Memories of volcanic flame in Hawaii

Lava fountains, at least 50 m high. Hawaiian Volcano Observatory helicopters took Dale Cruikshank, Steve Platt, Bob Howell, and Jay Pasachoff a few kilometers up the ridge from this area, to where fountains had been a few days before.

John Dvorak's article about the founding of the Hawaiian Volcano Observatory (PHYSICS TODAY, May 2011, page 32) reminded me of a high point of my expeditionary career as an astronomer, when colleagues and I used our solar-eclipse spectrometer on the Kilauea volcano in Hawaii, with the help of helicopter transportation from the HVO.

Thirty years ago, electronics that could sensitively detect the IR spectrum were rare, but Tektronix engineer Phil Schierer had supplied a spectrometer with near-IR capability that he and I had used to take spectra of the solar corona during total eclipses. On a sabbatical leave I took at the University of Hawaii's Institute for Astronomy during 1980–81, the institute's Dale Cruikshank and I developed a plan to use the spectrometer to study volcanoes on Earth, a far cry from Cruikshank's usual subjects on Mars and elsewhere in the solar system.

With the aid of a research grant from the National Geographic Society, we worked to make our equipment portable—mainly by putting a heavy oscilloscope on one backpack frame and a gasoline generator on another—in case Kilauea awakened from its long dormancy. In 1983 Williams College student Steven Platt and I traveled to Honolulu to join Cruikshank in testing the equipment. Soon after our arrival, we heard on the radio that the volcano had erupted! We hadn't prepared our equipment yet, but joined by planetary astronomer David Morrison and IR astronomer Robert Howell, we took it, unmounted, by airplane to the Big Island, where Kilauea was erupting. When we landed, though, we learned that the volcano had subsided, so we flew back to Honolulu.

The next morning, however, Kilauea erupted again—it has been erupting for the nearly 30 years since—and Cruikshank, Howell, Platt, and I flew back to the area and drove out to a staging site where HVO staff members were observing 100-foot-high lava fountains. We could feel the heat, even at a great distance. Eventually, a helicopter took us a couple of miles up the ridge. We waited there for darkness, when we would be able to observe volcanic flame, the hot gas emanating from the cracks in the rock where the fountains of lava had been. We were left overnight.

Unfortunately, to meet the weight limit on the helicopter, we'd had to leave behind extraneous material such as bedrolls and even the loaf of bread that would have made a great pillow. I am grateful that the wind didn't shift to blow poisonous gas on us, since we had no radio or other emergency equipment.

As darkness fell, we could indeed see the volcanic flame flickering a meter or two high, and we recorded spectra in the 800- to 1000-nm near-IR region for the three hours or so until our generator ran out of gas. We spent the rest of the night trying to get comfortable on the hard lava. The next day, helicopters picked us up close to noon, after we had baked in the sun. I have never been so exhausted, except for one later trek back to the same site after a lava lake had formed there.

When we examined our spectra back in Honolulu, we found regularly spaced bands indicating the presence of water.[1] Later comparisons to spectra from Los Alamos National Laboratory confirmed the Kilauea water vapor's temperature range of 1390–1565 K. Previously, Cruikshank, Morrison, and Kenneth Lennon had detected water vapor at Kilauea,[2] but they had used old-fashioned, relatively insensitive film and had interpreted it in terms of hydrogen burning in air. We were slightly disappointed to have found few spectral bands or lines beside those of water. We had hoped to find some traces that could help show why the Kilauea lava erupted in such a slow and steady fashion instead of explosively, as so often occurs at other locations, notably Mount Saint Helens and, more recently, Eyjafjallajökull.

Volcanoes all around the solar system continue to fascinate me,[3] especially the ice volcanoes of Saturn's Enceladus. But I remember fondly my overnight at Kilauea and, in 1989, a trek led by some NASA planetary scientists out to the lava lake, called Pu'u 'O'o, that was left from the original eruption we had studied. We found the lava lake by following the circling tourist helicopters.

References

1. J. M. Pasachoff, D. P. Cruikshank, *Natl. Geogr. Res. Rep.* **5**, 391 and 501 (Sept.–Oct. 1989).
2. D. P. Cruikshank, D. Morrison, K. Lennon, *Science* **182**, 277 (1973).
3. J. M. Pasachoff, *Science Digest*, February 1986, p. 28.

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