Alaska Volcano Observatory

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Highlights and Summary

- Okmok Caldera is cooling off from its recent intracaldera eruption.
- AVO has implemented improved seismicity maps to report bimonthly (and other time periods) activity.
- A seismic network was installed around Shishaldin Volcano.
- Field work at Shishaldin revealed a late-Pleistocene/early Holocene collapse and subsequent prodigious cone-building activity.
- Field work near the Valley of Ten Thousand Smokes identified a previously unknown Pleistocene volcano, Alagogshak, near Mt. Martin. A stratocone comprising part of the Katmai edifice was found to be the source of pre-1912 explosive rhyodacite eruptions.
- Changes in the crater lake at Mount Mageik may reflect shallow magmatic intrusion during the October 1996 seismic swarm.

This period saw the commencement of seismic monitoring and geological field studies at one of the gems of the Aleutian Arc: Unimak Island with its North Pacific's Fuji—Shishaldin Volcano. Unimak includes as well the Holocene Fisher Caldera, frequently active (last at Thanksgiving '91) Westdahl Volcano, and a center now suspected by Tom Miller as being guilty of a large silicic explosive eruption in the Holocene—Round Top. Unimak is near the point where dip-parallel slab velocity reaches a maximum, and so the high rate of magma production may be readily explicable. This year's seismic effort is the first of a two-year plan to fully instrument the island.

Another highly "productive" group of volcanoes is the Katmai cluster. The complexity of this field, with its numerous centers and chemical range from basalt to high-silica rhyolite, continues to produce new discoveries. This is despite of the fact that intensive field work was begun here by Wes Hildreth a decade before the birth of AVO. We have a long way to go though, before we know why these clusters of high activity exist.

John Eichelberger

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

Eruptions

Okmok Caldera -The intracaldera lava flow continued to cool and remained detectable as hot spots on AVHRR satellite imagery through mid-August. No explosive activity occurred though an occasional steam plume was detected.

Alaid volcano, 50°40'N, 155°56'E - A possible small hot spot was detected on 22 August at Alaid volcano, the northernmost Kurile Island just south of the tip of the Kamchatka Peninsula. Weather clouds confused the analysis for any volcanic ash cloud. KVERT's inquiries into the situation provided no confirmation of any eruptive activity.

Terry Keith

Monitoring

Satellite observations of Alaska and Kamchatka volcanoes

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. All of these systems include visible and thermal infrared (TIR) wavelength data.

The polar orbiting satellite 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. These satellite images are received by a ground station at the Geophysical Institute, University of Alaska Fairbanks, and are analyzed daily to detect volcanic eruption clouds and thermal anomalies at volcanoes in the north Pacific region. Repetitive coverage by these data are 8 images per 24 hours for Alaska volcanoes and approximately 4 images per 24 hours for Kamchatka 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 (4 km resolution in the visible and TIR) are available for analysis within about an hour 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 quiescent period, cooling of Okmok Volcano received most of our attention, but there were some additional observations of possible volcanic-related activity from Alaid and Sheveluch volcanoes on the Kamchatka Peninsula, Russia, and Pavlof Volcano, Alaska. Table 1 shows dates of eruptions or reports of volcanic-related activity at these volcanoes.

Note: hot spots mentioned in the report are Band 3 pixels with elevated temperatures compared to the surrounding ground. The AVHRR Band 3 sensor saturates at approximately 50°C. A lava flow or hot ground needs to occupy only a portion of a pixel to increase the temperature.

Okmok Caldera

Thermal anomalies continued to be observed at Okmok Volcano, and are most likely related to the lava flow as it cools. On July 8 (n14.97189.1423) one pixel at 24°C, about 20° above background, was observed. Clouds prevented viewing for over a month, but finally on 13 August a warm pixel was again observed with a temperature of 13°C, about 10 degrees above background (n14.97225.1431). A possible 15-km-long plume was also observed blowing to the northwest, but essentially only minor negative band 4 minus 5 values were detected, so it was probably composed mostly of steam. The next day (n14.97226.1420), one pixel at 17° above background temperatures was detected over Cone A. A morning image on August 19 detected one pixel at 14°C about 6° above background temperatures. The next day (n14.97232.1455), one pixel at 15°C was observed, about 7° above background temperatures. On August 29 (n14.97241.1457), one pixel at 14°C, around 8° above background, temperatures was observed. Visible band data (B-2) indicates that hot spots observed on the August images were not related to solar heating.

Unconfirmed Alaid (Kurile Islands) Activity

It is still unclear if Alaid Volcano briefly awoke from its ten-year slumber this summer. On August 21 (n14.97233.0230), six pixels with temperatures around 40°C, about 19° above background, were detected with similar anomalies observed the next day (n14.97234.0218). On August 23 (n14.97235.0208), 4 pixels around 36°C about 8° above background temperatures were observed. Images after this were cloudy and the anomaly was not seen again. Some observers in the area reported ash and others saw nothing. It is possible that solar heating was responsible for the thermal anomalies.

Sheveluch

A possible plume was observed at Sheveluch on August 28 (n14.97238.1530) blowing to the northeast. This plume was 60 km long and low band 4 minus 5 values, suggesting it was composed mostly of steam with little ash present. No other anomalies from Sheveluch were observed in later images.

Visitors

Drs. R. J. Thompson and Brian Bailey from the USGS EROS Data Center, Sioux Falls, SD., visited the Geophysical Institute and AVO on 1 August. Discussions concentrated on satellite remote sensing systems to be launched in 1998. These include MODIS, ASTER and Landsat 7. The spatial resolution of these systems range from 1 km to 15m. They have many new spectral bands that will significantly improve volcano monitoring and analysis. MODIS data will be available daily while the others will have a lower frequency of temporal coverage. Estimated data cost for Landsat data will be $300 to $400 per image but MODIS and ASTER will be free. MODIS is the only data that could be available in near-real time. There is a ground station down-link capability external to NASA for MODIS data. We intend to utilize these data as much as possible when they become available.

Ken Dean, Brooke Foster, Angie Roach, Kevin Engle and Dave Schneider

Seismicity

Finally, the highly advertised and much anticipated new and improved seismicity basemaps are here! Guy Tytgat did a most excellent job on these maps; all credit (and blame) should be directed towards him. For most of the volcanoes, the areas covered by the new versions of the basemaps are not all that different from those previously in use. However, for the Dutton, Iliamna, Katmai and Spurr regions the scale/area covered have been significantly changed (see previous Bimonthly Reports for comparison). The areas covered by these maps decreased in the case of Dutton and increased in the case of the other three map regions. These factors should be taken into account when comparison is made between the older seismicity maps and those generated using the new versions of the basemaps.

Since this is the ceremonial unveiling of the new maps, so to speak, the seismicity maps will be included in this report even in those cases in which no earthquakes have been plotted. The new maps are quite different from the earlier versions and therefore, a bit of explanation is in order. The volcanic vents are indicated

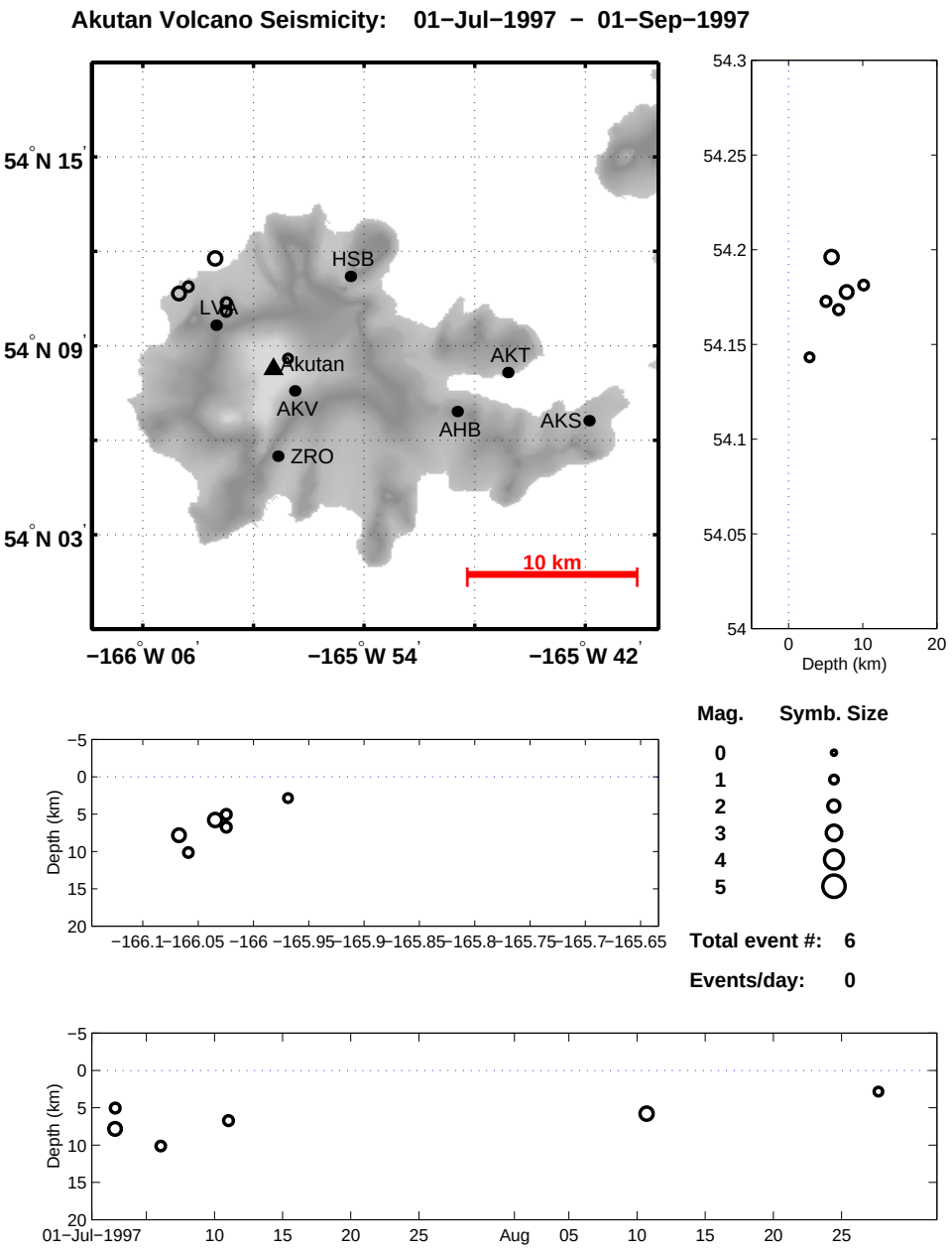

Figure 1: Locatable Akutan seismic events in space and time for July through August.

by triangles, seismic stations are solid circles, towns are squares and earthquakes are indicated by open circles, the size of which is proportional to their respective magnitude. Elevation is indicated by a gray scale in which the lighter shades indicate greater elevation. The seismicity map is flanked on the bottom and right sides by east-west and north-south cross-sections. The decimal latitude or longitude is indicated on one of the axes of the cross-section and the depth in kilometers is indicated on the other. For each volcano, there are also time-depth plots similar to those given by the previous version of the seismicity plots. All earthquakes plotted on the seismicity map are projected onto the two cross-sections and also appear on the time-depth plot. However, should an earthquake have a hypocentral depth exceeding the maximum cross-section depth of 20 km, such an event would appear on the seismicity map but not on the time-depth plot and two the cross-sections. Note that this differs from how the earlier set of seismicity maps handled such events. Previously, such earthquakes still appeared on the time-depth plots even though their hypocentral depths were greater than the indicated maximum plotted depth; these events were simply plotted at the maximum allowed depth on the time-depth plot and a special symbol was used on the seismicity map to indicate that their actual hypocentral depths were greater than the indicated depth range.

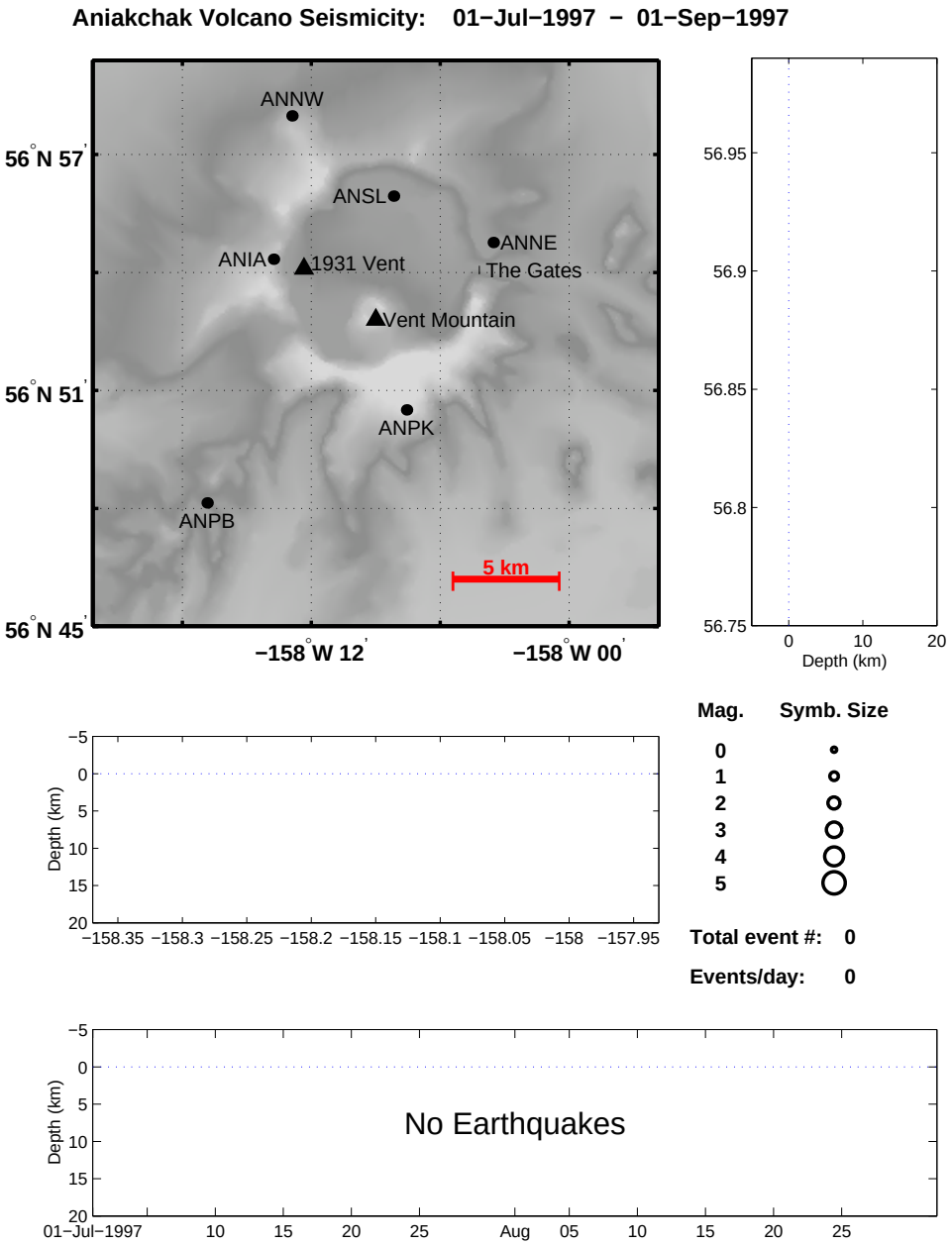

Figure 2: Locatable Aniakchak seismic events in space and time for July through August,.

Akutan

Six earthquakes were located in the vicinity of Akutan during July and August (figs. 1, 12 and 13). The largest earthquake located during this time period had a magnitude of 2.4. One event was located beneath the summit at a depth of about 3 km. Three events were located along the northwestern coast of Akutan Island about 7-8 km from the summit. The final two events were located a bit more inland at a distance of about 5 km northwest of the summit. The number of earthquakes located at Akutan during July and August is three times that of the previous two-month interval. This value, however, is much lower than the 23 located earthquakes predicted from the 6-month mean seismicity rate. Since the number of located events has been less than the predicted value since November 1996, perhaps the heightened seismic activity associated with the March 1996 swarm continued, albeit at a lower level, during at least some of the time period over which the mean rate was computed. This question will be resolved with continued seismic monitoring of Akutan.

Aniakchak

The first event to be located in the Aniakchak region occurred on August 11, 1997 (figs. 2, 12 and 13). Unfortunately, this event is located about 12 km west-southwest of the 1931 vent, just barely off the map area. This was the only event located in the vicinity of Aniakchak during this two-month interval. However, note that the Aniakchak subnet was not added to the seismic acquisition system until July 18, 1997. Therefore, the period of data collection does cover not the entire two-month interval indicated on the plots. Aniakchak helicorder counts were not initiated in earnest until

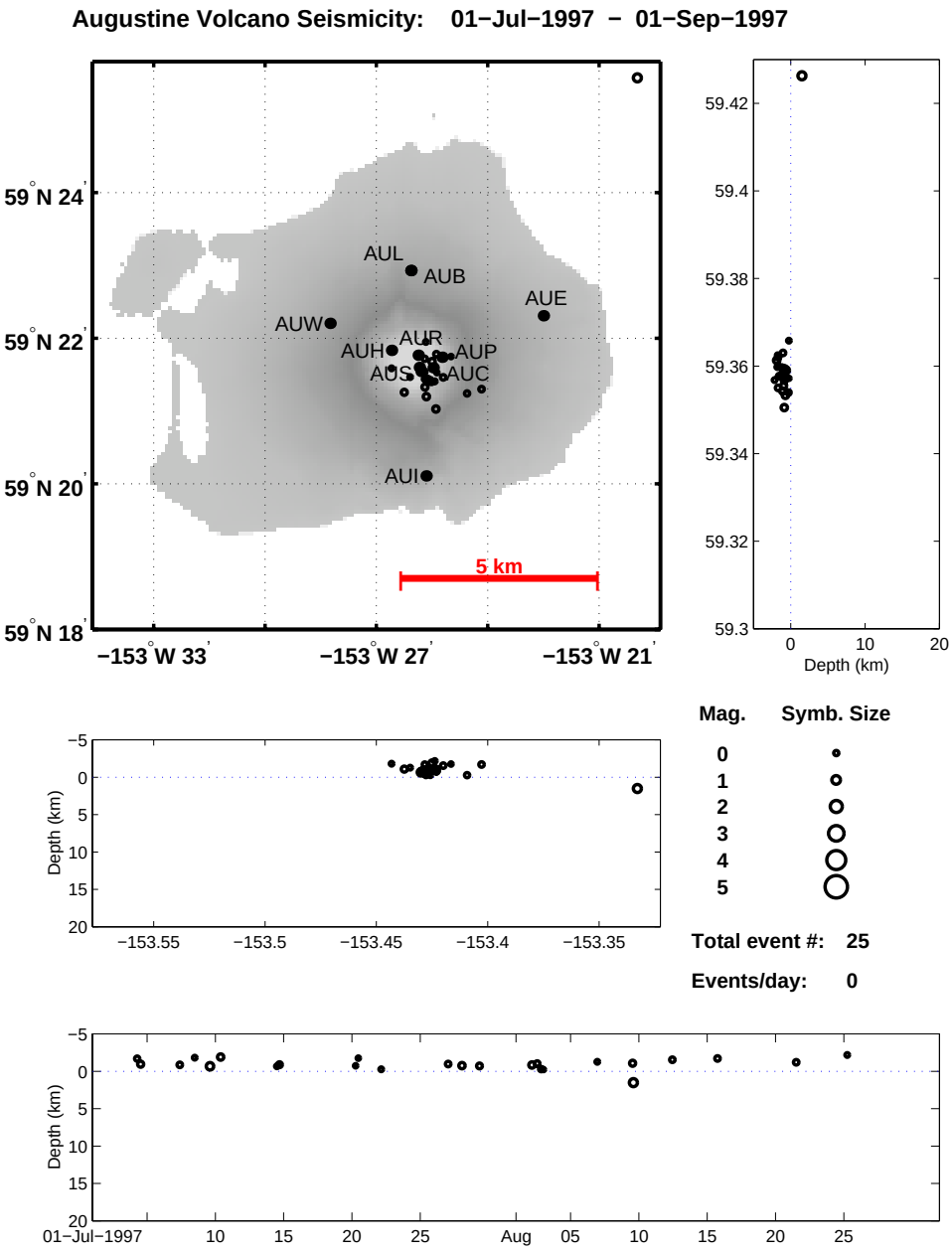

Figure 3: Locatable Augustine seismic events in space and time forJuly through August,.

September. Although this is the first time AVO has had earthquake location capabilities, at Aniakchak it is not the first time AVO has monitored the seismicity there. On July 6, 1994 a single station, ANK, was installed about 1.5 km west-northwest of the 1931 vent. Data from this station were transmitted to Port Heiden and recorded by helicorder. The flow of data eventually ceased after about a year or so when the station's antenna suffered too much abrasion damage from the ash-laden winds. The ANK helicorder records give some insight into what sort of background activity is to be expected in the Aniakchak region. These records indicate that the background seismicity at Aniakchak is generally quite low. In this light, the fact that no earthquakes were located in the Aniakchak region during the 5-weeks or so of operation is not all that surprising. The periods of apparent quiescence can, however, be abruptly interrupted by periods of greatly heightened seismic activity. For example, during the November 18, 1994 swarm nearly 70 earthquakes were recorded over a time period of only about four hours (see the November/December 1994 Bimonthly Report).

Augustine: During July and August a total of 25 earthquakes were located in the vicinity of Augustine (Figs. 3, 12 and 13). The largest event located during this time period had a magnitude of 0.9. This earthquake was located about 10 km northwest of the summit or about 3 km offshore of the island. Due to its relatively great distance from the Augustine Volcano, it was probably a regional tectonic event not related to activity at Augustine. The remaining 24 earthquakes, the largest of which had a magnitude of 0.7, were all located at or near the summit. Of the 24 such events, 18 were located beneath the summit. The final six events were located less than 1.5 km from the summit. One event was located to the west of the summit while the other five earthquakes were located south to southeast of the summit. All 24 events had shallow locations within the volcanic pile. The observed seismicity rate during this two-month interval is a bit greater than that of the previous two-month interval and is much greater than the three-year average of 6.8 located events per month. Although the scale and coverage area of the new Augustine seismicity basemap is not very different from the previous version, the new basemap is much improved with respect to aspect ratios (see previous Bimonthly Reports for comparison).

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Dutton: Two earthquakes were located in the vicinity of Dutton during July and August (figs. 4, 12 and 13). he largest such event had a magnitude of 1.6 and was located about 7 km south-southeast of Dutton. The other event was located about 5 km west of Dutton and had a magnitude of 1.5. Note that these are the first earthquakes to locate relatively close to Dutton since September 1996.

Iliamna During July and August, a total of 30 earthquakes were located in the general vicinity of Iliamna (figs. 5, 12 and 13). The largest earthquake located during this time period had a magnitude of 1.1. Twenty-nine of these events were located relatively close to Iliamna. The one remaining event, however, was located about 24 km northeast of the summit. Due to its relatively great distance from Iliamna, this earthquake is probably a regional event unrelated to volcanic activity at Iliamna. Readily apparent in the seismicity plot (fig. 5) are the two persistent clusters of seismicity located near the summit and about 7 km south of the summit. Also present is the cluster of earthquakes east-southeast of the latter cluster. This cluster first appeared in April, 1997 or perhaps as early as January; an earthquake was located slightly to the north of this cluster in January. At any rate, this cluster of seismic activity is a relatively recent feature of the pattern of seismicity at Iliamna. The seismic activity at Iliamna has continued to rapidly decrease. The number located during July and August represents about a 28% decrease from that of May and June. Note that the number of located events during July and August is a bit greater than the 24 events predicted from the estimated mean seismicity rate.

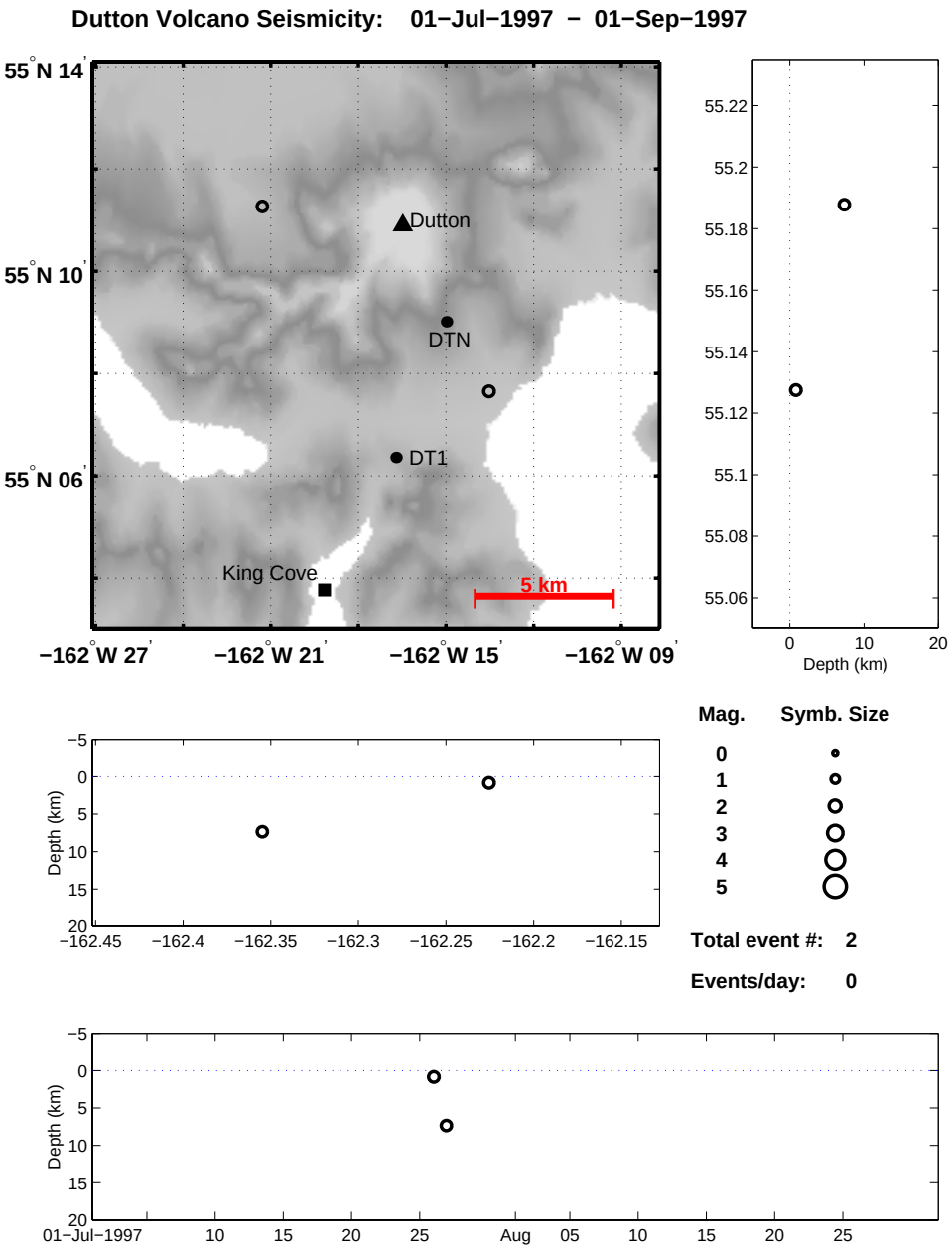

Figure 4: Locatable Dutton seismic events in space and time for July through August.

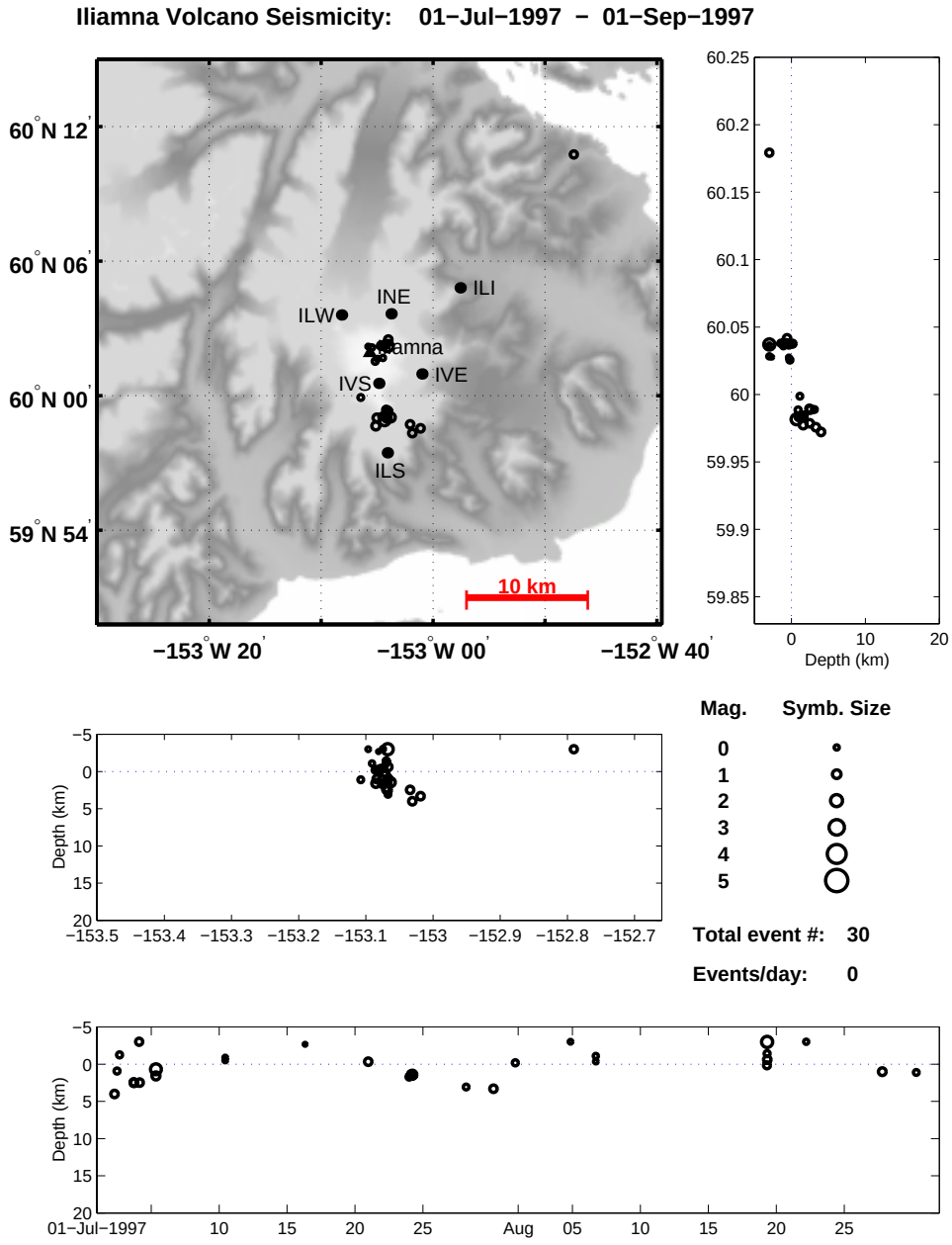

Figure 5: Locatable Iliamna seismic events in space and time for July through August.

Katmai

A total of 80 earthquakes were located in the Katmai/Valley of Ten Thousand Smokes region during July and August (figs. 6, 12 and 13). This fairly low value is, for the most part, due to the fact that some stations were still out for much of July. The stations of the central Katmai network were not operational and once again recording until July 20, 1997. This is shown quite clearly on the time-depth plot (fig. 6) by an apparent increase in seismicity corresponding to that date; only five earthquakes were located prior to the

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20th. The “resurrection” of the central Katmai network resulted in the number of located events far exceeding the 28 earthquakes located during the previous two-month period. The largest event located in this region during July and August had a magnitude of 2.1. This event was located about 6 km east-northeast of Griggs. Most of the seismicity appears to locate in the Martin/Mageik area, a region for which there remained adequate station coverage. Although this is one of the most active areas of the Katmai/Valley of Ten Thousand Smokes region, the dominance of earthquakes located there is probably a bit misleading due to the absence of data from the central Katmai network for nearly a month. As usual, the seismicity forms three general clusters of activity: (1) the Martin/Mageik area; (2) a bit west of Trident; and (3) slightly northwest of Katmai Caldera. Note that the persistent cluster of activity located between Griggs and Snowy, which has been quite apparent on the original seismicity map, does not show up on the new version of the map. The new map does not extent quite far enough to the east for this fourth cluster of seismicity to show up well. Also plotted in Figure 6 are four events located about 15 km north-west of Martin. Only one of these events would have been plotted using the original seismicity map. From our earthquake database it is clear that earthquakes have occurred in this area in the past, but this activity is considerably lower than that associated with the clusters indicated above; one would probably not refer to this seismicity as a “persistent cluster of activity”.

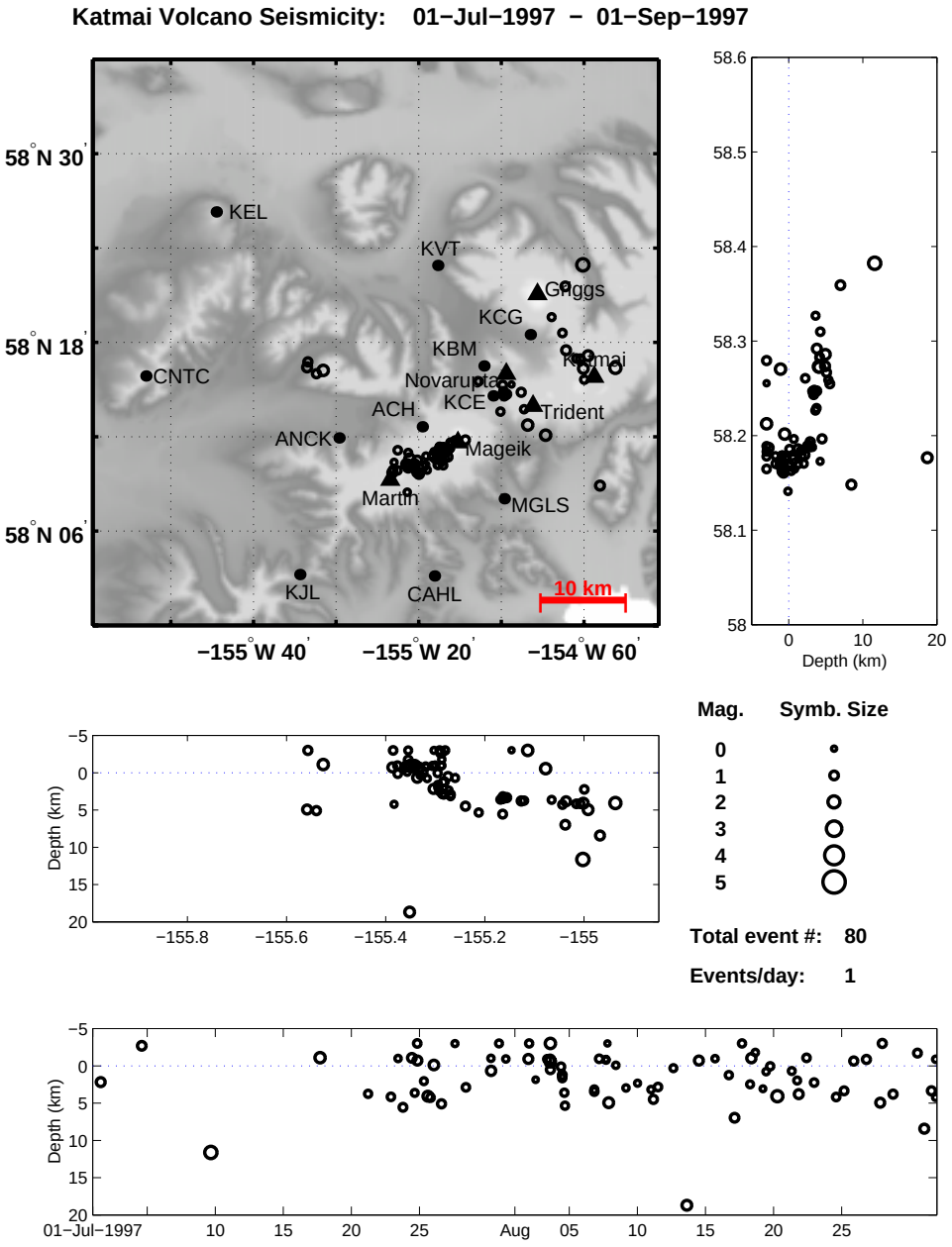

Figure 6: Locatable Katmai Group seismic events in space and time for July through August.