**2018 Collapse of Kīlauea Caldera — Animation directed by Dr. Paul Segall, Stanford University**

Narration from the animation found here: <https://www.iris.edu/hq/inclass/animation/829>

In 2018, Kīlauea Volcano experienced its largest caldera collapse in more than 200 years profoundly changing the landscape. Hawaii Volcanoes National Park, home of this popular visitor destination, was closed for four and a half months due to unprecedented volcanic and seismic activity that damaged its infrastructure. Over a period of just a few months the bottom dropped up to 500 meters with a total collapse area of 5 square km. The collapse was accompanied by an outpouring of lava, 40 km from the summit, that covered over 35km2 of land, destroyed 700 homes, and displaced over 2,000 people.

Scientists can often forecast when and where an eruption will occur. In 2018 there was clear warning of potential for eruption in the Lower East Rift Zone.

Caldera collapses are fortunately rare, as they are associated with the largest volcanic eruptions. Sensitive monitoring equipment has helped scientists understand how magma moves below the surface, how it is stored, and what triggers a caldera collapse.

So…What have we learned from this episode? And how might it improve our understanding of volcano hazards.

Kilauea Volcano is the youngest and most active of the five volcanoes on the island of Hawai`i. Eruptions are concentrated at the summit caldera and within two rift zones that radiate away from the summit. A cross section will help us describe what happened in 2018 both at the summit caldera, and within the East Rift Zone.

The summits of most large shield volcanoes are occupied by large collapse features, called calderas.  Calderas are large basin-shaped volcanic depressions that form when magma is withdrawn or erupted from a shallow underground magma reservoir.Calderas are observed at hundreds of volcanoes around the world. Fortunately for us, caldera forming eruptions are rare, as they can be extremely hazardous. Hawaiian caldera collapses tend to occur during passive eruption of fluid magma at distant vents, vs the more-dangerous explosive volcanoes that form calderas during catastropic eruptions of pumice and ash.

Rift zones are linear sets of cracks and fissures that can facilitate the movement of magma below the surface.

The eruption that created the Puʻu ʻŌʻō cone began on January 3, 1983, and erupted nearly continuously for 35 years, relentlessly mantling the landscape with over 117 km2   of lava.

During that time, Magma rose from deep in the mantle forcing magma, stored in the summit reservoir, down the east rift zone to erupt at Pu’u o’o

On April 30, 2018, Pu`u O`o abruptly collapsed and shut off.

Following this, earthquakes and ground deformation moved down the East Rift Zone as magma forced its way underground, ultimately erupting in the Leilani estates subdivision. By mid-June, lava was erupting at a rate nearly 50 times the rate that it had been venting at Pu’u O’o.

We will use a highly simplified cross section of a magma reservoir and the overlying caldera to look at the subterranean architecture of Kilauea, and to show how the massive outpouring of lava in 2018 caused the summit of the volcano to collapse. The shape of the subterranean magma reservoir is only roughly known, we idealize its shape here for simplicity.

Sensitive instruments that measure motions of the ground surface record changes in pressure within magma reservoirs. When pressure increases the ground bulges ever so slightly upward, much as a balloon inflates; when pressure decreases the ground surface slightly deflates.

In 2018 magma flowed out of Kilauea’s summit reservoirs far faster than it was replaced by fresh magma from the mantle, causing the pressure in its summit reservoir to decrease,and the active lava lake in Halema’uma’u to drain away

We represent this deflation with arrows pointing downward and inward (left).

As the eruption continued in May of 2018, and the magma pressure decreased, it could no longer support the weight of the overlying crust, which is about a half a mile thick and over a mile across. As the overlying crust began to break, thousands of small earthquakes occurred on the edges of the caldera block.

Eventually the stress became too great, and the caldera block dropped almost 10 feet in a matter of a few seconds. The small earthquakes immediately stopped. As the block dropped, it squeezed the underlying magma increasing its pressure. This pressure pulse sent surges of magma down the rift zone, peaking about 3 hours after the collapse 40 km down rift in the Leilani Estates

As magma drained from the summit, the surge diminished and the pressure of the magma within the summit magma reservoir began to decrease again, and the cycle repeats.

Ultimately, the summit collapsed in 62 discrete events, spaced roughly a day and a half apart. The graph shows the sudden drops of the Cals GPS station, which occurred over roughly 10 seconds per drop.

The cumulative effect of these collapse events was to form a new caldera, nested within Kilauea’s pre-existing caldera that formed about 500 years ago, with a floor fully 500 m below the previous bottom of Halema`uma`u crater.

Finally on August 10, the eruption stopped. Scientists are uncertain as to why it stopped so abruptly.

Because Kilauea is so well studied, and covered by state-of-the-art monitoring devices, we were able to take the pulse of the volcano as the caldera formed. Lessons learned during the events of 2018 will be incredibly helpful in guiding response to future volcanic eruptions around the world.