Alaska Volcano Observatory

Vol. 9 No. 3 May-June 1997

BiMonthly Report

USGS ADGGS UAFGI

Highlights and Summary

- An eruption continued on the floor of Okmok Caldera.
- Bezymianny Volcano, Kamchatka, erupted an ash plume to 40,000-50,000 ft.
- Pavlof Volcano entered a week-long period of seismic activity accompanied by steam emission that ended without an eruption.
- Distal tephras at Dutch Harbor appear to correlate with proximal caldera-forming deposits of Makushin Volcano.
- Installation of a seismic net was begun at Aniakchak Caldera, accompanied by a significant geological/ geochemical field effort.

The May-June period was quiet - blessedly so given the preparations that were underway for field work at Aniakchak Caldera and Shishaldin Volcano. If you want to contemplate the peaceful beauty of Aniakchak Caldera and an Alaska spring, try http://images.jsc.nasa.gov/iams/html/earth.htm and select Space Shuttle Image STS45-94-088. I keep it on my desktop for indulging in occasional escapism, along with a view of the basalt-and andesite strewn back yard of Carl Sagan Station on Mars. Images like Aniakchak, as well as the endless nights of winter, give Alaska a very "planetary" feel. Certainly, some of the planetary perspective that is applied to volcanism elsewhere could be appropriately applied closer to home. It may be that we have in some ways been too close to our objects of study, and that there is something to be gained by gazing at them from afar, as in STS45-94-088.

This bears on another matter of remote sensing: remoteness. I had the experience in May of standing on the top of the recently silent Unzen Volcano, looking down on the recovering city of Shimabara, Japan. A colleague standing next to me (not a field geologist, I should admit), commented on how remote the spot seemed. Certainly it was other-worldly, being made of 2 or 3 year-old rock, but my impression was just the opposite, that this was an urban volcano. Remoteness is in the eye of the beholder, and as I have been part of AVO's advance out the Aleutian Chain, I have found my own concept of remoteness changing profoundly. Regardless of how one makes the very subjective assessment of remoteness, it does not increase monotonically westward. Our most "remote" islands were named the Near Islands by the Russians. Perceived remoteness is not a valid reason for neglecting an area, and I fear that American Geo-science has seriously neglected the opportunities for exceptional discovery provided by high-rate plate convergence in the Aleutians. But at the other end, Russian scientists and even some Americans are hard at work in Kamchatka. With advancing westward, perhaps we can meet in the middle on the Near Islands.

John Eichelberger

In This Issue

AVO is a cooperative program of the U.S. Geological Survey,[1] University of Alaska Fairbvanks, Geophysical Institute[2], and the Alaska Division of Geological and Geophysical Surveys[3].
Scientist-in-Charge: Terry Keith [1A] (907) 786-7443,
email: tkeith@tundra.wr.usgs.gov
Coordinating Scientist: John C. Eichelberger[2] (907) 474-5530,
email: eich@gi.alaska.edu
This report was edited by John C. Eichelberger and designed and prepared by Jean Sobolik, email: jsobolik@gi.alaska.edu

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

Monitoring

Alaska and Kamchatka Satellite Observations

AVO monitors volcanoes in Alaska and Kamchatka using the relatively high spatial resolution and nadir view of Polar Orbiting satellite data, and the high temporal resolution of Geostationary satellite data. Both of these systems include visible and thermal infrared wavelength data.

The Polar Orbiting system is the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA-12 and -14 satellites. Images are recorded in five spectral bands at a spatial resolution of 1.1 km at nadir. Alaskan volcanoes are received by the 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. Repetitive coverage by these data are 8 images per 24 hours for Alaskan volcanoes and approximately 4 images per 24 hours for Kamchatkan volcanoes. The timing of satellite passes are not distributed evenly over a 24- hour period.

Geostationary data are received from the GMS and GOES Satellites via computer networks at AVO-Anchorage, and provide off nadir observations of the western North Pacific (GMS), and the eastern North Pacific (GOES). Hourly GMS data (4km resolution in the visible and TIR) are available for analysis within 1.25 hours after reception by a ground station. GOES data are available at 15-minute and 30-minute intervals at resolutions of 1 km (visible band), and 4 km (TIR bands), respectively within 15-30 minutes after reception by a ground station.

During this period our attention was primarily focused on the continuing eruption of Okmok Volcano, but there were additional observations of activity at Bezymianny (Kamchatka) and Cleveland (Alaska) volcanoes. Table 1 shows dates of eruptions or reports of volcano-related activity at these volcanoes. Note that hot spots mentioned in the report are Band 3 pixels with elevated temperatures, and that the AVHRR Band 3 sensor saturates at approximately 50°C. A lava flow or hot ground can occupy only a small portion of a pixel and still increase the temperature of the pixel.

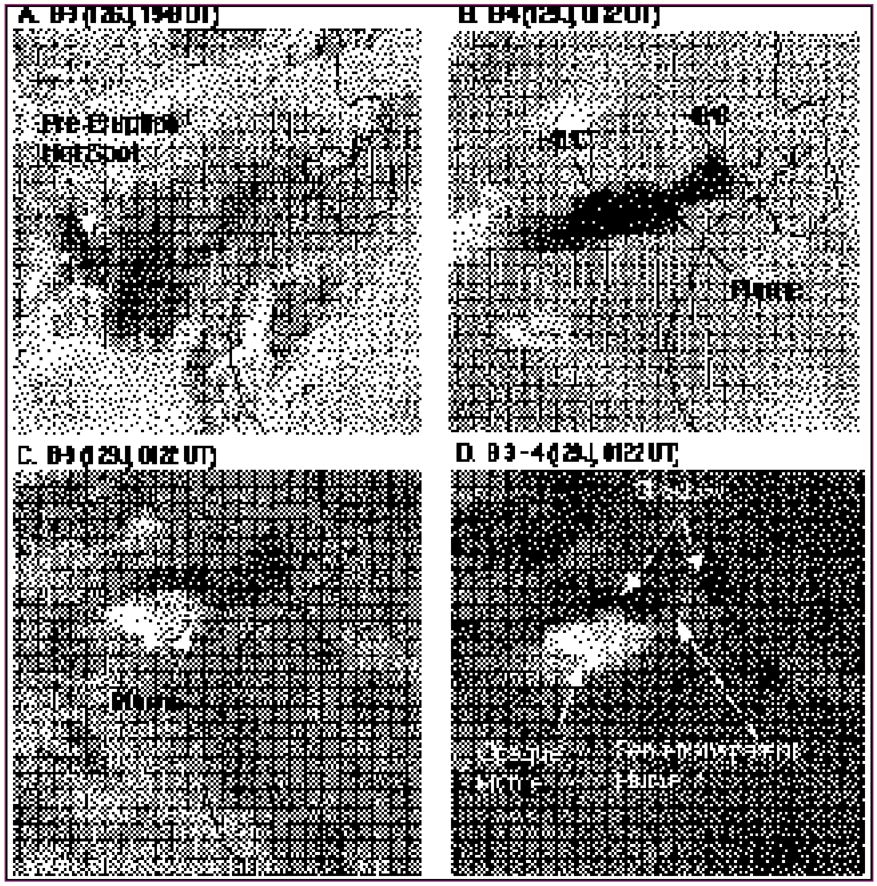


Figure 1: AVHRR thermal infrared band satellite images of the eruption at Bezymianny Volcano on 9 May 1997. A hot spot was observed 6 May, three days prior to the eruption (A). On May 9 the explosive eruption was recorded by an AVHRR pass at 1943 UT. The Band 4 image shows a cold plume, indicating high altitude (B). The Band 3 image shows distinct variations within the plume not seen in the B-4 (C). Band 3 was subtracted from Band 4 to minimize solar interactions, and further reveals structures within the plume (D). The May 9 image was recorded about 52 minutes

Okmok

Okmok Volcano continued to be active throughout this period, with hot spots and plumes observed. On the morning of May 1 (n12.97121.1504) and on through the evening (n14.97121.0108 and n12.97121.1504) a hot spot was visible through the clouds. A possible steam plume blowing west of the caldera was observed on the morning of May 5 (n12.97125.1834) and progressed into the night (n12.97126.0553) when the plume was 10 km long.

Cloudy conditions made observations difficult on May 6 (n14.97126.1538), but a steam plume was still observed. Cloudy conditions continued throughout the month. A morning image on May 28 (n14.97198.1510) showed the hot spot once again, but lost to view due to, cloud-cover until late June.

The hot spot was again observed on June 25 (n14.97176.0109) and was 3 pixels long with temperatures between 40 to 44° C. The activity continued (n14.97176.1324) on the 25th with a hot spot growing to 5 - 10 pixels and averaging 11 º C. The temperatures were obscured due to cloud cover.

On the morning of June 26 (n14.97177.1313), a hot spot 8-12 pixels in size was detected but with temperatures reaching only 14 ºC, apparently due to weather effects. In the evening, a clear pass (n14.97177.0058) detected the hot spot in the center of the caldera reaching temperatures up to 44° C.

The next day, 27 June, two morning images (n14.97178.1302 and n14.97178.1443) detected the hot spot with activity continuing on through the evening (n12.97178.0513) 10 pixels in size with temperatures at 32 ºC.

Bezymianny

The eruption of Bezymianny Volcano on May 9 presents another

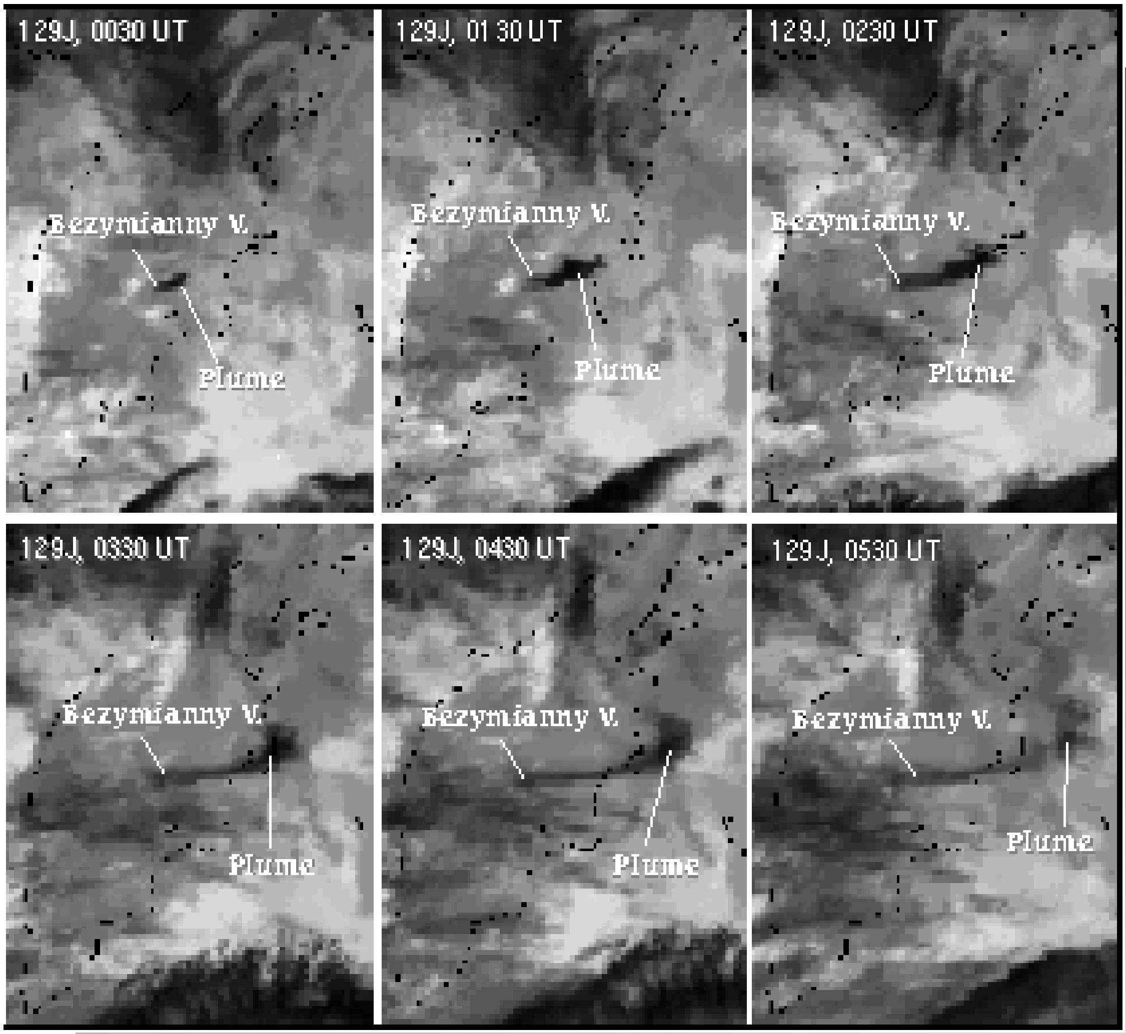


Figure 2: A time series of GMS satellite images of the eruption of Bezymianny Volcano, Kamchatka Peninsula, 9 May 1997. The thermal infrared band images (Band 1, 10.5 microns) are shown at hourly intervals, starting at 0030 UT (A), and bottom right image is from 0530 Z. The volcanic cloud is in the center of the image, and moves towards the east in subsequent images. At 0530 Z, it extends for ~450 km to the NW.

example of elevated surface temperatures being observed a few days prior to an explosive eruption. The plume was observed on AVHRR and GMS satellite images .

On AVHRR images, a 1-2 pixel hot spot was observed beginning on May 6 (n14.97126.1550) and grew in size by the afternoon (n12.97126.1943) to 4 pixels reaching temperatures of 35 º C. May 7 and 8 images revealed no volcanic activity but there was heavy cloud cover. On May 9, the volcano erupted and a 143 km long plume was observed (image n14.97129.0122), ~ 22 minutes after the start of the eruption (fig. 1). Plume temperatures, ranged from -48 º C near the vent, to -40° C to the east at the advancing edge. Subtraction of the thermal bands revealed a few regions within the plume with negative values to -1.5, indicating the presence of ash. The activity continued on May 14 (n12.97134.2008). An image on May 15 (n12.97135.1946) showed a plume blowing east to southeast reaching 60 km long but with no negative B4 minus B5 values. That evening, a hot spot was seen on the 9:30 pm pass, but no other volcanic activity was observed after this.

Data from the GMS sensor proved valuable in monitoring and tracking the volcanic cloud produced by the eruption on May 9. According to KVERT, a strong eruption occurred on May 9 at ~0100 UT, sending an ash cloud to a height of 12-14 km ASL. The volcanic cloud was first observed at 0030 UT, and was detectable in satellite imagery until 1030 UT on May 9, at hourly intervals. Although each image was not available until 1.25 hours after collection, it was valuable for assessing the level of activity.

Cleveland

A one-pixel hot spot was seen on May 5 (n12.97125.1814) with temperatures of 11° C. No other anomalies were recorded from Cleveland due to cloud cover.

Ken Dean, David Schneider, Angie Roach, Brook Foster, Shelly Worley, Pavel Izbekov and Kevin Engle

Table 1: Satellite Observations of Alaska and Kamchatka Volcanoes for the Months of May-June, 1997

May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Okmok	X	X			X?	X																			X	X	X	X			
Bezymianny					X	X			X	X				X	X																
Cleveland	X																														

June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Okmok																									X	X	X	

Legend
X = Satellite observation of thermal anomaly and/or plume
? = Questionable volcanic-related plume or thermal anomaly
P = Pilot report of plume
Blanks = Cloud cover prevents observations

Seismicity

Akutan: Only two earthquakes were located in the vicinity of Akutan during May and June (figs. 1, 9 and 10). The largest event had a magnitude of 1.9 and was located just off the northwestern coast of Akutan Island about 10 km from the summit. The final event was located slightly northwest of the summit at a depth of about 5 km. The observed seismicity rate during this two-month period is much lower than that of the previous two-month interval (i.e. 2 events vs. 16 events). The Akutan seismic stations and their telemetries appear to have been operating properly during this period of time, which suggests that the observed reduction in located events is indeed real.

Augustine: During May and June, a total of 20 earthquakes, the largest of which had a magnitude of 0.7, were located at Augustine (figs. 2, 9 and 10). Most of these events were located beneath the summit. The seven events that were not actually located beneath the summit were all located within ~2 km of it. The number of located earthquakes during May and June is over twice the number of Augustine events located during the previous two-month interval. The observed seismicity rate for this time period is also much greater than the 3-year mean seismicity rate. Based upon the 3-year mean rate, one would expect a total of 14 located events over a two-month period.

Dutton: Seismic activity in the Dutton region continued to be very low (figs. 3, 9 and 10). Two earthquakes are plotted in Figure 3. Both of these earthquakes, however, were located quite some distance (>25 km) from Dutton and are thus in all probability regional tectonic earthquakes unrelated to volcanic activity at Dutton.

Iliamna: A total of 40 earthquakes were located in the vicinity of Iliamna during May and June (figs. 4, 9 and 10). The largest earthquake located during this time period had a magnitude of 1.8 and was located about 5 km south of the summit. Two events were located well off the volcano and are probably regional tectonic seismicity. The remaining 38 located events form two clusters of seismic activity, one located slightly east of the summit and the other located 5-7 km south of the summit. Both clusters of activity have been fairly persistent features of the distribution of seismicity at Iliamna. Note that during the previous two-month interval, a cluster of seismicity was observed further southeast than had been previously observed. This zone may still be somewhat active as indicated by the single event located there during the present two-month interval. In general, seismic activity at Iliamna has continued to slowly decrease. The observed rate of seismicity for May and June is a bit lower (17%) than that of the previous two-month interval.

Katmai: The loss of the five stations of the central Katmai seismic network, which occurred on April 16, 1997 (see the previous Bimonthly Report for details), continued to impact the detection and location of seismicity within this region during May and June. Only 28 earthquakes, the largest of which had a magnitude of 2.4, were located in the Katmai/Valley of Ten Thousand Smokes region during this two-month interval (figs. 5, 9 and 10). This compares with the 269 events located within this same region during the previous two-month interval. Sufficient station coverage, however, remained in the Martin/Mageik region. As a result, nearly all of the located events occurred in this general area. A total of 20 earthquakes were located in the Martin/Mageik region. Only three other events were located along the volcanic axis. One of these events was located near Trident while the other two were located about 5 km northwest of Snowy. The remaining five located earthquakes are not along the volcanic axis and may represent systematic mislocations due to an inadequate station distribution, or are regional tectonic earthquakes that just happen to locate within the Katmai region. Since station coverage in the Martin/Mageik area is fairly good, those events having locations relatively close to this area probably represent the latter. The remaining two events are probably also regional earthquakes, but without additional information there is no way of being certain of this.

Makushin: During May and June, 56 earthquakes were located in the vicinity of Makushin (figs. 6, 9 and 10). The number of located events greatly exceeds that previously observed in this region. In fact, only an additional 23 earthquakes have been located in the Makushin region during the entire time AVO has been monitoring the seismicity there. Nearly all the observed seismicity during this two-month interval can be divided into three swarms of activity. One swarm was just off the northeastern coast of Unalaska Island in the general vicinity of Eider Point. A total of 11 earthquakes, six of which occurred during a single day (May 28, 1997), were located in this region between May 15 and June 4, 1997. The largest event of this swarm had a magnitude of 3.2. This was also the largest earthquake located in the Makushin region during this two-month interval. The second swarm occurred on June 5-6, 1997 and formed a very linear northwest-southeast trending zone of activity slightly east of the summit. This swarm consisted of a total of 12 located events, the largest of which had a magnitude of 1.8. Note that nine of these earthquakes occurred on June 6 over a span of only about an hour. The final seismic swarm occurred June 25-30, 1997 and consisted of total of 29 earthquakes. The largest of these events had a magnitude of 2.2. The swarm's 29 earthquakes were located in a somewhat diffuse northeast-southwest trending zone southeast of the summit. Although not readily apparent in Figure 6, this zone of seismicity is located a bit further southeast than epicenters of the previous swarm. Since station MCIR was repaired during the intervening time between these two swarms, the resultant improvement in station distribution may account for some of the location differences observed between the two swarms. Of course, it is also quite possible that the two swarms do indeed have somewhat different locations. The three earthquakes that do not appear to have been a part of the seismic swarms were located at three separate locations. One event was located ~3 km south of the summit. The remaining two events were located ~14 km east of the summit and ~12 km east-southeast of the summit.

Pavlof: It continued to be quiet in the Pavlof region during May and June. No earthquakes were located there during this two-month period. Furthermore, very little was observed on the Pavlof helicorder plots (figs. 9). This was also the case during March and April.

Redoubt: During May and June, six earthquakes were located in the vicinity of Redoubt (figs. 7, 9 and 10). The largest such earthquake had a magnitude of 2.0. This event, along with four others was located beneath the northern flank of Redoubt, 5-8 km from the summit. Five of these earthquakes locate within a 10-km radius of Redoubt's summit. The remaining event was located quite some distance to the northeast and is thus likely a regional, tectonic event. The number of located events within the 10 km radius during this two-month interval is about half that of March and April (i.e. 5 events vs. 12 events) and a third the number predicted from the three-year average seismicity rate.

Spurr: A total of 227 earthquakes were located in the vicinity of Spurr during May and June (figs. 8, 9 and 10). The largest event located in the region during this two-month interval had a magnitude of 3.0. However, of the 227 located earthquakes, a total of 209 were located in the Strandline Lake area, leaving only 18 non-Strandline Lake events. The largest such event had a magnitude of 0.8. Of the 18 non-Strandline Lake events, 11 were located within a 10 km radius of the summit of Spurr. Five of these 'proximal" events were located beneath the summit of Spurr. Two other proximal events were located about 5 and 8 km west of the summit while another two of these events were located 3 and 7 km east of the summit. The remaining proximal event was located about 9 km south of the summit. Note that the number of events located within the 10 km radius during this two-month interval is slightly higher than the nine such events located there during the previous interval. This value, however, is much lower than the 19 events predicted by the three-year mean seismicity rate. The remaining seven non-Strandline Lake events were located some distance from Spurr and are probably tectonic earthquakes unrelated to activity at Spurr.

Scott Stihler, Pete Stelling, Michelle Harbin, Cristyn Presley, Michelle Coombs, Dan Wiesneth, Art Jolly, Guy Tytgat, Steve McNutt, Bob Hammond, and John Benoit

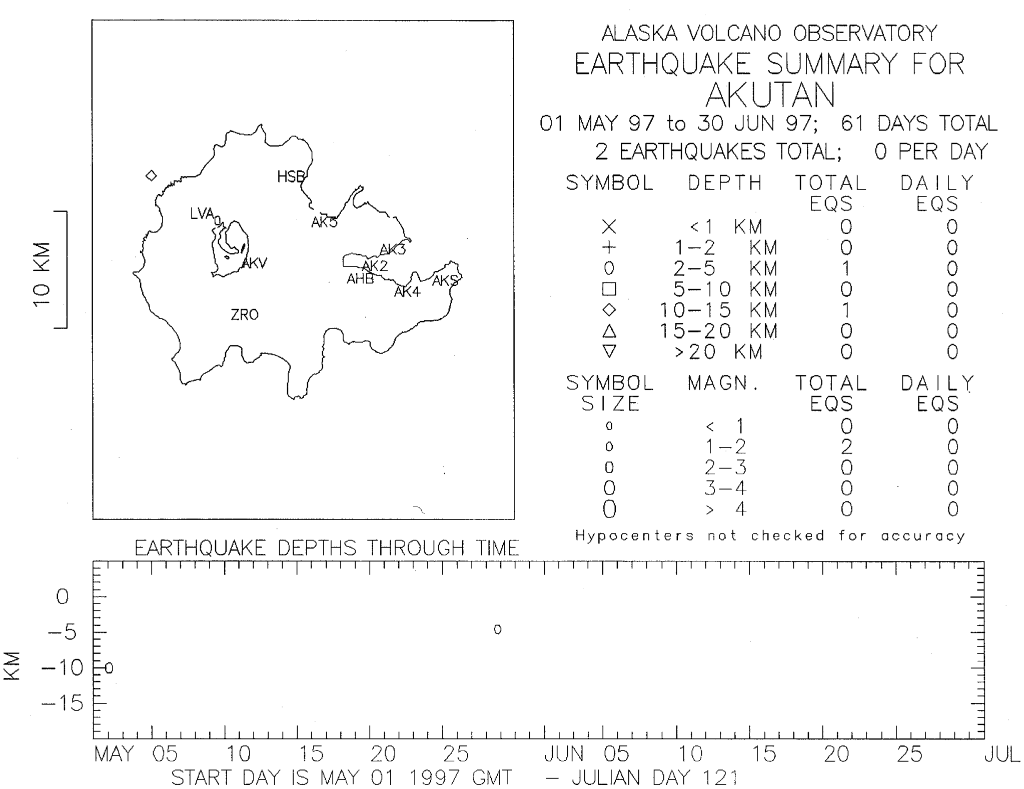


Figure 3: Locatable Akutan seismic events in space and time for May through June, 1997.

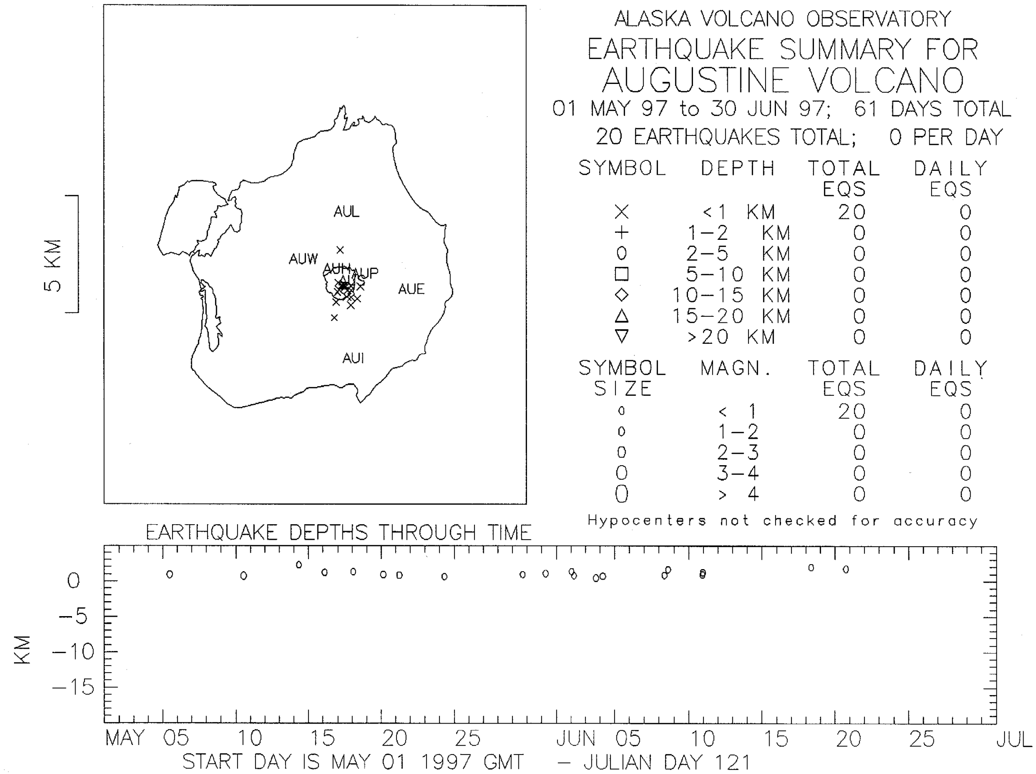


Figure 4: Locatable Augustine seismic events in space and time for May through June.

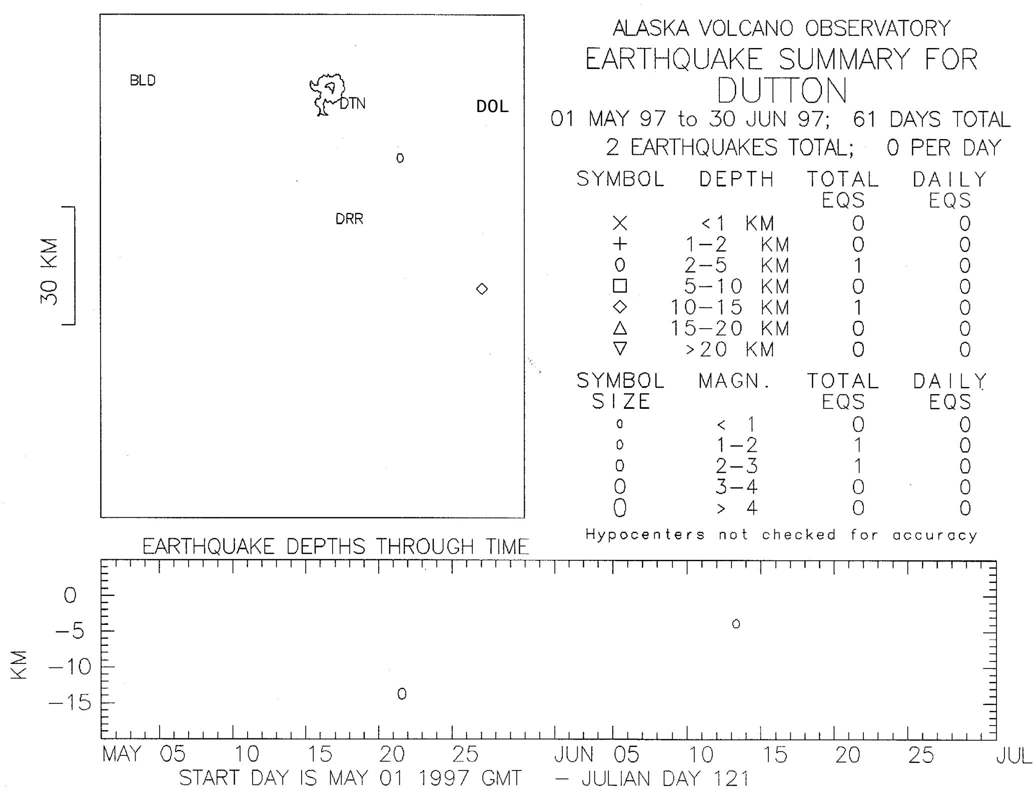


Figure 5: Locatable Dutton seismic events in space and time for May through June.

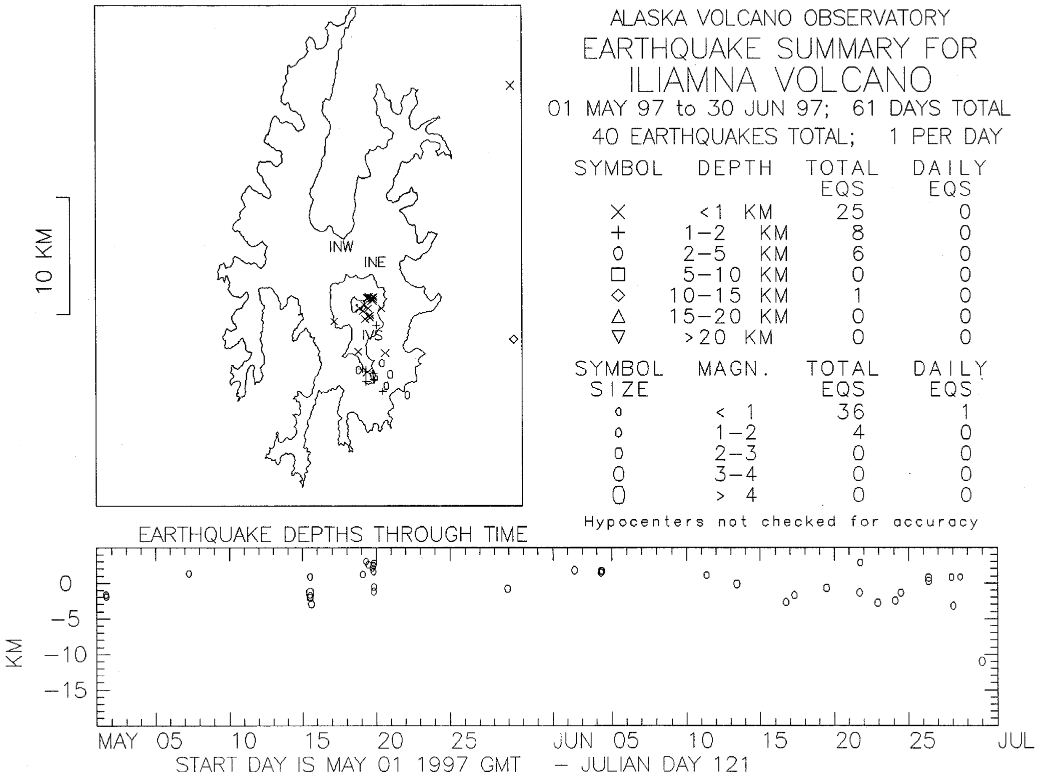


Figure 6: Locatable Iliamna seismic events in space and time for May through June.

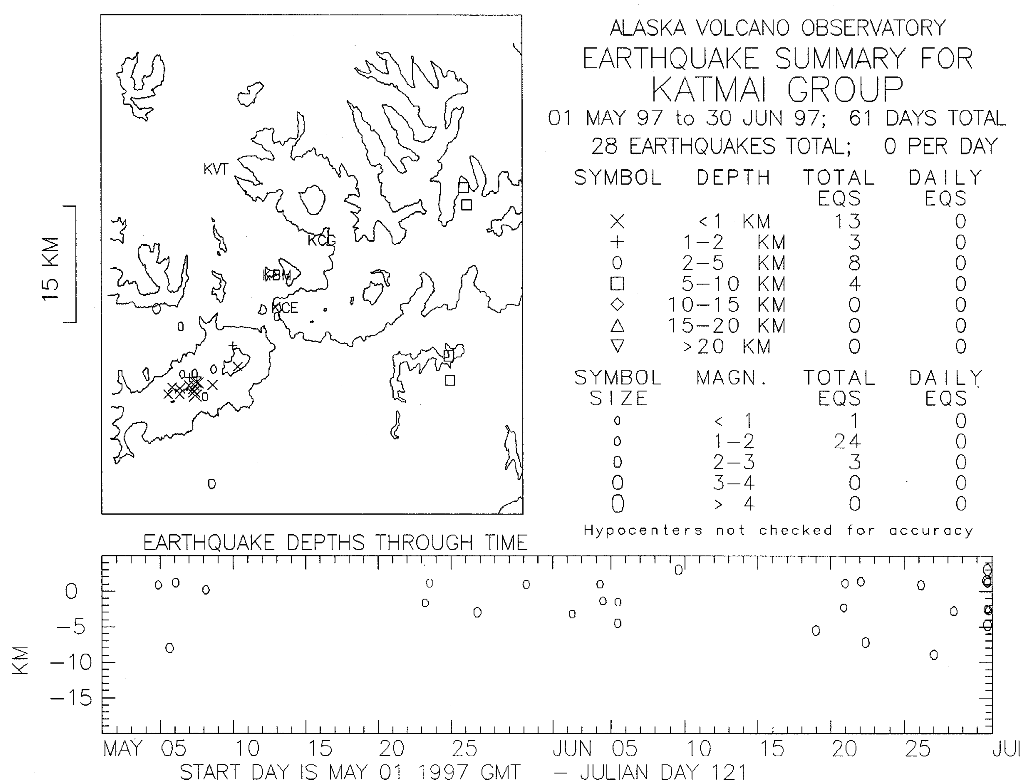


Figure 7: Locatable Katmai Group seismic events in space and time for May through June.

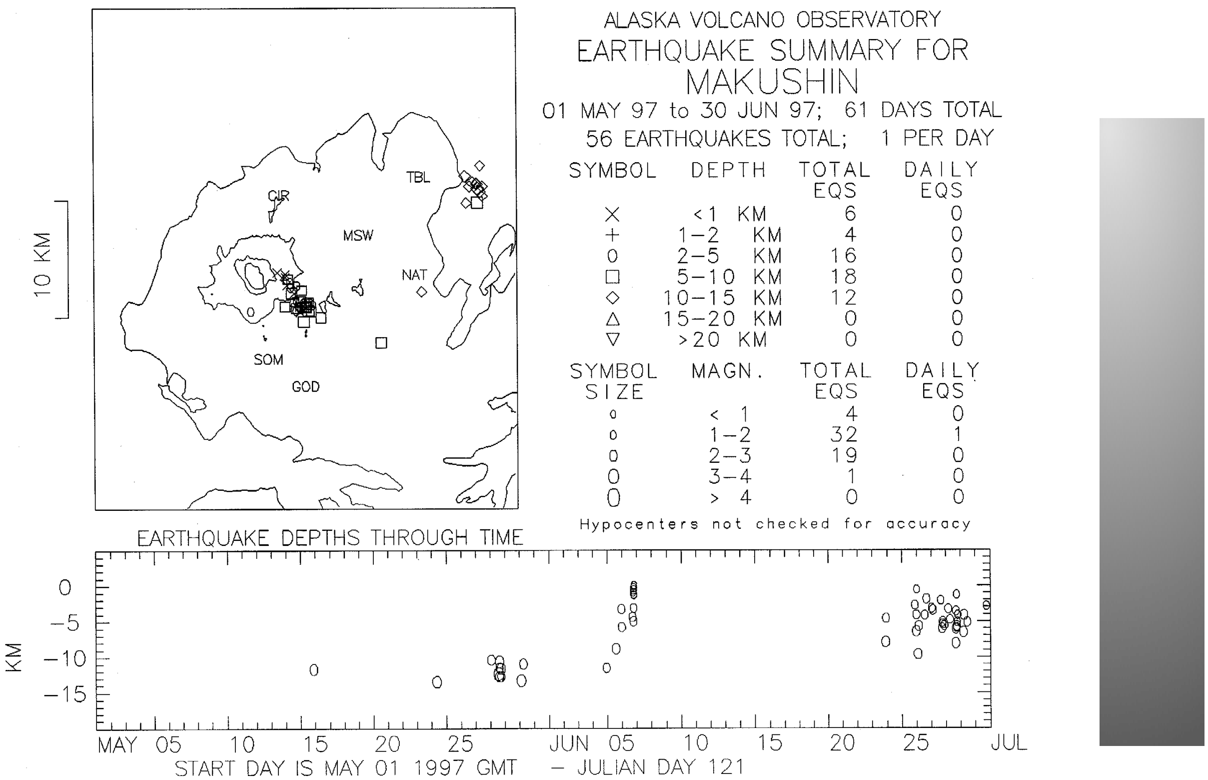


Figure 8: Locatable Makushin seismic events in space and time for May through June.

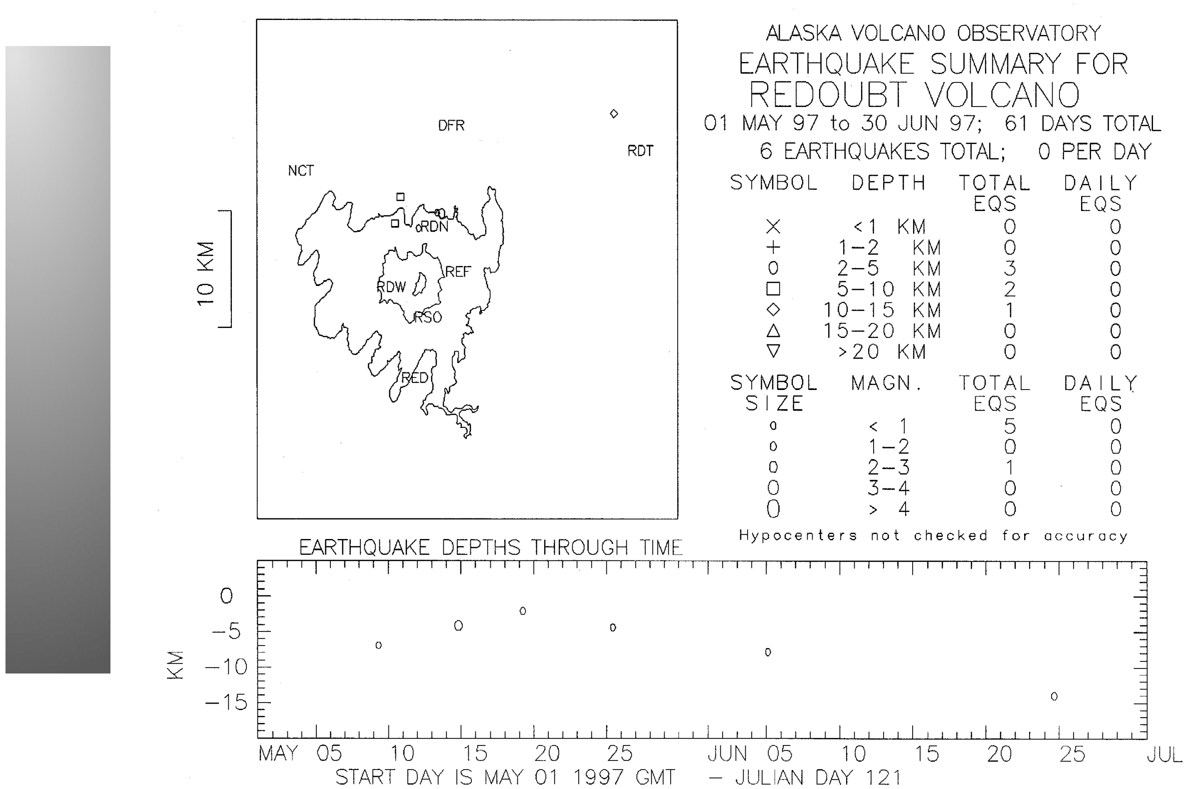


Figure 9: Locatable Redoubt seismic events in space and time for May through June.

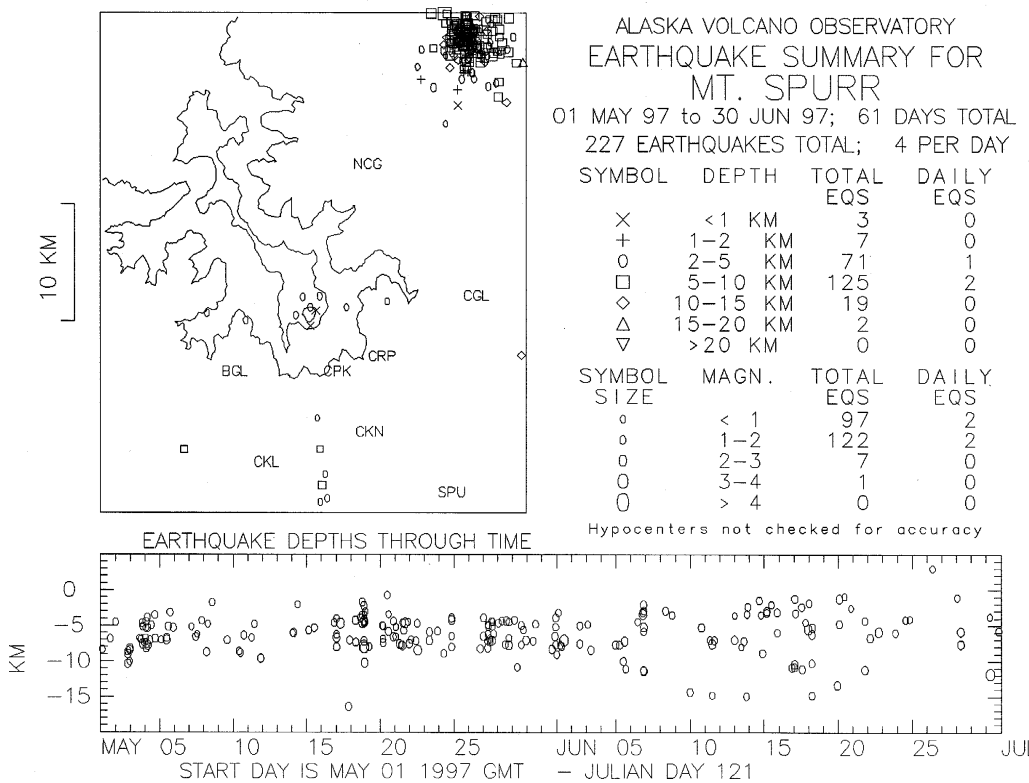


Figure 10: Locatable Spurr seismic events in space and time for May through June.

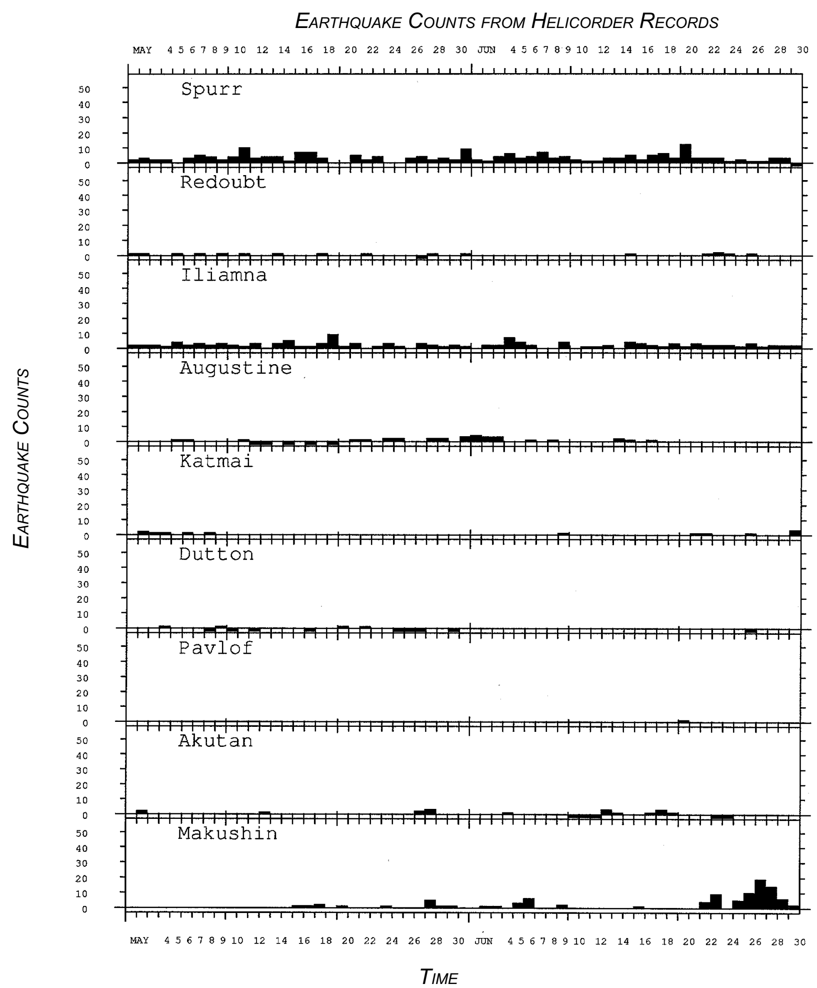


Figure 11: Histogram of seismic events counted from helicorder records during May through June.

Earthquake Counts from Detetcted Events

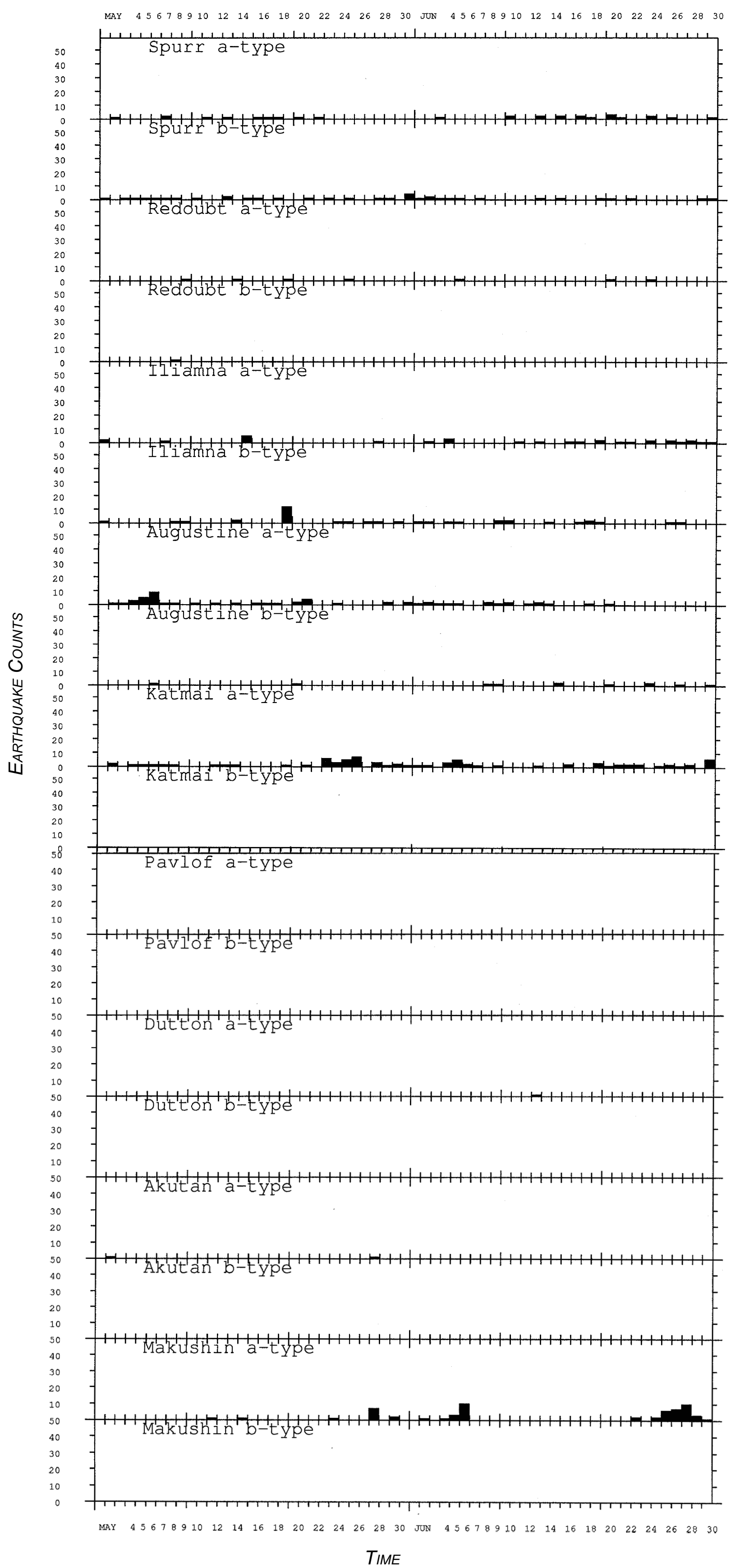


Figure 12: Histogram of computer detected ("Willie system") seismic events during May through June.

Augustine deformation

GPS

All three GPS receivers are working and have performed well over this past winter. Figure 13 (Mound-Domo) and figure 14 (Mound-Windy) show that the trends continue and nothing out of the ordinary is happening.

Tiltmeters

Figure 15 continues to show the downward trend that started this past winter. Perhaps there is water in the electronics or the site may be totally saturated. Figure 16 (Windy tiltmeter) seems to continue its yearly trend. Figure 17 (Domo tiltmeter) also continues its trend with no significant changes.

Summer Plans

We have no major expedition planned for this coming summer. Tom Murray will probably visit the working GPS and tiltmeter sites, and hopefully get 2-3 old tiltmeters up and running again.

Gene Iwatsubo

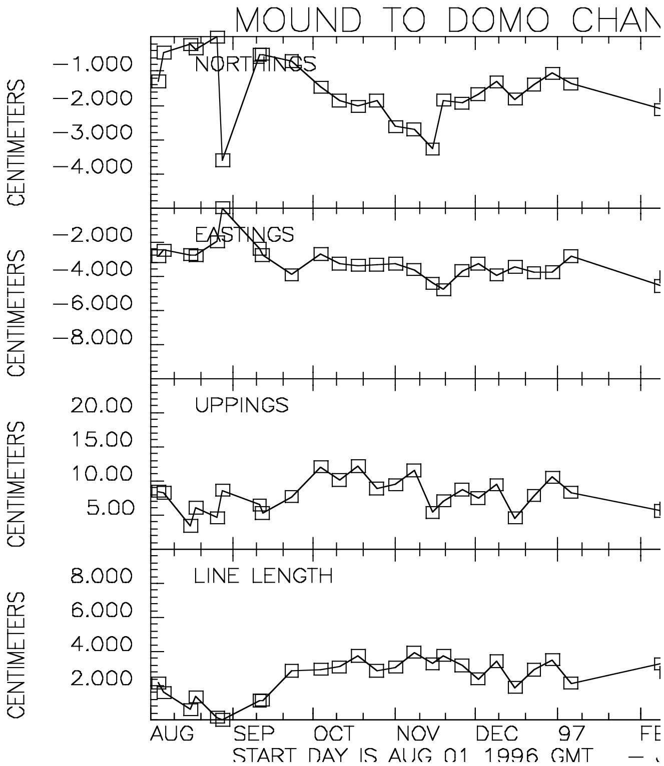


Figure 13: Mound-Domo GPS data plotted through June 1997. No significant changes.

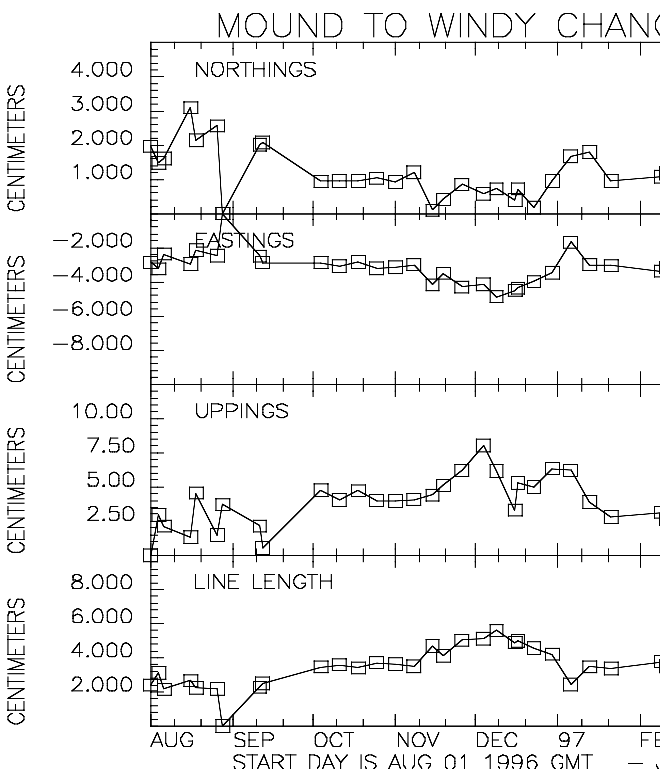


Figure 14: Mound-Windy GPS data plotted through June 1997. Data is quiet.

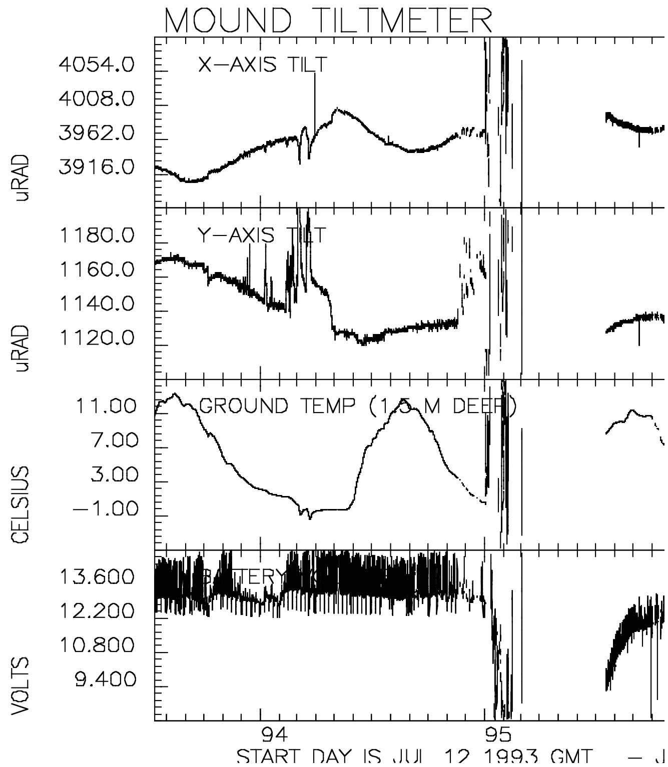


Figure 15: Plot of Mount tiltmeter data. Note that the X-axis continues its downward trend, probably due to environmental factors.

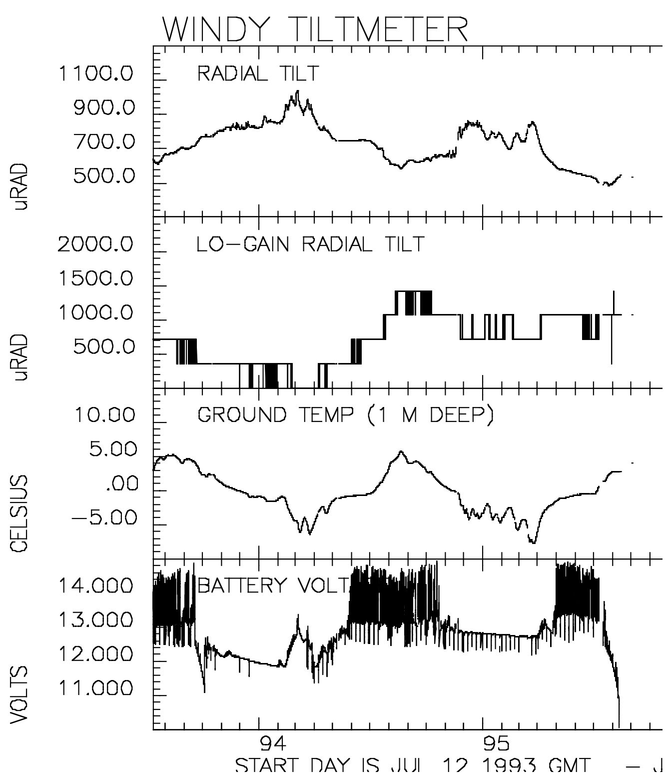


Figure 16: Plot of Windy tiltmeter data. Yearly patterns are similar and the longer term trend remains the same.

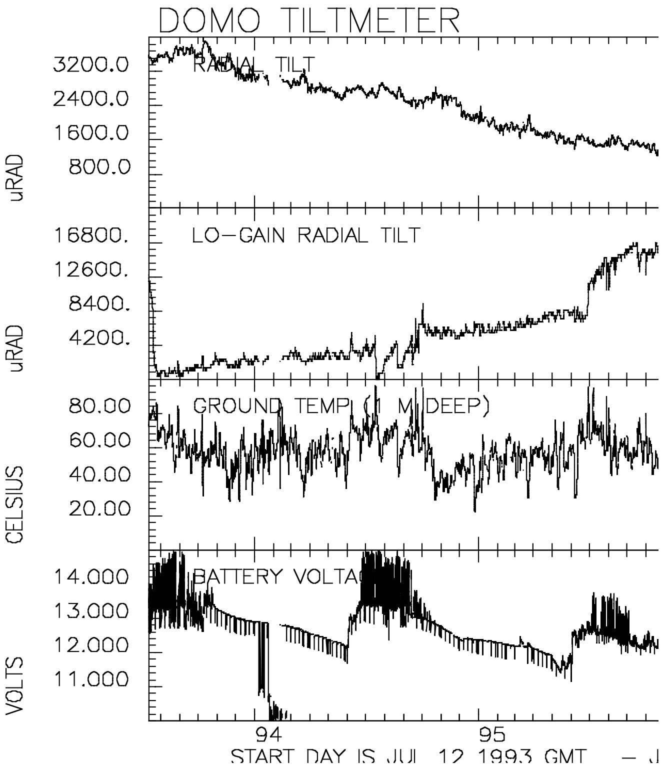


Figure 17: Plot of Domo tiltmeter data. Radial tilt trend continues, no significant changes.

Operations

Highlights of 1997 Aniakchak field effort

Editors note: This report extends into the next reporting period. However, in the interest of timeliness and of evening-out the size of issues, we will include it here.

The operative word for Aniakchak, 1997 was: SUN! The weather was unbelievably cooperative and entirely non-Peninsula-like for our campaign, leading to early wrap-up of seismic installation and completion of all other sampling and mapping tasks. Will this ever happen again?

On June 23, Game, Tina, and Bob arrived on the Reeve Electra, retrieved pallets of gear and began setting up shop and house. On June 24 and 25, we assembled seismic equipment piles in Port Heiden and did much of the preliminary set-up of the receive site at the FAA electronics building adjacent to the Port Heiden airfield. The helicopter arrived bearing Andy Lockhart, pilot Arnie Johnson, and about 200 glass floats late on June 25. Immediately on June 26, the team of four began the process of installation and, by June 30, all but the burial of the three component station inside the caldera were complete. Congratulations to John Paskievitch for an excellent field design of the econo 2000 seismic stations. We took full advantage of the weather and have thorough video and still photo documentation of all steps of installing these fine units.

As expected, several return trips to each site were required — to switch out diodes, replace a bad radio, retrofit conduit — but the network was in and running by July 3 and waiting for the phone line to be activated. The first data arrived at the GI on July 10, and digital recording began on July 18. Unfortunately, poor quality and intermittent power in Port Heiden is

continued

Figure 18: The crew.

proving a vexing problem for our receiver electronics. Bob Hammond returned to Port Heiden on August 4 and replaced the power supply, which seems to have solved the problem.

Gail Ferguson of the Air Traffic Division, FAA Alaska Regional Office visited the Aniakchak team June 30-July 2. Gail is the local point of contact for AVO issues as they pertain to FAA and she was interested in a close-up view of what it is we do with FAA money.

The weather was as wet and uncooperative as we would see it during the entire three weeks, but Gail still was able to observe final installation of ANSL, tour the caldera a bit, and visit several other sites to learn from Andy and Bob. The highlight of her visit was undoubtedly the putanesca dish (Andy) with ingredients direct from the north end of Boston and the delicate corned beef hash (Bob) for breakfast.

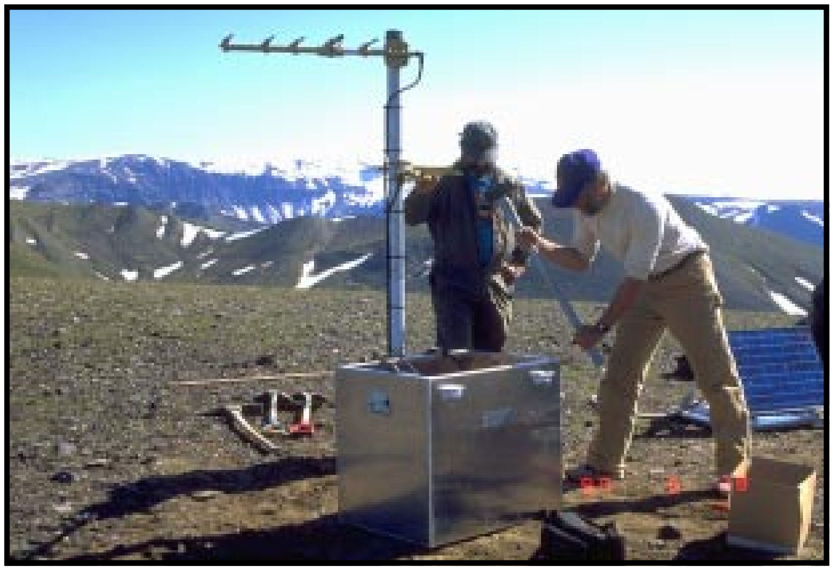


Figure 19: Bob Hammond supervises Andy Lockhart installing grounding rods at station ANPK. Aniakchka Peak on skyline.

Tom Miller spent several days chasing down loose ends related to his map of the Aniakchak ash flow and related caldera-forming deposits. He reports much success in solving important mysteries and managed to give C. Dan Miller and John Eichelberger's graduate student Scott Dreher, a comprehensive overview of the caldera and the ash-flow story. C. Dan was visiting Aniakchak and Pavlof with Tom as a familiarization tour of AVO activities and work in Alaska and with an eye towards ongoing VDAP presence in the Aleutian arc.

Scott Dreher, who is commencing a project to explore the causes of compositional gaps and zoning in large eruptions, spent a number of days familiarizing himself with the ash flow in all its variations and contemplating caldera forming processes. Scott worked with Tom and Charlie Bacon and has collected a good suite of samples to get started.

Charlie Bacon joined us for a week, filling long days with critical examination of stratigraphy and field textures and sampling of post-caldera rocks for investigation of pre-eruption magmatic conditions. Charlie was a great help as we visited critical outcrops and sections and problem areas on the caldera map. In addition, Charlie and Scott spent long, careful hours at several classic sections through caldera-forming deposits.

Tina and Game, after absorbing as much seismic installation lore as they could in a full week of assisting Andy and Bob, spent several days fixing rough spots on the post-caldera geologic map. The map had been compiled into a very decent pre-review shape in June thanks to Tracey Felger's digital wizardry and it will require one more digital round of editing before being ready for technical review. In order to try and pin down the Surprise Lake flood story better, we revisited the Hidden Creek cutbank site and carefully sampled and described a section atop the flood surface, collecting what we hope will be organic horizons to narrow the window on the possible age of the flood.

Game also took advantage of the phenomenal weather anda medium format camera to take a significant number of high quality images, including a set of color and black and white photos from a Father Hubbard photo point on the east caldera wall.

Bob Symonds quietly and efficiently zipped into the caldera with Charlie one blustery morning to sample gas discharging at Bolshoi spring (located at the base of the lava dome by the same name). This is the first gas sampling at Aniakchak and we are seeking to quantify composition and likely discharge for incorporation into the hazard report in progress.

Stay tuned for a wrap up of Aniakchak science this fall at AGU where at least 5 of us plan to present

Figure 20: Gail at ash flow

our work at an informal poster session gathering.

The AVO helicopter was made available on a number of occasions to the National Park Service who had two crews operating in the Aniakchak area. One group of NPS archeologists prowling the Aniakchak River/Meshik Lake/Caldera area for cultural sites used the ship to move to two spike camps. Game and I visited a pit house site near the mouth of the Aniakchak River with Richard Vanderhook which was a treat: good tephra stratigraphy in the section (they are working with Jim Riehle on tephra ID and dating) and a chance to see the Alaska Packer's Cabin where Father Hubbard et al. stayed during one or more of their visits to the area.

Two NPS rangers verifying cabin use in the Amber Bay/Aniakchak area also used the helicopter for a few hours to scour drainages and document structures (or lack thereof). At one point, all NPS personnel assembled with me at station ANSL to receive a tour and explanation of the seismic installation, see first hand the scale of the instrumentation and impact of our digging, and discuss the geology of the caldera.

As a note for operations of the future, both NPS camps used satellite phones to contact us to coordinate helicopter use. This was a terrific way to communicate from a fixed camp and, as many people have suggested, AVO should add this equipment to our inventory.

The success of this entire operation is due to the hard work and enthusiasm of many people inside and outside AVO. Special thanks to the great planning and up-front work by John Paskievitch, Cindy McFarlin, Tim Plucinski, the purchasing group Ginnie Shepard, Greg Krause, Tammy Bagley, and Paula Miller; due to their efforts, gear-up and preparation for field work in Port Heiden went quite smoothly. Pilot Arnie Johnson was superb and managed to fit right into the subtle Montana humor stream. Our thanks to the FAA for facility access, loan of a warning light for our truck, and use of their vehicle in a pinch; Mark Wellborne and the State of Alaska DOT for hangar space and much other assistance; and the Wise family of Reeve Aleutian Airways. The community of Port Heiden received us warmly, and we appreciate their interest and support during our stay.

Tina Neal, Bob Hammond, Andy Lockhart, and Game McGimsey

The 1997 Makushin-Akutan field campaign

A second year of helicopter-supported fieldwork occurred at Makushin and Akutan volcanoes between June 13-27, 1997. Tasks completed include: maintenance and repair of seismic stations on both Akutan and Makushin volcanoes, modification of the central receive site at Akutan school, demobilization of the temporary Akutan seismic array, and reoccupation of some of the Akutan and Makushin GPS sites.

All stations of the Makushin seismic net were visited. Solar regulation was added as needed, and system voltages and radio outputs were checked. Prior to the 1997 field campaign, only station Cirque (MCIR) was not being received on the Makushin circuit. A visit to its repeater site at Table Top (MTBL) revealed that its relay antenna mast had failed during the previous winter. This antenna mast was remounted, double-gooped and the communication relay reestablished.

At Akutan, all sites were visited except Hot Springs Bay (HSB), which suffered from poor weather conditions throughout the campaign. Likewise, our single visit to station AKV was curtailed by rapidly deteriorating weather conditions. For all other stations, we added solar regulation, checked system voltages, and monitored radio outputs. All visited sites were in proper operating condition except Akutan Harbor (AHB), an important repeater site which relays signals from Hot Springs Bay (HSB), Lava point (LVA) and Zero (ZRO) back to Akutan Village. The site was maligned by an antenna interference problem which was manifested as an intermittent signal, a failing common to sites repeating multiple stations. The problem was mitigated by adjusting the antennas on the AHB mast to minimize antenna desensing. At the central receiving site in Akutan village, a new antenna mast was installed to receive the revitalized AHB signal. This mast, which was located on the roof of the Akutan school, replaced the former mast, which was located within the school's ground level. The new location offers a clear shot from the transmitter and doesn't suffer from high levels of cultural interference; a problem that plagued signal reception at the previous location.

The final seismological task was to demobilize the temporary seismic net originally installed during the February-March 1996 Akutan seismic crisis. This net was removed from the field, boxed, and shipped to Anchorage for repair. A portion of this emergency net is now deployed at Strandline Lake.

Time and weather constraints limited the amount of GPS work completed during the Akutan-Makushin field campaign. The Dutch Harbor site (DCH1) was occupied for 8 days at the beginning of the campaign. The GPS unit was then moved to Akutan where the Akutan Pass site (AKPS) was occupied for about 6 hours.

Arthur Jolly, Andy Lockhart, Pete Stelling, Marianne Guffanti, John Power, John Paskievitch, and Steve Estes

Figure 21: Akutan-Makushin field crew: left-right, pilot, Arnie Johnson, Pete Stelling, Marianne Guffanti, Andy Lockhart and Art Jolly.

Katmai graduate student field trip

In what has become an annual summer event, a team of AVO research assistants led by John Eichelberger trekked into the Valley of Ten Thousand Smokes and spent a week-and-a-half doing geologic field work and collecting samples for further geochemical and petrological analysis. This year's AVO crew consisted of Michelle Coombs, Scott Dreher, Evan Thoms, Darren Chertkoff, and John Eichelberger (fig. 22). This trip differed from years past in that work focused on sampling tephras, lavas and enclaves from New Trident volcano as well as lava and enclaves from Novarupta Dome; rather than a field-trip style introduction to the largest eruption of this century (Katmai, 1912).

Also, in contrast with past visits to the VTTS, we took a more aggressive approach to field work in the Katmai region. The group decided to shun the warmth and safety of Baked Mountain hut and set up "base camp" on New Trident Volcano itself. This provided us with direct access to the New Trident (1953-1963) lava flows, enclaves and tephras (fig. 23). It allowed us to collect several pounds of New Trident samples and we hope will provide us with the necessary samples for further understanding of the eruptive history of New Trident volcano.

After spending a little over a week at New Trident volcano (including two days stuck in our tents during blizzard conditions), the group decided to retreat to the relative solitude of Baked Mountain hut. This left us with two days for intensive sampling of lava and enclaves from Novarupta Dome (fig. 24). By sampling lava flows with enclaves and associated tephras without enclaves we hope to study the apparent correlation between enclave formation and effusive eruption. Fortunately, the final two days of field work were blessed with amazingly clear and sunny weather, which afforded us stunning views of all the Katmai group of volcanoes. We trekked out of the VTTS in relative comfort with 20-30 pounds of samples each; thus concluding another productive field season in the greater VTTS area.

Darren Chertkoff

Figure 22: AVO crew heading out from "basecamp" near the top of New Trident Volcano. L-R. Scott Dreher, Darren Chertkoff, Evan Thoms, Michelle Coombs. Photo by John Eichelberger.

Figure 23: Mafic enclave in lobe of '57 dacite lava flow from New Trident. Photo by Michelle Coombs.

Figure 24: Mafic enclave in rhyolite lava of 1912 Novarupta Dome. Note dispersal of enclave material into the host lava. Photo by Darren Chertkoff.

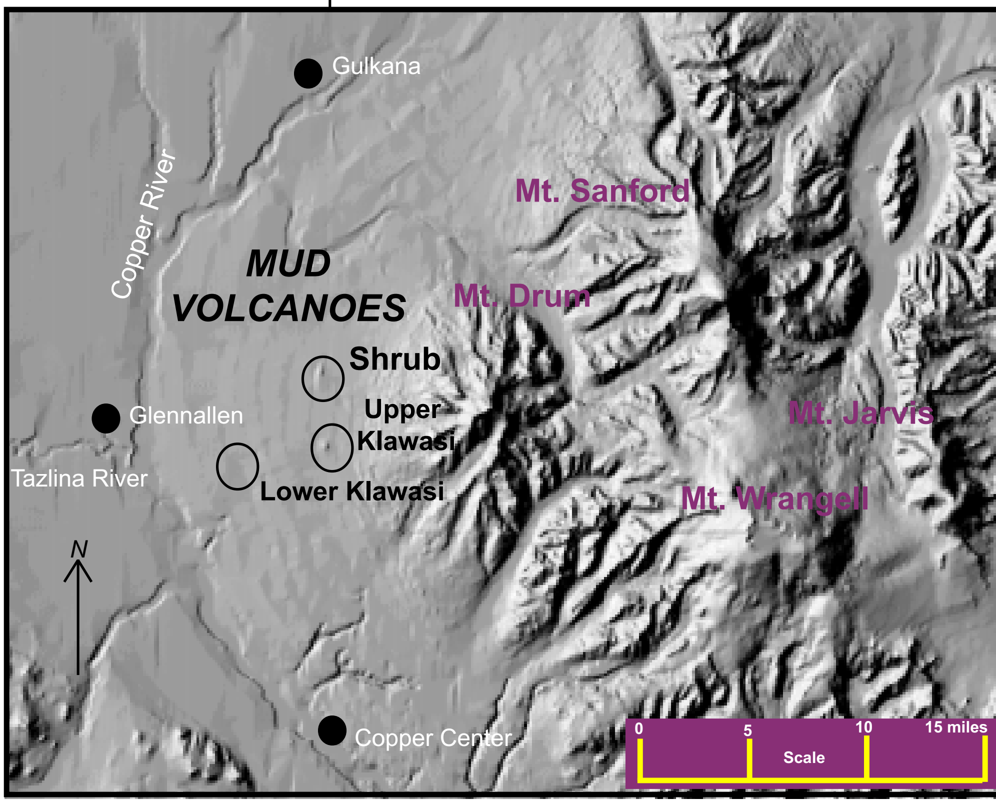


Figure 25: Index map of the Glennallen, Alaska area showing locatin of shrub mud volcano.

On Going Investigations

Renewed activity at Shrub mud volcano, Wrangell-St. Elias National Park and Preserve, Alaska

Mud volcano “Shrub” in Wrangell-St. Elias National Park and Preserve, approximately 27 km east of Glennallen, Alaska, began to vigorously erupt potentially dangerous carbon dioxide-rich gas and warm saline mud in the spring of 1997. The activity was first observed on June 12, 1997 and has been monitored since then by the U.S. Geological Survey and the National Park Service. Although the erupting gas poses no hazard to Glennallen or other communities in the Copper River Basin, it does pose a potential hazard in the vicinity of the mud volcano.

Shrub is one of three large mud volcanoes in the Copper River Basin near the west slope of Mt. Drum, a large extinct volcano. These mud volcanoes, between 50 and 100m high, are constructed entirely of material derived from the underlying glacial deposits of the Basin. Shrub has been virtually inactive since the first recorded observations in the 1950’s, until the summer of 1996 when a brief eruption occurred low on the volcano’s north flank. The other two mud volcanoes of the group, Upper and Lower Klawasi mud volcanoes have been active throughout this period. Temperature and chemical data have been collected on the mud and gas discharges. The Klawasi mud volcanoes erupt sodium bicarbonate-rich saline mud at temperatures of 57º-88º F and carbon dioxide. Researchers from the Alaska Division of Geological and Geophysical Surveys suggested in1989 that the warm water and gas are due to the breakdown of subsurface limestone by the heat of a deep-seated magma body and that the CO_2 derives from both the magmatic and limestone sources.

A second group of smaller mud volcanoes, called the Tolsona group, occur west of Glennallen. These mud volcanoes discharge very minor (less than 1 gal/min) amounts of cold slightly gas-charged mud that is chemically different from the Klawasi mud volcanoes.

The present ongoing activity at Shrub is more vigorous, and the temperatures higher, than what has been observed in the past at the nearby Klawasi mud volcanoes. At the summit of Shrub, vents erupt gas-charged mud to heights of more than 5m on occasion. Down the north flank of the cone collapse pits, as deep as 5m, have emitted carbon dioxide which apparently formed “rivers” of gas that flowed further down the flank browning vegetation for distances of a few hundred meters. Still lower on Shrub’s north flank, numerous small vents quietly discharge mud.

On June 30, 1997, gases were sampled from a less vigorous vent near the summit of Shrub. The purpose of sampling the gases was to determine the exact composition of the gas, which may be hazardous to visitors, and to determine the origin of the gases. Samples were collected to determine bulk gas composition, $\delta^{13}C$ in CO_2, and $^3He/^4He$. Preliminary analytical results show that the gases contain over 98% CO_2 and are similar chemically and isotopically to past analyses of gases from nearby Upper and Lower Klawasi mud volcanoes. As suggested previously for the other localities, this indicates that the CO_2 comes from a mixture of magmatic and limestone sources and that He is a mixture of magmatic and crustal sources.

continued

On August 13, 1997, the main vent at the summit was estimated to be producing mud at the rate of about 400-800 L per minute and the gas flow was estimated at tens of cubic feet meters a minute. Temperature of the mud has consistently been between 38° and 48° C.

Although the renewed activity at Shrub is not thought to be a precursor to a magmatic volcanic eruption, the copious amounts of carbon dioxide being discharged does present a local life-threatening hazard. Numerous dead snowshoe hares and song birds have been observed near the gas emitting collapse pits and more birds and animals are undoubtedly now buried by mud at other vents. Carbon dioxide is an odorless and colorless gas that will not support life and can rapidly overcome a person without warning. It is denser than air and hence will collect in low-lying areas such as gullies, pits and other ground depressions.

Although Shrub is relatively inaccessible in the summer, the possibility of easier winter-time access exists. Visitors, therefore, should be discouraged from visiting the mud volcano while it is in this very active and dangerous eruptive phase. The U.S. Geological Survey and theNational ParkService are awaiting further analytical results on the gases sampled in June 1997. Both agencies will continue to monitor eruptive activity at Shrub and the Klawasi mud volcanoes.

Don Richter, Game McGimsey and Bob Symonds

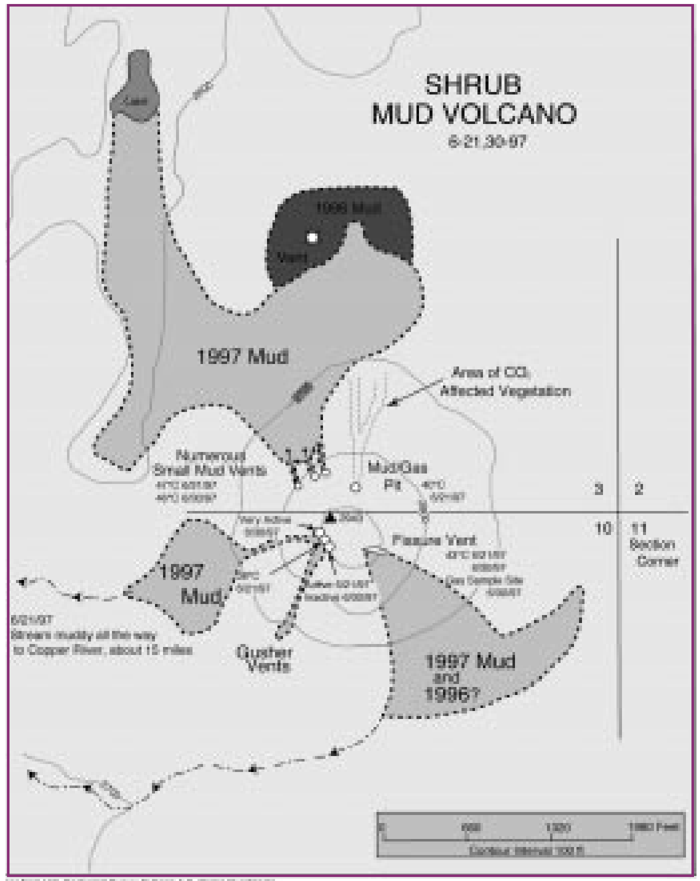
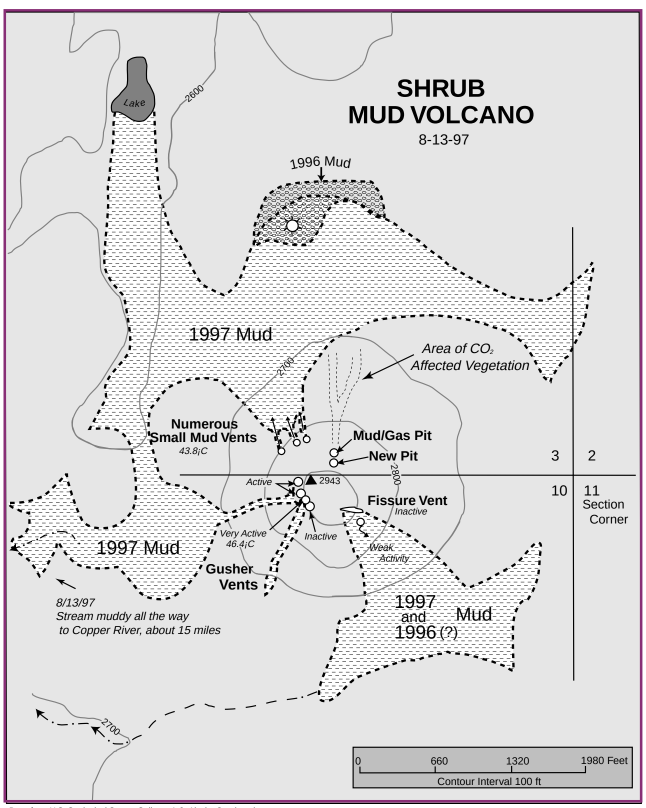


Figure 26: Sketch map of Shrub mud volcano showing vents and mud deposits as of June 21 and 30, 1997.



Base from U.S. Geological Survey Gulkana A-3, Alaska Quadrangle.

Figure 27: Sketch m ap of Shrub mud volcano showing vents and mud deposits as of August 13, 1997.

Makushin geologic mapping

All field data have been collected and processed and the Makushin map is being peer-reviewed by S.A. Liss, ADGGS, and D. Richter, USGS. We anticipate a final, edited version of the map by the end of the summer.

Work was conducted with P. Layer and J. Drake of the UAF Isotope Geochronology Lab to determine $^{40}Ar/^{39}Ar$ ages of select samples from the Makushin Volcanic Field. In particular, I was interested in obtaining an indication of the age or ages of the satellite vents and several flows located on the north side of the volcano. The satellite vents are presumed to have erupted at very near the same time, according to their weathering morphology. All display minor amounts of glaciation indicating they have existed at a time of greater glacial activity than the present. It is not known when the last glacial surge took place on Unalaska Island although Arce (1989) suggests a neoglacial surge may have occurred as recently as 2000 years ago. Successful dating of material this young pushes the window of applicability of the Ar dating technique. The results of note from the satellite vents are that Pakushin and Table Top yield ages that are significantly above zero, Pakushin gives an age of 15±7 ka. Ages determined for Lava Ramp, Sugarloaf Cone, Wide Bay Cone, and Wislow Cape Cone are inconclusive at zero (previous, unpublished K/Ar measurements gave non-zero ages).

We infer that the satellite vents have a more protracted eruptive history than anticipated.

At the other end of the age spectrum sit the results from a sample of basaltic rock from the western margin of Driftwood Valley. This is a sample taken by S. Swanson and C. Nye during their 1983 field season. Unpublished K-Ar age determinations of this sample gave an age of 3.03±.09 Ma. This is old for Aleutian Arc volcanic rocks that have been dated and I was curious what $^{40}Ar/^{39}Ar$ age determinations would reveal. Step heating of the sample yielded an age of approximately 2.5 Ma after release of excess argon. One sample does not a volcanic field make but it does indicate that volcanic activity associated with the present-day arc system could be extended back into the Tertiary. Other K/Ar ages from overlying volcanic samples cluster around 900 ka (Nye et al., 1986).

Vicki McConnell

References:

Arce, G.N., 1983. Volcanic hazards from Makushin Volcano, Northern Unalaska Island, Alaska, Master Thesis, UAF, 142 pp.

Nye, C.J., S.E. Swanson, and J.W. Reeder, 1986. Petrology and geochemistry of Quaternary volcanic rocks from Makushin Volcano, Central Aleutian Arc, Alaska Div. Geol. and Geophys. Surveys, PR86-80, 123 pp.

TABLE 1.
AGES DETERMINED FOR SELECTED SAMPLES FROM MAKUSHIN VOLCANIC FIELD. AGES ARE REPORTED WITH THEIR 1 SIGMA CONFIDENCE LIMITS. SAMPLES WERE ANALYZED USING STANDARD BERN4B WITH AN ASSUMED AGE OF 17.25 MA

Single grain fusions

Unit	*Sample number*	*Number of analyses*	*Mean age*	*Description*
Qlrf	96Mv98	8	<13 ka	"lava ramp" andesite flows
Qlrf	*MN57	10	<54 ka	"lava ramp" andesite flows
Qmaa	**96Mv09**	**9**	**40 ± 6 ka**	**basaltic andesite flow**
Qmob	96Mv46	4 (plag)	<1.9 Ma	basaltic deposits
Qmob	96Mv47	4	75 ± 297 ka	basaltic deposits
Qom	**96Mv60**	**6**	**45 ± 11 ka**	**ancestral Makushin lavas**
Qom	**96Mv37**	**11**	**100 ± 29 ka**	**ancestral Makushin lavas**
Qom	***M30**	**10**	**651 ± 35 ka**	**ancestral Makushin lavas**
Qpf	**96Mv121**	**5**	**22 ±5 ka**	**flank vent**
Qsl	96Mv112	2	<33 ka	monogenetic cinder cone
Qwbc	96Mv99	6	19 ± 15 ka	monogenetic cinder cone
Qwc	96Mv123	6	45 ± 49 ka	isolated agglutinate cone
Qom	***MQ24**	**11**	**208 ± 36 ka**	**lava flows**
Qom	**96Mv13**	**7**	**139 ± 10 ka**	**lava flows**
Qtt	**96Mv105**	**9**	**68 ± 14 ka**	basaltic cone

Quoted ages are weighted mean ages of a number of small whole-rock (or plagioclase where noted) samples. Ages are reported with their 1 sigma confidence limits. Ages denoted by ' < ' indicate that these samples were essentially zero age and the number quoted is the 1 sigma uncertainty associated with the analysis. Ages which are statistically different from zero age at the 95% (2 sigma) confidence level are shown in **bold**. Samples were analyzed using standard mineral Bern4B with an assumed age of 17.25 Ma. Samples designated by a ' * ' are from a sample set provided by C. Nye, Alaska Division of Geological and Geophysical Surveys.

New age dates correlate distal volcanic deposits in the Dutch Harbor area with proximal caldera forming pyroclastic deposits

Age dates from 1996 investigations of Makushin volcano give bracketing ages of 8270 B.P and 8780 B.P. on early Holocene proximal caldera forming deposits. During the summer of 1997, Jim Begét and I revisited Unalaska for the purpose of studying the distal volcanic deposits in and around Dutch Harbor. Preliminary results confirm the stratigraphic and temporal correlation of these distal deposits to the proximal caldera forming deposits.

The most prominent distal caldera forming deposit, in the Dutch Harbor area, is easily recognized by its distinct oxidized orange to red color and poor sorting. Thickness can vary greatly in a single exposure, but is typically 15 to 60 centimeters. A similar though thinner unit underlies the previously mentioned deposit, and is separated by a soil horizon suggesting that Makushin had more than one significant early Holocene eruption.

A new age date on this distal deposit comes from Hog Island, a small low relief island situated in the middle of Unalaska bay, which separates the town of Unalaska from the main volcanic edifice. Here the caldera-forming deposit buries an organic horizon containing charred grass and brush stems in upright position, as if the deposit itself was the source of heat. A radiocarbon age date on these plant remains gives an age of 8320 B.P. This correlates nicely with the timing of the proximal pyroclastic flows.

There are several indicators that the distal deposit does not simply represent an airfall component of the caldera forming eruptions. The deposit is thermally oxidized and there are

continued

charred woody fragments in and under the deposit. The deposit changes in thickness at outcrop scale. It thickens in lows and thins in highs, instead of mantling topography like underlying and overlying airfall beds. It is thin to absent at high elevations, is pumice poor and lithic rich, and in places contains dune structures. In at least one locality it was injected under an older airfall deposit. These facts, coupled with the age dates and stratigraphic evidence, suggest that the distal deposits in Dutch Harbor are directly related to the proximal pyroclastic flows. If so, these pyroclastic flows may be a relative of low aspect ratio ignimbrites or LARIs as discussed by Walker (1983). Whatever the case, early Holocene eruptions of Makushin volcano were particularly violent and had a very destructive impact as far away as the present town and port of Dutch Harbor/ Unalaska, a distance of approximately 25 km.

Kirby Bean

References:

Walker, G.P.L., 1983. Ignimbrite types and ignimbrite problems., J. Volcanol. Geotherm. Res., 17: 65-88.

Figure 28: Jim Begét points to a distal caldera forming deposit that was injected under an older tephra.

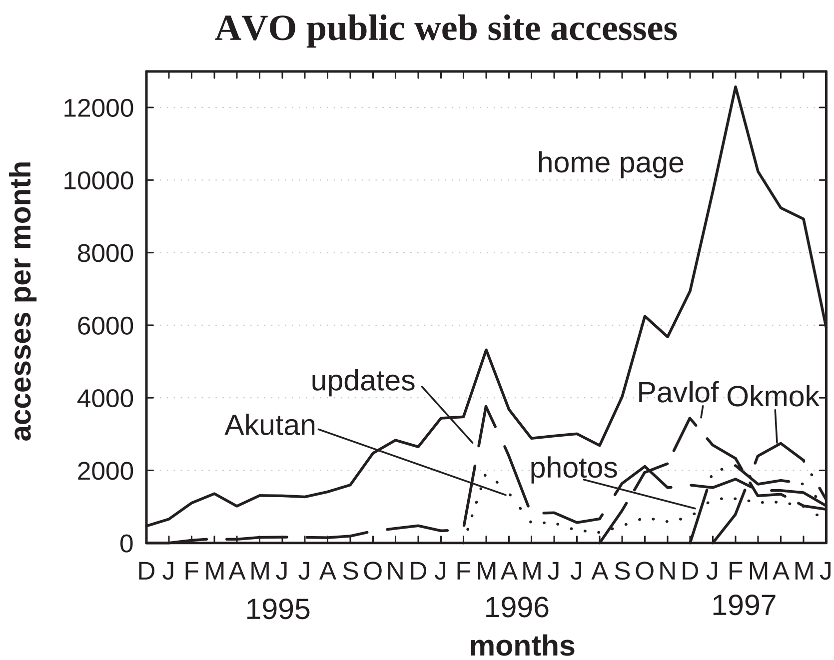


Figure 29: Graph showing requests and access usage by web browsers of the AVO web site.

AVO on the Web

Traffic on the Web

Traffic on the AVO web pages (http://www.avo.alaska.edu) continues to increase. We now have over 200, and as many as 400 visitors each day (not including gi.alaska.edu users or internal page accesses). The main draws to the site are current event items and photographs and maps. Starting with the Akutan seismic swarm in the spring of 1996 we have built new pages around each major volcanic event, including the Pavlof eruptions in the late fall of 1996 and the Okmok eruption in the spring of 1997. These pages contain the official AVO updates, pertinent open AVO memos, location maps, photographs, and an informal written commentary. The logfile for the web site shows that these pages, along with the updates file and the photo archive page are among the most popular subpages.

Access to other unrelated pages also increases, but to a lesser extent, when the current events pages are being frequently updated. People come to the site for current information, but stay to browse throughout the site.

We have yet to complete an in-depth analysis of who are users are, but we are aware of the following audiences. Secondary school students come to the site for help with assignments, and also for browsing. Our access rate climbed significantly in the spring when schools science projects were under construction. AVO web content was spotted on several science project posters throughout the state. We know from conversations with major transpacific aircraft operators that they are frequent visitors to the site. One large air-freight company reported that they log in daily just to see if anything new is happening. The biggest single user group, by a factor of three, is the combined Japanese academic group (ac.jp domain, similar to the .edu domain in the United States). The ac.jp domain includes Japanese universities as well as most of the volcano observatories.

Expansion plans for the AVO public web page include a separate page for each active volcano, and new content which describes our monitoring procedures and better reflects our daily activities.

Chris Nye

Personnel

A "robust" welcome to our new hires during this time period: Dave Schneider, Geophysicist (AVO-Anchorage; contracted through Hughes STX Mapping), and Shelly Worley, Research Assistant, University of Alaska Fairbanks, Geophysical Institute.

Publications

McNutt, S.R., Seismic monitoring of volcanoes: A review of the state-of-the art and recent trends, in: Scarpa, R. and R. Tilling (eds), Monitoring and Mitigation of Volcano Hazards, Chapter 3, Springer-Verlag, Berlin, p. 99-146, 1996.

McNutt, S.R., Y. Ida, B.A. Chouet, P. Okubo, J. Oikawa, and G. Saccorotti, Kilauea Volcano provides hot seismic data for joint Japanese-U.S. experiment, EOS Trans. Amer. Geophys. Union, v. 78, p. 105-111, 1997.

Miller, T.P., D.G. Chertkoff, M.L. Coombs, and J.C. Eichelberger, Mount Dutton Volcano, Alaska: An Aleutian arc analog to Unzen Volcano, Japan, in. Proceeedings: Unzen International Workshop: Decade Volcano and Scientific Drilling, Shimabara, Japan, May 26-29, 1997, p. 95, 1997.

Nye C.J., Massive widespread crustal contamination in the eastern Aleutian Arc: Eos v. 78 no. 17 supplement, p. 331-332, 1997.

Seismic monitoring of the September-December 1996 eruptions of Pavlof Volcano by the Alaska Volcano Observatory, (abstract) EOS Trans, Amer. Geophys. Union, Supplement, v. 78, no. 17, p. S47, 1997.

Weimer, S. and S.R. McNutt, Variations in the frequency-magnitude distribution with depth in two volcanic areas: Mount St. Helens,Washington, and Mt. Spurr, Alaska, Geophys. Res. Letts., v. 24, p. 189-192, 1997.

Addendum

Log of Updates for the Current Period

Alaska Volcanoes Update
Friday, May 2, 1997, 10:30 AM ADT (1830 UTC)
Okmok Volcano: 53.4°N, 168.17°W; 760 m (2,500 ft)
Eruptive activity at Okmok Volcano is continuing. Hot lava flows within the caldera as well as thin, low-level, ash plumes have been observed via satellite during the last week. The current eruptive phase began February 13. 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 not monitored seismically and is not assigned a color code. 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).
Other Volcanoes: (repeated in subsequent updates)
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.
Pavlof, Iliamna, Spurr, Redoubt, Augustine, Griggs, Katmai, Novarupta, Trident, Mageik, Martin, Dutton, Akutan, and Makushin volcanoes are all at or near normal levels of background seismicity.

Alaska Volcanoes Update
(for the Kamchatka Peninsula)
Thursday, May 8, 1997, 11:50 PM ADT (0750 UTC)
Bezymianny Volcano: 55°58'N, 160°36'E
Bezymianny volcano, a frequently active volcano in north-central Kamchatka, began showing signs of renewed activity about 5 days ago. Early this morning local time, an ash plume was observed rising to about 13,000 feet ASL; at 1:00 PM local Kamchatka time, the volcano went into continuous seismic tremor and about 2:00 PM local Kamchatka time (0100 UTC), a strong eruption occurred sending an ash plume to an estimated 40,000-45,000 feet ASL and extending in an east to northeast direction for several tens of miles. Two vents may have been active as of 4:00 PM local time (0300 UTC). Satellite images as of 0630 UTC indicated the eruption plume extended 260 miles to the east-northeast.
Bezymianny volcano has erupted over 25 times in this century with it's most vigorous eruption in 1956 when an explosive event occurred similar to that of May 20, 1980 at St. Helens volcano in Washington, USA destroyed the summit of the volcano. Since that climactic event, lava domes have grown and collapsed episodically with the most recent vigorous activity in 1994-1995. Based on the information presently available, at least part of the current lava dome at Bezymianny may have been destroyed. If this is the case, sporadic ash plumes to 20,000-30,000 feet ASL might be expected over next 48 hours.
Although KVERT operations have been temporarily suspended due to lack of funding, most of the above information was initially provided by KVERT personnel (repeated in subsequent Kamchatka updates).

Alaska Volcanoes Update
Friday, May 9, 1997, 10:30 AM ADT (1830 UTC)
Okmok Volcano: 53.4°N, 168.17°W; 760 m (2,500 ft)
Eruptive activity at Okmok Volcano is continuing. Indications of hot lava flows within the caldera and small, low level, ash plumes have been observed via satellite during the last week. The current eruptive phase began February 13. 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 not monitored seismically and is not assigned a color code. 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
Bezymianny Volcano: 55°58'N, 160°36'E
Friday, May 9, 1997, 1:30 PM (2130 UTC)
Eruption activity at Bezymianny volcano appears to have declined over the past 12 hours. Visual

continued

observations made by Russian volcanologists about 1400 UTC indicated an ash column reaching to about 20,000 feet ASL (down from the +40,000 feet levels of yesterday) and extending at least several tens of kilometers to the SE. Seismic activity has also declined from the high levels recorded during the most explosive events of yesterday. Satellite imagery today shows the volcano is obscured by cloud cover but no ash plume is visible above the clouds, an observation in keeping with that reported by the Russian volcanologists. The volcano continues in eruption, however, and although current ash plumes appear to be no more than 20,000 feet ASL, occasional ash plumes to 30,000 feet ASL are still possible.

Because of a FAX problem at AVO, some users did not receive the Update issued last night on Bezymianny volcano and we are including that report below…

<u>Alaska Volcanoes Update</u>
Friday, May 16, 1997, 10:30 AM ADT (1830 UTC)
Okmok Volcano: 53.4°N, 168.17°W, 760 m (2,500 ft)

The current eruptive phase at Okmok Volcano, which began February 13, is continuing at a relatively low level. The eruption could intensify at any time, and lava flows, as well as ash emission, may occur without warning for a period of weeks to months. Okmok is not monitored seismically and is not assigned a color code. 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).

<u>Alaska Volcanoes Update</u>
Friday, May 23, 1997, 11:00 AM ADT (1830 UTC)
Okmok Volcano: 53.4°N, 168.17°W; 760 m (2,500 ft)

The current eruptive phase at Okmok Volcano, which began February 13, is continuing at a relatively low level. The eruption could intensify at any time, and lava flows, as well as ash emission, may occur without warning for a period of weeks to months. Okmok is not monitored seismically and is not assigned a color code. 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).

<u>Alaska Volcanoes Update</u>
Friday, May 30, 1997, 11:00 AM ADT (1900 UTC)
No activity detected.

<u>Alaska Volcanoes Update</u>
Monday, June 2, 1997 10:00 PM ADT (06:00 UTC)
Pavlof Volcano: 55°25'N, 161°54' W summit elevation 2,518 m (8,262 feet)

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

Beginning Sunday morning, a low level increase in seismic activity was detected at Pavlof Volcano. Today at 3:30 pm ADT, the NWS at Cold Bay reported seeing a steam plume which increased in vigor and reached a height of 3,000 ft above the summit of the volcano. Based on the recent eruptive activity at Pavlof (September - December, 1996) as well as it's history and character, renewed activity at this time could be expected. AVO has a seismic network of six stations near the volcano, which are monitored by a computerized alarm system.

Pavlof Volcano, perhaps the most active volcano in the Aleutian volcanic arc, has a history of 3-8 year-long periods of repose between eruptions. A new eruption is then marked by a period of strong explosive events that can send ash plumes to over 10 km (33,000 feet) above sea level. The eruptive phase then changes to sporadic strombolian eruption of lava spatter and small amounts of ash that may last several months. Spatter-fed lava flows emanate from the summit vent on occasion. The eruption then typically has a quiet period of several months followed by renewed strombolian activity. Pavlof was most recently active from Sept 13 to end Dec 1996.

The nearest towns to the volcano are Cold Bay (37 mi), King Cove (30 mi), Sand Point (60 mi), and Nelson Lagoon (50 mi); these towns could expect light ash fall depending on wind direction and continuing eruptive activity. Mudflows and some flooding in the Cathedral River valley north of the volcano may occur. Airborne ash hazards to aircraft may be considerable if a large explosive event occurs but are much less severe during a typical Strombolian phase.

Shishaldin Volcano: 54°45'N, 163°58'W; summit elevation 2857 m (9,373 ft)

Visual report from NWS at 3:35 pm ADT, Cold Bay, of a small steam and ash plume rising 1000 - 1500 ft above the summit of Shishaldin and drifting about 5 miles downwind to the north. This volcano is not seismically monitored but has frequent small eruptions.

<u>Alaska Volcanoes Update</u>
Friday, June 6, 1997, 11:00 AM ADT (1900 UTC)
Pavlof Volcano: 55°25' N, 161°54' W; summit elevation 2,518 m (8,262 feet)

LEVEL OF CONCERN COLOR CODE: YELLOW

The slight increase in the level of seismicity that began on Sunday, June 2, continued through the week at Pavlof Volcano. On Monday, National Weather Service observers at Cold Bay reported seeing a steam plume 3,000 ft above the summit of the volcano. On Tuesday, satellite images recorded a moderate thermal anomaly at Pavlof. Since then, AVO has received no further reports of unusual activity at Pavlof and clouds have obscured the volcano for the remainder of the week. Based on the recent eruptive activity at Pavlof (September - December, 1996), renewed activity at this time could be expected. AVO has a seismic network of six stations near the volcano; this network is monitored by a computerized alarm system.

Pavlof Volcano, perhaps the most active volcano in the Aleutian volcanic arc, has a history of 3-8 year-long periods of repose between eruptions. A new eruption is then marked by a period of strong explosive events that can send ash plumes to over 10 km (33,000 feet) above sea level. The eruptive phase then changes to sporadic strombolian eruption of lava spatter and small amounts of ash that may last several months. Spatter-fed lava flows emanate from the summit vent on occasion. The eruption then typically has a quiet period of several months followed by renewed strombolian activity. Pavlof was most recently active from September 13 to late December of 1996.

The nearest towns to the volcano are Cold Bay (37 mi), King Cove (30 mi), Sand Point (60 mi), and Nelson Lagoon (50 mi); these towns could expect light ash fall depending on wind direction and continuing eruptive activity. Mudflows and some flooding in the Cathedral River valley north of the volcano may occur. Airborne ash hazards to aircraft may be considerable if a large explosive event occurs but are much less severe during a typical Strombolian phase.

Shishaldin Volcano: 54°45'N, 163°58'W; summit elevation 2857 m (9,373 ft)

On Monday, June 2, NWS observers in Cold Bay reported a possible small steam and ash plume rising 1000 - 1500 ft above the summit of Shishaldin and drifting about 5 miles downwind to the north. This volcano is not seismically monitored but has frequent small eruptions. AVO has received no additional reports of activity at Shishaldin this week.

<u>Alaska Volcanoes Update</u>

Friday, June 13, 199, 12:30 PM ADT (2030 UTC)

Pavlof Volcano: 55°25' N, 161°54' W; summit elevation 2,518 m (8,262 feet)

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

The seismic activity has declined over the last week and although fluctuations in activity are continuing to occur, the level is near background. Thus we are returning to Color Code Green. AVO has received no further reports of unusual activity at Pavlof and clouds have obscured the volcano for the entire week. A seismic network of six stations near the volcano is monitored by a computerized alarm system.

Shishaldin Volcano: 54°45'N, 163°58'W; summit elevation 2857 m (9,373 ft)

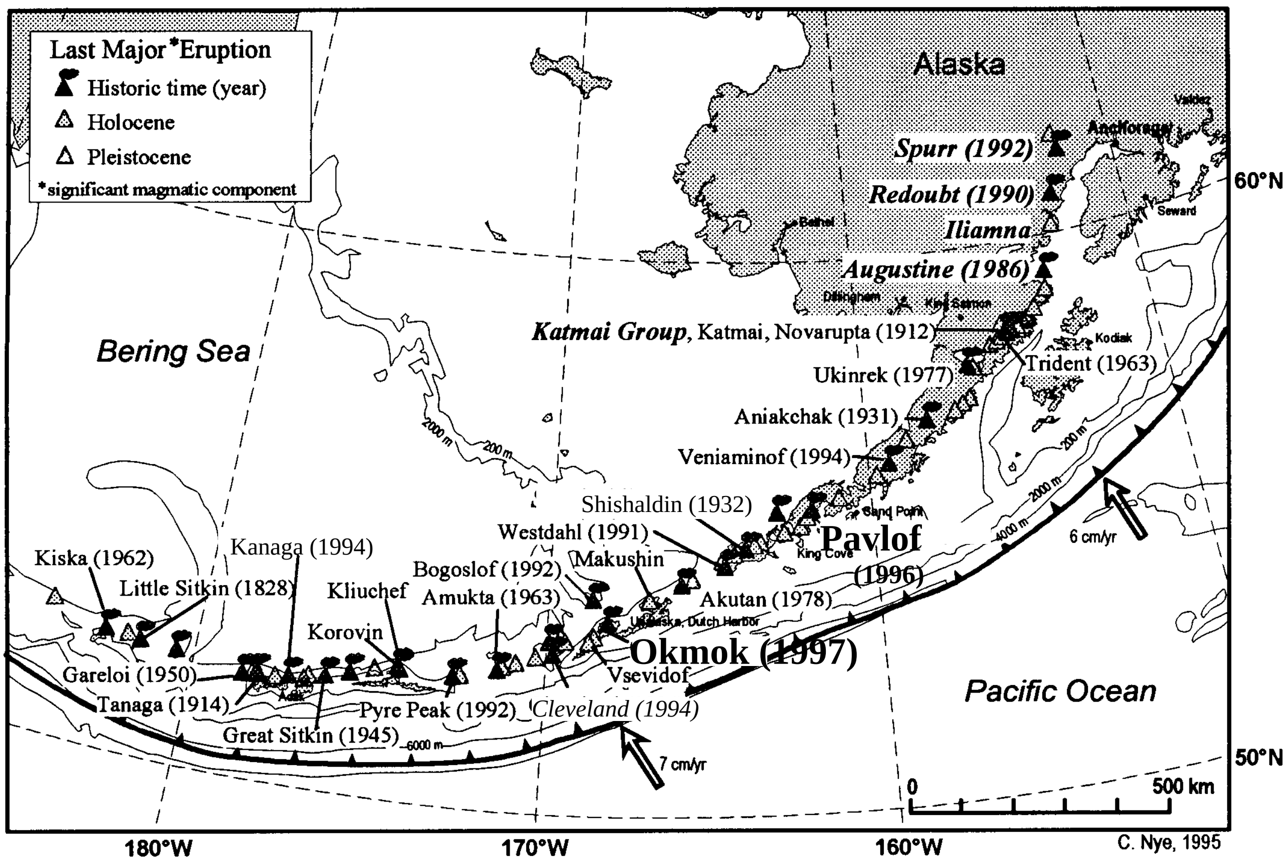
On Monday, June 2, NWS observers in Cold Bay reported a possible small steam and ash plume rising 1000 - 1500 ft above the summit of Shishaldin and drifting about 5 miles downwind to the north. This volcano is not seismically monitored but has frequent small eruptions. AVO has received no additional reports of activity at Shishaldin this week.

<u>Alaska Volcanoes Update</u>

Friday, June 20, 1997, 11:30 AM ADT (1930 UTC) No activity detected.

<u>Alaska Volcanoes Update</u>

Friday, June 27, 1997, 10:30 AM ADT (1830 UTC) No activity detected.



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.

For further information and/or contributions to this newsletter please contact:

U.S. Geological Survey
Alaska Volcano Observatory
4200 University Ave.
Anchorage, AK 99508
(907) 786-7497

Alaska Volcano Observatory
Geophysical Institute
University of Alaska Fairbanks
P.O. Box 757320
Fairbanks, AK 99775-7320
(907) 474-5681

Alaska Division of Geological and Geophysical Surveys
Alaska Volcano Observatory
794 University Ave., Suite 200
Fairbanks, AK 99709
(907) 474-7147

U.S. Geological Survey
Cascades Volcano Observatory
5400 MacArthur Blvd.
Vancouver, WA 98661
(360) 696-7693

U.S. Geological Survey
Alaska Volcano Observatory
345 Middlefield Rd.
Menlo Park, CA 94025
(650) 329-4742