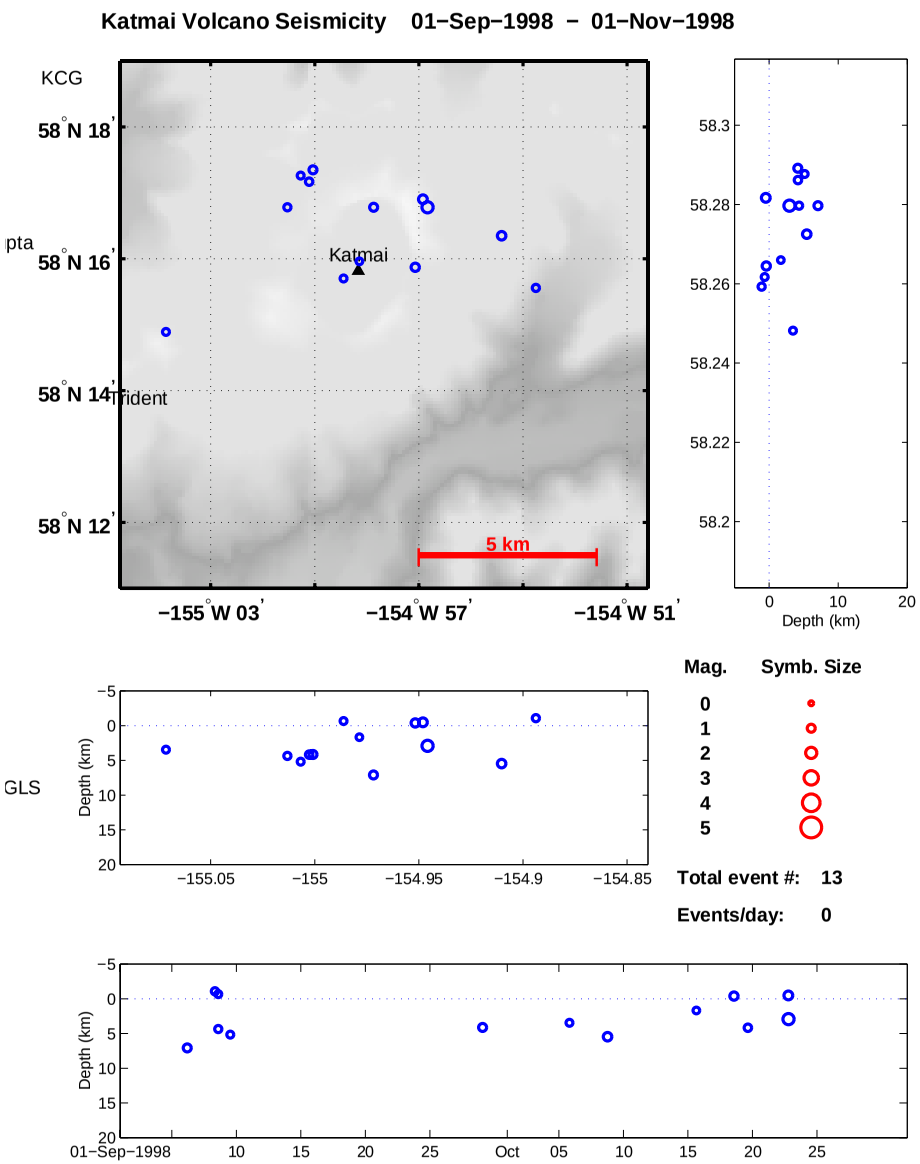

Figure 10a: Locatable Katmai seismic events in space and time for September through October.

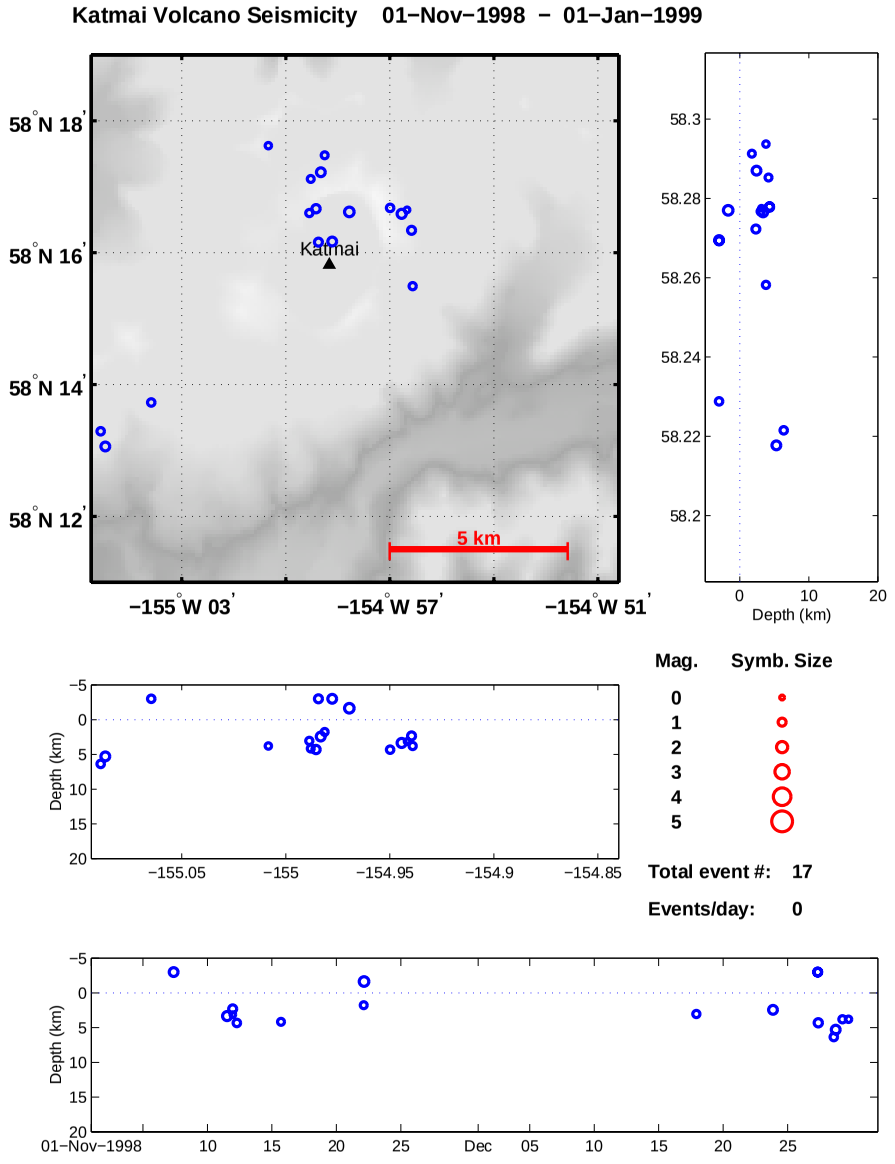

Figure 10b: Locatable Katmai seismic events in space and time for November through December.

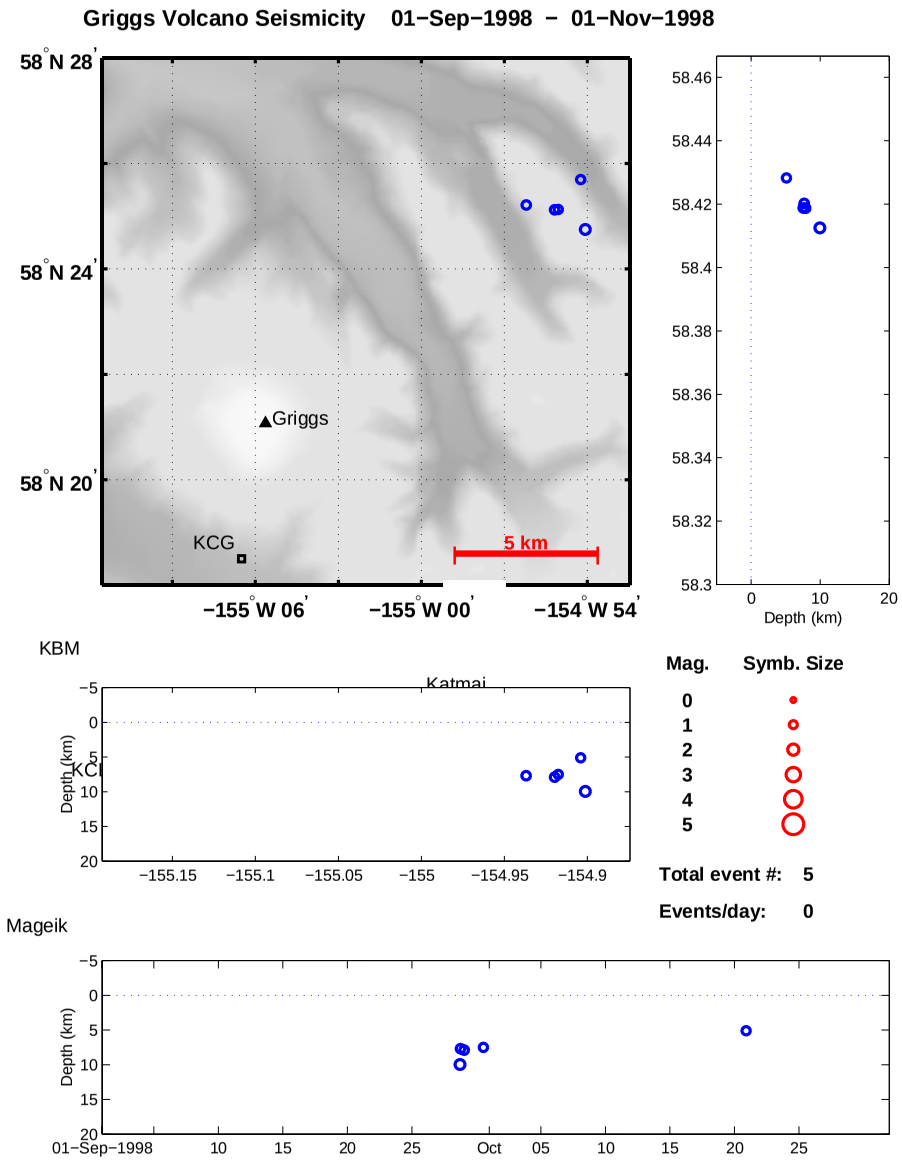

Figure 11a: Locatable Griggs seismic events in space and time for September through October.

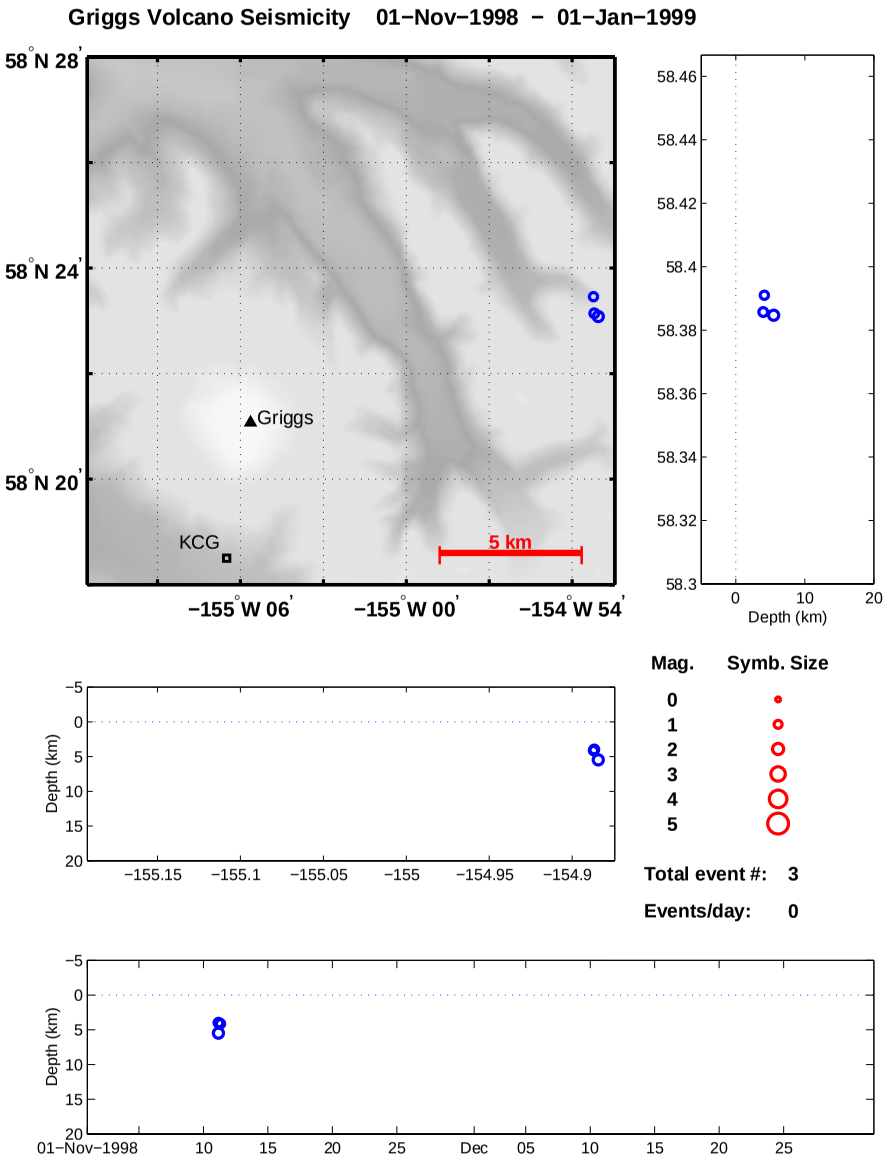

Figure 11b: Locatable Griggs seismic events in space and time for November through December.

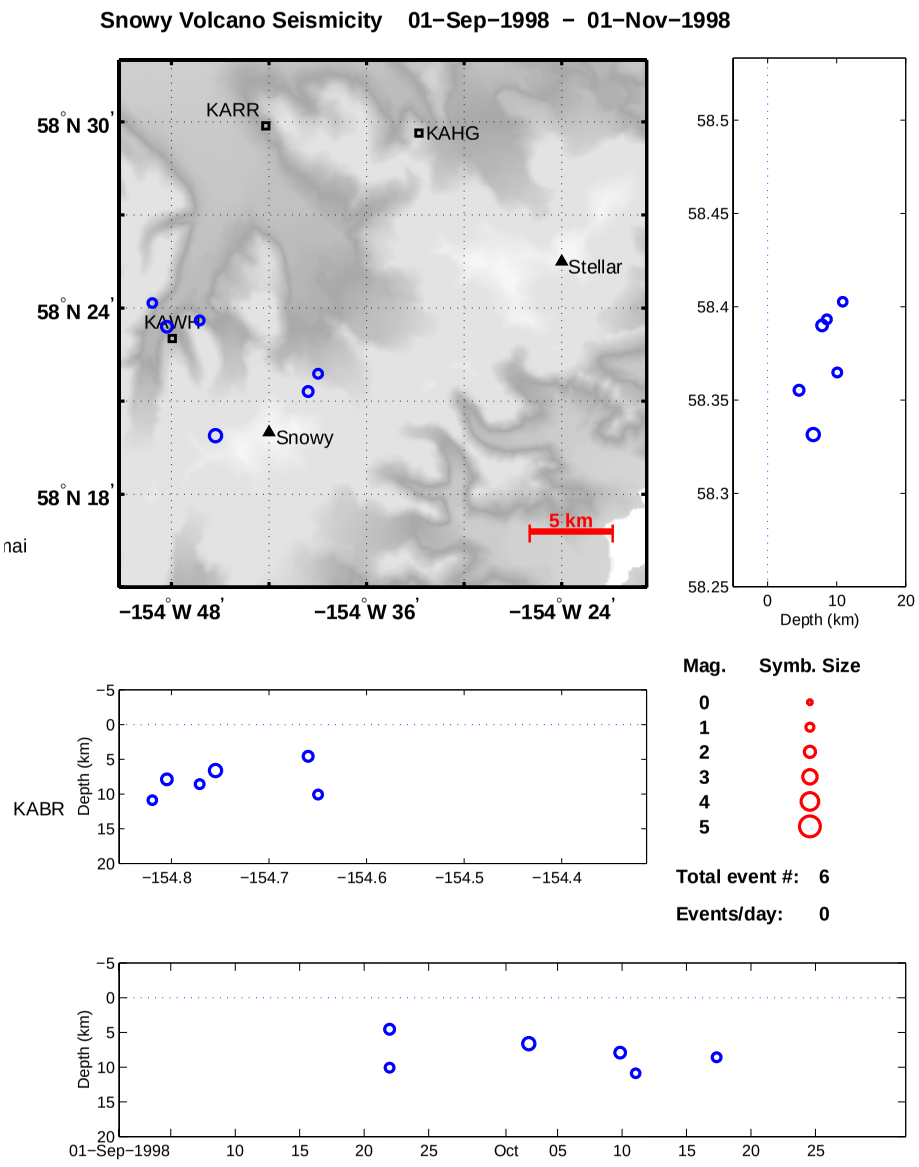

Figure 12a: Locatable Snowy/Stellar seismic events in space and time for September through October.

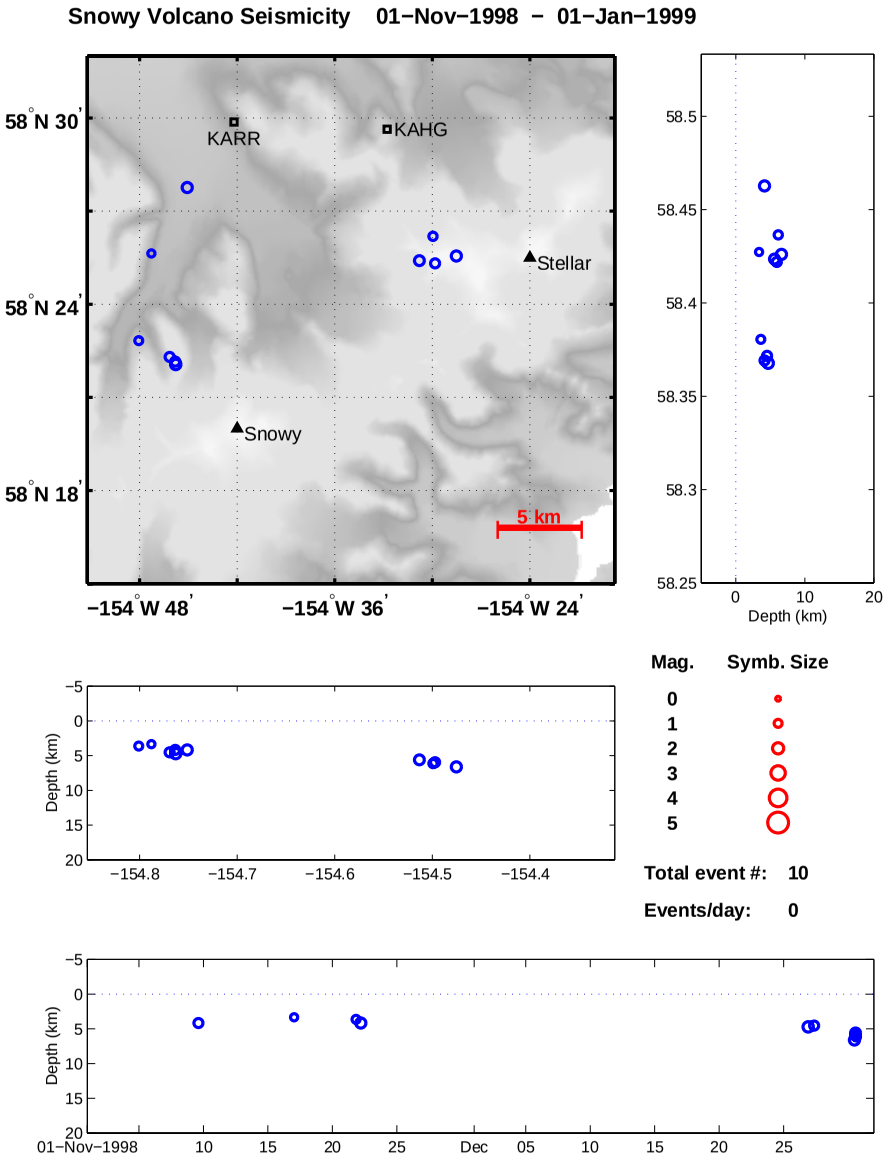

Figure 12b: Locatable Snowy/Stellar seismic events in space and time for November through December.

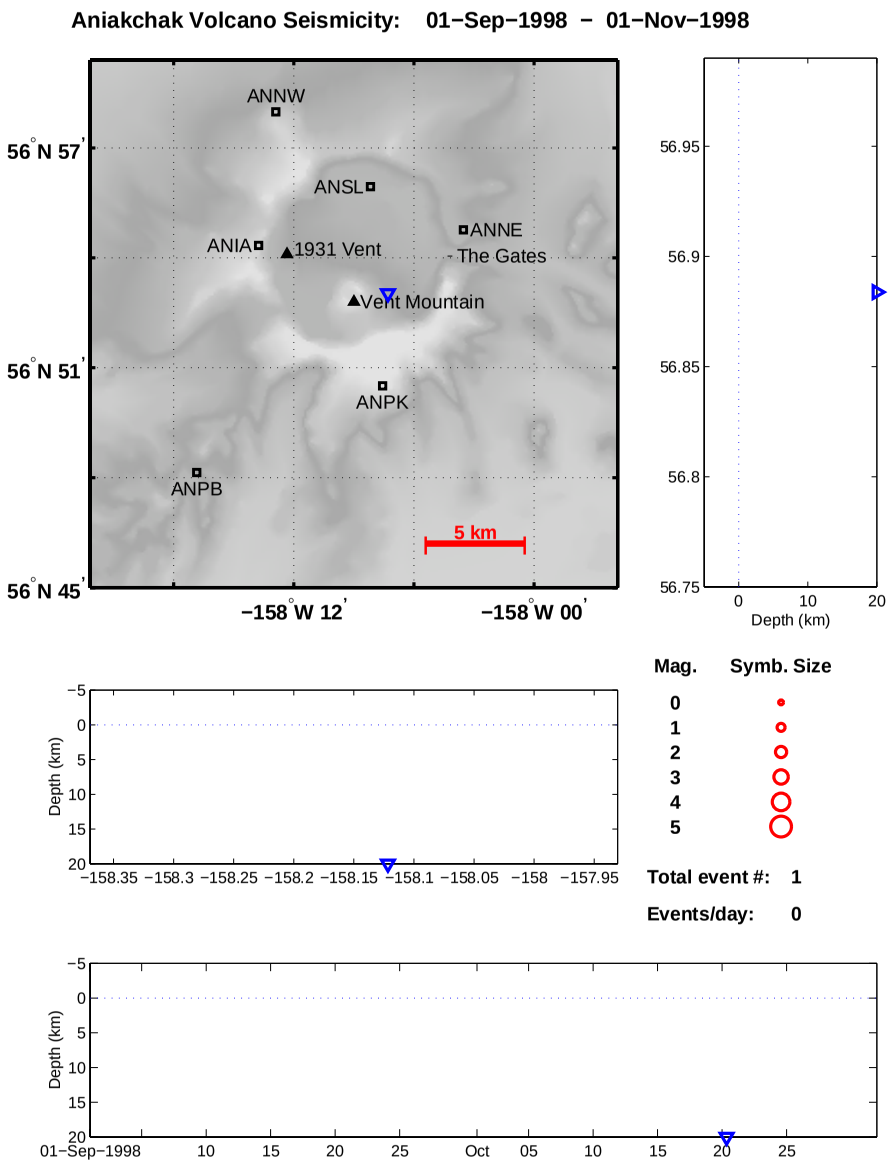

Figure 13a: Locatable Aniakchak seismic events in space and time for September through October.

Mageik (fig. 8a), Trident/ Novarupta (fig. 9a), Mount Katmai (fig. 10a), Griggs (fig. 11a), and Snowy Mountain/Stellar (fig. 12a).

Another change has been made to the Katmai seismicity maps which may not be immediately obvious. The location of Martin has been shifted about 3 km northeast of where it had been previously plotted (e.g. see May-August 1998 Bimonthly Report). The location of the seismicity with respect to Martin and Mageik on the seismicity map seemed to differ from the location indicated by the volcano database accessed by the NEAREST program. From the Mt. Katmai (A-5) U.S.G.S. 15-minute topographic map it was apparent that the location of Martin plotted on the seismicity basemap was incorrect. This location also differed by about 0.7 km from that of the NEAREST volcano database. A more accurate location for Martin was determined from the topographic map and was incorporated into the new seismicity maps (figs. 7a and 8a). The coordinates of Martin were also changed in the volcano database in order to be in agreement with the map value.

One result of the shift in the location of Martin and expansion of the area covered by the seismicity basemap was that the previously computed seismicity rates for Martin, Mageik, Martin/Mageik, and the entire map area were probably no longer valid. The seismicity rates for these areas were revised to reflect the increased map area as well as the shift in the location of Martin. These revised values are included below in Table 1 footnotes found on page 17.

September-October 1998:

A total of 151 earthquakes were located in the Katmai/Valley of Ten Thousand Smokes region during September-October 1998 (figs. 7a-12a, 20A, and 21A). The largest Katmai event located during this two-month period had a magnitude of M_L=2.4 which was located about 4 km west of Snowy Mountain (figs. 7a and 12a). As was the case with the last two Bimonthly Reports, the September-October seismicity was assigned to the various volcanoes based upon the epicentral distances between the earthquakes and the volcanoes. Earthquakes were designated as being associated with a particular volcano if the epicentral distance separating them was ≤ 5.0 km. In those cases in which an event was within 5 km of multiple volcanoes, the event was assigned to the closest volcano. Seventeen events remained unassigned after application of the above criteria. Thirteen of these events were located well off the volcanic axis while the remaining four events were located relatively close the volcanoes but were just not within the 5 km cutoff. The "off-axis" events probably represent regional tectonic activity in the region that is unrelated to volcanic processes.

A total of 134 earthquakes, however, were within 5 km of at least one volcano. The number of these events associated with the various volcanoes is given inTable 1 on page 17.

For the purpose of comparison, the July-August 1998 values (see May-August 1998 Bimonthly Report) have been adjusted to reflect both the new regional basemap and the correct location of Martin. For the most part, the number of events located at the various volcanoes during September-October were quite a bit lower than those for the previous two-month period (table 1). This was also much the case for the numbers of events predicted from the revised 8-month mean seismicity rates. The number of events located near Martin during this two-month period, however, was a little greater than that expected from the mean seismicity rate. Since the number of Mageik events was somewhat lower than the corresponding predicted value, the combined number of events for Martin and Mageik was nearly the same as that predicted by the

mean seismicity rate. The number of events located in the vicinity of Snowy Mountain during September-October was greater than both the July-August and the predicted values. The eastward expansion of the Katmai seismic network resulted in greatly improved detection and location capabilities in the Valley of Ten Thousand Smokes.The fact that there was no apparent increase in seismicity on the time-depth plot corresponding to the addition of the new seismic stations suggests that the level of activity in this region is probably fairly low (fig. 7a). In fact, the location of the three earthquakes near Snowy Mountain during this two-month period had nothing to do with the eastward expansion and the associated improved monitoring capabilities; each of these events occurred prior to the addition of the new stations, with the exception of KABR, to the acquisition system (fig. 8a).

November-December 1998:

A total of 311 earthquakes were located in the Katmai/ Valley of Ten Thousand Smokes region during November-December (figs. 7b-12b, 20b and 21b). The largest of these events had a magnitude of M_L=2.3 and was located about 2 km west of Martin at a hypocentral depth of ~3 km. A total of 279 of the events were assigned to the various volcanoes on the basis of epicentral distances. The number of events associated with each of the volcanoes is summarized in Table 1. The 31 unassigned events were in most cases located quite some distance from the primary areas of activity and as such it was fairly obvious which events in figure 6B were of this category. Most of these events were probably regional tectonic events unrelated to volcanic activity in the Katmai/ Valley of Ten Thousand Smokes region.

The level of seismic activity at the various volcanoes during November-December 1998 was, for the most part, elevated with respect to that of the previous two-month period (Table1). Most notably, the number of events associated with Mageik and Martin were much greater than that of the previous two-month period as well as the numbers predicted from mean seismicity rates. A total of 224 earthquakes were located in the Martin/Mageik area with 103 events located near Martin and the remaining 121 events were located near Mageik. There were a number of short-lived “bursts” of activity at Mageik throughout this two-month period. During one such period, a total of 29 events were occurred near Mageik within a single day (i.e. November 27, 1998). Such a specific period of intense activity at Martin is not readily apparent; the activity was elevated but fairly constant during most of this two-month period. Although this seismic swarm was significant it should be put in perspective. During the October 1996 swarm some 215 earthquakes were located in the Martin/Mageik area (i.e. 208 events near Mageik and 7 events near Martin) during a single day (i.e. October 17, 1996).

Also during November-December 1998, there was a small swarm of seismicity at Novarupta. During a two day period (December 23-24, 1998), 14 events were located in the vicinity of Novarupta. Although the number of events located at Novarupta is nearly twice that of September-October, this value is in keeping with the number of such events predicted by the mean seismicity rate. The number of events associated with Trident was in agreement with the predicted number while the number of Katmai events was a bit lower than the predicted value (i.e. 14 vs. 20 events).

Aniakchak:

September-October 1998:

One earthquake was located in the vicinity of Aniakchak during September-October 1998 (figs. 13a, 20a and 21a). This event had a magnitude of M_L=2.0 and was located about 2 km east-northeast of Vent Mountain at a depth of 27 km. This event was classified as being a hybrid event because its waveform exhibited characteristics of both a-type (VT earthquakes) and lower frequency b-type events. This was the first event to be located in this region since December 1997. The number of events located in this region during this two-month period, however, is in agreement with the estimated 5-month mean seismicity rate for this area. Because so very few events

Table 1- Summary of Katmai Region Seismicity

Volcano/Region	Jul.-Aug. 1998[A]	Sept.-Oct. 1998	Nov.-Dec. 1998	Predicted from the Mean Seismicity Rate
Entire Map Area	173	151	311	183[B]
Griggs	0	0	0	1
Katmai	18	12	14	20
Mageik	35	30	121	34[C]
Martin	75	67	103	62[C]
Martin/Mageik	110	97	224	96[C]
Novarupta	27	17	33	28
Snowy Mountain	0	3	0	0.26[D]
Trident	12	5	8	8

[A]These values differ from those previously given (see May-August 1998 Bimonthly Report) in that they have been changed to reflect the newly expanded map area and the correct location of Martin.

[B]The value given here is for the expanded map area. The 8-month mean seismicity rate for this area is 91.5 events/month while that previous map area was 85.0 events/month. Therefore, the seismicity rate for the larger map area would predict a total of 183 located events for a two-month period while that for previous, smaller area would predict a total of 170 located earthquakes.

[C]The value for Mageik is based upon a revised 8-month mean seismicity rate of 16.9 events/month (135 located events over an 8-month period). The value for Martin is based upon a revised mean seismicity rate of 31.1 events/month (249 located events over an 8-month period). The Martin/Mageik value is based upon a revised combined Martin/Mageik mean seismicity rate of 48.0 events/month (384 located events over an 8-month period). The previous mean seismicity rates for Mageik, Martin and Martin/Mageik were 17.8 events/month, 33.0 events/month and 50.8 events/month respectively.

[D]A mean seismicity rate for Snowy was not originally given in the table, which appeared in the previous Bimonthly Report. During the 8-month period for which the seismicity rates in the Katmai region were determined, only one event was located within 5 km of Snowy Mountain, which resulted in an estimated seismicity rate for this region of only 0.13 events/month.

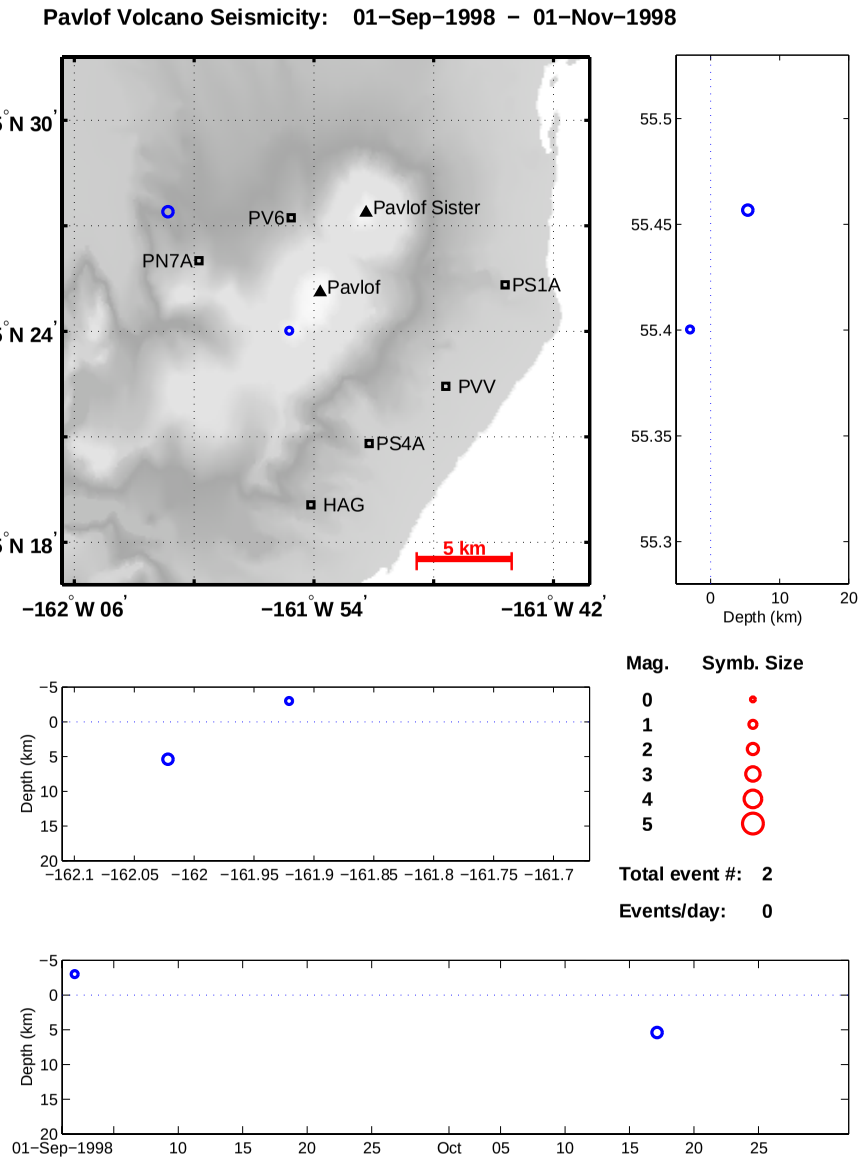

Figure 14b: Locatable Pavlof seismic events in space and time for November through December.

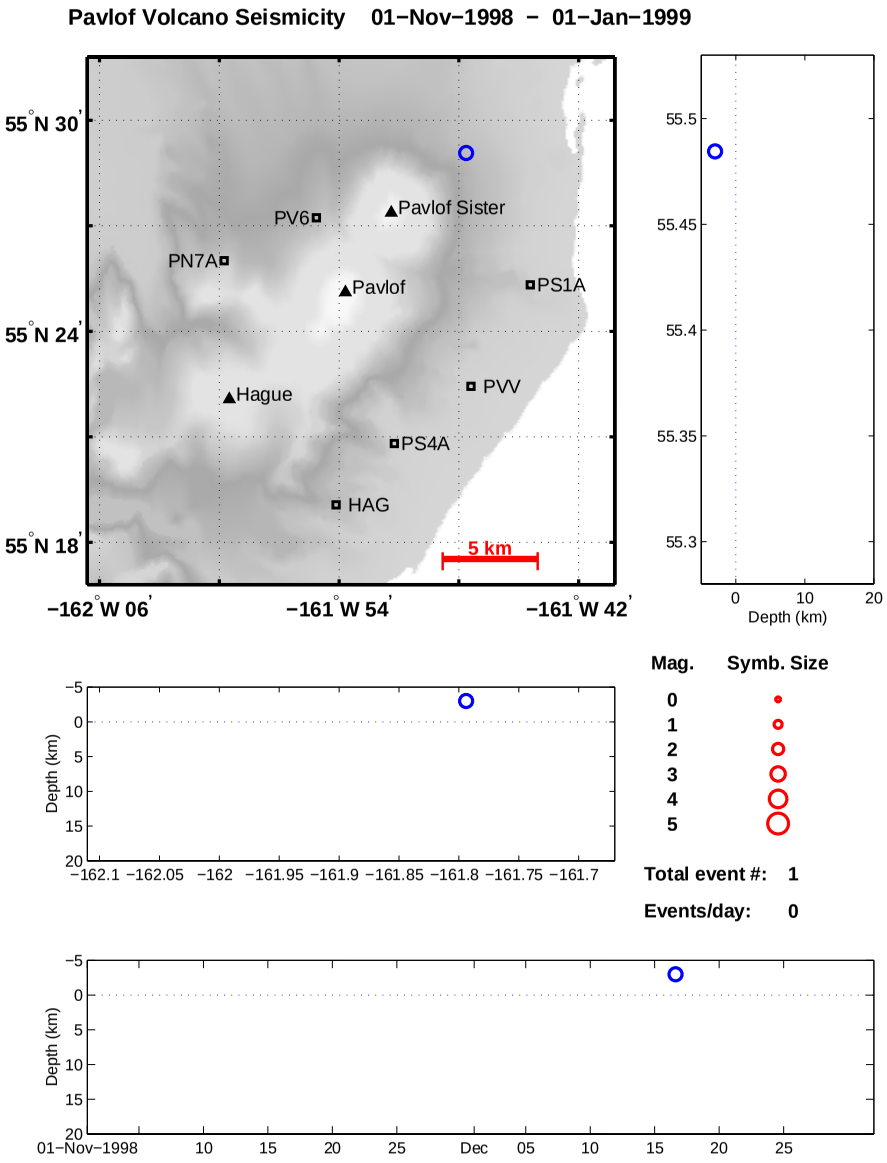

Figure 14a: Locatable Pavlof seismic events in space and time for September through October.

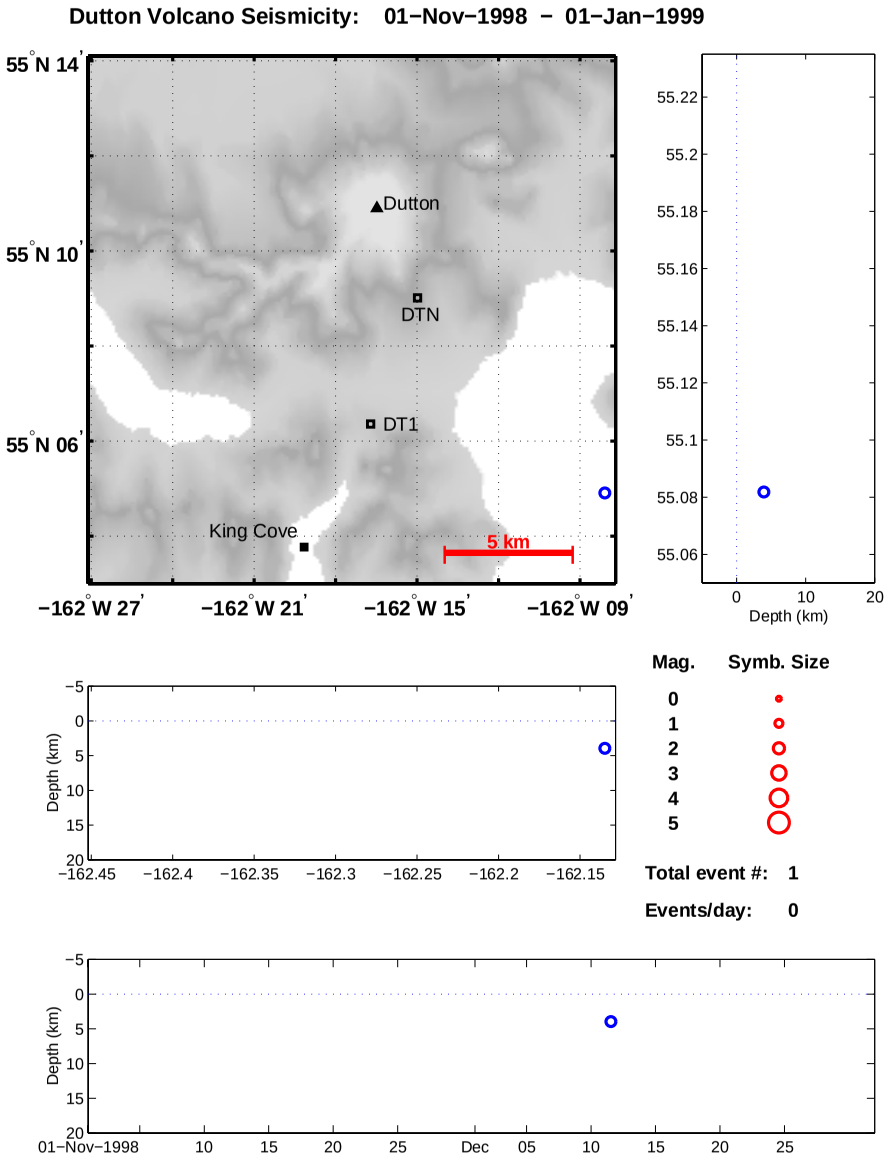

Figure 15a: Locatable Dutton seismic events in space and time for September through October.

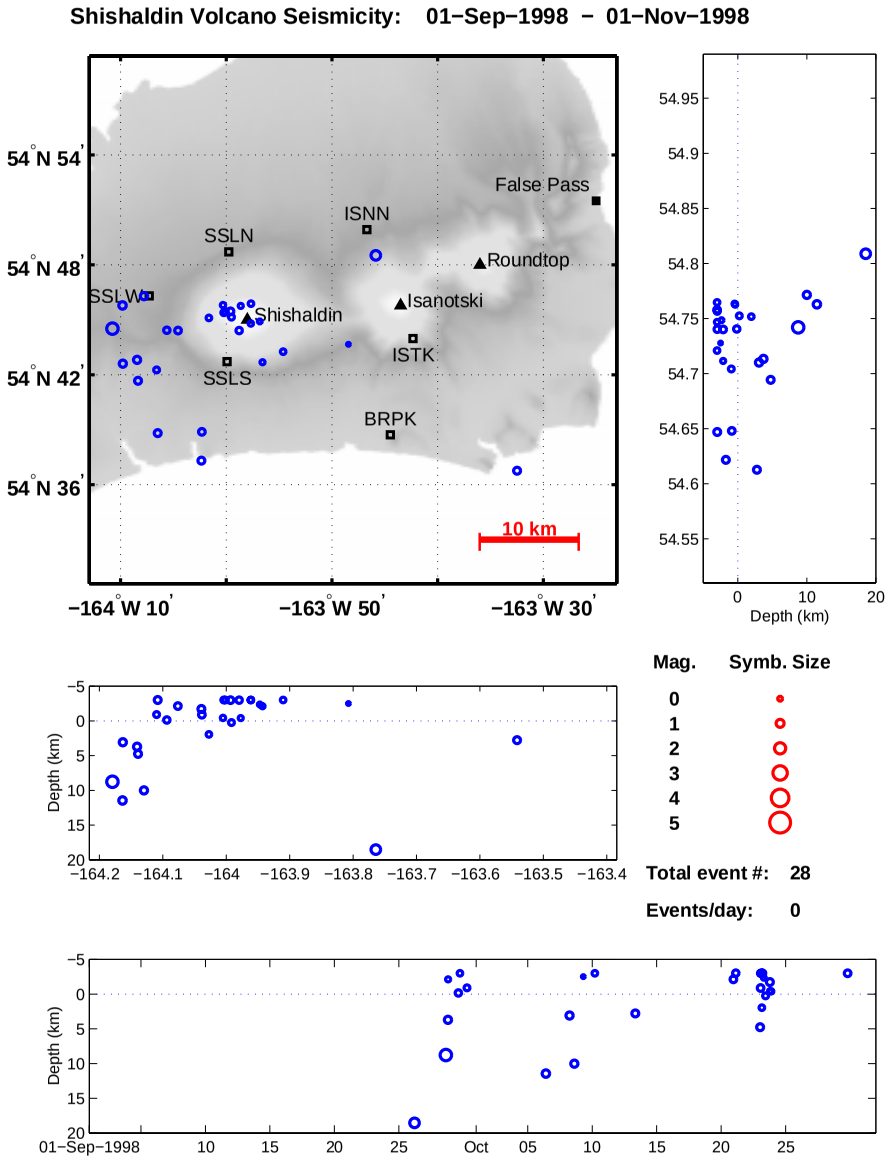

Figure 16a: Locatable Shishaldin seismic events in space and time for September through October.

have been located at Aniakchak, this mean seismicity rate is very likely a gross overestimation of the true rate for this region; the mean seismicity rate was probably based upon a time period which just happened to include a period of anomalous activity (i.e. the only other two events located in this area thus far).

November-December 1998:

No earthquakes were located in the Aniakchak region during November-December 1998. During this two-month period no local events were detected by the data acquisition system (fig. 21b). Only a few events were sufficiently large to meet the counting criteria for the Helicorder event counts (fig. 20b).

Pavlof:

September-October 1998:

During September-October 1998, two earthquakes were located in the Pavlof region (figs. 14a, 20aa and 21a). The largest of these had a magnitude of M_L=1.8 and was located about 10 km west-northwest of Pavlof at a hypocentral depth of about 5 km. The second event was located about 3 km southwest of Pavlof and had a shallow hypocentral depth (i.e. above sea-level). This second event was classified as being a b-type event because of its low frequency waveform. Because of its low frequency character, shallow hypocentral depth and epicentral location (i.e. along the heavily glaciated southwestern flank of Pavlof) this event may very well be just an icequake. The number of events located in the Pavlof area during September-October was a little lower (i.e. 2 vs. 3 events) than that of the previous two-month period, but was consistent with the number of events predicted from the 1-year mean seismicity rate.

November-December 1998:

One earthquake was located in the Pavlof region during November-December 1998 (figs. 14b, 20b and 21b). This event had a magnitude of M_L=2.6, was located about 5 km northeast of Pavlof Sister (~10 km northeast of Pavlof), and had a shallow hypocentral depth. The number of Pavlof events located during November-December is half that of the previous two-month period as well as the number predicted from the 1-year mean seismicity rate.

Dutton:

September-October 1998:

No earthquakes were located in the Dutton area during September-October 1998. The histograms of the detected events and Helicorder events counts further indicate that the level of activity in this region was quite low during this two-month period (figs. 20a and 21a). This seems to generally be the case in the Dutton region.

November-December 1998:

One earthquake was located in the Dutton region during November-December 1998 (figs. 15b, 20b and 21b). This event had a magnitude of M_L=1.6 and was located about 14 km southeast of Dutton (nearly off the map in fig. 15b) at a hypocentral depth of about 4 km. The number of events located in this region agrees with the 0-1 located events predicted from the Dutton mean seismicity rate.

Shishaldin:

September-October 1998: After nearly a month-long hiatus, the activity west of Shishaldin began once again in late September 1998. During September-October 1998 a total of 28 earthquakes were located in the Shishaldin area (figs. 16a, 20a and 21a). All but one of these events had waveforms that were of relatively low frequencies and therefore, were classified as being b-type events. The largest event located in the Shishaldin region during September-October had a magnitude of M_L=2.1 and was located about 14 km west of Shishaldin at a hypocentral depth of about 9 km. The majority of the earthquakes were located ~7-14 km to the west of Shishaldin or in the summit region. The three exceptions to this are a relatively deep (depth = ~19 km) M_L=1.5 event about 6 km north-northwest of Isanotski, a small (M_L=-0.3) event about 7 km southwest of Isanotski and a M_L=0.7 event in the Cape Lazaref region. The latter event was the only a-type or VT event located in the Shishaldin region during this two-month period. The number of events located in the Shishaldin area during September-October is nearly twice the number predicted from the 4-month mean seismicity rate. However, the number of Shishaldin events located during the previous two-month period was much greater than the September-October value (127 vs. 28 events). The much larger number of events from July-August was, for the most part, the result of electronic “glitches” on the Shishaldin circuit which produced a large number of triggers, many of which happened to coincide with actual events. In most cases, these events were too small to have triggered the acquisition system by themselves. As a result, the number of events located during the previous two-month period was artificially elevated.

Due to a delay in the activation of a new phone circuit from Cold Bay, data from station SSLW was not recorded until 10/21/98. Prior to this date, the location of earthquakes in this region had virtually no control to the west. This lack of westward control appears to have had an effect on the location of Shishaldin events. From the time-depth plot (fig. 16a) it appears that the addition of SSLW on 10/21/98 has greatly reduced the observed scatter in hypocentral depths. Accompanying this reduction in scatter was an apparent shallowing of hypocentral depths. Following the addition of SSLW the vast majority of the events (11 of 14 events) had shallow hypocentral depths. Prior to this addition, only three earthquakes were located within about 5 km of the summit of Shishaldin but after SSLW was employed in the location of earthquakes an additional 10 events were located in the summit region. This suggests that perhaps some of the previously located events may have been systematically mislocated to the west. However, there were also four events in which SSLW was used that were not located near the summit. Three of these events were located about 13-16 km southwest of Shishaldin while the fourth event was located about 13 km west of Shishaldin (i.e. the same general area as the pre-SSLW events). The presence of these events suggests that at least some of the earthquakes located west of Shishaldin may represent actual seismicity in that area. Of course, another possibility is that these four events were also mislocated. At this time it is uncertain which of these two scenarios is the case. With continued monitoring a better constrained pattern of seismicity will eventually emerge for the Shishaldin area.

November-December 1998:

No events were located in the Shishaldin region during November-December 1998. Small Shishaldin events were apparent on the Helicorder records on and off throughout this two-month period. However, only five of these events were large enough to meet the Helicorder event count criteria (fig. 20b). During this same period of time only a single, unlocatable event at Shishaldin was detected by the data acquisition system (fig. 21b).

Westdahl:
The stations of the new Westdahl seismic network (i.e. WESE, WESN, WESS, WFAR, WPOG, and WTUG) are shown in figure 17a. The three southern most Westdahl stations (i.e. WESE, WESS and WFAR) are transmitted to Akutan while the three remaining stations (i.e. WESN, WPOG and WTUG) of the Westdahl network plus SSLW are transmitted to Cold Bay. The Akutan telephone circuit was activated in late August 1998 and the corresponding stations began to be recorded at that time. Unfortunately, the Cold Bay circuit was not activated until much later (i.e. mid-October).

Since earthquake locations from a subnet consisting of only three stations would be very unreliable, the Westdahl subnet was not added to the acquisition system until 10/19/98. Therefore, no events would have been detected by this subnet prior to this date (fig. 21a). There were, however, Helicorder event counts starting in September since data from the southern part of the Westdahl network were already being recorded at that time (fig. 20a).

September-October 1998:
A total of eight earthquakes are plotted in figure 17a. None of these events triggered the Westdahl subnet. Because of overlap between maps the seven events located east of Fisher Caldera also appear on the Shishaldin seismicity map (fig. 16a). The one event not shared between the two maps was a magnitude M_L=1.2 earthquake which was located about 2 km north of the rim of Fisher Caldera or ~30 km west of Shishaldin. This event was detected by the Shishaldin subnet and was located using stations from the Shishaldin and Westdahl networks. At present it is unclear how commonplace such events are in the Westdahl region. This issue will eventually be resolved with continued monitoring of the seismicity in this area.

November-December 1998:
No earthquakes were located in the Westdahl area during November-December 1998. From the histograms of the Helicorder and detected event counts (figs. 20b and 21b) the level of activity also appears to be relatively low.

Akutan:
September-October 1998:
Eight earthquakes were located in the Akutan region during September-October 1998 (figs. 18a, 20a and 21a). The largest such event had a magnitude of M_L=2.3 and was located ~7 km northwest of the summit of Akutan (~3 km northwest of station LVA) and a hypocentral depth of about 8 km. Two other events were located in virtually the same place. These events, however, had hypocentral depths that were about 2 km deeper than that of the M_L=2.3 event. A fourth event was located in a slightly different location; it was located about 6 km northwest of the summit (~1 km northwest of LVA) at a depth of nearly 8 km. Three events were located offshore ~11-14 km north-northwest of the summit of Akutan with hypocentral depths of ~8-10 km. The final event was located about 1 km north-northeast of the summit with a hypocentral depth of about 2 km. The number of earthquakes located in the vicinity of Akutan during September-October was nearly thee times the number of events located there during July-August. This value, however, agrees fairly

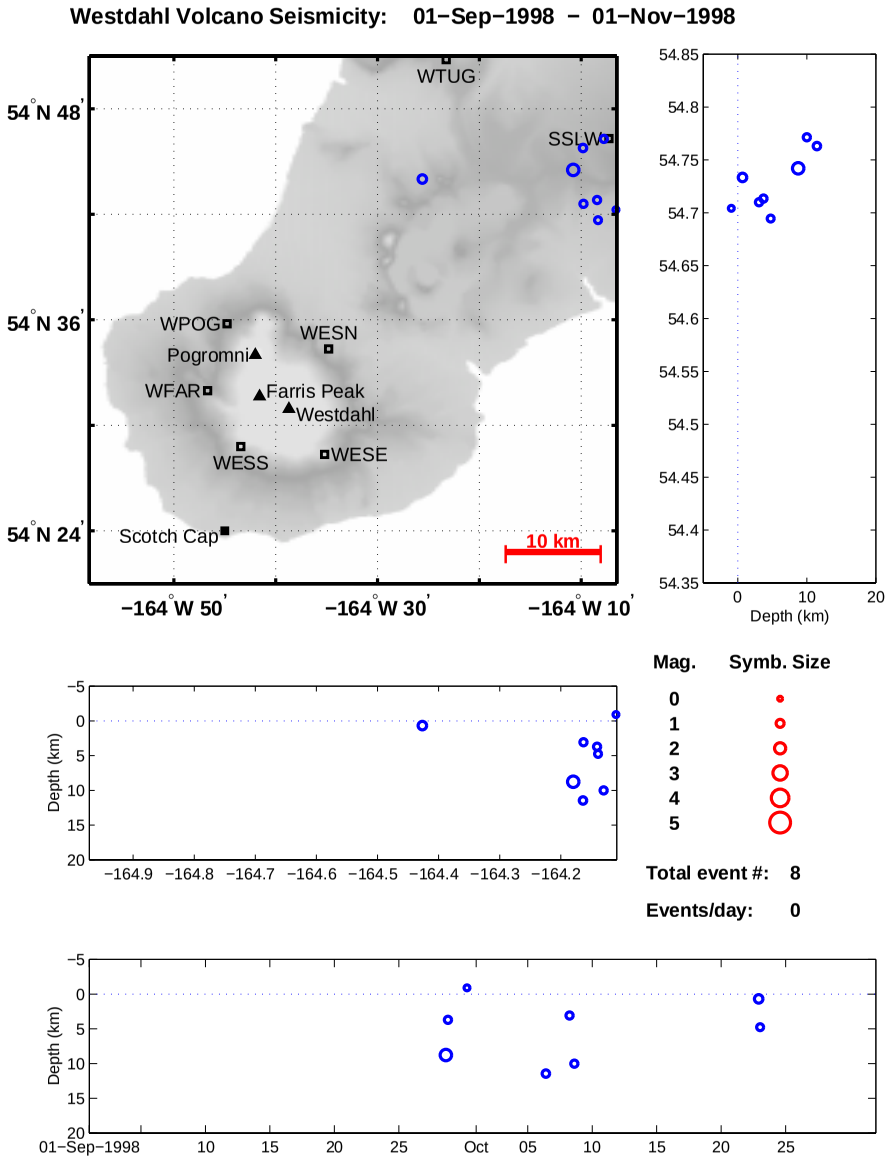

Figure 17a: Locatable Westdahl seismic events in space and time for September through October.

well with the number of events expected (8 vs. 7 events) based upon the 1-year mean seismicity rate for Akutan.

November-December 1998:

One earthquake was located in the Akutan region during November-December 1998 (figs. 18b, 20b and 21b). This earthquake had a magnitude of M_L=0.7 and was located about 3 km northwest of the summit of Akutan at a hypocentral depth of about 4 km. The number of events located in this region during November-December is much lower than that of the previous two-month period. From the mean seismicity rate one would expect about seven earthquakes to be in this area during a two-month period of time.

Makushin:

September-October 1998:

During September-October 1998, six earthquakes were located in the general area of Makushin (figs. 19a, 20a and 21a). The largest of these events had a magnitude of M_L=2.0 and was located about 2 km southeast of the summit of Makushin. A second event was located about 2 km further to the east of the above event. Two events were located ~7-9 km east-southeast of the summit. These four events had hypocentral depths of ~3-7 km. Another event was located nearly 19 km east-southeast of the summit and had a shallow hypocentral depth. The sixth event was located about 24 km south of the summit (nearly off the map) at a hypocentral depth of about 7 km. The number of events located in the Makushin region during this two-month period is less than the eight events located there during July-August and is considerably lower than the 15 such events predicted from the 1-year mean seismicity rate.

November-December 1998:

Four earthquakes were located in the Makushin region during November-December 1998 (figs. 19b, 20b and 21b). The largest such event had a magnitude of M_L=1.9 and was located about 23 km south of the summit of Makushin (nearly off the map). One earthquake was located about 1 km south-southeast of the summit at a hypocentral depth of ~5 km. The remaining two events were located about 9 km east-southeast of the summit at hypocentral depths of ~3-5 km. The number of located earthquakes in the vicinity of Makushin during this two-month period was a bit lower than that of September-October (i.e. 4 vs. 6 events) and much lower than the 15 such events predicted from the 1-year mean seismicity rate.

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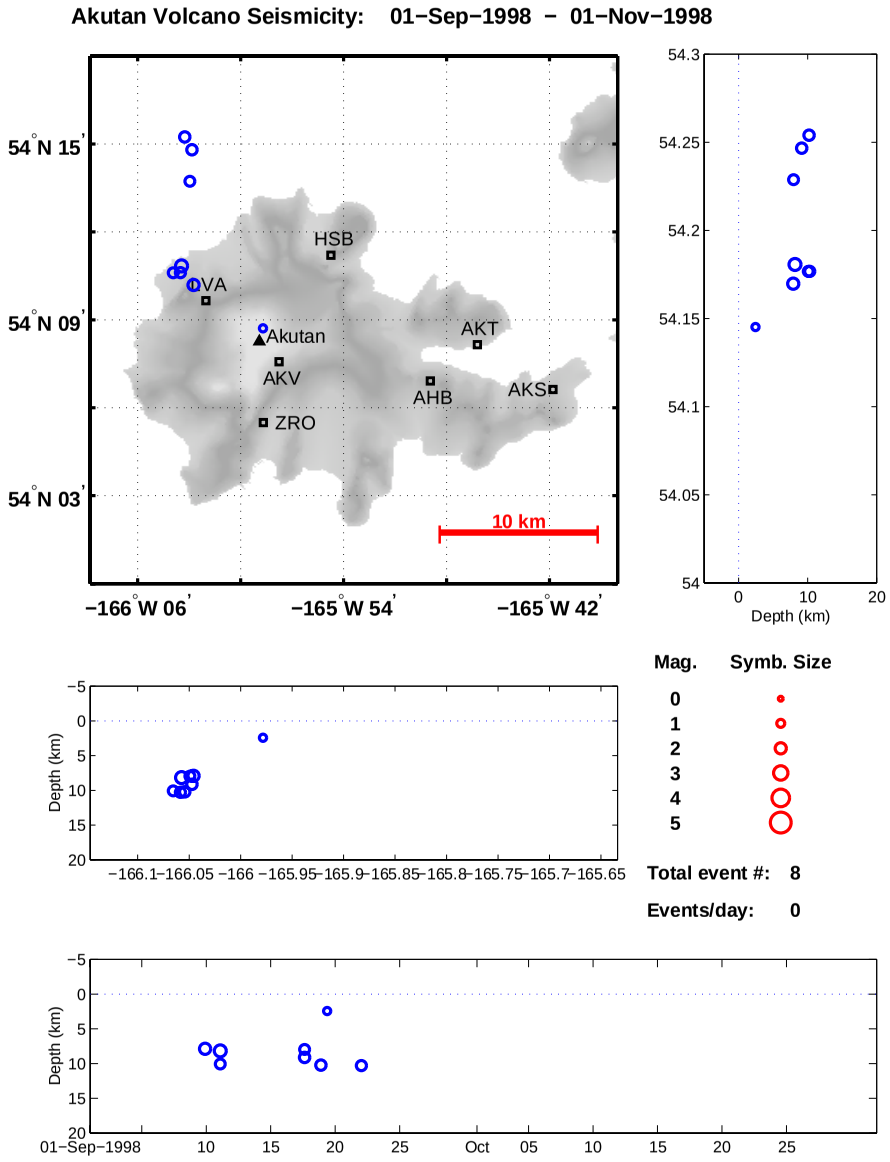

Figure 18b: Locatable Akutan seismic events in space and time for November through December.

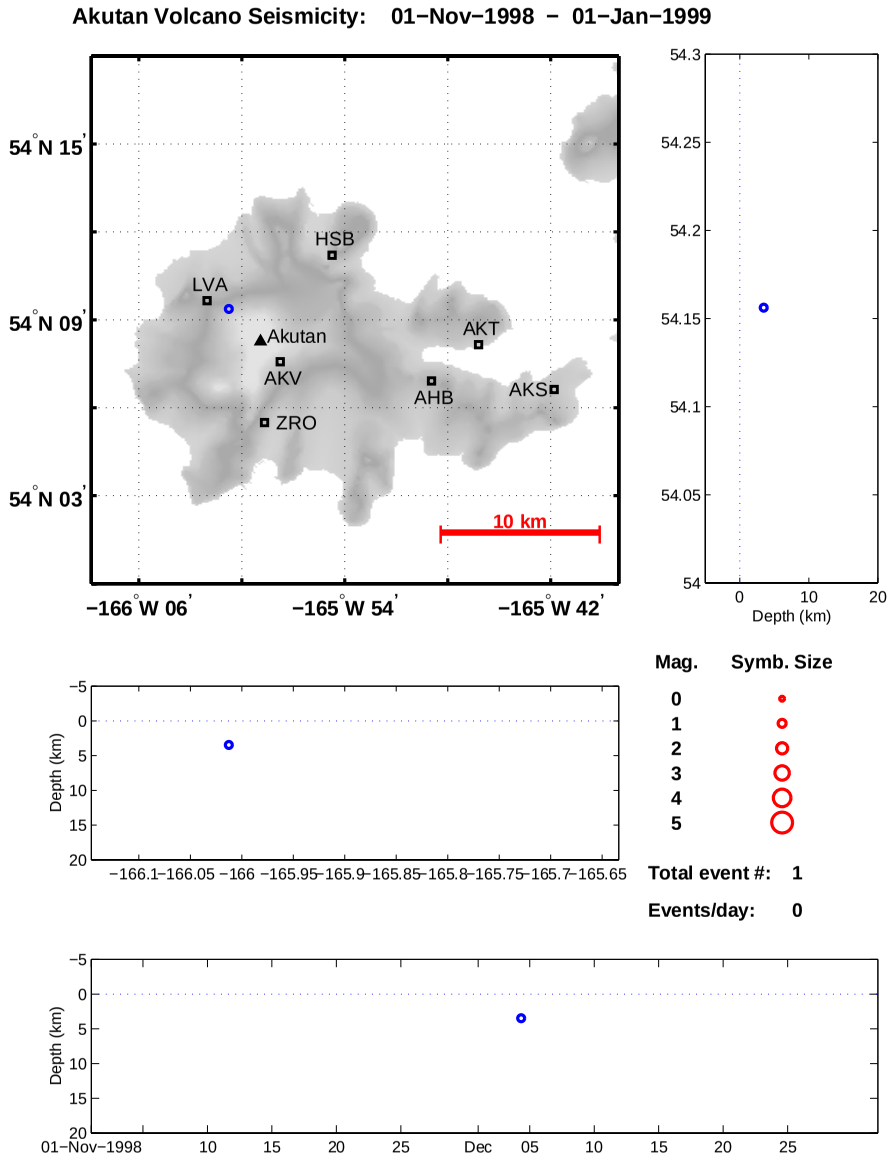

Figure 18a: Locatable Akutan seismic events in space and time for September through October.

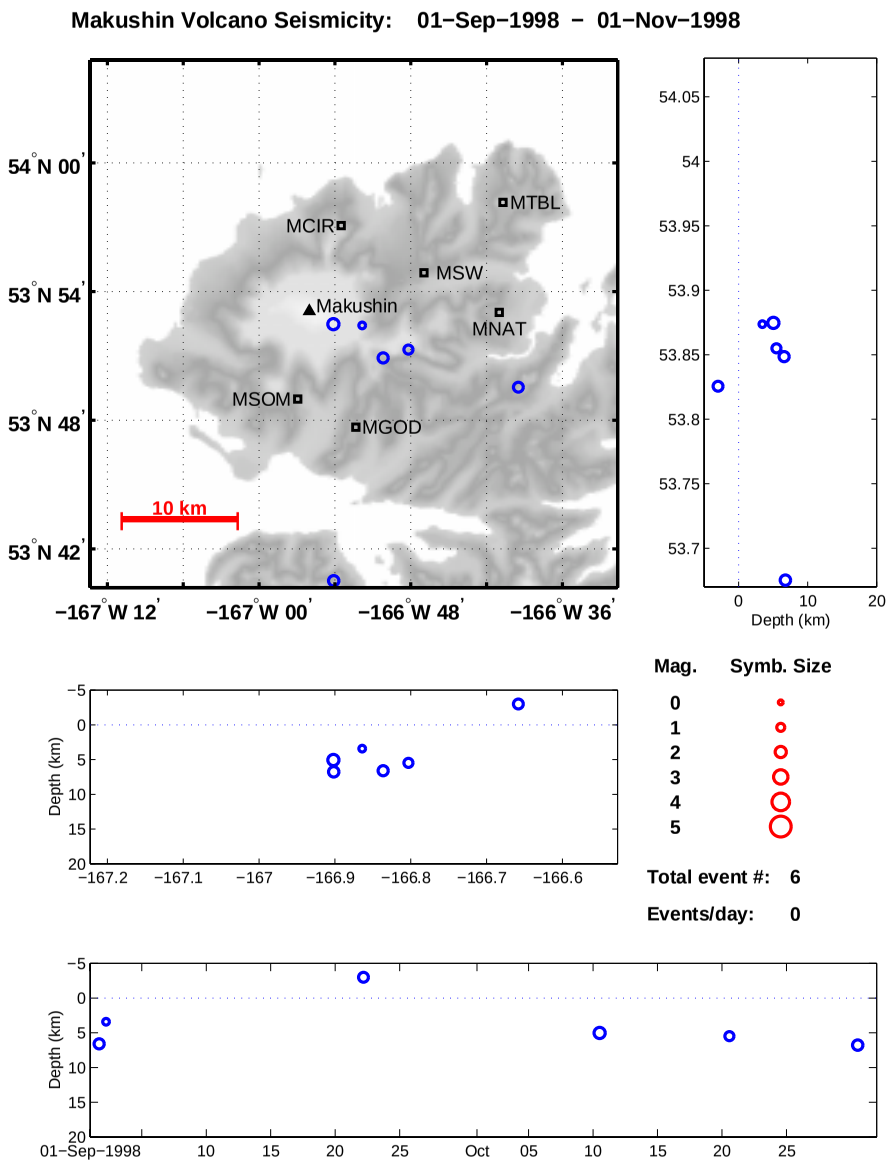

Figure 19a: Locatable Makushin seismic events in space and time for September through October.

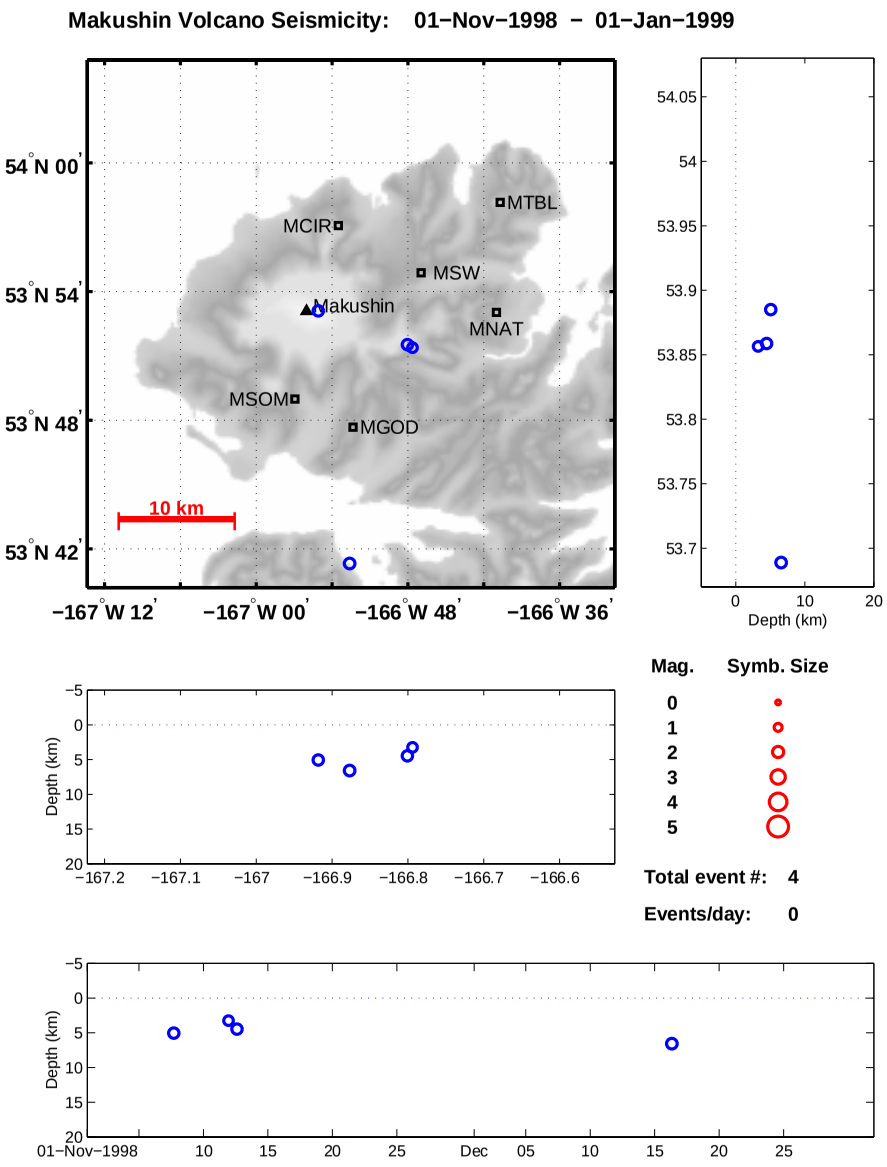

Figure 19b: Locatable Makushin seismic events in space and time for November through December.

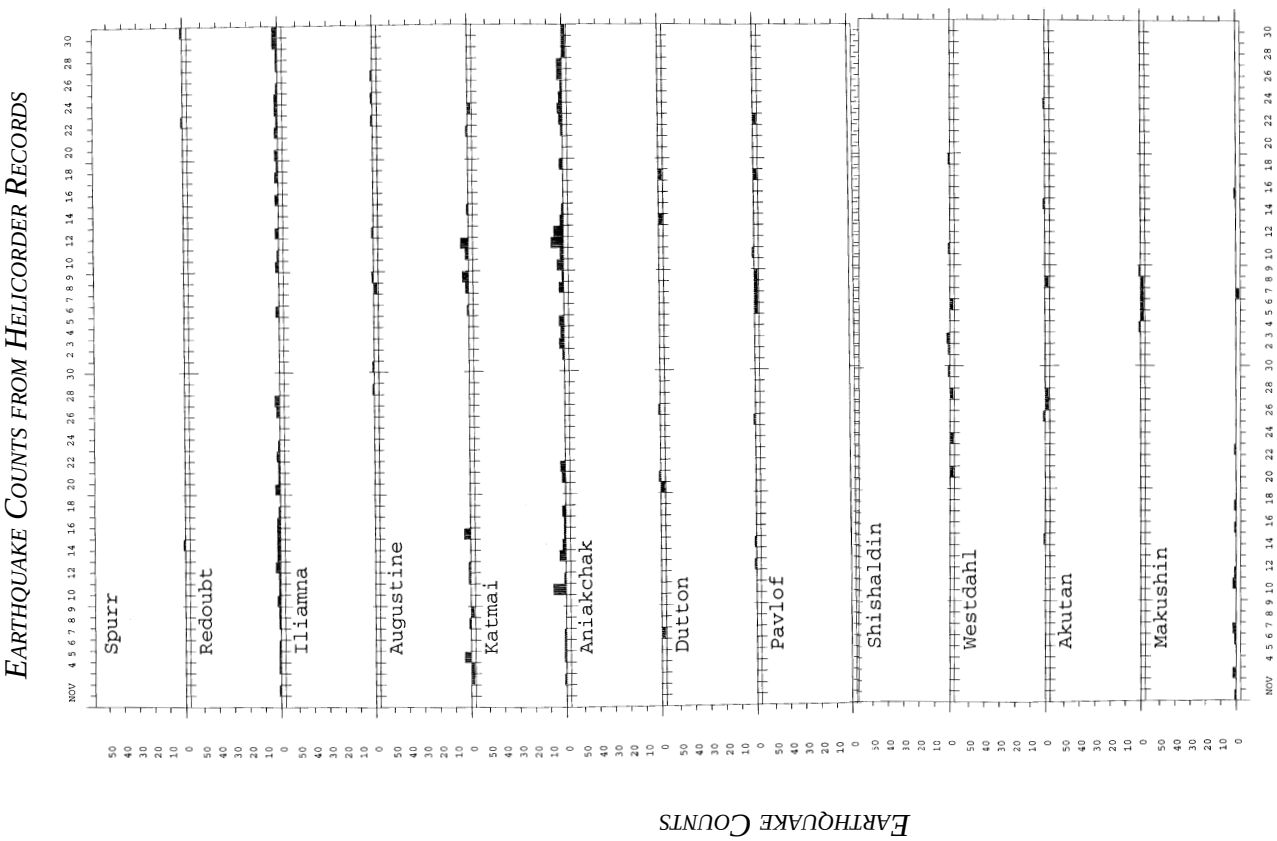

Figure 20b: Histogram of seismic events counted from Helicorder records during November through December.

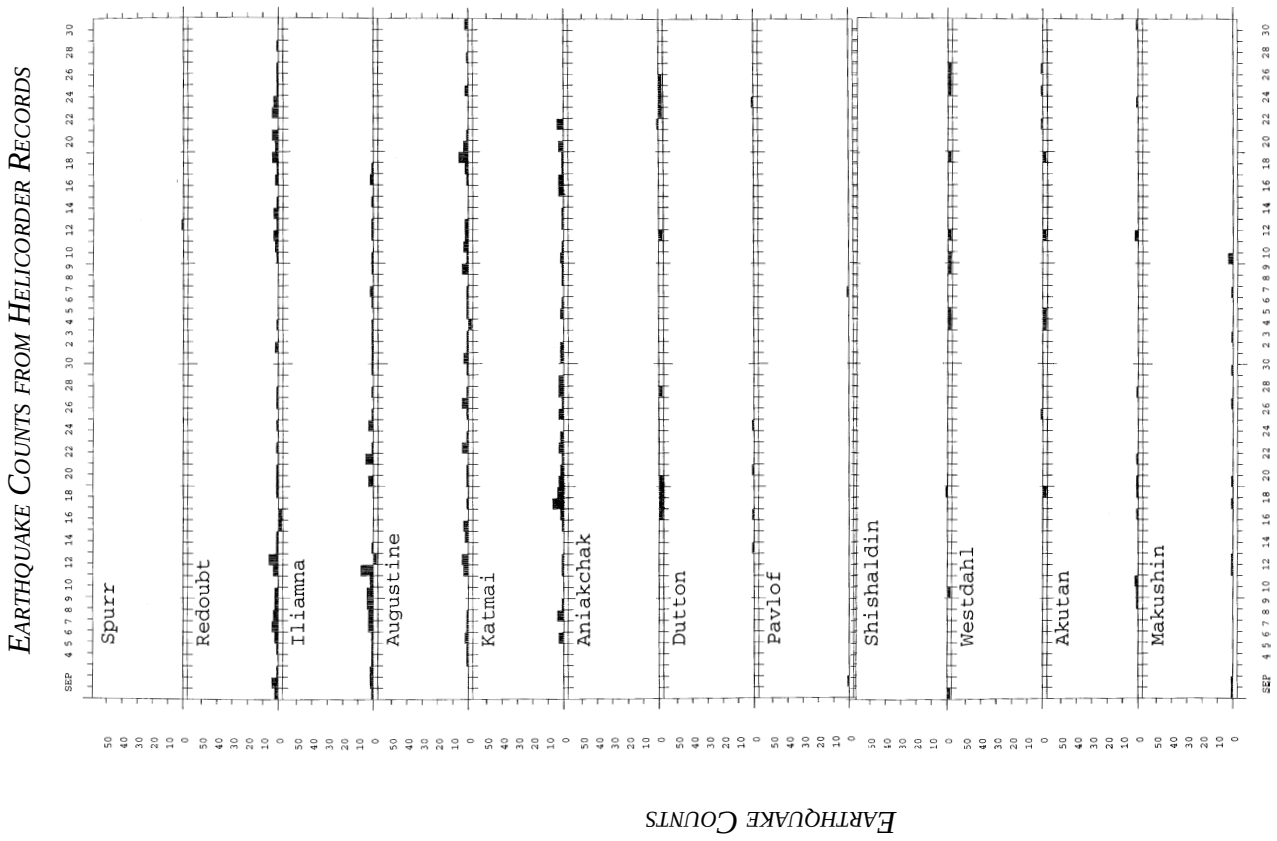

Figure 20a: Histogram of seismic events counted from Helicorder records during September through October.