

Not My Fault: Earthquakes, volcanoes and tsunamis? A Hawaii trifecta

Lori Dengler/For the Times-Standard
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It's been an exciting week on the Big Island. Earthquake activity ramped up on May 1, leading to volcanic activity alerts. On May 3, following a magnitude 5 earthquake, Kilauea's status was upgraded to Warning and new eruptive fissures were observed. A magnitude 6.9 earthquake occurred the following day. As I write this, nearly 2000 residents remain under evacuation orders, 14 new fissures have been observed and 36 structures destroyed.

Kilauea is the most active volcano in Hawaii. Its name can be roughly translated from Hawaiian as "spewing." The longest historic eruptive pause was from 1934 to 1952. The current eruptive phase began in early 1983 and has been nearly continuous ever since.

The Island of Hawaii is comprised of five major volcanoes, of which only Mauna Loa and Kilauea are considered active. Most volcanic activity on the earth's surface is related to the interaction of tectonic plates and concentrated along spreading centers and subduction zones. Hawaii and the Hawaiian Islands owe their existence to a different source, a hot spot.

Hot spots are places where a plume of hot and partially melted rock slowly rises from deep in the mantle, perhaps as deep as the core-mantle boundary nearly 1800 miles beneath the surface. Many earth scientists interpret hot spots as the rising limb of a giant convection cell that help to drive tectonic plate motion. Where the hot spot reaches the surface, volcanic activity occurs.

Hawaii is the most famous and best-studied oceanic hotspot. Kilauea is the southernmost volcano on the Big Island and was formed about half a million years ago. Mauna Loa, slightly to the north, is 200,000 years older and is also active. Mauna Kea, now inactive, is a million years old. Moving further northwest, the age of volcanism on Maui is about 1.1 million years, Oahu 2.5 million years and Kauai 4.7.

The ages trace the movement of the Pacific plate over the hot spot, each volcanic center enjoying about a million

years of growth and activity before it moves too far from the heat source and begins to erode and sink back into the ocean. The pattern doesn't end with the main islands. The Hawaiian Seamount chain are the eroded remnants of former islands and continues the story back about 40 million years old. At this point, the extinct volcanoes make an abrupt turn following a more northerly trend and are called the Emperor Seamounts. The last seamount, where the chain ends near Kamchatka, is nearly 80 million years old.

Life atop a hotspot is complex and dramatic. The rising plume bulges the oceanic crust creating stress. The voluminous eruption of lava adds weight to the surface and more stress. The growth of the island creates faults and gravitational instability. Magma doesn't rise uniformly but may make sudden lateral shifts. Moving magma creates cracks in the rock and cracks mean earthquakes. All of this combines to make Hawaii not only volcanic but also seismically active.

These processes were on display in the past week. The USGS Hawaii Volcano Observatory has an array of seismographs, tiltmeters, GPS stations, gas sensors and other methods to monitor Kilauea. On April 27, HVO noted a pattern of swelling at the Kilauea summit switched to deflation. On May 1, the number of small earthquakes increased from an average of about 10 per day to over 100 and the earthquakes were clustered east of the current eruptive center. A notice was issued that magma was moving to the east and new outbreak of lava was possible. The first new fissures and small lava flows were observed on May 3rd and officials issued evacuation orders for the Leilani Estates area where the earthquakes were clustered.

On May 4th at 12:32 pm HST, a magnitude 6.9 earthquake occurred. It was about 12 miles SSW of where the fissures were located and not directly related to the magma movement. It is the largest earthquake to strike Hawaii since the M 7.4 Kalapana earthquake in 1975, and like that earthquake, was probably related to slumping of the flank of the volcano towards the ocean. The displacement caused deformation not only on land, but also beneath the sea floor and caused a small tsunami that registered about 10 inches high on the Hilo tide gauge.

The May 4th tsunami was too small to pose a threat but it did generate discussion about the potential tsunami hazard from a larger Hawaiian earthquake. The 1975 earthquake caused a major tsunami that approached 50 feet in height in the source area. The tsunami quickly lost

amplitude away from the source – it was just under 5 feet on Catalina Island and less than a foot on the US West Coast. If that earthquake were to occur today, California would likely be placed in an Advisory status. The good news from our perspective is that we have five hours of heads up, about the same amount of time as a tsunami coming to us from Alaska. And it's a good reminder of why it's important to conduct our annual Tsunami Warning Test.

What next? The earthquake activity is still elevated, magma is still migrating to the east and there is concern that groundwater could flow into the magma conduit and cause steam-driven explosions. Evacuation orders are still in effect over concerns of new fissures, lava flows and toxic gasses. It's Mother Nature's call.

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