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Letters on June 23, 1997

Waveform analysis of seismoacoustic signals radiated during the Fall 1996 eruption of Pavlof Volcano, Alaska

Abstract

Theoretical modeling of acoustic and seismic signals associated with the 1996 eruption of Pavlof volcano suggests that volcanic tremor at Pavlof originates in the deeper part of the magma conduit, and is generated by random fluid oscillations in the magma flow. Explosions (fig. 30) that generate air waves are believed to occur in the shallower part of the magma conduit, and to be caused by the rapid and violent expansion of metastable magma-gas or magma-water mixtures. The effect of increasing the exsolved quantities of H_2O and CO_2 gas with reduced pressure in the melt is to decrease the sound speed and density, and increase the viscosity of the magma-gas mixture. This causes an acoustical decoupling of the upper and lower parts of the magma conduit (fig. 31). The reduced sound speed and density of the melt at shallow depths act as a sharp impedance contrast, which strongly reflects acoustic energy originating at depth and traps it in the lower part of the magma conduit. Alternatively, acoustic energy originating from the upper part of the conduit remains trapped in the low-velocity region formed by the exsolved gas in the melt, and hence shallow explosions may preferentially couple into the atmosphere. Explosion signals may be triggered by an increased flow of melt at depth, and may be preceded and accompanied by vigorous mass flux transients.

Milton Garcés and Roger Hansen

Garcés, M. A. and S. R. McNutt,
*Theory of the sound field
generated by a resonant magmatic
conduit, J. Volcanol. Geotherm.*

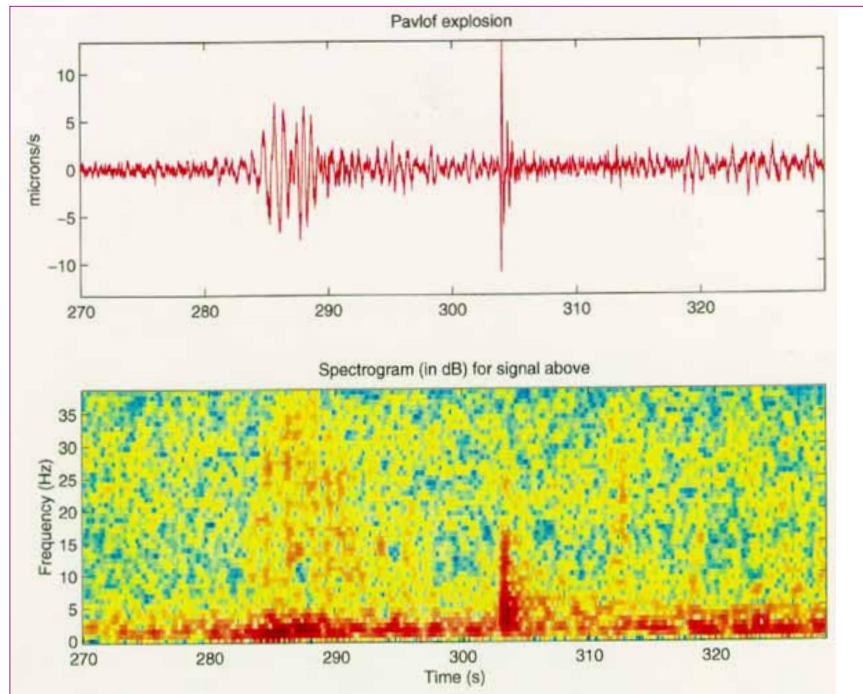


Figure 30: Waveform and spectrogram (sliding 1.28 s panning window with 90% overlap) for a seismic explosion signal discernible from the continuous background tremor recorded by station PS4 (8 km range) at Pavlof volcano on September 29, 1996. The explosion signal consists of two distinct phases, the first one beginning at 284 s and lasting approximately 6 s and the second one beginning at 304 s and lasting less than 3 s. Note that the first phase may contain numerous explosive events of varying intensities, and that this process repeats itself at lower intensities through the complete record.

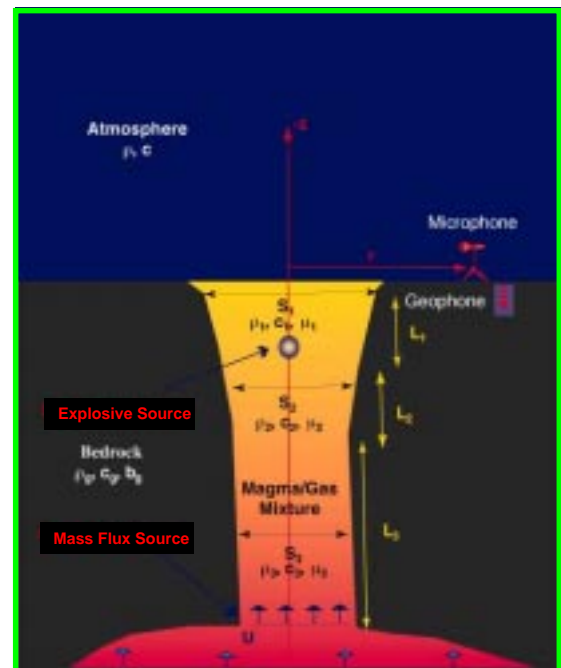


Figure 31: Geometry and physical parameters for the volcanic acoustic resonance model (VOLAR) model. The pressure and seismic sensors are located near the ground's surface, at some distance from the active vent. The density, ρ_a , and the compressional and shear speeds, c_a and b_a , of the bedrock (possibly layered), and the density, ρ_b , and sound speed, c_b , of the atmosphere are propagation variables. The magma conduit is divided into three layers ($i=1,2,3$, from top to bottom), each with cross sectional area S_i and length L_i , with a melt of density ρ_i , sound speed c_i , and viscosity μ_i . An initial melt composition is prescribed at depth and determines the values of the density, sound speed, and viscosity for each layer. A velocity field, U , is imposed at the bottom of the conduit, and excites the magma conduit into resonance. Velocity fluctuations at depth may be directly proportional to the variations in mass flux. An explosive source in layer 1 may also ensonify this shallow layer. The sound field in the magma conduit propagates into the atmosphere through the open vent and radiates into the ground through the conduit wall.

Satellite and Seismic Monitoring of the 1996 Eruption of Pavlof Volcano

In late September 1996, Pavlof erupted after almost 10 years of quiescence (see C.A. Neal, September/December 1996 bimonthly). The course of the 1996 eruption was primarily traced by two techniques: AVHRR satellite imaging and seismic monitoring. These remote monitoring methods were occasionally supplemented by reports from observers on the ground or in passing aircraft. Processing of AVHRR data was performed by Alaska Volcano Observatory staff at the Geophysical Institute, University of Alaska Fairbanks. While much of Earth is covered by two AVHRR passes daily, the high latitudes of Alaska may receive up to fourteen passes per day due to the polar convergence of the satellites. However, during the 1996 Pavlof eruption, we experienced difficulties with the ground receiving station in mid-November, and the station was completely disabled by the end of the month. The vast majority of the seismicity recorded during the Pavlof eruption was in the form of tremor. Alaska Volcano Observatory staff used a triggered event recording system which digitized and recorded detected events. Additional seismic monitoring systems included RSAM, SSAM, and a near real-time plot of reduced displacement. We also received reports of visual observations of ash plumes and other activity at Pavlof during the 1996 eruption. These visual observations included pilot reports (PIREPS) from overflying

aircraft and ground observations made by the residents and National Weather Service personnel in Cold Bay, King Cove, Sand Point, and Nelson Lagoon.

Volcanic eruptions generally have associated thermal anomalies which may be observed on AVHRR images used to track the course of an eruption (e.g. Harris et al., 1997 and Wyatt, in press). AVHRR band 3 is particularly sensitive to thermal anomalies and is used by the Alaska Volcano Observatory staff in routine monitoring of the Aleutian arc volcanoes. Thus, the size of a thermal anomaly for the Pavlof eruption was reported as the number of hot ($>30^{\circ}$ C) pixels observed in band 3. An examination of the size of the Pavlof thermal anomaly through time reveals that it increased in size from the beginning of the eruption until October 7-13 (Julian days 281-287) (fig. 32). At that time, the size of the hot spot decreased slowly. The few outliers from this trend are a few unusually large hot spots that occur a day or two after the appearance of large plumes. The size of the thermal anomaly may have begun a slower level of decay on Julian day 310 but the loss of the AVHRR receiving station on November 24 (Julian day 330) renders any speculation pointless. Interestingly, the largest eruption plumes occur shortly after the thermal anomaly reaches its maximum size (fig. 32). Wyatt (in press) observed a similar pattern in his observations of Klyuchevskoy volcano; there the thermal anomaly increased gradually in size leading up to a paroxysmal eruption. Again, the longest and highest eruption plumes at Pavlof occurred a few days after an apparent maximum in the size of the thermal anomaly.

One of the unusual characteristics of the 1996 Pavlof eruption was a lack of volcano-tectonic (or A-type) events associated with the eruption. Seismic monitoring was based almost exclusively on detection of volcanic tremor and explosions with their associated air waves. Triggered and recorded events were subsequently examined for air wave arrivals, and daily counts of tremor bursts and explosions were derived. A temporal plot of the daily counts of tremor burst reveals apparent peaks in the number of events (fig. 33). However, it must be remembered that this graph includes only events which are larger than some short-term average background level. A cursory examination of the Helicorder records reveals that the apparent lull between days 295 and 309 (Oct. 21-Nov. 4) is actually due to



extended periods of continuous, low-level tremor. Note that the evolution of tremor bursts into extended periods of low-level tremor was shortly followed by the occurrence of large eruption plumes.

The combined satellite and seismic observations suggest that the activity at Pavlof increased through time, culminated in several large plumes, and then slowly decreased with a few remaining bursts. The first thermal anomaly was observed on Julian day 257 (Sept. 13). A low-level of activity was reported by observers on day 260. For the following few days, the hot spot slowly increased in size and rare short (<50 km) eruption plumes were observed in AVHRR images. On Julian day 269 (Sept. 25), increases in tremor amplitude, number of triggered events, and the size of the thermal anomaly record an increase in Strombolian activity at the volcano. This activity produced several plumes reaching 100-150 km in length and lasted for approximately 10 days. Even as Strombolian activity decreased, gradual increases in the reduced displacement and the number of triggered events were noted between Julian days 280 and 290 (Oct. 6-16). The first large eruption plume was observed on Julian day 293 (Oct. 18) after a peak in the size of the thermal anomaly and the evolution of nearly-continuous tremor. Two additional large plumes were observed on Julian days 303 and 309 (Oct. 29 and Nov. 4). Seismic activity at the volcano began to decline about Julian day 315 (Nov. 10). The final large plume (Julian day 328) accompanied a second period of increased seismic activity during days 323-331 (Nov. 18-26). As seismicity continued to decline, two final bursts in triggered events and tremor occurred on Julian days 345-351 (Dec. 10-16) and 361-366 (Dec. 26-31); no large plumes were observed to accompany these bursts of activity. Seismicity gradually decreased to background levels, and the last thermal anomaly was observed on Jan. 17, 1997.

Angie Roach, John Benoit and
Chris Wyatt

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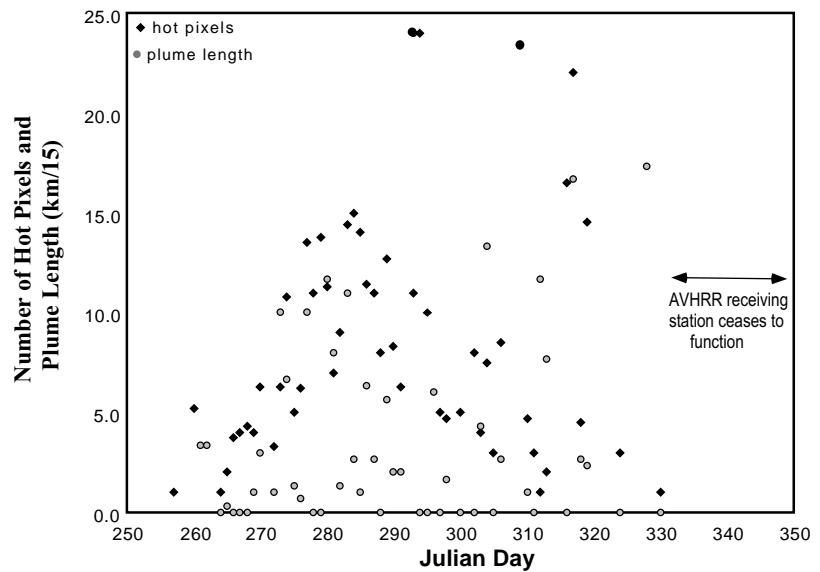


Figure 32: Number of hot (> 30°C) pixels and the length of eruption plume observed for the Pavlof eruption of 1996. The number of pixels is denoted by diamonds and was averaged from all the images examined on the given day. Plume length given is the maximum length observed on a day. Plumes are represented by circles and are given in km/15. Two filled circles represent occasions when AVO staff declared color code RED for the eruption. Note the overall increase in hot pixels until day 284 when the number of involved pixels begins a slow decline. Further, the largest eruption clouds are observed after day 284.

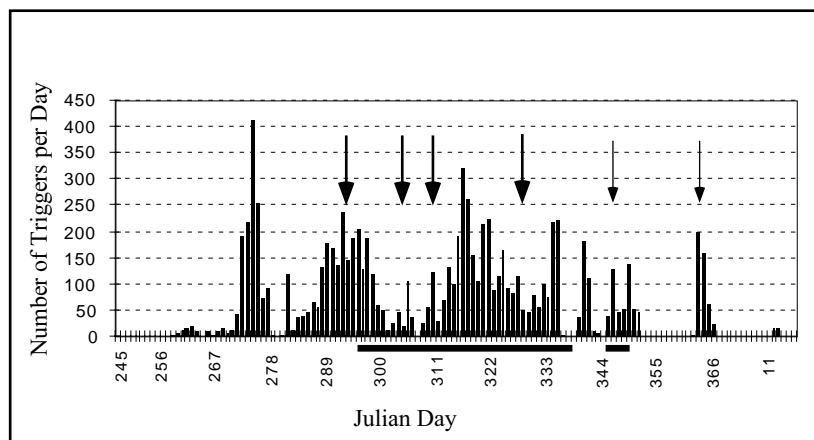


Figure 33: Number of triggered tremor bursts per day for the 1996 Pavlof eruption. Tremor bursts are denoted by vertical columns. The apparent peaks in the number of tremor bursts are an effect of triggered event recording; on Julian day 295 (October 21) tremor became nearly continuous and reduced the triggering of the recording system. The horizontal bars indicate periods of continuous low-level tremor as observed on helicorder records. Large arrows denote the occurrence of plumes greater than 250 km in length; AVO staff declared an alert code RED for the first two of these plumes. Small arrows denote occasions when AVO personnel declared a code RED, but large plumes were not subsequently observed. Note that most of the large eruption plumes occurred after the evolution of tremor bursts into a continuous tremor.

Trip Log—Alaska State Trooper flight

FLIR-equipped King Air, March 19 and 24 - 27, 1997-3/24/97 departed ANC at 1000 clear conditions all the way to CDB (Cold Bay)

Redoubt

No thermal areas visible in IR scans of all flanks. 1990 lava dome shows up sharply on IR, the canyon and piedmont lobe show no thermal anomalies. (*Obtained video, visual and IR*)

Iliamna

Thermal areas high on the east face of the cone were slightly diminished in intensity and extent as compared to our fly-by and filming on 12/6/96, both in visual and IR modes (*Obtained video, visual and IR*).

Augustine

Summit dome complex shows patchy areas of higher temperature.

Mageik/Martin

Viewed from just east of King Salmon, noted normal steaming to just above respective summits.

Veniaminof

We deviated from flight route to do a 360° turn over the caldera. The kidney bean-shaped depression from 1993-94 lava flow is much filled in with snow/ice, but margins of the depression are still discernable (fig. 34). Some irregular surfaces of dark lava poking through the snow/ice, especially near the base of intracaldera

cinder cone. Three open holes in ice/snow pack at the south (?) base of the cone - collapse pits or melt depressions - were steaming weakly. The small spatter cone that formed at the vent for this flow (located at the base of the intracaldera cone) is indistinct and snow-covered except for its very top.

The main intracaldera cinder cone is mostly snow-covered but its upper flanks and summit are bare and scattered wisps of steam were visible. Nested within the summit crater of the main cinder cone is a smaller spatter/cinder cone (fig. 35), likely the site of the most vigorous strombolian activity in the recent eruption. It looks to be quite similar to photographs of the 1983-84 vent. A slight steam plume

emanated from the summit crater and along one limb of the cone. Bright yellow sulfur deposits occur near the snowline on the SW side of the main cone.

Windblown fines discolored the snow in patches on the flank of the main cone and adjacent ice surface. There was no sign of freshly erupted ash. (*35-mm and video, visual and IR*)

Pavlof

Pavlof was completely clear. The two multi-lobate principal lava flow fields were snow-free and steaming lightly, especially along the margins. A dark area of debris (lahar?) extended beyond both flow fronts toward the Cathedral River drainages as well as from the saddle between Pavlof and

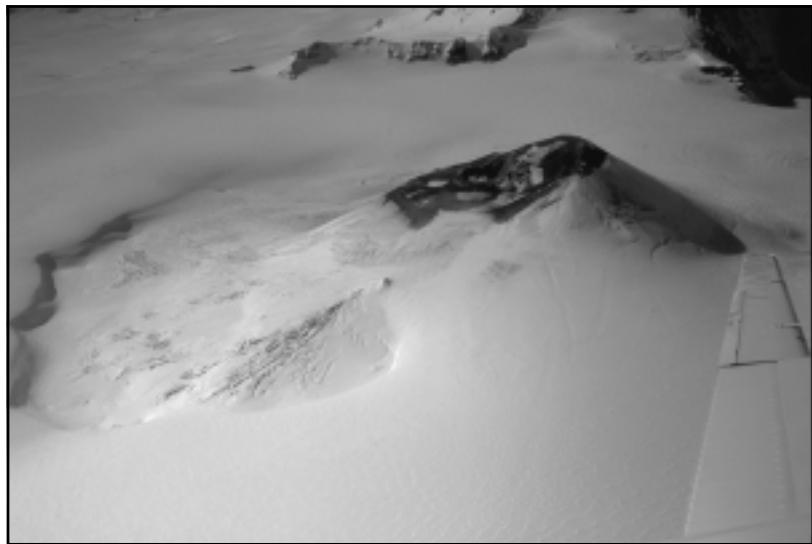


Figure 34: Main intracaldera cone of Veniaminof volcano. The depression in the snow and ice demarcates the location of the 1993-94 lava flow.

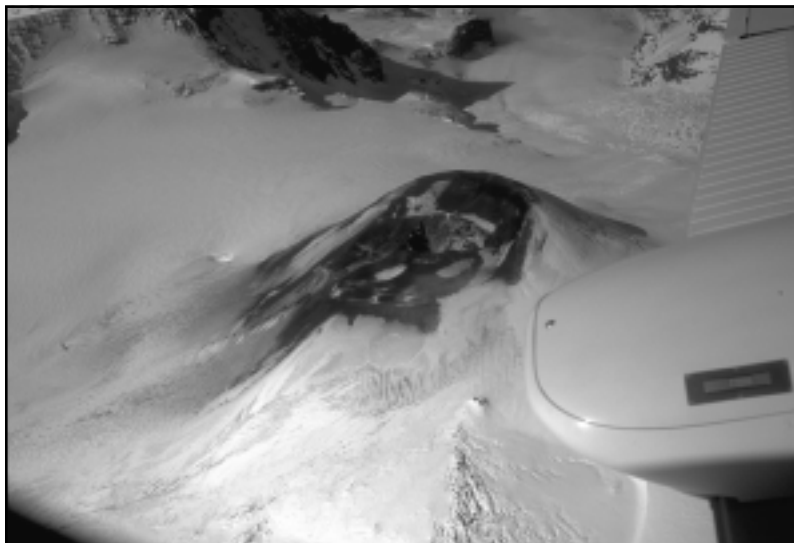


Figure 35: Small cinder/spatter cone nested within main intracaldera cone of Veniaminof. This is likely the vent for vigorous strombolian fountaining in 1993-94.

Pavlof Sister towards the Pacific (fig. 36). An open channel (recently cut?) extends from the terminus of the Pavlof saddle lava flows towards the Cathedral River side, joining an outflow channel formed by the more westerly flows. Based on its dark appearance above snowline, warm water is likely still flowing from both flow fields.

Pavlof cone itself was mostly covered with dirty snow. A prominent streak of reddish-black fragmental material extended from the SE summit (near the site of the 1986 crater?) down the east flank nearly to the base of the cone (fig. 37). This is likely a debris slide or avalanche from unstable agglutinate near the top of the volcano. It must have been fairly

continued

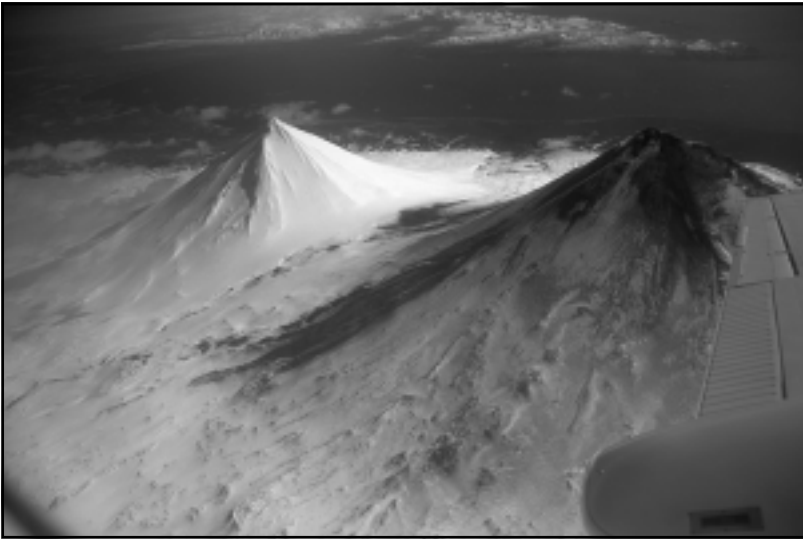


Figure 36: Pavlof volcano (foreground) and Pavlof Sister tower above the Alaska Peninsula. A dark area of debris, possibly deposited by a lahar, is visible in the saddle between the volcanoes.

recent as it was quite bright in IR; anomalous thermal spots lower on the flank of the cone are likely warm water seeps. Similar streaks of dark debris extended in nearly all directions from the summit area of spatter accumulation down the upper flanks.

Many of the bare-appearing patches on the surface of Pavlof looked to me to be wind-scoured or wind-exposed ash and I suspect many sightings of "activity" this spring were really windborne redistribution of ash. Streaks of brownish windblown material were prevalent in the lee of various features both on and off the cone.

The summit area appears significantly disrupted, although a careful comparison of images pre and post eruption has not been done. The vent area is much infilled by debris and the crater resembles an elongate scallop in the side of the cone (fig. 38).

Viewing the cone from Cold Bay later in the day, the upper 2/3 of the cone looked dark. Based on the close-in aerial recon, I suggest much of this is due to wind redistribution of old ash or scouring of loose snow on the surface.

Notes on Cold Bay vantage point: from the Flight Service Station and NWS tower, you can see the tops of Shishaldin, Pavlof, and Dutton. Roundtop, Isanotski, and Amak are visible from other parts of town (e.g. USFWS HQ). (For Pavlof, we have 35 mm slides, excellent visual and IR video)

Hague

Summit crater is snow-filled but steaming slightly, no open water or sulphur deposits visible (see AVO bimonthly May/June, v. 8, n. 3 for observation of open water and steaming last spring before Pavlof erupted).

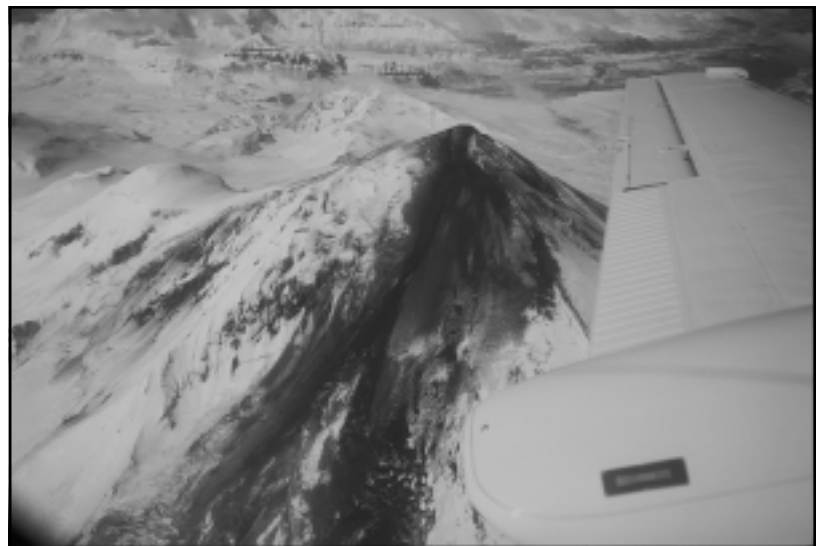


Figure 37: Dark material from debris slide or avalanche covers the eastern flank of Pavlof Volcano.

Shishaldin

We completed several orbits of the summit under nice, low light conditions and got especially good views to SW down the chain. The cone was snow covered as was most of the crater rim. There were a few bare rock patches on ribs extending away from the crater. We saw no fresh ash on flanks or crater rim. Steam

filled the crater but did not rise appreciably above the rim. With backlighting, the steam cloud appeared to have an envelope of haze with a bluish-brown cast to it. The crater interior is dramatically funnel shaped and completely covered with snow. (Obtained 35 mm slides and visual, IR video)

Westdahl

The sinuous fracture formed in the late 1991-92 eruption was nearly invisible due to infilling with snow and ice; the 1991-92 cinder cone was heavily blanketed by snow. No steaming was evident from any point on the volcano (35 mm slides)

Akutan

Through breaks in the clouds, we could see the summit caldera, entirely snow-covered with the exception of the intracaldera cone which was dark, about 70% snow-free, and very bright on IR. A few dark spots of bare ground occur around base of intracaldera cone and one directly across the caldera from the cone near the intracaldera lake (?). There was a small wisp of steam from summit of the main intracaldera cone. (Obtained 35 mm slides and visual, IR video)

Okmok

Unfortunately, on March 25, Okmok was completely obscured by layers of clouds. Several steam pillars pierced a clear layer between about 7-10,000 feet, rose to about 8,000 feet and drifted downwind. Over the approximate position of the vent, the steam column had a bluish brown



Figure 38: Summit area of Pavlof Volcano. The vent area is the elongate crater on the side of the cone.

haze associated with it that may have contained some ash. Activity must not have been very vigorous, because despite clear weather the day before and early the morning of our flight, there were no recorded PIREPS of activity.

On our next pass on March 27, I got partial views through breaks in the cloud cover. There was no extensive ash mantle on the fresh snow on the caldera floor or the volcano's flanks. The main NE lava flow was snow free and largely unchanged in position (e.g. it lapped onto the Cone D terrace) from the late February photos by John Sease of NOAA. A second lava flow lobe traveled north from Cone A towards the east base of Cone E (by inferred map position, there were few cloud-free reference points). Neither flow front appeared active (e.g. no incandescence or robust steaming).

Adak

We enjoyed only clouds beyond Akutan. Adak was snotty and blowing and greeted us with a nearby M 6.4 earthquake hours after landing. The formal end of US Navy presence was only a few days away. For a taste of what life there is like now with contractors keeping central facilities at a minimum level of operation, here are the words of Joe Meehan, USFWS: "Only 150 or so people around (mostly contractors). Most services (including recreational) have been closed but a few of the essentials remain (post office, workout rooms, and of course the bar). Alcohol and its associated problems (vandalism, assaults, theft, etc) are now a factor that we have to contend with - just like the real world."

We spent the day in Atka Village, where we visited with local elders and educators about volcanoes.

After an overnight stay in St. Paul, we overflowed Okmok but it was mostly in the clouds. Nothing significant was piercing the cloud deck at about 7,000 feet. We returned to Anchorage via Dutch Harbor and Kodiak, arrived at 2300.

Tina Neal

Flank Vents

The comparison of seismic activity associated with eruptions from central vents and flank vents has been largely ignored, due to lack of data and to the ambiguity of the terms involved. However, tools like the global volcanic earthquake swarm database (GVESD) of Benoit and McNutt (1996) have allowed for advancement in the area.

Zobin (1988) suggested fundamental differences exist between central vent swarms and flank vent swarms. The differences are that central vent swarms last longer and have larger seismic moments than flank vent swarms. Also, the two types of swarms have different frequency of occurrence versus time profiles. Central vent swarms begin slowly and gradually ramp up in seismicity, reaching a peak that coincides with the onset of eruption. Flank vent

swarms, on the other hand, begin with an initial intense peak in seismicity and gradually decay (almost resembling a mainshock - aftershock sequence), commonly resulting in a period of quiescence prior to eruption.

Queries of the GVESD generally support Zobin's conclusion about the duration of swarms. However, the results do not support his conclusions concerning frequency of occurrence versus time profiles, and in fact are the exact opposite. Seismic moments of individual events or entire swarms were not analyzed, as there were no immediately available data. The GVESD also revealed that central vent swarms are not only longer in duration, but consist of fewer events, leading to a lower temporal seismic density. Flank vent swarms, however, have higher temporal seismic densities. The energy released in swarms of both types are very similar, which indicates that the average energy of each event in a central vent swarm must be greater than that of each flank vent swarm event.

This could have interesting applications. Assuming that the conduit of a central vent is filled with cold rock that has partially fused to the wall rock, this could create a highly resistant barrier to fracture. This strong rock would have a greater yield strength, requiring larger-energy events to propagate a fracture system to the surface. Greater amounts of time would be necessary to build up enough magmatic pressure to overcome the yield strength, thus accounting for the longer duration of the swarm. Contrast this with the creation of a flank vent, which must connect a series of en echelon fractures within a presumably crumbly volcanic pile composed of lava flows, pyroclastic flow deposits, surficial sediments and hydrothermally altered material. The propagation of a fracture system in this setting is easier, allowing a large number of lower-energy events to create a conduit.

This hypothesis leads to an interesting question: why does magma more often prefer the path of most resistance in the central conduit?

Pete Stelling

Outreach

From Anchorage:

There has been approximately 10 tours between January and April. These tours informed elementary students, college-aged, and older adults about the importance of AVO. The staff involved in coordinating and running these tours were Tina Neal, Terry Keith, Game McGimsey, Chris Waythomas, Brendan Kelly, and Cindy McFarlin

From Fairbanks:

Bob Hammond continued his involvement in the Partners In Science project. He trained 3 West Valley High students in operation of the Pearl Creek Elementary Seismograph Station and interpretation of seismological data. These 3 students in turn work with Pearl Creek Elementary students on earthquake-related projects.

Bob also worked with students and teachers at McGrath and Grayling Schools regarding their seismograph stations.

Bob also took part in the USGS Ask-A-Geologist email program and answered geological questions from the public.

In March, Bob and Tina Neal visited Meshik School and presented talks on volcanology and seismology to several classes.

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Addendum

Log of Updates for the Current Period

Alaska Volcanoes Update

Friday, January 3, 1997, 12:00 noon
AST (2100 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft elevation

CURRENT LEVEL OF CONCERN CODE IS YELLOW

The eruption at Pavlof Volcano is intermittent and much reduced from the vigorous activity of last weekend. Seismicity has remained low and clouds have obscured the volcano for much of the week. This morning, however, a National Weather Service observer in Cold Bay spotted a small burst of ash rising just above the summit of the volcano. A pilot report yesterday also noted steam and ash drifting south from the summit. Based on the previous pattern of eruptive activity at Pavlof, a resumption of more energetic ash and lava emission could resume with little or no warning. AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Pavlof is located 600 miles southwest of Anchorage. The nearest towns to the volcano are Cold Bay (37 mi SW), King Cover (30 mi SW), Sand Point (60 mi E), and Nelson Lagoon (50 mi NE). AVO has a seismic network of six stations near the volcano. (repeated in subsequent updates)

Other volcanoes:

Seismic activity is monitored in real time at the following volcanoes. Some of the volcanoes listed below may have anomalous seismicity as noted, but are not considered to be at a dangerous level of unrest. (repeated in subsequent updates)

Iliamna Volcano: 60.04N° 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past week but at a reduced average rate of two earthquakes per day.

Spurr, Redoubt, Augustine, Griggs, Katmai, Trident, Mageik, Martin, Dutton, Akutan, and Makushin volcanoes are all at or near

normal levels of background seismicity. (repeated in subsequent updates)

KVERT Information Release 97-1

Monday, January 6, 1997, 13:00 KST
(0100 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

CURRENT LEVEL OF CONCERN COLOR CODE IS GREEN LAST LEVEL OF CONCERN: YELLOW

During the last week (December 31, 1996-January 5, 1997), seismicity under Klyuchevskoy volcano remained slightly above background levels. On January 4, gas and steam explosions rose to 200 m above the crater and a plume extended 10 km to the northwest. On January 4, a fumarolic plume extending to the east was observed above Bezymianny volcano. The rest of the week Klyuchevskoy and Bezymianny volcanoes were obscured by clouds. Sheveluch volcano was obscured by clouds during the past week. *Karymsky Volcano*: 54°03'N, 159°27'E

CURRENT LEVEL OF CONCERN COLOR CODE IS ORANGE

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. According to seismic data, about 300 explosions per day are occurring.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

CURRENT LEVEL OF CONCERN COLOR CODE IS GREEN

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

KVERT Information Release 97-2

Wednesday, January 8, 1997, 19:00
KST (0600 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

CURRENT LEVEL OF CONCERN COLOR CODE IS YELLOW LAST LEVEL OF CONCERN: GREEN

An increase in eruptive activity at Klyuchevskoy volcano was first noticed on January 7, 17:40 KST from Klyuchi. An ash and steam plume was observed rising 2,500-3,000 m above the crater and

extending 20 km to the southeast. Seismic activity, while still elevated, did not show an increase. The volcano was obscured by clouds on January 8; an AVO analysis of a satellite image taken early on the morning of January 8 indicated the plume had subsided.

Alaska Volcanoes Update

Friday, January 10, 1997, 12:00 noon
AST (2100 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft elevation

CURRENT LEVEL OF CONCERN CODE IS YELLOW

A pause in eruptive activity continues at Pavlof Volcano. During the past week, AVO recorded very low levels of seismicity at the volcano. The FAA received no pilot reports of ash or lava eruption and weather observers in Cold Bay report seeing no eruptive activity during breaks in the weather this week. The last sighting of weak ash emission from Pavlof was on Thursday, January 2.

Although the current pause is now in its second week, based on the previous pattern of eruptive activity at Pavlof, a resumption of more energetic ash and lava emission could resume with little or no warning. AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Iliamna Volcano: 60.04N° 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past week at an average rate of 11 earthquakes per day.

KVERT Information Release 97-3

Monday, January 13, 1997, 16:30 KST
(0430 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

CURRENT LEVEL OF CONCERN COLOR CODE IS GREEN LAST LEVEL OF CONCERN: YELLOW

During the last week (January 9-12, 1997), seismicity under Klyuchevskoy volcano remained slightly above background levels. On January 9, gas and steam explosions (possibly with minor ash according to E. Zhanova) rose to 300-600 m above the crater and a plume extended 15 km to the west. On January 11, gas and steam explosions (with ash?) rose 700 m above the

crater and extended up to 10 km to the southwest. On January 10 and 12, the volcano was obscured by clouds. Bezymianny and Sheveluch volcanoes were obscured by clouds for much of last week. On January 9, a fumarolic plume rose 100 m above Bezymianny volcano and extended 3-5 km to the west. On January 7, the usual fumarolic activity above Sheveluch volcano was observed.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. Eruptive activity during the past week may have declined as recorded explosions dropped from 300 to 150 per day.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, January 17, 1997, 12:00 noon
AST (2100 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft elevation

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The eruptive pause continues at Pavlof Volcano. During the past week, AVO recorded very low levels of seismicity at the volcano. Pilots reported seeing no eruptive activity during overflights this week. The last sighting of weak ash emission from Pavlof was on Thursday, January 2.

Although the current pause is now in its third week, based on the previous pattern of eruptive activity at Pavlof, a resumption of more energetic ash and lava emission could resume with little or no warning. AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past

week at an average rate of 2 earthquakes per day.

KVERT Information Release 97-4

Monday, January 20, 1997, 20:30 KST
(0830 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN LAST
LEVEL OF CONCERN: YELLOW**

During the last week (January 13-20, 1997), seismicity under Klyuchevskoy volcano remained slightly above background levels. On January 13-14 and 16, gas and steam rose to 300-600 m above the crater of Klyuchevskoy and a plume extended 10 km to the east. On January 15, a gas and steam explosion rose 1200 m above the crater and extended up to 15 km to the southeast. On January 17-20, the volcano was obscured by clouds. Bezymianny and Sheveluch volcanoes were obscured by clouds for much of last week. On January 14-15, fumarolic activity was observed above Bezymianny volcano and Sheveluch volcano.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. During the past week (Jan. 13-20, 1997) eruptive activity slightly declined.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, January 24, 1997, 12:00 noon
AST (2100 UTC)

Pavlof Volcano: 55.42°N, 161.9°W
8,262 ft

**CURRENT LEVEL OF CONCERN
CODE IS YELLOW**

The eruptive pause at Pavlof Volcano is now beginning its fourth week. AVO seismometers continue to record very low levels of seismicity at the volcano. Although the weather has prevented any

ground observations from Cold Bay or Nelson Lagoon, pilots saw no significant eruptive activity during overflights this week. This morning, a pilot did report weak emission of steam and possibly minor ash rising to an estimated 14,000 feet, mixing with a cloud layer, and drifting southeast.

Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Iliamna Volcano: 60.04°N, 153.17°W
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past week at an average rate of less than one earthquake per day, a significant reduction from last week's rate of 11 per day.

KVERT Information Release 97-5

Sunday, January 26, 1997, 16:30 KST
(0430 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (January 21-26, 1997), seismicity under Klyuchevskoy volcano remained slightly above background levels. The volcano was obscured by clouds during the week. Bezymianny and Sheveluch volcanoes were also obscured by clouds for much of last week.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. According to seismic data, about 200 explosions per day are occurring.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, January 31, 1997, 10:00 AM
AST (1900 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The eruptive pause at Pavlof Volcano is now beginning its fifth week. AVO seismometers continue to record very low levels of seismicity at the volcano. AVO received no pilot reports of activity this week. Ground observations from Cold Bay and Nelson Lagoon today and earlier in the week during a break in the weather confirm that there is no eruptive activity at the volcano.

Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past week at an average rate of about 3 earthquake per day.

KVERT Information Release 97-6

Monday, February 3, 1997, 20:30 KST
(0830 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE LAST
LEVEL OF CONCERN: GREEN**

During the last week (January 27-February 2), seismicity under Klyuchevskoy volcano increased above background levels. On January 30-31, and February 1-2, gas and steam rose to 100-300 m above the crater of Klyuchevskoy and a plume extended 5 km to the south. On January 27-29, the volcano was obscured by clouds. On February 3, at 9:30 KST (2030 UTC), the seismicity increased again and at 10:30 KST (2130 UTC), an eruption started from the central crater of the volcano. By 11:30 KST (2230 UTC), ash explosions were rising to 300 m above the crater and an ash plume extended 30-50 km S-SE of the volcano. At 12:30 KST, activity declined somewhat with steam clouds without ash rising only 100 m above the crater. This

minor eruptive activity may have been connected to the collapse of unconsolidated material inside the summit crater. Bezymianny and Sheveluch volcanoes were also obscured by clouds for much of last week although normal fumarolic activity was observed on January 28-29 above both volcanoes.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week.

Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, February 7, 1997, 10:30 AM
AST (1900 UTC)

Pavlof Volcano: 55.42°N, 161.9°W
8,262 ft

**CURRENT LEVEL OF CONCERN
CODE IS YELLOW**

The eruptive pause at Pavlof Volcano is now beginning its sixth week. AVO seismometers continue to record very low levels of seismicity at the volcano. AVO received no pilot reports of activity this week. On Tuesday, ground observers got a brief glimpse of the volcano and reported that the summit vent area, which had been snow covered last week, was bare of snow. Yesterday, the same observer saw a small steam plume rising from the vent area several hundred feet up to about the summit level.

Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Iliamna Volcano: 60.04°N, 153.17°W
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past

week at an average rate of about 4 earthquakes per day.

KVERT Information Release 97-7

Sunday, February 9, 1997, 22:30 KST
(1030 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN LAST
LEVEL OF CONCERN: ORANGE**

During the last week (February 4-9), seismicity under Klyuchevskoy volcano remained above background levels. On February 4-6, a gas and steam rose 100-300 m above the crater of Klyuchevskoy and a plume extended 10-20 km to the east. On February 7, gas and steam explosions (without ash) rose 1.5-2 km above the crater of the volcano and the plume extended 10 km to the Southeast. On February 8-9, the volcano was obscured by clouds. On February 5-7, fumarolic activity (200-400 m above the crater) was observed above Sheveluch volcano.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Satellite images examined by AVO indicated a continued hot spot at the summit. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

February 13, 1997, 12:30 PM AST
(2130 UTC)

Okmok Volcano: 55°24' N, 168°10' W;
caldera rim elevation 3520 feet
(1,073 m) elevation of erupting
cone about 2500 feet (760 m)

A small eruption began this morning at Okmok volcano on Umnak Island, in the eastern Aleutian Islands, about 75 miles west-southwest of Dutch Harbor. AVO received a report from observers at the former Fort Glenn military base at the east end of the island at 10:46

am AST that an ash plume began rising from a cone inside the caldera at about 10 am AST. The dark plume rose to about 5,000 feet ASL, was carried to the southwest by prevailing winds and was described as dissipating somewhat at the time of the call. Satellite images from 5 am and 10:30 am AST show a hot spot in the vicinity of a cone along the south rim of the caldera. AVO does not have seismic monitoring equipment on the island and therefore at this time is not instituting a color code designation.

Okmok volcano is a 6-mile-wide caldera that occupies most of the eastern end of Umnak Island that has had several eruptions in historic time. Historic eruptions typically consist of ash emissions occasionally to over 30,000 feet but generally to much lower altitudes; lava flows crossed the caldera floor in 1945 and 1958. The last eruption occurred November 1986 through February 1988 and was characterized by intermittent ash emission.

The nearest settlements are Nikolski, population about 35, about 45 miles west of the volcano, and a small number of people at the abandoned Fort Glenn military base 10 miles east of the volcano.

Alaska Volcanoes Update

Friday, February 14, 1997, 2:30 PM AST (2330 UTC)

Pavlof Volcano: 55.42°N, 161.9°W; 8,262 ft elevation

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The eruptive pause at Pavlof Volcano is now beginning its seventh week. AVO seismometers continue to record very low levels of seismicity at the volcano. AVO received no pilot reports of activity this week.

Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Pavlof is located 600 miles southwest of Anchorage. The nearest towns to the volcano are Cold Bay (37 mi SW), King Cove (30 mi SW), Sand Point (60 mi E), and Nelson Lagoon (50 mi NE). AVO has a

seismic network of six stations near the volcano.

Okmok Volcano: 53.4°N, 168.17°W; 2,500 ft elevation

A small eruption began on the morning of February 13 from a cone within Okmok caldera. First sign of unrest was observed as a "hot spot" on early morning satellite images at 5:00 and 10:30 am AST. Observers 10 miles east of the volcano at the former Fort Glenn military base reported seeing a dark ash plume at about 10 am AST rise above the caldera rim to an altitude of about 5,000 feet ASL where prevailing winds carried it to the southwest. Since the volcano is not monitored seismically and no observations have been reported today from this remote volcano, the state of the eruption is unknown. The volcano is currently obscured by clouds. Okmok is located on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Iliamna Volcano: 60.04°N, 153.17°W; 10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano continued during the past week at an average rate of about 2 earthquakes per day.

KVERT Information Release 97-8

Sunday, February 16, 1997, 23:00 KST (1100 UTC)

Klyuchevskaya Group of Volcanoes: 56°38' N, 161°19' E; elevation 4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (February 10-16), seismicity under Klyuchevskoy volcano remained above background levels. On February 10-13, a gas and steam rose 100-200 m above the crater of Klyuchevskoy and a plume extended 1-5 km to the north-northeast. On February 14, gas and steam explosions rose 400m above the crater of the volcano and the plume extended 1 km to the north. On February 12, 15, and 16, the volcano was obscured by clouds. On February 10-14, fumarolic activity (50-100 m above the crater) was observed above Sheveluch and Bezmyianny volcanoes.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week.

Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes: 153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

February 20, 1997, 1:30 pm AST (2230 UTC)

Okmok Volcano: 53°24' N, 168°10' W; caldera rim elevation 3520 feet (1,073 m) elevation of erupting cone about 2500 feet (760 m)

The small eruption that began last week continues at Okmok volcano on Umnak Island. On Tuesday morning, February 18, U.S. Coast Guard pilots reported an ash plume rising to between 10,000 feet and 15,000 feet ASL at the volcano. Satellite images showed a large circular hot spot. Observers at the former Fort Glenn military base at the east end of the island reported seeing a bright red glare reflected from the 6,000-foot-high weather clouds above the volcano. The red glow was visible from about 1:00 am (AST) until sunrise. A large steam plume was subsequently observed rising from, and covering the top of the caldera. At 1:35 pm (AST) pilots reported an ash cloud above Okmok rising to 16,000 feet ASL and moving slowly to the southwest. Satellite images from the afternoon of Wednesday, February 19 showed no hotspot, but images from this morning show a small hotspot. AVO does not have seismic monitoring equipment on the island.

Although AVO lacks direct observations inside the caldera, the reported activity appears to indicate that a lava-producing eruption has occurred from an intracaldera cone located along the south rim. The main pulse of activity began early on Tuesday morning and subsided sometime yesterday. The south rim cone has been the source of most of the recent historical activity. Based on previous activity, the current eruption could continue for weeks or months with intermittent steam and ash emission and

extrusion of intracaldera lava flows.

Okmok volcano is a 6-mile-wide caldera that occupies most of the eastern end of Umnak Island, located 75 miles southwest of Dutch Harbor in the eastern Aleutian Islands. Okmok has had several eruptions in historic time typically consisting of ash emissions occasionally to over 30,000 feet ASL but generally to much lower altitudes; lava flows crossed the caldera floor in 1945 and 1958. The last eruption occurred November 1986 through February 1988 and was characterized by intermittent ash emission.

The nearest settlements are Nikolski, population about 35, about 45 miles west of the volcano, and a small number of people at the abandoned Fort Glenn military base 10 miles east of the volcano. AVO is closely monitoring the situation and will issue further updates as more information becomes available.

Alaska Volcanoes Update

Friday, February 21, 1997, 10:30 AM
AST (1930 UTC)

Pavlof Volcano: 55.42°N, 161.9°W
8,262 ft elevation

**CURRENT LEVEL OF CONCERN
CODE IS YELLOW**

The eruptive pause at Pavlof Volcano is now beginning its eighth week. AVO seismometers continue to record very low levels of seismicity at the volcano. NWS observers in Cold Bay reported a small steam plume up to 1000 feet above the summit vents last weekend, and pilots reported on Wednesday a similar steam plume 2000 to 3000 feet above the volcano.

Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Pavlof is located 600 miles southwest of Anchorage. The nearest towns to the volcano are Cold Bay (37 mi SW), King Cove (30 mi SW), Sand Point (60 mi E), and Nelson Lagoon (50 mi NE). AVO has a seismic network of six stations near the volcano.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft elevation

The small eruption that began on the morning of February 13 from a cone within Okmok caldera continued this week. A hot spot was visible on satellite images throughout the week and pilots reported an ash plume to 16,000 feet ASL on Tuesday, February 18. Observers 10 miles east of the volcano at the former Fort Glenn military base reported seeing a red glow over the caldera on Tuesday night. The volcano is not monitored seismically. Okmok is located on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano appears to be diminishing. Earthquake count averages have gradually decreased over the past several weeks. Only 2 located events were recorded this week.

KVERT Information Release 97-9

Sunday, February 23, 1997, 23:00
KST (1100 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN.**

During the last week (February 17-23), seismicity under Klyuchevskoy volcano remained above background levels. On February 17-18, a gas and steam explosion rose 50-300 m above the crater of Klyuchevskoy and a plume extended 1-3 km to the east-northeast. On February 19-23, the volcano was obscured by clouds.

On February 17-18, fumarolic activity (50-100 m above the crater) was observed above Sheveluch and Bezymianny volcanoes.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, February 28, 1997, 11:30 AM
AST (2030 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft elevation

**CURRENT LEVEL OF CONCERN
CODE IS YELLOW**

The pause in eruptive activity at Pavlof Volcano is now beginning its ninth week. AVO seismometers continue to record very low levels of seismicity at the volcano. NWS observers in Cold Bay saw the volcano early in the week and observed no visible signs of volcanic activity. Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes. Pavlof is located 600 miles southwest of Anchorage. The nearest towns to the volcano are Cold Bay (37 mi SW), King Cove (30 mi SW), Sand Point (60 mi E), and Nelson Lagoon (50 mi NE). AVO has a seismic network of six stations near the volcano.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft elevation

The eruption that began the morning of February 13 from a cone on the south side of the Okmok caldera floor continued throughout the week with production of incandescent lava accompanied by intermittent steam and ash plumes that reached as high as 12,000 feet ASL and drifted as far as 60 miles downwind. Residents living at Fort Glenn reported climbing to the rim of the caldera and viewing a 1/2 to 3/4 mile-long lava flow from the cone, thus confirming the satellite imagery analyses showing major hot spots in the caldera. Satellite imagery analyses and pilot reports verified ongoing eruptive activity. The volcano is not monitored seismically. Based on past eruptive history, the current activity is expected to continue for weeks to months. Okmok is located on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest

settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Iliamna Volcano: 60.04°N, 153.17°W; 10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano appears to be diminishing. Earthquake count averages have gradually decreased over the past several weeks. Only 5 located events were recorded this week.

KVERT Information Release 97-10
Sunday, March 2, 1997, 20:00 KST
(0800 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (February 24-March 2), seismicity under Klyuchevskoy volcano remained above background levels. On February 24-25, a gas and steam explosion rose 50-100 m above the crater.

On February 27, a gas and steam explosion with a small amount of volcanic ash rose 1000 m above the crater of Klyuchevskoy and a plume extended 1 km to the northeast. On February 26, 28, and March 1-2, the volcano was obscured by clouds.

On February 25, fumarolic activity (100 m above the crater) was observed above Sheveluch volcano.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. Satellite images received by AVO indicate a persistent hot spot and occasional low level ash plumes.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

KVERT Information Release 97-11
Thursday, March 6, 1997, 20:00 KT
(0800 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE LAST
LEVEL OF CONCERN COLOR
CODE: GREEN**

On March 5 at 2300 KT, an explosive eruption of Klyuchevskoy volcano began from several vents in the summit central crater. Gas and ash explosions rose 2000 m above the crater (22,000 feet ASL) and extended 50 km to the southeast. On March 6 at 10:00 KT, gas and steam explosions were visible rising to 500 m above the crater (17,000 feet ASL); the volcano was obscured by clouds the remainder of the day.

AVHRR satellite images at 1:19 PM (97065.0119) and 6:30 PM (97065.0630 UTC) March 6 (KT) obtained by AVO indicated an eruption plume extending 40-65 miles southeast of the volcano. Pilot reports suggest the plume was between 25,000-29,000 ft ASL.

KVERT Information Release 97-12
Friday, March 7, 1997, 18:00 KT (0600 UTC)

Klyuchevskaya Group of Volcanoes:
56°38' N, 161°19' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

On March 7, the explosive eruption at Klyuchevskoy continued from the central crater in a manner similar to the past several days. At 0040 KT, a gas and ash explosion rose 2000 m (19,000 feet ASL) above the crater, extending 50 km (30 miles) to the southeast. At 0300 KT, ash explosions were rising to 1,500 m above the crater rim and at 0730 KT, gas and ash explosions were observed rising to 1000 m above the rim; the plume extended only 2 km to the northeast. AVHRR satellite images at 1:05 PM KT obtained by AVO indicated an eruption plume extending about 65 km east of the volcano. According to Kamchatkan pilot reports, at 1530 KT, the ash plume from the volcano was rising to 6,500 m ASL (21,000 feet ASL) and was moving to the northeast.

Alaska Volcanoes Update
Friday, March 7, 1997, 10:30 AM AST
(1930 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft (2518 m)

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The pause in eruptive activity at Pavlof Volcano is now in its tenth week. AVO seismometers continue to record very low levels of seismicity at the volcano. Observers in Cold Bay have seen no visible signs of volcanic activity for several weeks. Based on comparisons to other historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes. Pavlof is located 600 miles southwest of Anchorage. The nearest towns to the volcano are Cold Bay (37 mi SW), King Cove (30 mi SW), Sand Point (60 mi E), and Nelson Lagoon (50 mi NE). AVO has a seismic network of six stations near the volcano.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft (760 m)

The eruption that began the morning of February 13 from a cone on the south side of the Okmok caldera floor appears to have continued intermittently throughout the week. Although low clouds obscured the volcano, pilots reported steam and ash plumes that reached as high as 15,000 feet ASL. Satellite imagery continued to show significant hot spots in the caldera. Okmok volcano is not monitored seismically. Based on past eruptive history, the current activity is expected to continue for weeks to months. Okmok is located on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Amukta Volcano: 52.5°N, 171.25°W;
3,491 ft (1064 m)

AVO received a pilot report of a small eruption on March 2 at Amukta Volcano in the central Aleutian Islands. Ash was reported barely clearing the top of the volcano. Amukta is an unmonitored, uninhabited island about 240 miles southwest of Dutch Harbor. Small ash eruptions have been reported at Amukta as recently as September, 1996.

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft (3054 m)

The seismic swarm that began on 1 August 1996 beneath Iliamna

Volcano appears to be diminishing. Earthquake count averages have gradually decreased over the past several weeks. An average of one earthquake per day was recorded this week.

KVERT Information Release 97-13

Sunday, March 9, 1997, 20:00 KT
(0800 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last two days (March 8-9), seismicity under Klyuchevskoy volcano remained above background levels. On March 9 a gas and steam plume (without ash) rose 100 m above the crater. On March 8, the volcano was obscured by clouds.

Sheveluch Volcano: 56°38' N, 161°19' E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

On March 8-9, an extrusive dome was observed growing inside the active crater of Sheveluch volcano. On March 8 at 0250 KT, ash and gas explosions rose 4000 m above the crater and extended 80 km to the north. At 0600 KT, an ash plume rose 2000 m above the crater and extended 70 km to the north. At 1340 KT, a gas and steam plume rose 1000 m above the crater and extended 60 km to the north. On March 9, fumarolic activity was observed with gas and steam rising 1 km above the crater and a plume extended 30 km to the north.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues. Satellite images received by AVO indicate a persistent hot spot and occasional low level ash plumes.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, March 14, 1997, 12:30 PM AST
(2130 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft elevation

**CURRENT LEVEL OF CONCERN
CODE IS YELLOW**

The pause in eruptive activity at Pavlof Volcano is now in its eleventh week. AVO seismometers continue to record very low levels of seismicity at the volcano. Observers in Cold Bay have seen no visible signs of volcanic activity for several weeks, but reports of a snow-free condition at the summit may indicate that recently emplaced lava flows are still warm. Satellite images do not show any thermal anomalies on the volcano. Based on comparisons with historical eruptions at Pavlof, it is possible that this pause will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft elevation

The eruption that began February 13 consists of a lava flow inside the caldera accompanied by intermittent plumes of steam and ash from a cone on the south side of the caldera floor. Satellite images throughout the week showed significant hot spots in the caldera and occasional plumes below 16,000 feet ASL drifting downwind as far as 85 km from the volcano. However, on March 11, a pilot reported a short-lived plume of steam and ash as high as 30,000 feet ASL drifting northwest. Okmok Volcano is not monitored seismically. Based on past eruptive history, the current activity is expected to continue for weeks to months. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Amukta Volcano: 52.5°N, 171.25°W;
3,491 ft elevation

AVO received a pilot report of a small eruption on March 2 at Amukta Volcano in the central Aleutian Islands. Ash was reported barely clearing the top of the volcano. Amukta is an unmonitored, uninhabited island about 240 miles southwest of Dutch Harbor. No reports of activity were

received during the week of March 10.

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft elevation

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano has diminished. Earthquake counts have gradually decreased over the past several weeks. An average of less than one earthquake per day was recorded this week.

KVERT Information Release 97-14

Sunday, March 16, 1997, 29:00 KT
(0800 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (March 10-16), seismicity under Klyuchevskoy volcano remained above background levels. On March 10-12, a gas and steam plume rose 200-300 m above the crater, moving northwest. On March 13-14, a gas and steam plume with a small amount of volcanic ash rose 100 m above the crater. On March 15-16, the usual fumarolic activity was observed above the crater of the volcano.

Sheveluch Volcano: 56°38' N, 161°19' E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

On March 10-14, a steam and gas plume rose 1-5 km above the crater of Sheveluch volcano, extending 40-70 km to the northwest. On March 15-16, the usual fumarolic activity above the crater was observed.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week.

Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, March 21, 1997, 12:30 PM AST
(2130 UTC)

Pavlof Volcano: 55.42°N, 161.9°W;
8,262 ft (2518 m)

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The pause in eruptive activity at Pavlof Volcano is now in its 12th week. AVO seismometers continue to record very low levels of seismicity at the volcano. Observers in Cold Bay report snow-free conditions at the summit. Satellite images do not show any thermal anomalies on the volcano. Based on comparisons with historical eruptions at Pavlof, it is possible that the pause in activity will persist for weeks or months, followed by resumption of ash and lava emission with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft (760 m)

The eruption that began February 13 continues. A lava flow issues from a cone on the south side of the caldera floor. Bursts of incandescent lava accompanied by intermittent plumes of steam and ash are common. Satellite images throughout the week showed significant hot spots in the caldera and occasional plumes below 16,000 feet ASL drifting downwind as far as 150 miles from the volcano. On March 19, a short-lived plume as high as 28,000 feet ASL was reported. Ash fallout was observed on the volcano flanks. Okmok Volcano is not monitored seismically. Based on past eruptive history, the current activity is expected to continue for weeks to months. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Iliamna Volcano: 60.04°N, 153.17°W;
10,196 ft (3054 m)

The seismic swarm that began on 1 August 1996 beneath Iliamna Volcano has diminished. Earthquake counts have gradually decreased over the past several weeks. Only one locatable earthquake was recorded this week.

KVERT Information Release 97-15

Monday, March 24, 1997, 12:00 KT
(0000 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (March 17-24), seismicity under Klyuchevskoy volcano remained above background levels. On March 17-20, a gas and steam plume rose 200 m above the crater, moving northeast. On March 22-24, a gas and steam plume rose 300-500 m above the crater.

Sheveluch Volcano: 56°38' N, 161°19'
E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

On March 17-20, a steam and gas plume rose 300-500 m above the crater of Sheveluch volcano, extending 15-20 km to the northwest. On March 21-24, the usual fumarolic activity 50-100 m above the crater was observed.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update

Friday, March 28, 1997 10:30
PM AST (1930 UTC)

Pavlof Volcano: 55.42°N 161.9°W;
8,262 ft (2518 m)

**CURRENT LEVEL OF CONCERN
COLOR CODE IS YELLOW**

The pause in eruptive activity at Pavlof Volcano is now in its 13th week. AVO seismometers continue to record very low levels of seismicity at the volcano. Satellite images do not show any thermal anomalies on the volcano. Based on comparisons with historical eruptions at Pavlof, it is possible that the pause in activity will persist for weeks or months, followed by the resumption of ash

emissions and lava flows with little or no warning. Accordingly, AVO continues to monitor the volcano closely and will issue further updates as the situation changes.

Okmok Volcano: 53.4°N 168.17°W;
2,500 ft (760 m)

The eruption that began February 13 continues. However, visual reports yesterday (3/27) indicate a much decreased level of activity. Satellite images throughout the week showed hot spots in the caldera and occasional thin, low-level plumes drifting downwind from the volcano. Okmok Volcano is not monitored seismically. Based on past eruptive history, lava flows and low-level ash emission could continue for weeks to months. Eruptive activity could intensify at any time. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

KVERT Information Release 97-16
Monday, March 31, 1997, 22:00 KDT
(0900 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (March 25-31), seismicity under Klyuchevskoy volcano remained above background levels. On March 25-26, a gas and steam plume rose 200 m above the crater, moving east. On March 27, a gas and steam plume rose 1,500-4,000 m above the crater, moving 70 km to the east. On March 28-31, gas and steam plume rose 200-500 m above the crater, moving 5-10 km to the southeast.

Sheveluch Volcano: 56°38' N, 161°19'
E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

On March 25, a steam and gas plume rose 1,500 m above the crater of Sheveluch volcano, extending 30 km to the northwest. On March 26-31, the usual fumarolic activity 100-300 m above the crater was observed.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week.

Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update
Friday, April 04, 1997, 10:30 AM AST
(1930 UTC)

Pavlof Volcano: 55.42°N, 161.9°W
8,262 ft elevation

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Pavlof has returned to a near-background level after fourteen weeks of eruptive quiescence. No thermal anomalies are present on satellite images. Although the likelihood of renewed activity is still above normal, the immediate hazard level is low. Pavlof will be removed from the itemized report if quiescence persists for another week, though AVO will continue to monitor the volcano closely.

Okmok Volcano: 53.4°N, 168.17°W;
2,500 ft (760 m)

Visual reports indicate that the eruption, which began February 13, is continuing at relatively low activity level. Satellite images throughout the week indicate the presence of hot lava flows in the caldera, and occasional thin, low-level plumes drifting downwind from the volcano. Plumes have also been reported by aircraft in the vicinity. Okmok Volcano is not monitored seismically and is not assigned a color code. Based on past eruptive history, lava flows and low-level ash emission could continue for weeks to months. Eruptive activity could intensify at any time. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

KVERT Information Release 97-17
Sunday, April 6, 1997, 22:00 KDT
(0900 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (April 1-6), seismicity under Klyuchevskoy volcano remained above background levels. On April 1, a gas and steam plume rose 300 m above the crater, moving 10 km east. On April 2 at 06:15, a gas and steam plume rose 1,500-3,000 m above the crater, moving 50 km to the east. On April 3-4, gas and steam plume rose 500 m above the crater, moving 1-10 km to the southeast. The volcano was obscured by clouds on April 5-6.

Sheveluch Volcano: 56°38' N, 161°19' E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

On April 1-4, a steam and gas plume rose 100-200 m above the crater of Sheveluch volcano. On April 5-6, the volcano was obscured by clouds.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

Alaska Volcanoes Update
Friday, April 11, 1997, 10:30 AM ADT
(1830 UTC)

Okmok Volcano: 53.4°N 168.17° W
760 m (2,500 ft)

Eruptive activity at Okmok, which began February 13, is continuing at a reduced activity. Okmok Volcano is not monitored seismically and is not assigned a color code. Based on past eruptive history, lava flows and low-level ash emission could occur without warning for a period of weeks to months. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

KVERT Information Release 97-18
Sunday, April 13, 1997, 22:00 KDT
(0900 UTC)

Klyuchevskaya Group of Volcanoes:
56°03' N, 160°39' E; elevation
4,750 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

During the last week (April 7-13), seismicity under Klyuchevskoy volcano remained above background levels. On April 7, a gas and steam plume rose 100 m above the crater, moving 2 km east. On April 8-13, a gas and steam plume rose 50-500 m above the crater.

Sheveluch Volcano: 56°38' N, 161°19' E; elevation 2,800 m

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

On April 1-4, a steam and gas plume rose 100 m above the crater of Sheveluch volcano.

Karymsky Volcano: 54°03'N, 159°27'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS ORANGE**

Seismicity remains above background level. No visual observations were made during the past week. Seismic activity indicates that the strombolian eruptive activity that has characterized the volcano for the past several months continues.

Avachinskaya Group of Volcanoes:
153°15'N, 158°51'E

**CURRENT LEVEL OF CONCERN
COLOR CODE IS GREEN**

Seismicity at Avachinsky and Koryaksky volcanoes remains at normal levels.

This is the last KVERT Information Release until additional funding is obtained; We hope this delay is temporary. (Next release was not until July 14, 1997.)

Alaska Volcanoes Update
Friday, April 18, 1997, 10:30 AM ADT
(1830 UTC)

Okmok Volcano: 53.4°N, 168.17° W;
760 m (2,500 ft)

Eruptive activity at Okmok, which began February 13, is continuing. Lava flows within the caldera are indicated by satellite images. Thin, low level, ash plumes have also been observed drifting downwind from the volcano. Okmok Volcano is not monitored seismically and is not assigned a color code. Based on past eruptive history, lava flows and ash emission may continue to occur without additional warning

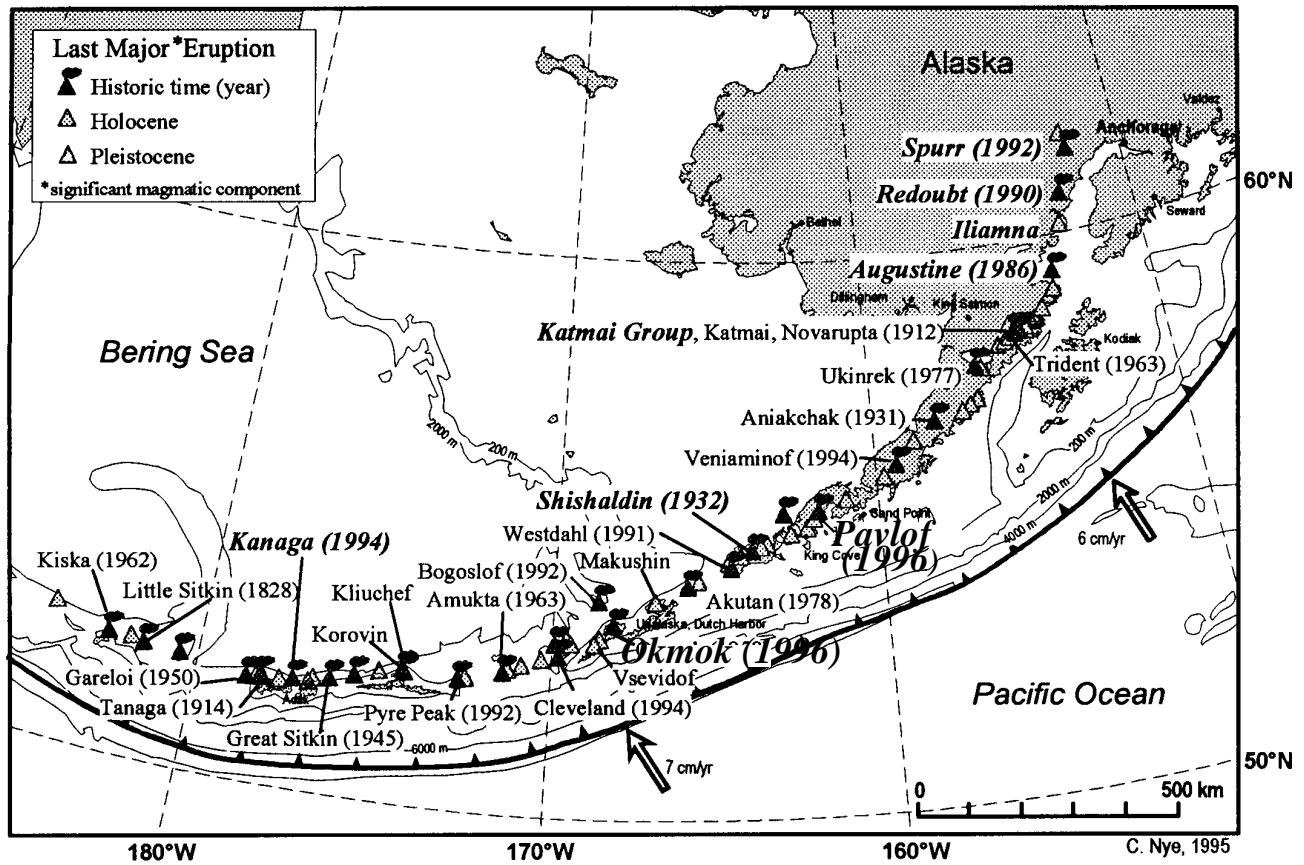
for a period of weeks to months. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).

Alaska Volcanoes Update

Friday, April 25, 1997, 10:30 AM ADT
(1830 UTC)

Okmok Volcano: 53.4°N, 168.17°W;
760 m (2,500 ft)

Eruptive activity at Okmok, which began February 13, is continuing, and hot lava flows within the caldera are suggested by satellite imagery. Okmok Volcano is not monitored seismically and is not assigned a color code. Based on past eruptive history, lava flows and ash emission may continue to occur without additional warning for a period of weeks to months. Okmok is on the eastern end of Umnak Island, 75 miles southwest of Dutch Harbor. The nearest settlements are Nikolski (45 miles W) and former Fort Glenn military base (10 miles E).



Map showing locations of Aleutian Arc Volcanoes. Those active in historic times are named with the year of the last eruption. For the purpose of this map, major eruptions are those with significant magmatic components. As a result, some volcanoes commonly considered to be active, but characterized purely by phreatic activity (such as Iliamna) are omitted. Volcanoes mentioned in this report are labeled in bold italic type.

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