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Redoubt Volcano Erupts: Scientists Respond

When Alaska's Redoubt Volcano began stirring on January 25, 2009, Geophysical Institute Research Professor Steve McNutt called his colleagues at New Mexico Institute of Mining and Technology who share his interest in volcano lightning. A few days later, McNutt was on the Kenai Peninsula with New Mexico Tech's Ronald Thomas, Paul Krehbiel, and Sonja Behnke. With logistical help from Geophysical Institute Research Technician Ed Clark, they installed lightning-monitoring stations in Ninilchik, Clam Gulch, Kenai, and Nikiski. The work paid off, as the researchers accomplished something they hadn't at other eruptions they have studied.

"With Redoubt, we had instruments in place before the eruption," McNutt said.

Data results allowed the researchers to confirm that the initial eruption that forms a volcano's vent produces a different kind of lightning than eruptions that follow.

"The vent-clearing eruption doesn't have as many fine ash particles–the particulate matter there is chopped-up pieces of mountain," McNutt said. "The more fine particles there are, the greater surface you have for charges to live on."

The four stations on the Kenai Peninsula consist of omnidirectional antennas, GPS receivers, and computers that have recorded in exquisite detail thousands of volcanic lighting strikes within Redoubt's eruption clouds.

"We can track a lightning flash moving through the sky in three dimensions," McNutt said.

McNutt became interested in volcano lightning after a Mt. Spurr eruption in 1992 in which seismometers–in a fluky circumstance that may have been related to exposed cables acting as antennae–detected volcanic lightning. He has since collaborated with researchers at New Mexico Tech to analyze volcano lightning at the eruptions of Augustine (2006) and Pavlof (2007) volcanoes in Alaska and Chaiten Volcano (2008) in Chile.

Scientists aren't sure why volcano ash clouds generate so much lightning. The charges associated with fracturing rock particles, particles colliding, charges built up in magma and transferred to ash, or those similar to thunderstorm lighting are possibilities, as are a combination of them all.

Redoubt sometimes generated lightning for up to an hour at a time during its 2009 eruptions. With the wealth of new data, McNutt and the New Mexico Tech team hope to find out if the ash clouds generated a continuous electrical signal. They also want to establish whether there is a relationship between lightning flashes and the height and density of the plume, and to see if lightning occurs mainly at the vent or migrates downwind with the ash cloud. And, because a good deal is known about thunderstorm lightning, the scientists want to see how volcano lightning compares to the more familiar version.

LIGHTNING ATOP REDOUBT: Above, lightning streaks across an ash cloud that erupted from Redoubt Volcano on March 28, 2009. Photo by Bretwood Higman, www.groundtruthtrekking.org/blog.

image courtesy of Dennis C. Anderson, Night Trax Photography

UAF UNIVERSITY OF ALASKA FAIRBANKS

Student the Last One Standing on Redoubt

Less than 30 hours before Redoubt Volcano erupted in March 2009, Graduate Research Assistant Helena Buurman was packing up her gear, loading it onto a helicopter and lifting off the mountain. Buurman was the last person on the volcano before an eruption cloud spewed from the Cook Inlet volcano. Now this young scientist has the story of a lifetime.

"It's the sort of thing I told my mother after the fact," Buurman said. "I was told by another scientist that these experiences only happen once or twice in a lifetime, and that I should cherish it. I certainly feel lucky."

Buurman is working on her master's degree with advisor and Research Assistant Professor Mike West at the Geophysical Institute. She also assists the Alaska Volcano Observatory by monitoring earthquakes occurring at Alaska's many volcanoes.

In March, Buurman's work with AVO took her to Redoubt Volcano to install four broadband seismometers at an elevation of about 6,000 feet. Such experiences are what drew her to Alaska from her native Scotland. While many students rely solely on textbooks and classroom lectures, Buurman gets to really dig in and get her hands dirty.

"Fieldwork is really exciting to do, especially in Alaska," she said. "I like to work with my hands and I enjoy that side of seismology. Some seismologists like to work in their office, but I like being outside."

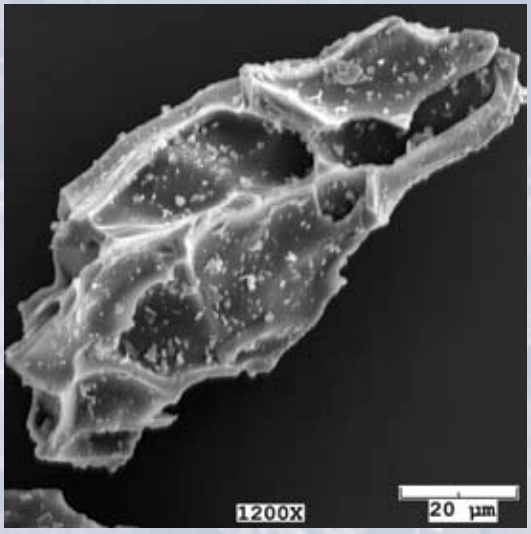
photo courtesy Helena Buurman

ON THE VOLCANO: Helena Buurman (above) is pictured below installing a broadband seismometer on Redoubt's west flank in March 2009. Photo by Cyrus Read, AVO/USGS.

Gathering Redoubt Ash from the Road System

Pavel Izbekov looked at a satellite image of Redoubt Volcano's eruption cloud on his computer monitor one spring morning and saw an opportunity. Even though Redoubt is about 350 miles from Fairbanks, the ash cloud was heading toward Interior Alaska. The Geophysical Institute Research Associate calculated the ash cloud's speed and direction, then jumped in his car. When he arrived in Healy, about 110 miles south of Fairbanks, a delicate ashfall was raining from the sky.

Izbekov used his windshield as a collection platform, and with a fine brush pushed ash samples into a plastic bag. When the ash stopped falling, Izbekov called Research Associate Professor Jon Dehn in Fairbanks, who checked updated satellite images to locate the ash cloud. Izbekov drove on, and collected ash-darkened snow samples from Cantwell.



ANALYZING ASH: A Scanning Electron Microscope image of ash particles from Redoubt on March 22, 2009. Image acquired by Pavel Izbekov and Jill Shipman.

Excited by the composition of the ash, Izbekov then drove back to Fairbanks and together with Graduate Research Assistant Jill Shipman processed his samples, creating several Scanning Electron Microscope images of ash particles. Fourteen hours after his workday began, he posted images of super-magnified ash particles on the Alaska Volcano Observatory (AVO) website (http://www.avo.alaska.edu).

Though part of the Geophysical Institute Remote Sensing Group, Izbekov is a petrologist at heart, having earned his doctorate studying rock and ash at Karymsky Volcano in Kamchatka, which is in the Russian Far East. He said that monitoring volcanoes is just one part of AVO's mission at the institute.

"We engage in research into what processes are behind eruptions," he said. "We're trying to understand magma processes."

Ash, especially when it is magnified, carries a lot of information about a volcano, Izbekov said.

"By looking at the morphology of the particles, you can tell what kind of event it was," he said. "Morphology, and particularly the composition of ash, are the fingerprints of the magma that erupted on that day."

Like Izbekov, Peter Rinkleff also hit the road to sample Redoubt ash. Rinkleff is a Geophysical Institute doctoral student working with Associate Professor Cathy Cahill on volcanic aerosols, mostly 2.5 microns or smaller.

"These are very small particles that can travel worldwide," said Rinkleff.

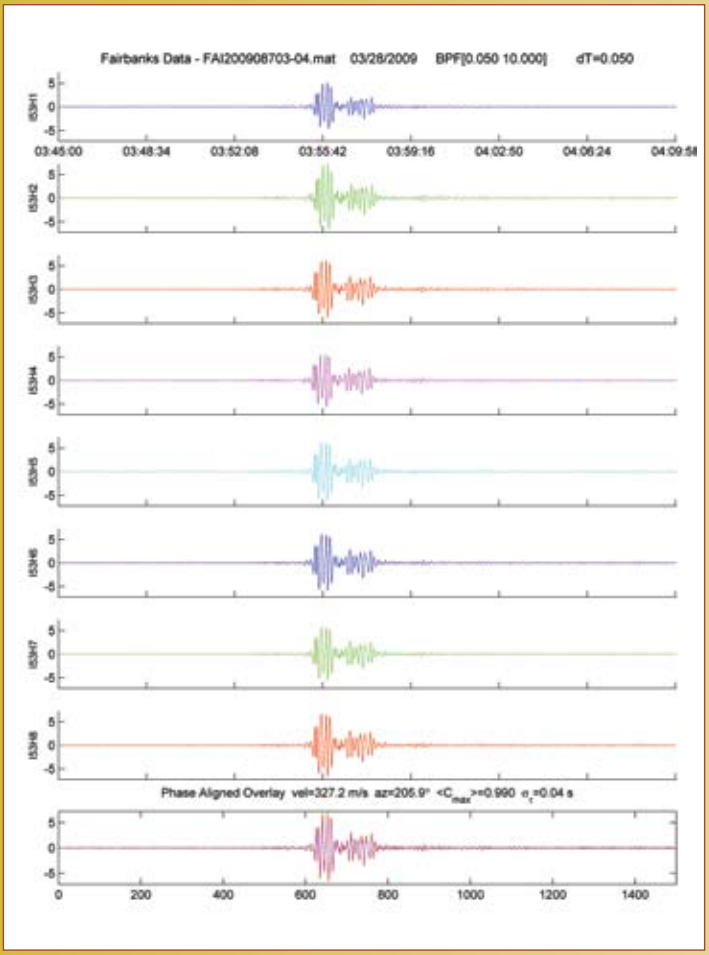
Rinkleff, who gathered bags of ash-covered snow samples from Ninilchik to Healy for AVO's Kristi Wallace, installed a portable ash sampler at Ninilchik school that collects samples of aerosols small enough for us to inhale into our lungs. He also is watching the results of air quality monitoring being performed by the Municipality of Anchorage, the Alaska Department of Environmental Conservation, and the U.S. Fish and Wildlife Service.

"With a range of different equipment, we're trying to see what particulate matter is coming out of the volcano," Rinkleff said.

With his research, Rinkleff hopes to find out more about ash-formation processes and the fate of volcanic ash as air transports it away from the volcano. His data might help improve computer models by relating ash size and composition to what appears on radar and satellite images.

Unlike recent eruptions that occurred in the mid-Aleutians, Redoubt is just across Cook Inlet from the Sterling Highway.

"The nice thing about Redoubt Volcano compared to Okmok, Kasatochi, or Cleveland is that I can drive to the sampling location for my field work," Rinkleff said.



Eruptions Detected on Fairbanks Infrasound

The Geophysical Institute's infrasound array, located at the University of Alaska Fairbanks, 350 miles from Redoubt Volcano, detected many of the volcano's recent eruptive events.

"We heard 25 out of 30 (occasions of volcano unrest)," said institute Research Professional Kenneth Arnoult.

Infrasonic signals–air-pressure changes from ocean storms, the aurora, nuclear explosions, large avalanches, and more–are too low in frequency for people to hear, and travel long distances without losing much intensity. An eight-element array, with microphones that detect subtle air pressure changes, is spread throughout the woods on campus. Signals from Redoubt explosions took about one-half hour to reach the infrasound array in Fairbanks. One explosive event was the largest signal recently recorded on the array.

"This one (shown at left) was 10 pascals peak-to-peak," said Assistant Professor of Physics Curt Szuberla. "I can't think of another signal that has come close."

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