Scientists find Galapagos volcano could help forecast future eruptions

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The Galápagos Islands have played a historic role since Charles Darwin's visit onboard the HMS Beagle in 1835. Today, a team of scientists, including from the University of Miami (UM) Rosenstiel School of Marine and Atmospheric Science, studied a large eruption in the archipelago to get new insights into how volcanoes behave and could help forecast future events. Credit: Falk Amelung, Ph.D. University of Miami Rosenstiel School of Marine and Atmospheric Science.

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visit onboard the HMS Beagle in 1835. Today, a team of scientists, including from the University of Miami (UM) Rosenstiel School of Marine and Atmospheric Science, studied a large eruption in the archipelago to get new insights into how volcanoes behave and could help forecast future events.

The study gives the first detailed description of a volcanic eruption from Sierra Negra found on Isla Isabela—the largest of the Galápagos Islands and home to nearly 2,000 people.

The findings, published in *Nature Communications*, reveal how the volcano inflated and fractured before it erupted and captures a new level of detail for any eruption from a volcano on the islands.

Networks of ground-based seismic and GPS monitoring stations, and satellites, captured data for 13 years before Sierra Negra's eruption, in June 2018.

The surface of the volcano rose during this time, indicating a gradual accumulation of molten rock—known as magma—found in a reservoir under the volcano. The signals were among the largest ever recorded at a volcano of this type, experts say.

The Galápagos Islands' remote location, in the Pacific Ocean, about 1000 kilometers off the Ecuadorian coast, means there were big gaps in scientists' understanding of the volcanic processes that formed them and control their activity.

This eruption provided a rare opportunity to fill some of the gaps, researchers say. An international team integrated geophysical data with analysis of the chemical composition of the erupted lava. They were supported in doing so by the Parque Nacional Galápagos.

"The run-up to the eruption was very exciting," said Falk Amelung, a professor of marine geosciences at the UM Rosenstiel School and a coauthor of the study. "Half-a-year earlier we saw from our satellite data that the caldera floor was uplifting at a rate of 10 centimeters a month. Such high inflation rates are rarely seen at active volcanoes."

Sierra Negra's eruption continued for nearly two months, spurting out lava flows which extended 10 miles to the island's coast. Fresh earthquakes accompanied the eruption and emptying of the magma reservoir.

After the eruption, the hills within a six-mile wide hollow at the summit of the volcano—known as a caldera—were nearly two meters higher. This phenomenon, known as caldera resurgence, is important for understanding when and where eruptions happen, scientists say. However, it is rare and has never been observed to this extent before.

The team also discovered that the ascending magma permanently uplifted what they call a 'trapdoor' in the floor of the caldera. This raised its surface and, in a complex interplay, triggered large earthquakes that led to the eruption.

The 2018 eruption was a stark reminder of the potential threat to life, livelihoods, and the iconic wildlife of the Galápagos—including the slow-moving giant tortoise and land iguana—the researchers said.

This new understanding of volcano behavior will allow local scientists to track the evolution of volcanic unrest before future eruptions and communicate warnings to local authorities and the public.

"The 2018 eruption of Sierra Negra was a really spectacular volcanic event, occurring in the 'living laboratory' of the Galápagos Islands," said Andrew Bell from the University of Edinburgh's School of GeoSciences

who led the research.

"Great teamwork, and a bit of luck, allowed us to capture this unique dataset that provide us with important new understanding as to how these volcanoes behave, and how we might be able to better forecast future eruptions."

The Galápagos' Isla Isabela is also the destination of the UM Rosenstiel School's UGalapagos Study Abroad program, which Sierra Negra volcano being one of several geological field trips where students got an opportunity to see first-hand a volcano showing signs of significant unrest.

More information: Bell, A.F., La Femina, P.C., Ruiz, M. et al. Caldera resurgence during the 2018 eruption of Sierra Negra volcano, Galápagos Islands. *Nat Commun* 12, 1397 (2021). doi.org/10.1038/s41467-021-21596-4

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