Transcript – 2017 09-07 (JB)

Kīlauea Summit Eruption | Lava Returns to Halemaʻumaʻu

00:00 – Hawaiian Chant:

E komo maloko o Halemaʻumaʻu
He mau nā puʻu e ʻolāʻolā nei
E Pele e Pele e Pele e Pele
E Pele e Pele
Hū ʻaʻina hū ʻaʻina kū
Pahū pahū ʻūhā maʻi o ka lani ani
Pahū pahū ʻūhā maʻi o ka lani ani
Pahū pahū ʻūhā maʻi o ka lani ani

00:53 – **Narrator**: Unfolding before our eyes, on the Island of Hawaiʻi, is a mesmerizing window into Kīlauea Volcano. When Mark Twain witnessed a Kīlauea lava lake in 1866, he remarked that the sight "fascinated the eye with its unapproachable splendor." But the story of this lava lake is more than splendor.

01:18 – **Noah Gomes** (National Park Service Ranger): Kīlauea, this volcano, in general, is a very sacred place.

01:29 – **Noah Gomes**: Halemaʻumaʻu crater, which is right behind me, is even more sacred because that is literally the home of Pele, who is the volcano deity.

01:43 – **Christina Neal** (HVO Scientist-in-Charge): Kīlauea has long been known to be a marvelous natural laboratory for the study of volcanoes, because it is frequently active and very accessible. We have such wonderful science that we're doing here—tremendous insights into how the volcano works and how the lava lake behaves.

02:04 – **Narrator**: The lava lake within Halemaʻumaʻu, a crater at the summit of Kīlauea is one of the two largest lava lakes on Earth. There are few features like this in the world.

02:25 – **Narrator**: The Island of Hawaiʻi is formed by five overlapping volcanoes, with the youngest, Kīlauea, to the southeast. Kīlauea is one of the world's most active volcanoes. It began growing on the Pacific Ocean floor as far back as 600,000 years ago. Repeated eruptions piled lava flow upon lava flow, building a gently-sloped shield volcano that eventually emerged above sea level. Today Kīlauea's summit rises to an elevation of just over 4,000 feet. About 500 years ago the top of Kīlauea collapsed forming the summit caldera we see today. Within this caldera is Halemaʻumaʻu crater.

03:29 – **Narrator**: For centuries, Hawaiians chronicled an intimate oral history of Kīlauea through chants. Written records began with the arrival of missionaries in 1823. For the next one hundred years, a nearly continuous lava lake existed at Halemaʻumaʻu. Its eruptions were a tremendous draw for visitors.

When geologist Thomas Jaggar first came to Kīlauea in 1909, he deemed it the ideal site for the systematic study of volcanic activity. In 1912, he established the Hawaiian Volcano Observatory.

Four years later, the national park was created. Today, about half of Kīlauea lies within the boundaries of Hawai‘i Volcanoes National Park.

In 1924, violent explosive eruptions doubled the diameter of Halema‘uma‘u to more than 3,000 feet. After the explosions, short-lived lava lakes occurred in Halema‘uma‘u until 1934. Then the entire volcano went quiet for 18 years. Lava returned to Halema‘uma‘u in 1952, with intermittent eruptions until 1982. The summit of Kīlauea was then quiet until 2008.

04:47 – **Jeff Sutton** (HVO Geochemist): And by mid-January the values of sulfur dioxide emissions from Kīlauea's summit caldera were higher than we'd seen them in over twenty years...and the numbers kept going up. And the overall chemistry of those gases had changed dramatically. That's when we really knew that something was up.

05:09 – **Narrator**: At 2:58 a.m. on March 19, 2008, Halema‘uma‘u awoke with an explosion. As the first summit eruption in almost 26 years, it was exciting! This explosion damaged the National Park overlook and ejected rocks large enough to have caused serious injury or death had anyone been on the rim or trail. The next morning, as U.S. Geological Survey scientists drove toward the crater, the crunching of rocky debris beneath their vehicle’s tires was one of the first clues that something big had happened.

After the explosion, a hole, or vent, more than 100 feet wide could be seen in the crater wall. Nighttime glow from this vent meant that lava was just below the surface. Over the next few months, the lava level slowly rose higher, and the vent grew wider. Views got better and better. Eventually, a lake of molten lava within the vent could be seen from the rim of Halema‘uma‘u.

In 2015, the lake rose high enough that lava briefly spilled onto the floor of Halema‘uma‘u for the first time during the eruption. Today, lava spattering on the lake’s surface is occasionally visible from the National Park’s Jaggar Museum Overlook. Millions of visitors have—like Mark Twain—witnessed the splendor of an active lava lake.

06:58 – **Narrator**: Since 2008, the active vent within the crater has grown due to collapses of the vent rim. By early 2017, the summit vent was more than 800 feet wide—and still growing.

Today, the lava lake at the summit of Kīlauea is one of two ongoing eruptions at the volcano. The other active vent is on Kīlauea’s East Rift Zone, which has been erupting nearly non-stop since 1983. This is not the first time two vents have erupted on Kīlauea at the same time. But the duration of these two active vents is unmatched in recorded history.

Since 1983 the ongoing East Rift Zone eruption has covered more than 54 square miles with lava flows and has destroyed more than 200 structures, including scores of homes. The continuous monitoring of Hawaiian volcanoes that was begun by Jaggar in 1912 continues today.

08:10 – **Christina Neal**: One of the fabulous opportunities we have right now, because of an ongoing simultaneous eruption along Kīlauea’s East Rift Zone and the summit, is to look at this connection between the summit and East Rift Zone, the magmatic plumbing connection.

08:22 – **Jim Kauahikaua** (HVO Geophysicist): For everyone at HVO it's an unparalleled opportunity to study the hydraulics of the eruption, of how Kīlauea works, it gives us a window into the magma chamber here.

08:37 – **Narrator**: "I ka nānā no a 'ike" is a Hawaiian proverb that means "by observing, one learns." And that's certainly the case for USGS Hawaiian Volcano Observatory scientists. Observing the physical processes on Kīlauea, combined with today's sophisticated monitoring instruments helps USGS scientists develop a more complete picture of how volcanoes work.

09:08 – **Matt Patrick** (HVO Geologist): This is a situation where we actually have a large lava lake that's easy to get to, so it's really probably one of the best research opportunities on Earth for understanding lava lake activity.

09:21 – **Narrator**: Many questions about Kīlauea Volcano's summit eruption are being answered through careful field studies and lab analyses.

09:35 – **Don Swanson** (HVO Geologist): We have a network of ten buckets out here to collect ash that is ejected from the lava lake. The network has existed since 2008. We do that so that we can keep track of how much ash is coming out of the lake and, therefore, this gives us some idea of how gassy, how gas rich the lava in the lake is. That's a pretty good haul for the past 24 hours. Also we're chemically analyzing this ash so that we can tell if there are any chemical changes that are taking place during the eruption.

10:18 – **Narrator**: Gas emitted from the summit vent can tell us a lot about what's happening inside the volcano.

10:27 – **Jeff Sutton**: One thing that we know about the emissions of sulfur dioxide gas is that it's tied to the amount of lava that's brought from depth up to atmospheric pressure. And it's that process that occurs when lava is erupted on the surface. So, by measuring the amount of sulfur dioxide that's released can tell us how much lava is being erupted on the surface. So, the FTIR instrument, we point it down at the lava lake, using the heat off the lava lake it's able to measure the concentration of about six or seven gas species that are boiling out of the lake at once, and we're able to measure that about every 5 or 6 seconds, so we're getting a gas analysis every five or six seconds which is fantastic.

11:18 – **Narrator**: Kīlauea emits more sulfur dioxide than the largest coal burning power plant in the U.S. These emissions produce volcanic air pollution, known in Hawaii as "vog."

11: 48 – **Jeff Sutton**: Since 2008, the overall gas emissions from Kīlauea essentially tripled. It's a tremendous amount of gas. All of that gas, the sulfur dioxide, irritating sulfur dioxide gas, and the sulfuric acid mist are carried downwind to communities at the southern end of the island and then the wind patterns carry those emissions up the Kona coast, where they affect people's lives in that area. So, this is a rather unique form of volcanic air pollution.

12:16 – **Narrator**: One spectacular feature of the eruption is Pele's hair, delicate strands of volcanic glass that carpet the ground downwind of the lava lake.

12:28 – **Don Swanson**: Pele's hair forms when gas bubbles in the lava pop, burst, and little droplets fly out and then they develop a tail on them. The tail is the Pele's hair. Yeah, the Pele's hair is glass, because it formed from the liquid that cools very quickly, so it forms a glass. It's very sharp. There's a very interesting lighting effect that takes place. When you're looking into the sun, and the sun's at a fairly low angle, the Pele's hair glistens like golden dry wheat or something.

13:10 – **Narrator**: Kīlauea's summit eruption provides an opportunity to observe and document the evolution of an active vent. These observations sometimes require the use of cutting edge tools.

13:22 – **Matt Patrick**: We also use lidar in collaboration with researchers on the mainland. And that lidar, which is basically a fancy name for laser scanning of the crater, that's able to give us a really precise scan of that crater geometry, so it's a nice 3D model of the vent.

13:41 – **Narrator**: Thermal cameras are another tool used to study the lava lake.

13:46 – **Matt Patrick**: So, the lava lake is set within this crater. We actually call the crater, the new crater, the "Overlook crater" because it opened just below the visitor overlook. So, in this Overlook crater, we have the lava lake, and the lake is set sometimes very deep within the crater, and that crater is often filled with fume. And obviously we want continuous observations of the lake, but the problem is, with the naked eye, with normal camera systems, those views can often be obscured by the thick fume. The fume is variable, it depends on the outgassing rates and also just the wind conditions, but one thing that we found to very useful is using thermal cameras to monitor that lake and look inside the crater. The benefit of the thermal camera is that it can see through the fume all the time, so it really gives us continuous observations of the lake. And obviously, when you're monitoring volcanoes you want continuous, 24/7, observations. So, the thermal cameras have proven really effective at being a good monitoring tool.

14: 49 – **Narrator**: Thermal cameras are just a part of the sophisticated digital network managed by HVO field engineers. This network delivers a constant stream of data on the volcano's activity.

15:03 – **Kevan Kamibayashi** (HVO Field Engineer): At a single site you could have a camera, you could have a gravimeter, you could have a GPS station, you could have a tiltmeter. Part of the uniqueness of the network we have monitoring that lake is that it's so close in proximity to the observatory. That allows us to have really high bandwidth radio links. That means that we can afford to do things like stream HD video from the vent back here to HVO.

15: 38 – **Don Swanson**: The lava lake has to be fed by lava that's coming up a conduit. The lava spills into the lake, but then it has to be recirculating and leaving the lake, otherwise the lake would fill up and spill out. So, there is a kind of convection that is taking place. The lava is coming up at the north end of the lake, flowing to the south end of the lake, and disappearing. The reason that it's dropping is that it's losing gas and it's cooling ever so slightly as it moves across the lake, so it's getting heavier. So, it's slightly heavier than the fresher magma that's coming in, lava that's coming in, so the whole thing circulates.

16:22 – **Narrator**: The lava lake level responds to pressure changes in the summit magma storage system, rising when pressure increases and dropping when it decreases. These changes occur over a matter of hours or days, and can shift the lava lake level by over 30 feet.

16:43 – **Narrator**: Scientists are looking at the rise and fall of the lava lake and how these changes impact the East Rift Zone eruption.

16:52 – **Matt Patrick**: So, Kīlauea has two ongoing eruptions, one at the summit and one on the East Rift Zone at Puʻu ʻŌʻō. And we've known that those eruptions are connected in some way. But, this new concurrent activity gives us new insight into that connection. One example of that connection is shown by the changing lava levels. The lava lake level at the summit fluctuates commonly, and what we observe at Puʻu ʻŌʻō is, there's often a small lava pond there, nothing like the lake we have at the summit. A small lava pond at Puʻu ʻŌʻō, and when we track the level there, it's basically in sync with the summit. And that makes sense because they're both basically fed magma from the summit magma chamber.

17:46 – **Narrator**: Explosive events have occurred throughout this eruption. Why they occur was initially a matter of speculation, but new tools have shed light on their cause.

17:58 – **Matt Patrick**: One of the interesting things about this eruption, and was a bit puzzling at first, was that we've had a handful of these small explosive events. These explosions have thrown volcanic bombs around the vent, so obviously it's not an area that you want to be when these explosions occur. And there was a debate, there were several theories proposed, but what we were able to determine based on geologic observations and also installing hi-res cameras around the vent, to look in the vent, is that we were able to determine that these explosions from the lake were actually triggered by large collapses of rock from the crater walls that were impacting the lake. And the lake is very gas rich, so it's very frothy, and when the rocks impacted the lake they triggered these explosions.

18:53 – **Narrator**: Many hazards are associated with the Halemaʻumaʻu lava lake.

18:58 – **Christina Neal**: Because of the ongoing hazards, both from gas emission and potential ballistic impact at the rim, HVO scientists who go into the area to conduct observations and make measurements follow a series of protocols that we've established through dialog internally, including wearing hard hats, always having a half face respirator around your neck to help you get out of the high gas concentration area, and also, where possible, wearing fire-proof or fire-resistant clothing.

19:27 – **Narrator**: The continuous study of active volcanoes is necessary to issue timely, accurate warnings of volcano hazards.

19:37 – **Christina Neal**: So we're building on a tremendous body of knowledge that goes back more than a century, using modern and sophisticated tools to answer some of the very basic questions that were asked 100 years ago. One of the important missions of the Hawaiian Volcano Observatory is to investigate and research volcanic processes really to better understand how volcanoes work. And with that understanding we can do a better job of advising about the nature

and extent of hazards, all of this in effect is to help people live safely with volcanoes which we must do, especially here in the State of Hawaii, where we live on volcanoes.

20:36 – **Narrator**: This is the longest Kīlauea summit eruption since 1924, and there are no signs that it's slowing down. But how long it will last, remains to be seen.

21:03 – **Noah Gomes**: There's something about lava that just inspires curiosity in humans. There's so many mysteries surrounding these volcanoes. There's so much we don't understand yet about how and why they work. This is like peering back to the beginning of Earth.

21:25 – **Jim Kauahikaua**: The opening up of the second vent at Kīlauea was very rare and the fact that it lasted so long is unprecedented in Kīlauea's known history anyway.

21:36 – **Don Swanson**: I think when people see lava, not just for the first time, but see it at all, it's a rather mesmerizing effect. You're used to seeing the Earth as being something solid, and here is rock, but it's moving. It's liquid rock and it's very hot. You can see that from the color and you can feel the heat, and so it's really a unique experience in nature.

22:00 – **Jeff Sutton**: So, working at HVO is a remarkable, remarkable experience. If you're a gas geochemist, that's going to put a song in your heart. It's allowing access to vents and fumaroles and one of the largest convecting lava lakes, active lava lakes, on the planet.

22:22 – **Noah Gomes**: In the case of Pele, her most famous and obvious body forms are the lava itself, she is the eruption, she is the volcano, she is the lava, she is the rocks after the lava cools, she is all this tephra that comes out in the plume out here, she's the gases coming out as well. So, all of this is Pele. And all of this is part of what is sacred and part of what is to be respected.

23:49 – **Christina Neal**: The fundamental scientific analysis is both exciting and gives us great insight into how the volcanoes and the Earth works, but it also allows us to help society live safely with volcanoes.

23:55 – **End**