Alaska Volcano Observatory

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BiMonthly Report

"Double Issue"

USGS ADGGS UAFGI

Highlights and Summary

- New lava from Cone A flooded the floor of Okmok Caldera beginning February 13, 1997.
- The eruption of Pavlof volcano ended January, 1997.
- Seismic swarm activity at Iliamna continued to decline.
- Notable flurries of seismic activity occurred at Augustine Volcano and in the Katmai region.
- AVO implemented an internal web page for near-real-time monitoring data, greatly enhancing the level of vigilance at the observatory.

This report is becoming the bi-Bimonthly. However, it should return to its normal frequency as soon as the volcanoes give us a break.

The Pavlof eruption, the first exercise of the new, expanded AVO, ended with the start of the new year. Although Pavlof ash clouds flirted with flight levels, they never became a serious threat to international aviation. They were, however, of significant local concern, requiring the closure of air space in the vicinity of the volcano.

Perhaps the most significant outcome of the eruption for AVO was that it provided the necessity to mother web inventions. This was a volcano seismologist's eruption: beautiful monochromatic tremor and not much else, save for the occasional spectacular glimpse. An active volcano needs to be watched, but without the excitement of the occasional civil emergency, lonely watches on darkening Arctic nights take their toll. We found we could conduct around-the-clock monitoring of the eruption at a relatively light burden to the staff by making the seismic data accessible over the web. This effectively makes most data instantly available to most personnel. For those few poor souls whose homes are so humble as to lack a web connection, we acquired a loaner computer to be used in the wee hours. Through incorporation of an interactive log, the web site also makes all observers comments instantly available to everyone. It even simplifies signing up for off-hours duties, by providing a sign-up sheet that is omni-present. Even in larger-scale events when round-the-clock staffing of offices is necessary, this new approach will make it possible for many people, not just the immediate person on duty, to be watching and thinking about an eruption. The dedicated volcanologist/workaholic can now monitor his or her favorite volcano continuously with the possible exception of time in the shower (an infrequent interruption for most Fairbanksans; perhaps more of a problem in Anchorage).

Pavlof had not been sleeping much more than a month when Okmok Volcano, which we do not yet monitor seismically, burst into eruption. From space, the Aleutian Arc had turned on its infra-red high-beam with 25 saturated, 20 hot, and 11 recovery pixels in AVHRR imagery (fig. 2). Lava surged across the floor of this spectacular 10-km-wide caldera, for the most part following the path of a similar eruption in 1958 (fig. 3). As with Pavlof, the activity was not sufficiently explosive to interfere with high-altitude air traffic.

In addition to marveling at Okmok imagery, the first third of the year was occupied by preparations for our second big Alaska Peninsula/Aleutian Islands summer. The challenging goals for this effort (one advantage of writing summaries for reports late is that I know the "future") are Shishaldin on Unimak Island and Aniakchak Caldera on the Peninsula.

John Eichelberger

In This Issue

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Cover photos: Pavlof Volcano in eruption September 1996: photo taken by S. Schulmeister, USFWS and video footage taken by Steve McNutt, UAFGI.

Eruptions

Okmok Erupts

Okmok volcano began a strombolian eruption on the morning of February 13, 1997 that proceeded through the next six weeks, abruptly declined in late March, and then continued to further decline over the next several months. The activity occurred from Cone A (Byers, 1959, USGS Bulletin 1028L, Plate 41), an historically active cinder cone located on the caldera floor near the south rim. The eruption produced lava fountains, multiple spatter-fed and effusive lava flows that nearly crossed the caldera floor, frequent ash bursts to heights up to 16,000 feet ASL, and at least one steam and ash plume reported to have risen as high as 30,000 feet ASL. AVO does not have seismic equipment on Umnak Island. The eruption was monitored by daily analysis of AVHRR satellite imagery, and frequent reports by commercial and charter pilots, local residents, and a NOAA marine mammals research crew.

The first sign of restlessness at Okmok was a steam plume rising from Cone A noticed by a commercial pilot during an overflight on November 11, 1996. On February 11, 1997, a dark plume was observed over Okmok by a pilot and passengers on a flight from Atka to Dutch Harbor. AVO received both of these reports several weeks after onset of the eruption. On the morning of February 13, at about 10 am AST, ranchers at Fort Glenn saw a dark ash plume rise from the caldera to 5,000 feet ASL. Prevailing winds carried the dissipating ash cloud to the southwest. Satellite images from 05:00 am and 10:30 am AST showed a hot spot near the location of Cone A. AVO issued an Update and began close monitoring of the situation.

Poor weather prevented observations for the next few days until February 20 when U.S. Coast Guard pilots reported an ash plume rising to between 10,000 and 15,000 feet ASL. The ranchers at Fort Glenn saw a bright red glow reflected from the weather clouds over the volcano earlier that morning, the first indication of lava production. AVO satellite imagery analysis revealed the largest hotspot to date—22 saturated pixels—in the caldera. A few days later, a Fort Glenn resident climbed to the south rim of the caldera and observed a 0.8 to 1.2-km-long lava flow extending NE from Cone A. Over the next week, satellite imagery analyses and pilot reports verified the ongoing eruption. On February 28, a NOAA marine mammals research crew circled Cone A by helicopter and witnessed spectacular strombolian lava fountaining, ballistic showers, and bubble bursts and documented several lava flows extending 5-6 km from the cone. On March 11, a pilot reported a short-lived plume of steam and ash up to 30,000 feet ASL drifting northwest, prompting the FAA to issue a NOTAM. Over the next week, several short-lived steam and ash plumes were observed as high as 28,000 feet ASL. Continuous emission of ash and steam with lava production occurred into early April, but on March 27 a visual observation revealed that the activity level had substantially declined. Over the next several months, occasional ash bursts and thin, low level plumes were reported, and satellite imagery analyses recorded persistent hotspots in the caldera. Reports of low-level activity at Okmok were included in AVO weekly updates until late May.

Okmok is a 10-km-wide caldera that forms the northeastern end of Umnak Island, 75 miles southwest of Dutch Harbor in the Central Aleutian Islands. The volcano has had several historic major eruptions and a dozen minor events. Eruptions in 1945 and 1958 produced lava flows, and the last eruption—November 1986 through February 1988—was characterized by intermittent ash emission. The nearest settlements are Nikolski, population about 35, located 72 km west of the volcano, and a small number of ranchers at the abandoned Fort Glenn military base situated 16 km east of the caldera.

Game McGimsey, Tina Neal, and Cindy McFarlin

Figure 1: Lava flows emanating from Cone A in Okmok caldera. Photo by John Sease, NOAA National Marine Mammals Laboratory, 2/28/97.

Monitoring

Alaska and Kamchatka Satellite Observations

AVO monitors volcanoes in Alaska and Kamchatka using the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA-12 and -14 satellites. Images are recorded in five spectral bands in visible and infrared wavelengths at a spatial resolution of 1.1 km at nadir. The images are received at a ground station at the Geophysical Institute, University of Alaska Fairbanks, and are analyzed daily to detect volcanic eruption clouds and thermal anomalies at volcanoes in the north Pacific region.

During this period, our attention was primarily focused on the eruption of Okmok Volcano, but there were additional eruption reports from Karymsky and Klyuchevskoi (Kamchatka), Katmai, Mageik, Amukta, and Pavlof (Alaska) volcanoes. Table 1 shows dates of eruptions or reports of eruptions at these volcanoes.

Okmok

The eruption at Okmok Volcano was first observed as a hot spot (M. Servilla) on a thermal-infrared band satellite image (Band-3; 3.55-3.93 micrometers), 13 February, 1401 UT (n14.97044.1401). The source of the eruption is Cone A near the southwest wall within the 10 km diameter caldera. The eruption resulted in a lava flow that extends to the northeast, crossing the caldera floor on top of an older flow. Pilot reports (PIREPS) and observations from people in the area confirmed satellite analyses. The Okmok eruption is similar to Pavlof in that it was not a highly explosive event (figs. 2 & 3).

The initial observation consisted of a single hot pixel with a radiant temperature near 50°C that saturated the sensor. This is the second time within a few months that a hot spot was observed in the very early stages of an eruption (See Pavolof, Sept/Dec/96 AVO BiMonthly). The hot spot grew to 8 saturated pixels by 18 February. During periods of darkness on February 18 and on March 13 the hot spot was detected in non-thermal IR data (near-infrared, Band 2; 0.72-1.1 micrometers) indicating the presence of incandescent lava. On 14 March, the hot spot reached a maximum size of 25 saturated pixels, at least 20 hot pixels (significantly warmer than the background), and 11 sensory recovery pixels. Sensor recovery pixels were associated with the majority of the saturated B3 pixels indicating a major effusive event. The size of the hot spot fluctuated throughout the last two weeks of March, but remained large through the beginning of April. Clouds limited detection of the hot spot most of April, but a few observations showed that its size and temperature decreased indicating that the flow was cooling.

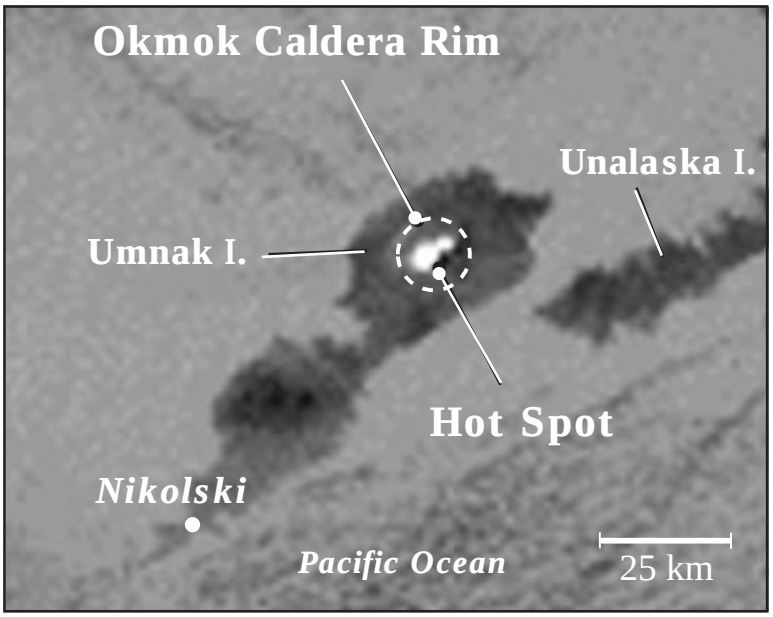

Figure 2: A thermal IR (Band 3) AVHRR image of the hot spot at Okmok Volcano, 20 March 1997 (n14.97.079.1421). The size of the hot spot is 22 pixels (white) and is located near the center of the caldera (white dashed line). These data detect thermal anomalies but do not show details of landforms. North is up.

Eruption clouds were most frequently observed in March, with the longest at approximately 260 kilometers on 31 March. Four plumes were

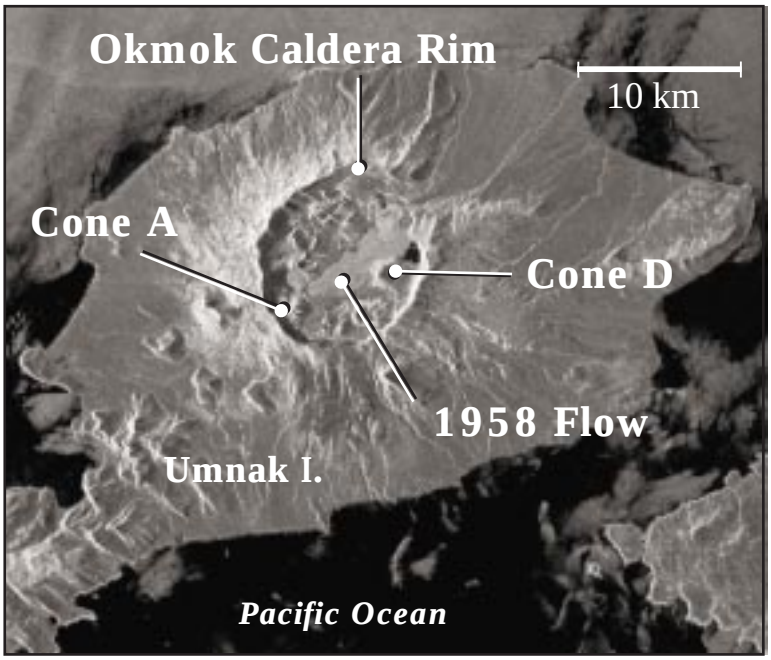

Figure 3: ERS-1 SAR image of Unimak Island and the Okmok Caldera. The SAR data show volcanologic landforms not seen on the coarser resolution AVHRR data. The source of the present eruption is Cone A and the lava flows to the northeast over the 1958 flow. This image was recorded on 28 August 1994. North is up. ERS SAR images are copyrighted by European Space Agency (ESA).

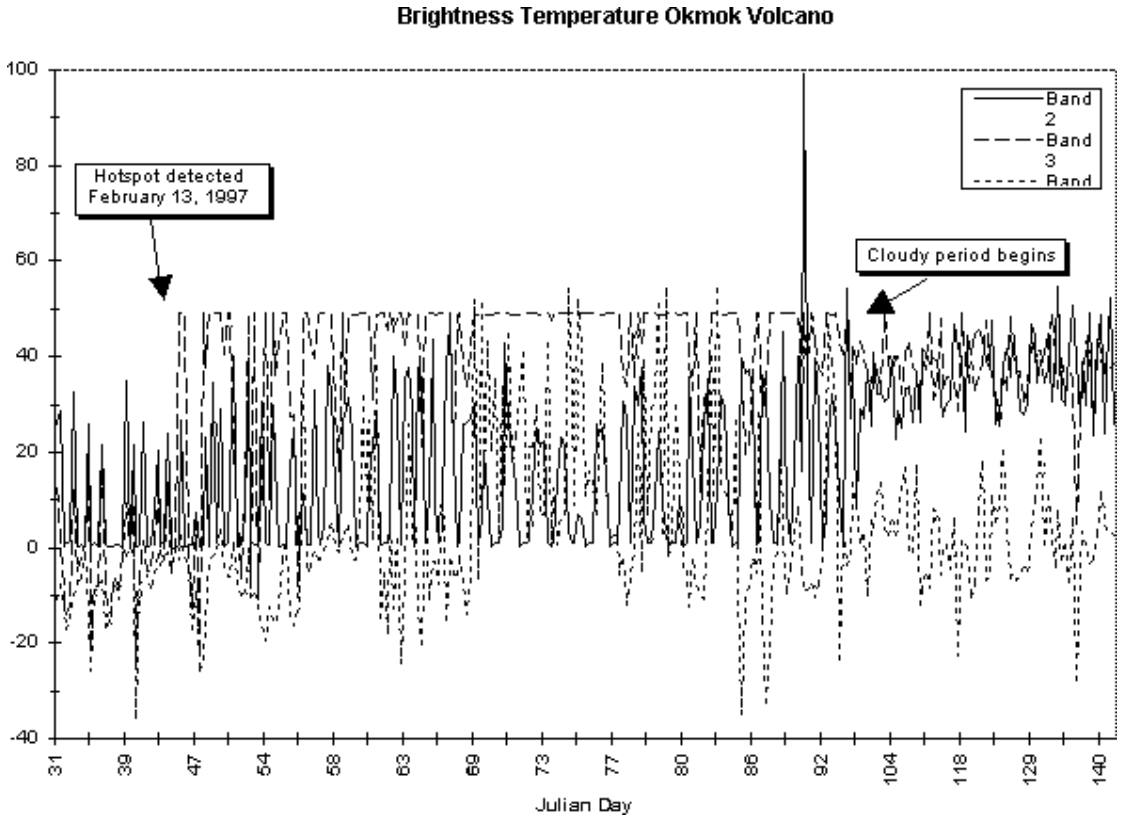

Figure 4: These temperature and albedo vs. time profiles show the the hotest or brightest pixel of a 40 X 40 pixel area around Okmok Volcano. If the band 3 temperature rises above 35 °C an automated message is sent to AVO staff.

observed in February and two in April. The plumes drifted both east and west. These eruption clouds dispersed quickly and hence were relatively short in length. They were sufficiently diffuse that reliable cloud temperatures could not be acquired to estimate plume height. Observer reports, including PIREPS, indicate that ash was below 15,000 ft although one reported ash at 28,000 ft. Volcanic ash was detected in only a few events using the subtraction of the two thermal IR channels (Bands 4 minus 5). Field observations often reported the presence of airborne ash but apparently the ash concentration or volume was not sufficient to be seen on the satellite data or the ash was masked by overlying clouds.

To improve monitoring capabilities, experimental, real-time temperature and albedo profiles were generated of Okmok and Pavolof Volcanoes (fig. 4). An algorithm was written to extract a 40 X 40 pixel area around each volcano. The program plots the hottest or brightest pixel for each channel as a function of time. This plot is converted to a GIF image and put on a web page (with limited access since it is experimental). The GIF images are smaller than satellite images, and thus quicker to download. Also, the profiles provide a continuous record of activity. Automated alerts were generated and sent to key personnel if the B-3 temperature exceeded 35°C. Technically, the profiles and alerts were a success but the simplistic analysis resulted in many false alarms as the summer season approached and the amount of sunlight increased. More sophisticated analysis techniques will be tried in the future.

Karmysky

A small warm spot (1-3 pixels) was observed beginning 29 January and continuing through the first week of February. Temperatures never reached saturation but rose to about 20 degrees C above the surrounding area in B3. Similar activity was noted 24, 25, and 26 February and 3, 4, and 6 March. No eruption clouds were observed.

Klyuchevskoi

A 110-km-long eruption cloud was detected on 6 March (n14.97.065.0119) blowing to the SE. The temperature of this cloud was – 45°C, and subsequent analyses estimate the cloud to be at 25 ,000-29,000 ft, which is near the flight level of commercial jet aircraft in the region. The eruption had at least two pulses: the first subsided prior to the next satellite pass, 14 hrs later (n14.97.65.1513). Another five hours later a new 40 km long plume was observed blowing east (n12.97.065.2019) and 4 hrs later this plume was 65 km long plume (n14.97.066.0107) and still blowing east. A hot spot was observed on 6 and 19 March in band 3 data. A small plume was detected again 26, 27, and 28 March and possibly on 1 April.

Katmai

A warm spot spanning 1-2 pixels was observed 16, 20, and 21 January. Temperatures at the volcano were higher than those of the surrounding area. No evidence of activity was observed.

Magiek

Satellite images were analyzed in response to a Pilot Report (PIREP) on 19 February. Nothing of interest was observed in these data.

Amukta

Satellite images were analyzed in response to a PIREP on 3 March. No evidence of volcanic activity was found.

Pavlof

The eruption at Pavlof Volcano appears to have subsided. Only two observations of warm pixels were observed on 17 January and 7 February that may have been related to volcanic activity.

Ken Dean