

In the Shadow of a Volcano

Around the world, volcanoes threaten nearly half a billion people. Scientists are working to better forecast when eruptions will occur...

Put together by Carol Gause for GEOG 6401

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In 2017, a volcanologist, a photographer, and a cartographer traveled to Guatemala on a National Geographic-funded expedition.

Their goal was three-fold: to conduct innovative research that could help shape volcanic eruption warning systems; to create educational materials that explain the risks of living in the vicinity of a volcano; and to better understand what it is about these locations that is appealing enough for communities to remain there despite the risks.



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There's nothing quite like the thrill of going into the field for research!

It's a kind of nervous excitement that just keeps building—through grant writing, planning, meticulously taking stock of the necessary gear, packing, hustling through the airport, watching the ground race by below the plane. Then, finally, the arrival.

I'm here—I've made it to Quetzaltenango, and the Santiaguito complex is waiting.

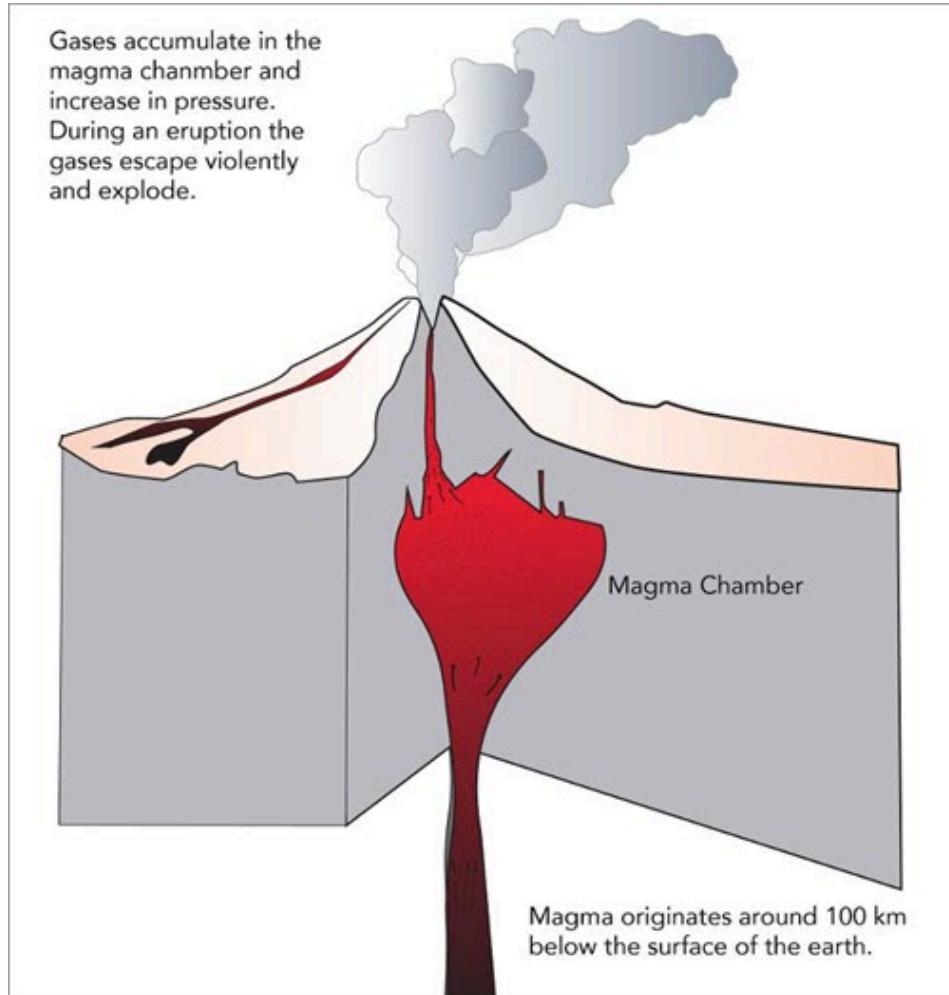
The goals for the expedition are threefold: 1) to summit Santa María volcano and investigate the hazards from an active Guatemalan volcano, 2) to monitor those hazards using photogrammetry techniques, and 3) to educate the local public about those hazards through a multifaceted media campaign.



Dr. Stephanie Grocke sets up and tests photogrammetry equipment before the expedition up Santa María Volcano. Photo: Gabby Salazar.

Santiaguito is a complex of four lava domes that sit at the base of the Santa María volcano. Santa María is best known for its massive eruption in 1902; the event was devastating, decimating the surrounding area and killing thousands. It ended up being one of the largest eruptions of the century.

Since then, the magma below the surface has started to emerge in lava flows at the base of the volcano. Over time, these flows have accumulated into the four different lava domes present today: Caliente, El Brujo, El Monje, and La Mitad.



The domes have been erupting on a regular basis over the past 100 years. Thankfully, these eruptions have been relatively minor. But the near-constant activity makes the complex an ideal place for research.

This expedition has the potential for some ground-breaking research. My team and I plan to explore the possibility of remote cameras and time-lapse photography as a way to identify indicators of imminent volcanic activity.

Hundreds of thousands of people live near the domes. Another major eruption could be devastating to the communities living in this region. But, if our camera experiment works, it could provide powerful, reliable tools for warning nearby communities when they need to evacuate ahead of an especially large eruption.

Why do people live so close to active volcanoes?

Each time I travel to Quezaltenango I imagine what it's like to grow up in such close proximity to an active volcano.

Santiaguito has small eruptions each day so it isn't a surprise when a huge cloud of water vapor and gas appear in the sky. For people that grew up in these communities it's a part of life. Families have been living here for generations and people depend on the land surrounding the volcano for their livelihoods.



Agriculture around volcanoes thrives in the productive soil. Coffee grows particularly well around Santa María.

Photo: Gabby Salazar



Hot springs are common in this region because of the geothermal activity near volcanoes. Tourists and locals alike can relax and enjoy the beautiful landscapes.

Photo: Gabby Salazar



Volcanoes have spiritual significance to local communities. It is not uncommon to see flower offerings as you climb a volcano.

Photo: Gabby Salazar

Like all good expeditions, this one started with a hike.

In order to collect scientific data on the volcanoes we needed to get in the right position. I wanted to set up three cameras overlooking the lava dome complex—to do that, the team needed to get above them.



hike

At first light on November 12th, we laced up our boots, shouldered our packs, and began our ascent of Santa María.



Santa María expedition route.

The scenery was incredible, complete with tranquil, foggy woods that opened up onto sweeping views of the world stretched out below. We climbed over 5,000 feet to the summit. Throughout the hike we ascended through variable microclimates, terrain, and weather. It was a long, intense

trek, but, as I sit perched at the top, I know it was completely worth it.

With camp set up, our next task will be to get the cameras into position. Each one needs to collect a different view of the same portion of the lava domes, and they have to be close enough together that the remote trigger fires them simultaneously

The clouds might be our biggest challenge, though. This high up, they can completely obscure the view of the domes for days at a time. With limited food and water supplies, time is of the essence. The clouds make for beautiful photos, but it's not so great for data collection.



An expedition can be ruined if you don't stay organized—it can also be costly. I used plastic bins and ziplock bags to keep equipment organized and protected from the elements.

Photo: Ross Donihue



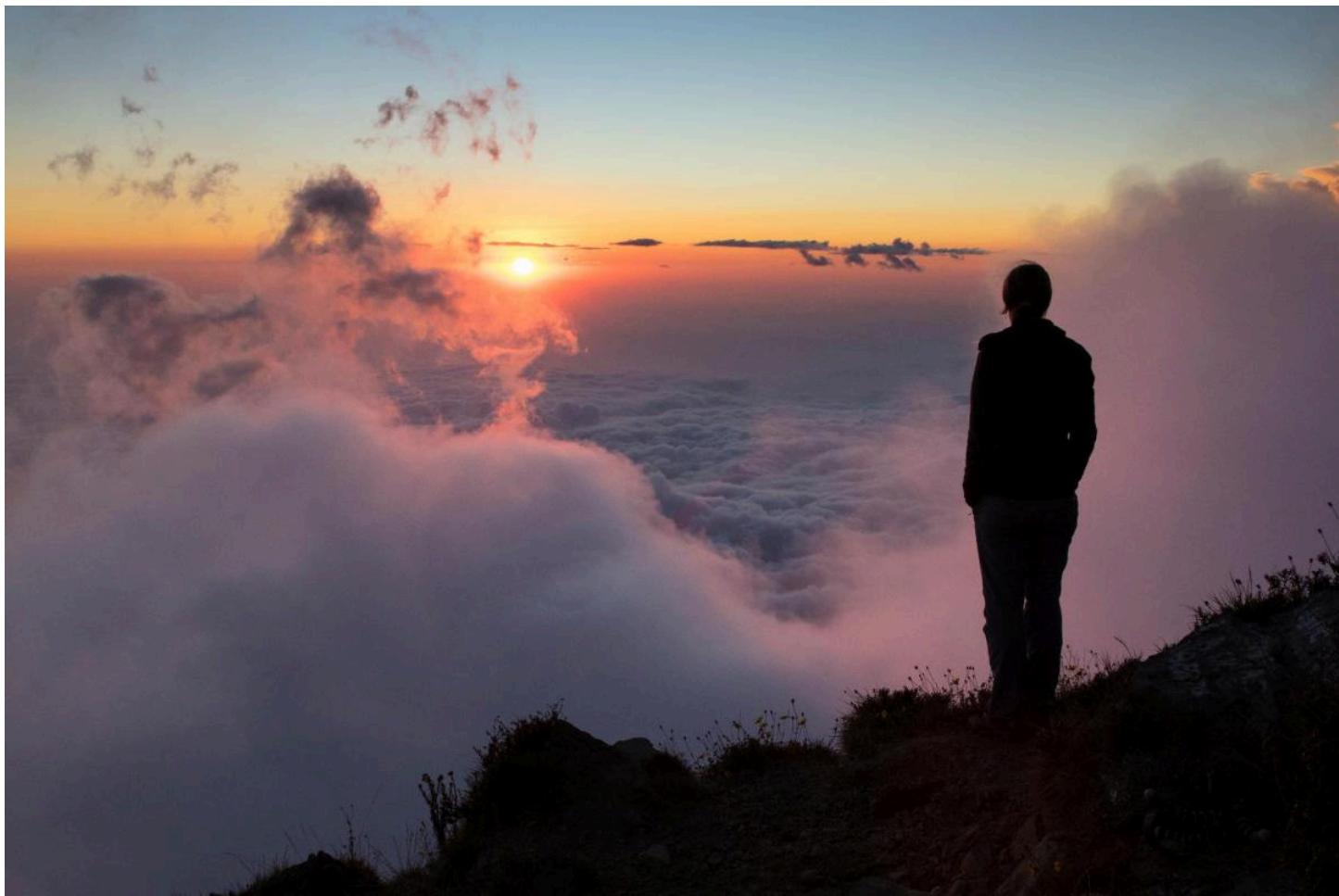
Basecamp at the top of a volcano is pretty sparse. There's no running water, bathrooms, or warm showers. Our tents have to be ready for the 60 mph gusts of winds, pelting rain, and near freezing temperatures.

Photo: Ross Donihue



Dinner consists of simple meals like spaghetti with tomato sauce, oatmeal, and peanut butter sandwiches. We had to keep the meals lightweight and easy to cook over a camp stove.

Photo: Ross Donihue



As I climb into my sleeping bag I'm filled with trepidation. All of our equipment was in place and ready to go. The only missing element was something you can't prepare for—luck. I have to be patient and hope tomorrow will bring clear skies.

Photo: Gabby Salazar

A break in the clouds.

After a turbulent night of wind and rain I woke up and peaked my head out of my tent to check the conditions. In the predawn light I could see the valley below our basecamp—the clouds had lifted. To my excitement the domes that were once obscured were now visible. I quickly sprung into action to sync the cameras so they would start recording photos in case there was an eruption.



Day breakPhoto: Ross Donihue

To ensure we collected the proper scientific data I had to check the cameras every few hours to make sure they had enough power and space to keep taking continuous images of the dome. With a radio coordinator synced to three cameras, they could simultaneously take a photo at the same time every 5 seconds. That created synchronous image sequences for use to monitor the eruptive behavior of the dome explosions. The photogrammetry was working without a hitch.

After setting up all the cameras it was time to wait for an eruption to occur.

During one of my camera checks I realized I was being watched by a blue and green lizard. It was basking in the sun on a nearby rock. It didn't seem bothered by my presence and I watched until it ran off into the brush. Volcanoes may

seem lifeless but in actuality their home for many species that have adapted to this ecosystem.



A lizard on a rock Photo: Ross Donihue

The first eruption of the active Caliente dome was impressive—it rose nearly 3,000 feet into the air. The excitement of our team was palpable as we photographed it and stood in awe of the power and might of the volcano below us.



An image of the Eruption Photo: Ross Donihue

The next three days at the summit were full of documenting the volcano and managing the photogrammetry equipment.



Cleaning up Photo: Ross Donihue

By day three our supply of food and water were beginning to run low, it was time to return to Quezaltenango. We journeyed down the volcano with over 20,000 photos of the volcano that can be used for scientific research.



The lights in this time exposure are from cities close to the active Santiaguito volcano. Photo: Ross Donihue

Back in Quezaltenengo, it was time to start phase two of our expedition. I wanted to share our research with the communities that live in the shadow of the volcano.

We set to processing the images from our journey up Santa María and crafting a photo exhibit to share the research and risks of living so close to active volcanoes.

We found a local printer to create print enlargements that would communicate the work of the project. After a week of processing images and finalizing a venue for the exhibit we were ready to print the images.



The expedition team presented our project to students at San Carlos Public University in Quezaltenengo after we returned from our trek up the Santa María Volcano. Photo: Gabby Salazar



At the gallery opening local community members came and learned about the project and work of researchers to study volcanoes. Photo: Gabby Salazar

The month-long journey was a success. Our results indicate that local volcanologists in Guatemala could employ this photogrammetry method to monitor changes of the lava dome, as it is a relatively inexpensive method. The data could be used to monitor surface changes of the dome, explosions, as well as slope stability, which will help reveal the volcano's behavior and therefore inform forecasting eruptive activity.

Through this research, we have introduced a new method of monitoring active volcanoes to the science community and made meaningful connections with the local Guatemalan communities.



The 2017 volcano expedition was funded by a grant from the National Geographic Society. While there, the team participated in several education events, and donated an exhibit of photos to the local tourism board. You can learn more about the project here.