcanoes produce relatively "unsticky" lava. At the other extreme are eruptions with no lava. These are the explosive eruptions most often caused by very sticky magma that gas cannot easily escape from.

The Volcanic Explosivity Index (VEI) is a qualitative measure of the effusive to explosive style of eruption. Eruptions in Hawaii and Iceland typically rang between 0 and 1 on the scale and are characterized by lava flows and lava fountains. The magma that feeds these eruptions is created in oceanic mantle and travel through the thin, homogeneous oceanic crust. It is basaltic in composition and contains much less silica that the magmas that feed Taupo and other explosive volcanoes. Silica is what makes magma sticky and traps gasses.

The recent eruption of Mauna Loa is a good case in point. Mauna Loa reawaked on November 27th and for two weeks produced rivers of lava and fountains up to 120 feet high. Once it was clear that only the northeast rift zone had been activated, there was little threat to property and the main management concern was keeping people from approaching too closely.

But even relatively well-behaved basaltic volcanoes pose risks and bring surprises. Although the USGS was closely monitoring Mauna Loa and earthquake activity had increased this fall, there were no abrupt changes in the days and hours before the eruption began. The earthquakes are a sign that magma is moving up but there is no way to image the magma itself.

Explosive eruptions behave very differently than Mauna Loa. Take the 1980 eruption of Mt. St. Helens for example. Like Mauna Loa, an increase in earthquake activity was a sign of magma on the move. The upwelling magma also deformed the volcano, causing the mountain to swell. But unlike Mauna Loa, when the magma finally reached the surface, it didn't ooze out. Like shaking a beer bottle, the gasses relieved of the overburden pressure burst out of

solution propelling the magma miles into the air, high enough to be caught in the jet stream and rain down ash particles in three states. It ranked a VEI of 5.

The MT. St. Helens eruption was dramatic, and I was lucky to be part of a field study a few months later. The site of old growth Doug Fir knocked over like match sticks is imprinted on my brain. But the 1980 eruption was small potatoes compared to eruptions in the geologic past. Explosive eruptions are much easier to find than ancient tsunamis because of the great cloud of volcanic ash and debris they leave behind. The chemistry of the ash particles is a volcano's DNA – each eruption has a slightly different chemistry.

Geologist have mapped the ash fall from a number of prehistoric eruptions and North America is one of the best places on the planet to investigate them. The 640,000 year before present Yellowstone and the 760,000 BP Long Valley in Eastern California eruptions both blanketed the entire Western US with thick ash clouds. Both of these eruptions are 8s on the VEI scale.

There are even larger eruptions in the geologic record. La Garita Caldera in the San Juan Mountains of Southern Colorado was produced about 27 million years ago and produced a volume of ash large enough to bury California to a depth of 40 feet. La Garita may be the only known eruption worthy of earning a VEI 9.

It's hard to parse out the details of prehistoric eruptions but a more recent one gives new perspective on what impacts these ancient whoppers had. Featured prominently at the Chicago AGU meeting was last January's eruption of Hunga Tonga volcano. There is now evidence it blasted water vapor into space. The atmospheric pressure wave triggered tsunamis in different oceans. Yet it only had a VEI of 5. Imagine the tsunami La Garita may have produced, and it was nowhere near the ocean.

Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt and an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times-Standard's. All Not My Fault columns are archived online at https://kamome.humboldt.edu/resources and may be reused for educational purposes. Leave a message at (707) 826-6019 or email rctwg@humboldt.edu for questions and comments about this column, or to request a free copy of the North Coast preparedness magazine "Living on Shaky Ground."