Seismicity

Spurr:
Eleven earthquakes were located in the Spurr region during January-February 2000 (figs. 2, 19 and 20). The largest of these events had a magnitude of M_L=1.1 and was located 8 km west of the summit of Spurr at a shallow hypocentral depth. Six of the 11 located events were located within 10 km of the Spurr. The remaining five earthquakes were probably regional tectonic events and not associated with volcanic activity in this area. The number of “proximal” earthquakes located during this two-month period was greater than the three such events located during November-December 1999. This value was, however, considerably lower than the 16 located earthquakes predicted from the mean seismicity rate. The nearest station, CP2 appears to have been intermittent during February which may, to some extent, explain the relatively low number of located events compared to the predicted value.

Strandline Lake Region:
There were five events located in the Strandline Lake region during January-February 2000 (fig. 3). The largest of these earthquakes had a magnitude of M_L=1.1 and was located ~9 km north-northeast of station NCG and had a shallow hypocentral depth. One event was plotted on both the Spurr and the Strandline Lake maps. This event was the most northerly (~8 km north of the summit) earthquake on the Spurr map and was plotted on the southern border of the Strandline Lake map (~7 km southwest of NCG). Since this event was located relatively close to the summit of Spurr is should not be included in the Strandline Lake total. There were, thus, four Strandline Lake events located during January-February rather than five.

Redoubt:
A total of 13 earthquakes were located in the Redoubt region during January-February 2000 (figs. 4, 19 and 20). The largest event located during this time had a magnitude of M_L=2.4 and was located 11 km west of Redoubt at a hypocentral depth of ~13 km. Seven earthquakes were located within 10 km of the summit of Redoubt. The remaining six more distally located events were probably tectonic earthquakes unrelated to volcanic activity in this area. The number of proximal events located during January-February was over twice the corresponding value for November-December 1999. The number of proximal events was, however, only about half the predicted number based upon the mean seismicity rate. The Redoubt stations appeared to be operating properly during this time period so the apparent lull in activity may have been genuine.

Iliamna:
Twenty-two earthquakes were located in the Iliamna region during January-February 2000 (figs. 5, 19 and 20). One earthquake was located about 26 km north-northeast of Iliamna. Due to its great distance from Iliamna this event was probably a tectonic earthquake and not related to volcanic activity at Iliamna. The largest of the 21 earthquakes actually associated with Iliamna had a magnitude of M_L=3.6 and was located about 2 km northeast of the summit of Iliamna at a shallow hypocentral depth. This event was the largest earthquake to be located at Iliamna since AVO has been monitoring the activity there. This earthquake as well as eight others occurred on February 14, 2000. However, this was not simply a case of a mainshock followed by many aftershocks. It appeared to be more of a case of seismic swarm activity; five earthquakes occurred prior to the M_L=3.6 event and were then followed by only three aftershocks. The number of Iliamna events located during this two-month period was about twice that of November-December as well as the predicted number of such events. For the most part, the February 14th swarm accounted for the observed differences in the numbers of located events.

Augustine:
During January-February 2000 a total of seven earthquakes, the largest of which had a magnitude of M_L=0.5, were located in the Augustine region (figs. 6, 19 and 20). All of these events were located in the summit region and had shallow hypocentral depths. The number of Augustine events located during January-February is considerably lower than the 30 such events located during the previous two-month period. Based upon the mean seismicity rate one would expect there to have been a total of 65 events located during a two-month period. Several of the Augustine stations appear to have been intermittent during this two-month period. These station outages are the most likely reason for the much lower than expected number of located events at Augustine.

Katmai/Valley of Ten Thousand Smokes Region:
A total of 62 earthquakes were located in the Katmai/Valley of Ten Thousand Smokes region during January-February 2000 (figs. 7-12, 19 and 20). The largest event located during this two-month period had a magnitude of M_L=2.1. There were two events of this magnitude. One was located ~48 km north-northwest of Stellar and is shown along the northern border (nearly off the map) of figure 6. The other was located 2 km east of Martin and had a hypocentral depth of 3 km. As usual, the earthquakes were assigned to the Katmai area volcanoes on the basis of their epicentral distances from the volcanoes. Earthquakes located within 5 km of a volcano were assigned to that volcano unless, of course, the event was located within 5 km of more than one volcano in which case it would be assigned to the closer one. The results of this earthquake assignment are given in Table 1.

Table 1
Summary of Located Events at Katmai Region Volcanoes

Volcano/Region	*Nov-Dec ‘99*	*Jan-Feb’00*	*Predicted from the Mean Seismicity Rate*
Entire Map Area	133	62	170
Griggs	0	0	0
Katmai	10	3	16
Mageik	17	7	31
Martin	44	19	61
Martin/Mageik	61	26	92
Novarupta	20	10	25
Snowy Mountain	0	0	1
Stellar	2	0	0
Trident	3	0	7
Not Assigned*	37	23	28^{+}

**Events located > 5.0 km from any of the eight volcanoes listed in Table 1.*

$^{+}$*This value is based upon a rate of 14.1 unassigned events per month which was calculated as the difference between the mean rate of the entire map area and the sum of the rates corresponding to each of the eight volcanoes listed in Table 1.*

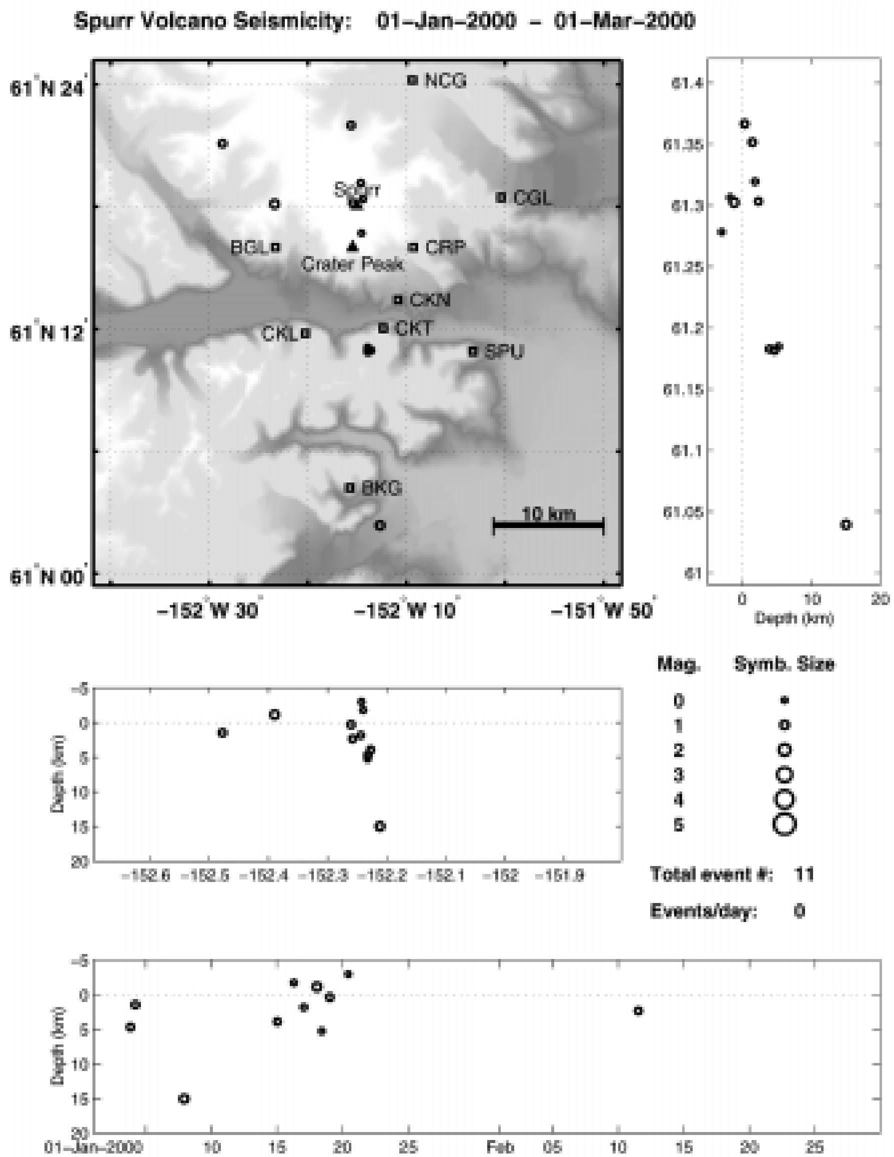


Figure 2: Located Spurr seismic events in space and time for the period January through February.

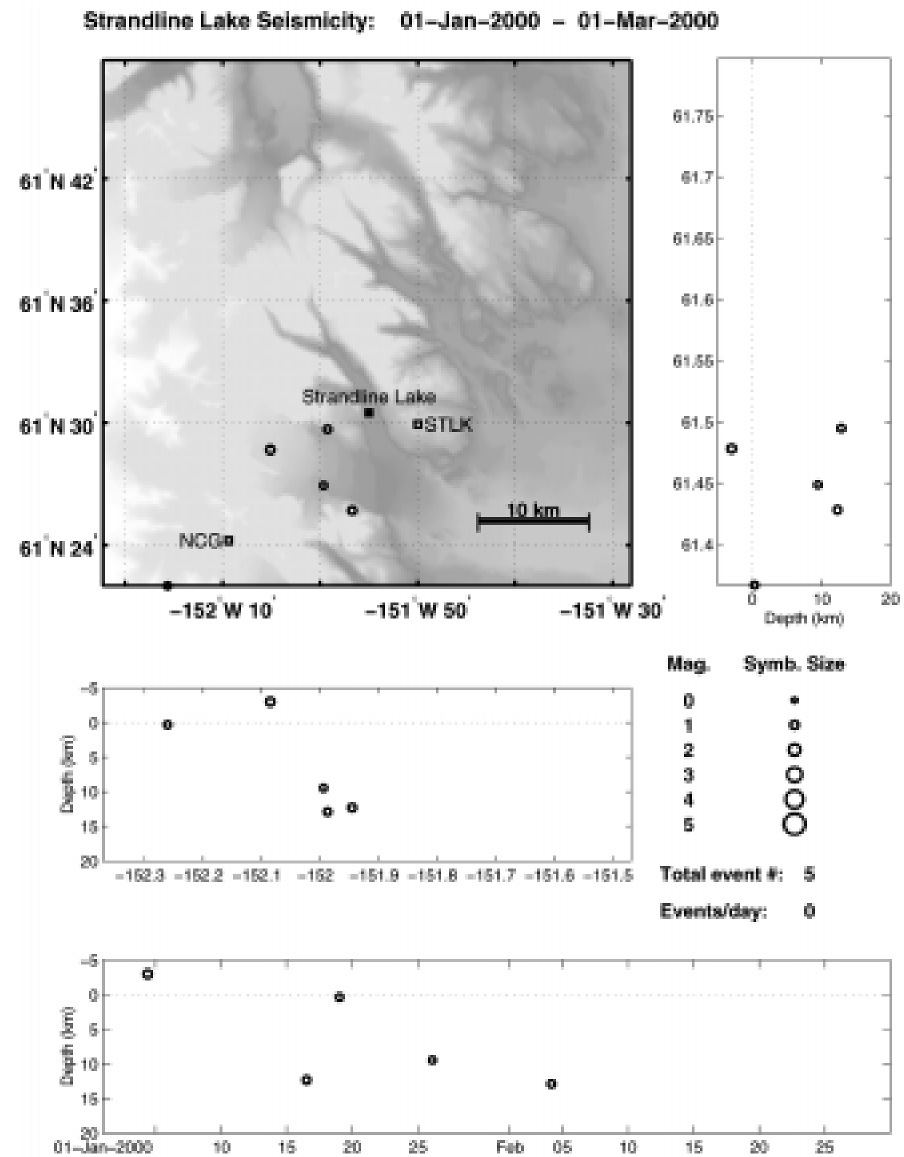


Figure 3: Located Standline Lakeseismic events in space and time for the period January through February.

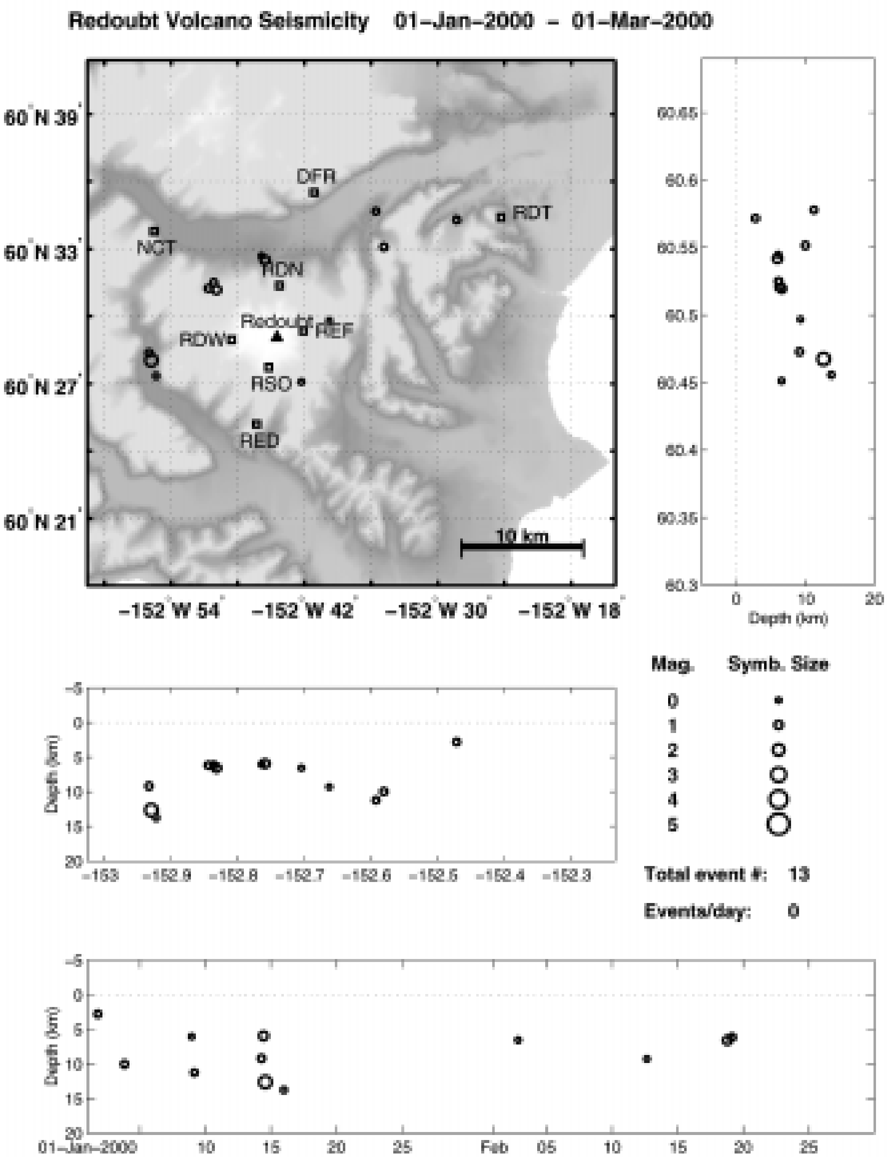


Figure 4: Located Redoubt seismic events in space and time for the period January through February.

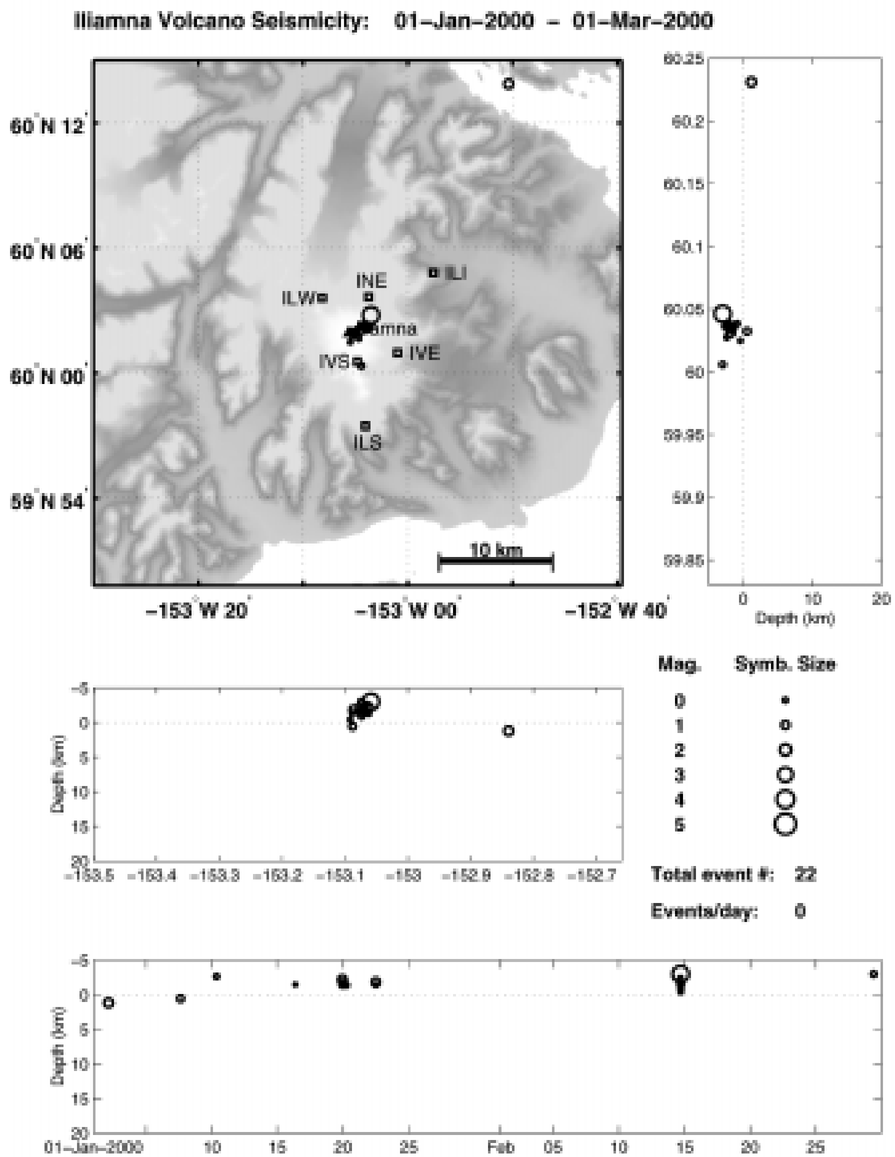


Figure 5: Located Iliamna seismic events in space and time for the period January through February.

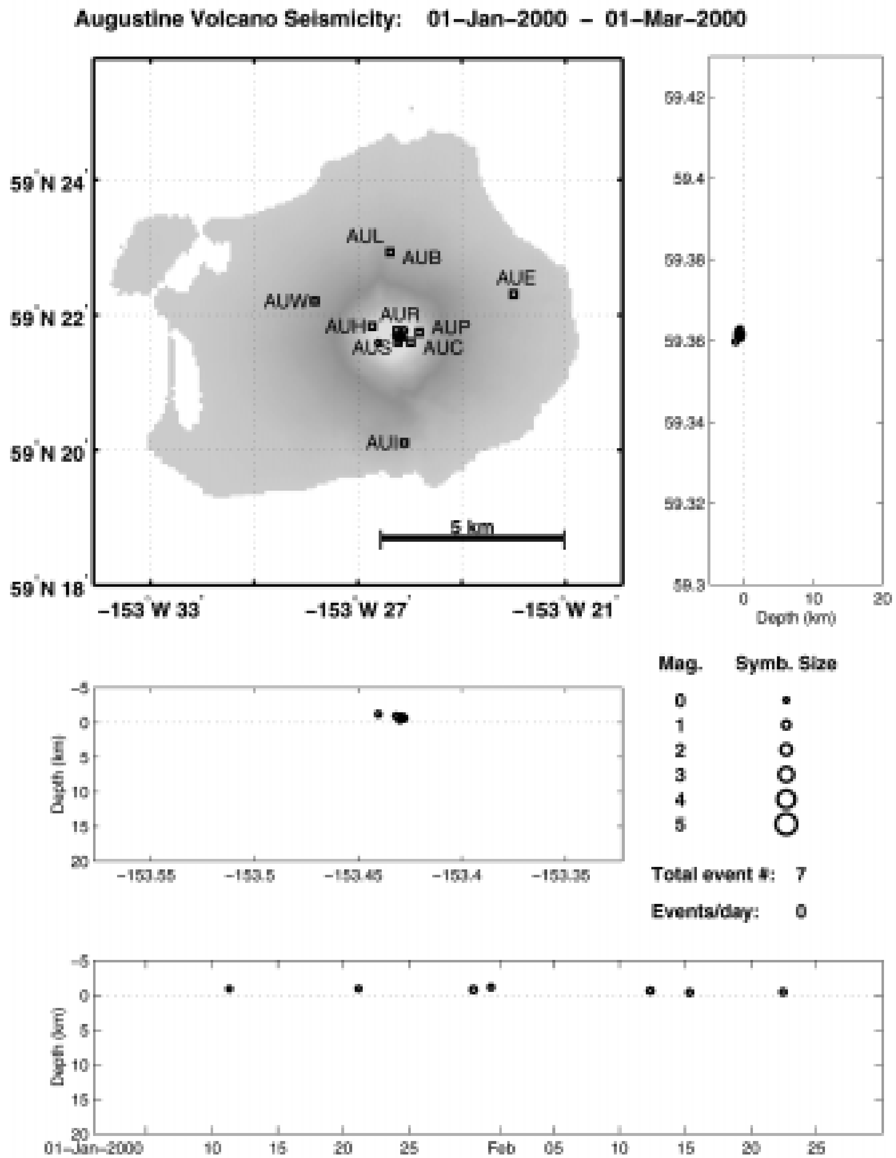


Figure 6: *Located Augustine seismic events in space and time for the period January through February.*

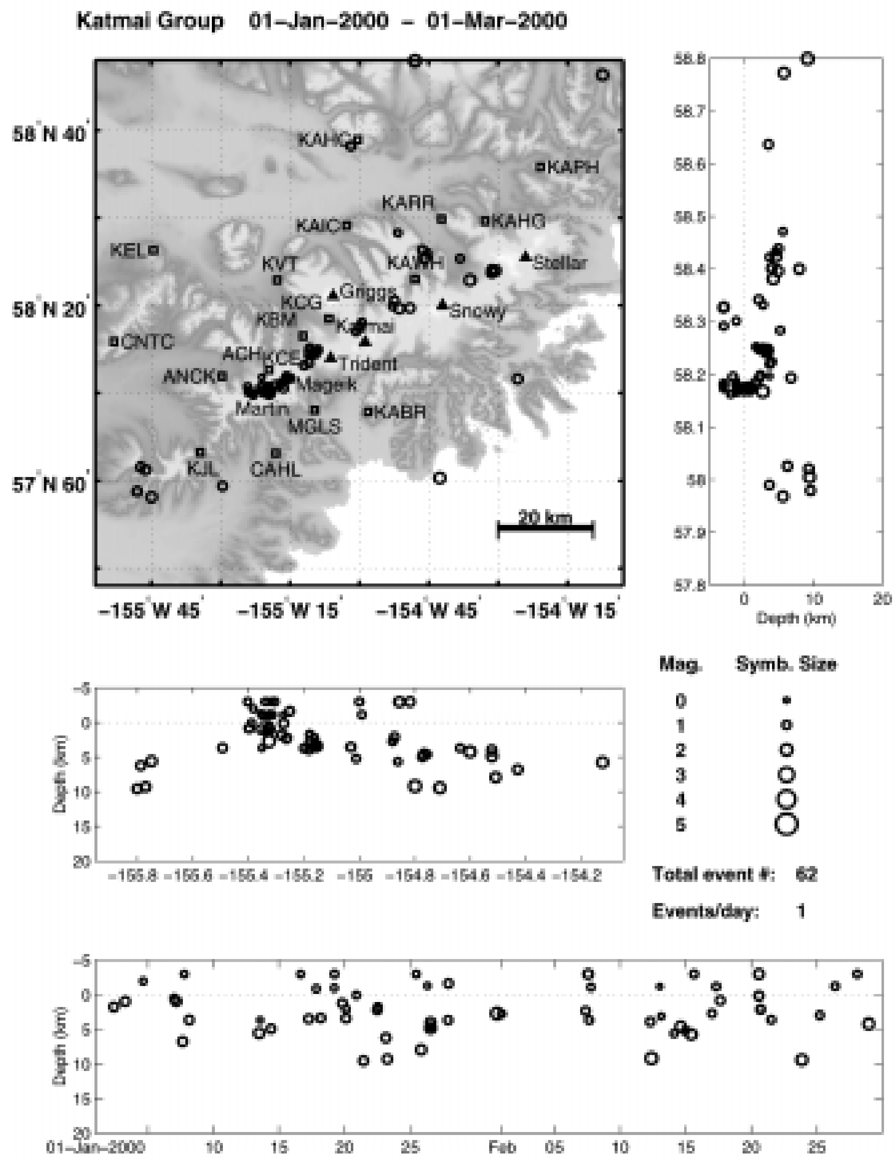


Figure 2: *Located Katmai Group seismic events in space and time for the period January through February.*

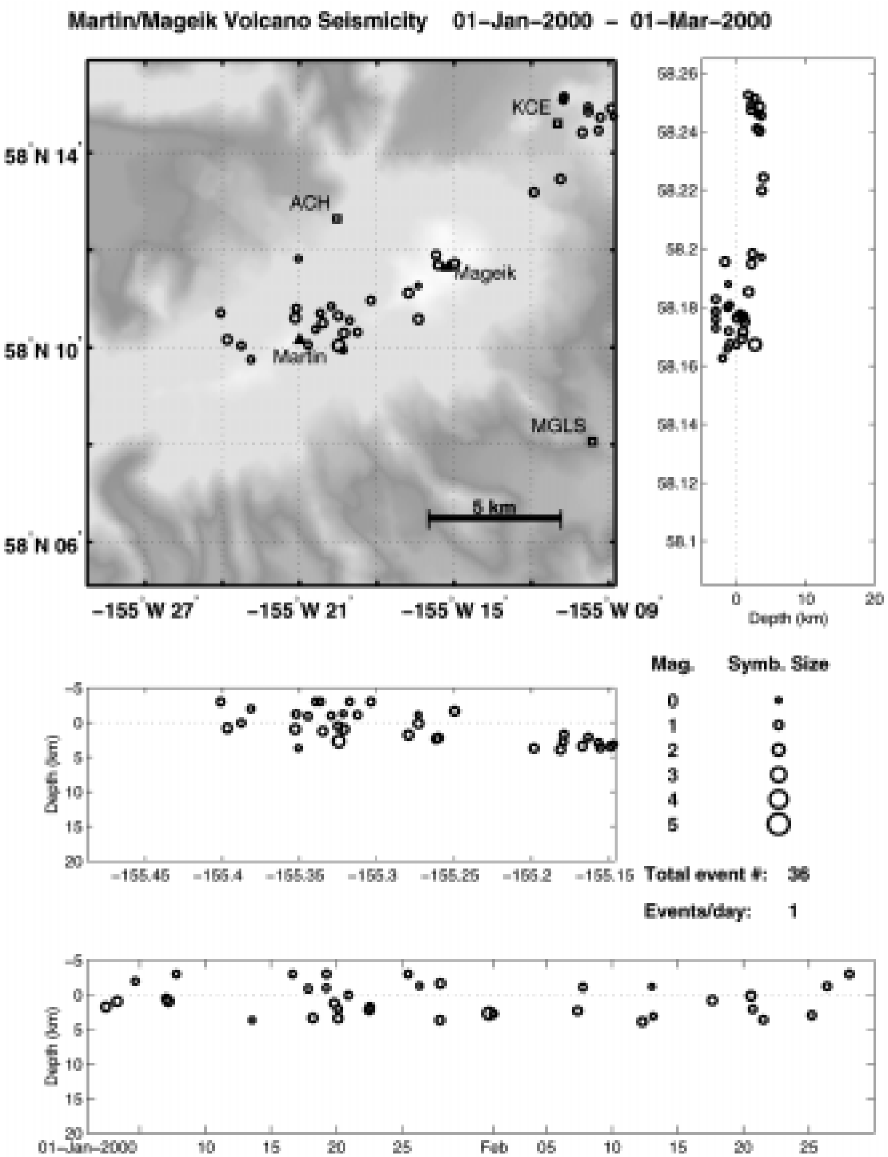


Figure 8: Located Martin-Mageik seismic events in space and time for the period January through February.

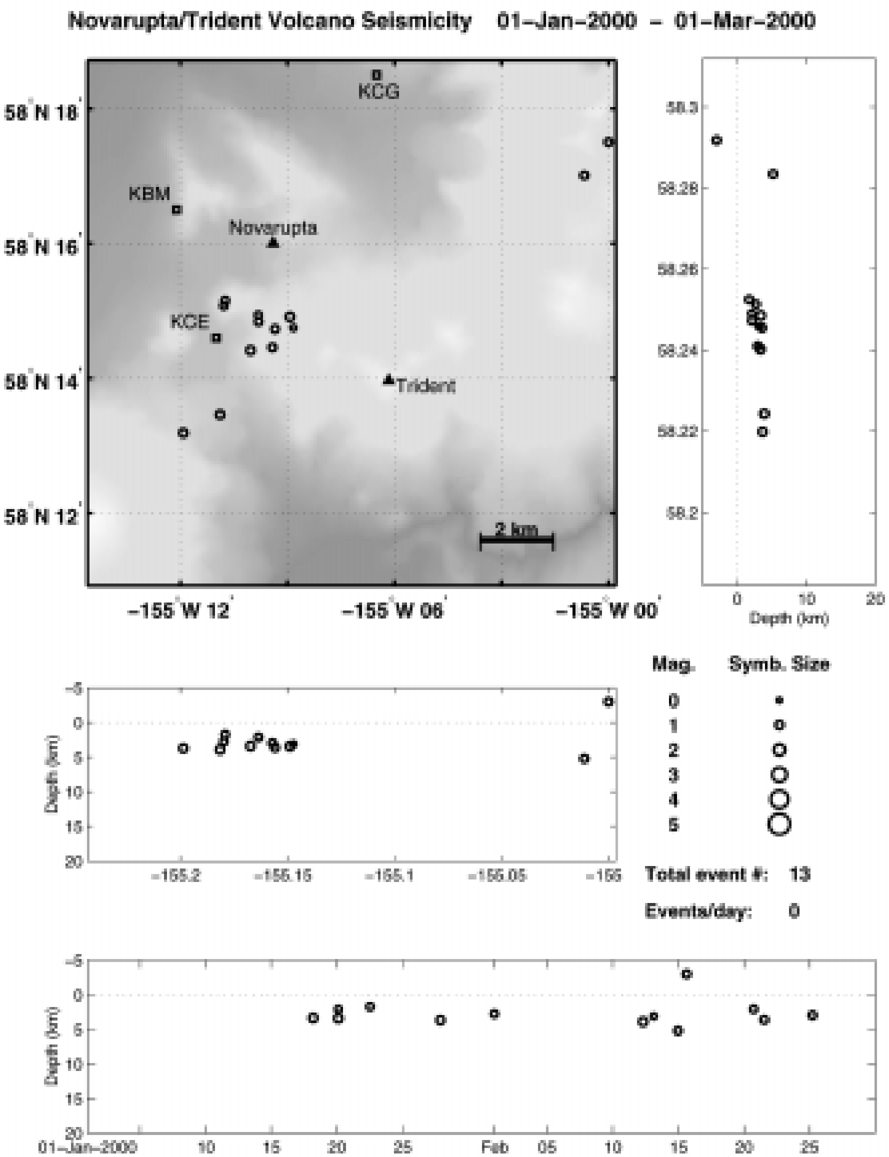


Figure 9: Located Novarupta-Trident seismic events in space and time for the period January through February.

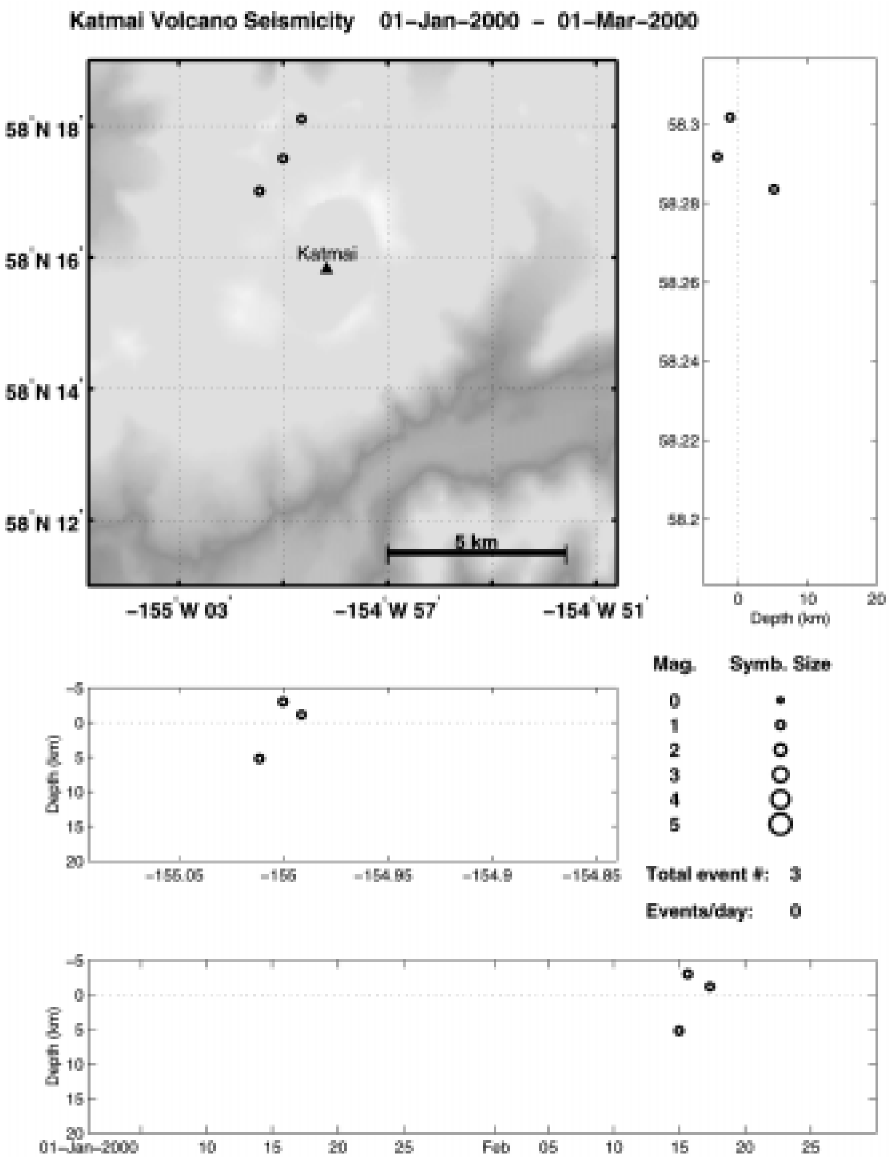


Figure 10: Located Katmai seismic events in space and time for the period January through February.

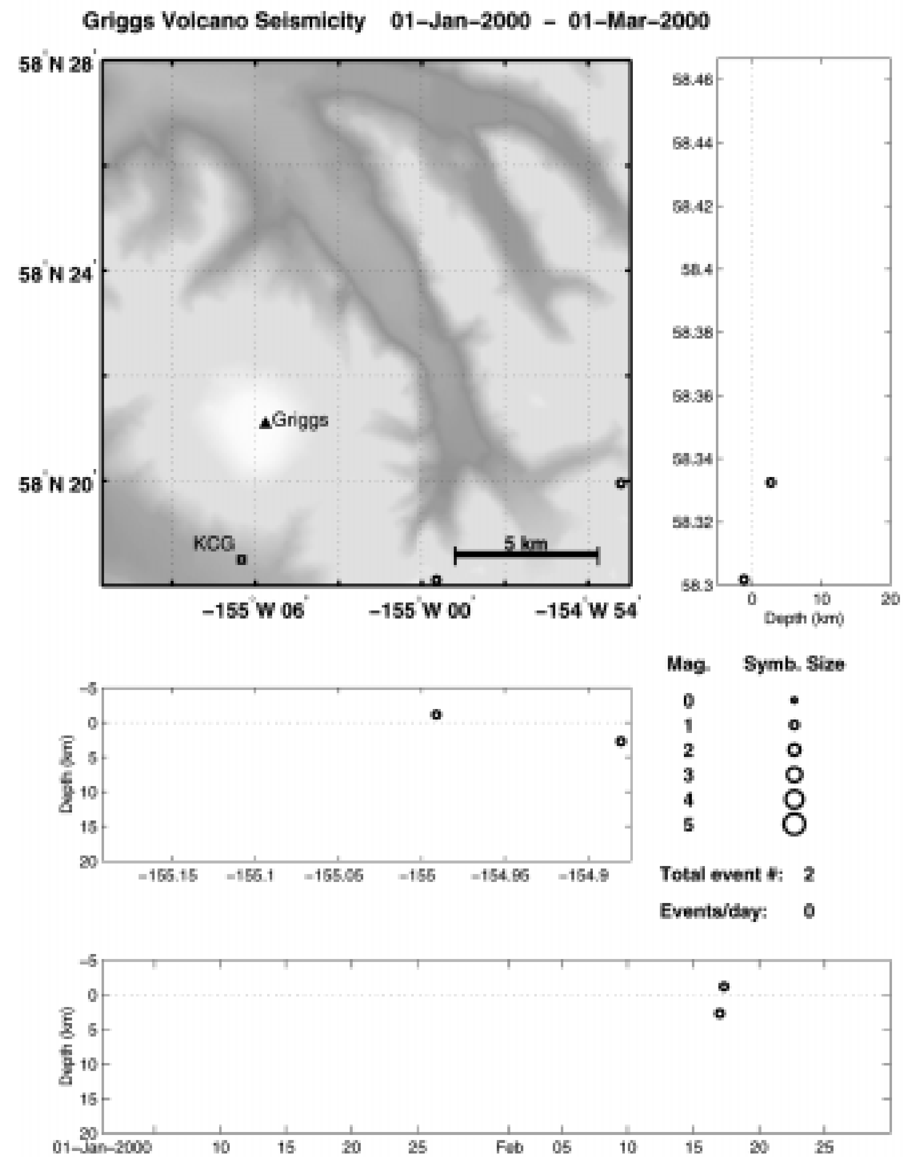


Figure 11: Located Griggs seismic events in space and time for the period January through February.

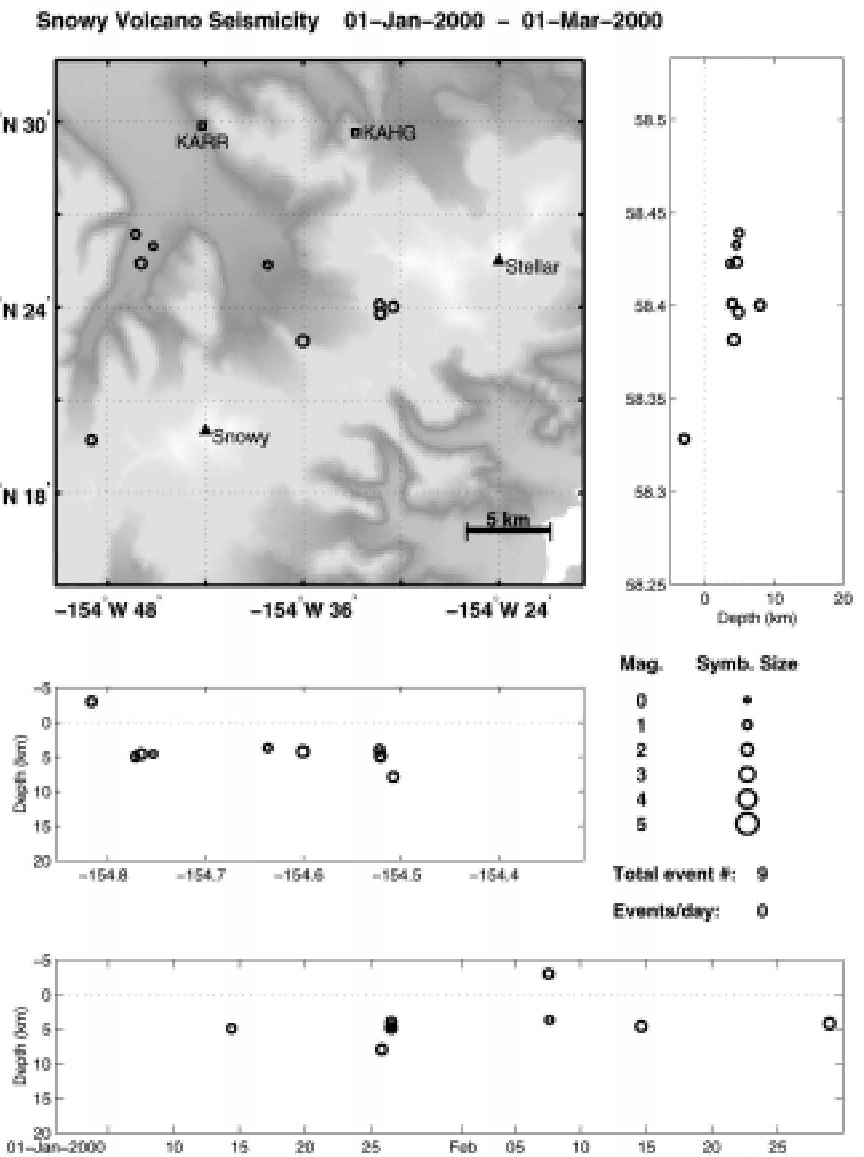


Figure 12: Located Snowy seismic events in space and time for the period January through February.

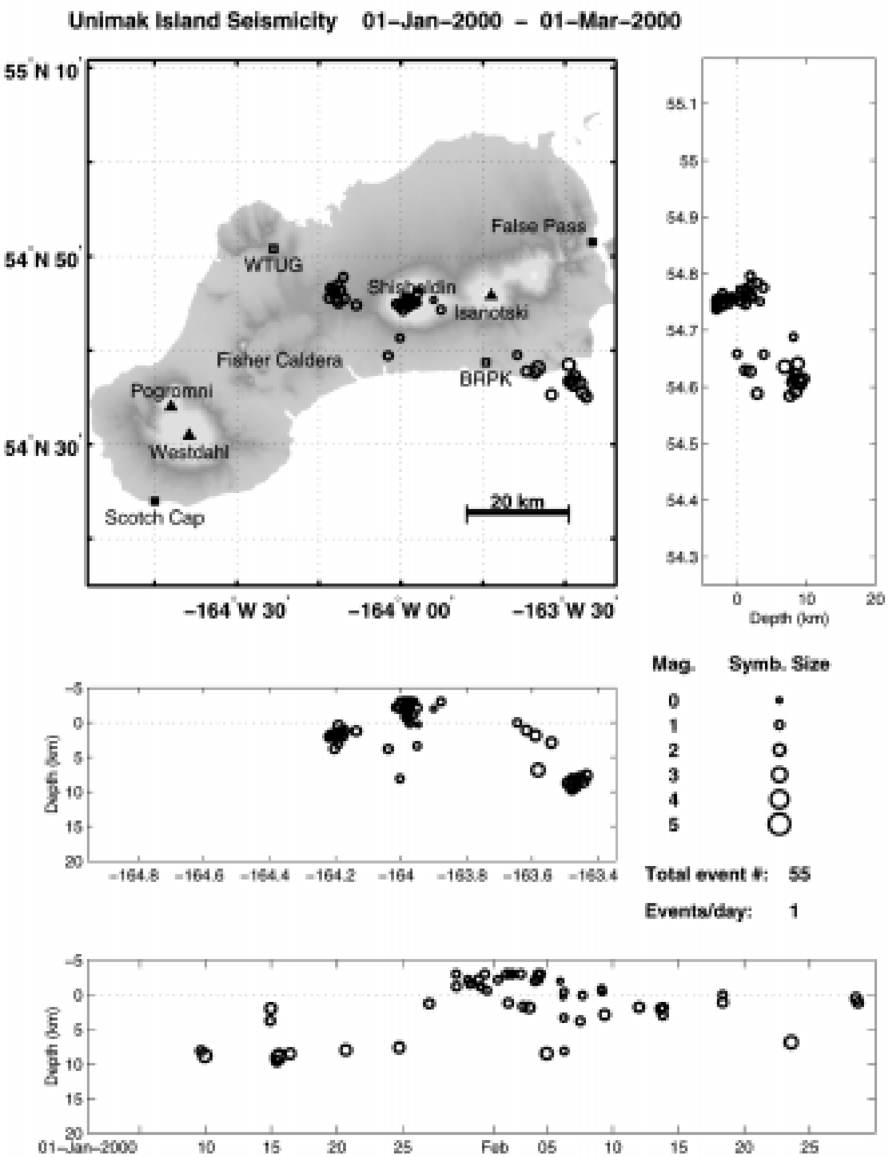


Figure 11: Located Unimak Island seismic events in space and time for the period January through February.

In all cases, the numbers of events located near each of the Katmai area volcanoes during January-February were much lower than the corresponding values for November-December as well as those estimated from the respective mean seismicity rates. It appears that winter has yet again taken its toll on the Katmai network. This was particularly true in the Martin/Mageik area. Most of the stations in the Katmai network were not completely out during January-February but rather their operation was quite intermittent.

Unimak Island Region (Shishaldin): Fifty-five earthquakes were located in the Unimak Island region during January-February 2000 (figs. 13, 19 and 20). The largest of these events had a magnitude of M_L=2.6 and was located off the southeastern shore of Unimak Island, 7 km east of Cape Lazaref at a hypocentral depth of 9 km. There were a total of 14 earthquakes located in the Cape Lazaref area during this two-month period. Twelve earthquakes, the largest of which had a magnitude of M_L=1.8, were located in the aftershock zone of the March 4, 1999 M_L=5.2 earthquake.

Most of the remaining 29 Unimak earthquakes were located much closer to Shishaldin (figs. 14, 19 and 20). A total of 32 earthquakes are shown on figure 13; the three most westerly events were located in the aftershock zone. The majority of the other 29 events were located in the summit region and had relatively low frequency waveforms. The largest of these Shishaldin events had a magnitude of M_L=1.1. There were three earthquakes of this magnitude, two were located 1 km southwest of the summit while the third one was located 1 km south-southeast of the summit. All three of these events had shallow hypocentral depths. The activity at Shishaldin in terms of tremor and/or small events has continued on and off since it last produced a plume in late May 1999. The fairly large number of events located in the summit region during January-February appears to be a reflection of this continued state of unrest. Explosions in the summit area were observed on the Helicorder records from late September to early February. No hotspots and/or plumes were visible on satellite imagery regardless of the zenith angle or the weather conditions. This suggests that the explosions may have been phreatic in nature and not associated with renewed volcanic activity. The located earthquakes in this region were probably not the explosions themselves. The incidence of Shishaldin earthquakes did not correlate well with the observed occurrence of explosions. For example, although the largest number of explosions occurred on December 28 and 29, 1999, there was no corresponding increase in the seismicity. In fact, not a single earthquake was located in the Shishaldin area during that time.

The numbers of events located in the Unimak Island region as well as near Shishaldin, were much greater during January-February than was the case during the previous two-month period. These values were also much larger than the mean seismicity rates would suggest. The continued aftershock sequence and the heightened activity at Shishaldin account for the disparity between the numbers of events located during January-February 2000, those of the previous two-month period, and the predicted values.

Akutan: Five earthquakes were located in the Akutan region during January-February 2000 (figs. 15, 19 and 20). The largest of these events had a magnitude of M_L=1.5 and was located at the head of Akutan Bay 10 km east of the summit of Akutan (~4 km west of the City of Akutan) at a hypocentral depth of 5 km. All five of the events had virtually the same location (i.e. 10-11 km east of the summit at hypocentral depths of ~5-6 km) and occurred on January 19, 2000 over a time period of less than 30 minutes. These earthquakes occurred in a region that had been quite active during the March 1996 volcanic crisis and the months that followed. During that time several thousand earthquakes were felt at the City of Akutan, which prompted the deployment of a temporary seismic network on Akutan Island by AVO (see the March/April 1996 Bimonthly Report). The number of earthquakes located in the Akutan region during January-February 2000 was greater than the single event located there during the previous two-month period. The number of Akutan events was also in agreement with the five events predicted from the mean seismicity rate.

Makushin: During January-February, one earthquake was located in the Makushin region (figs. 16, 19 and 20). This event had a magnitude of M_L=2.7 was located 26 km south of the summit of Makushin (nearly off the map) at a hypocentral depth of ~7 km. Due to its great distance from Makushin, this earthquake was quite likely just a regional tectonic earthquake and not related to volcanic activity in this region. The number of earthquakes located in the Makushin region during this two-month period was the same as that for November-December 1999. This value was, however, much lower than the nine such events predicted from the mean seismicity rate.

Adak Region (Great Sitkin): Thirteen earthquakes were located in the general Adak region during January-February 2000 (fig. 17). Three of these events were located relatively far away from the volcanic centers of the region and probably represent regional tectonic activity. The remaining 10 events were located relatively close to Great Sitkin.

A total of 10 earthquakes were located in the Great Sitkin area during January-February 2000(fig. 18). The largest event located in the Adak/Great Sitkin region during this time had a magnitude of M_L=2.2 and was located 4 km east of Great Sitkin at a hypocentral depth of 33 km. The remaining nine earthquakes were located within 2 km of the summit and most had shallow hypocentral depths. The number of Great Sitkin earthquakes located during January-February was much lower than the 46 such events located during the November-December 1999.

This apparent decrease in activity probably did not represent a real decrease in the activity in the Great Sitkin region but was likely the result of a change in the means by which Great Sitkin events were "detected". This change took place on January 13, 2000. Prior to this date the Great Sitkin events were detected by visually scanning the Iceworm continuous data for local events. Such events were then extracted and converted to standard AH-format and finally located using xpickvol. This method of detection was employed rather than using the standard AVO data acquisition system because the Great Sitkin data did not come directly to Fairbanks via phone lines but rather were electronically terminated first in Anchorage. While in Anchorage, the data were digitized and transferred to Fairbanks over the internet. Since the AVO acquisition systems require the input to be in analog form, and the Great Sitkin data were then arriving in Fairbanks in digital form, it was not possible to conduct event detection on the Great Sitkin data in the usual manner.

continued

On January 13, 2000 AVO implemented Great Sitkin event detection in Anchorage; prior to digitization the analog Great Sitkin data were routed through one of AVO's acquisition systems. In this way, earthquakes would trigger the acquisition system and data extracted in the usual manner. These data were then copied up to Fairbanks where they are processed along with the data from the other volcanoes.

Scott Stihler, Aaron Pearson, Pete Stelling, Scott Dreher, Ellen Wilson, Art Jolly, Steve McNutt, John Sanchez, Bob Hammond, Guy Tytgat, and Gordon Bower

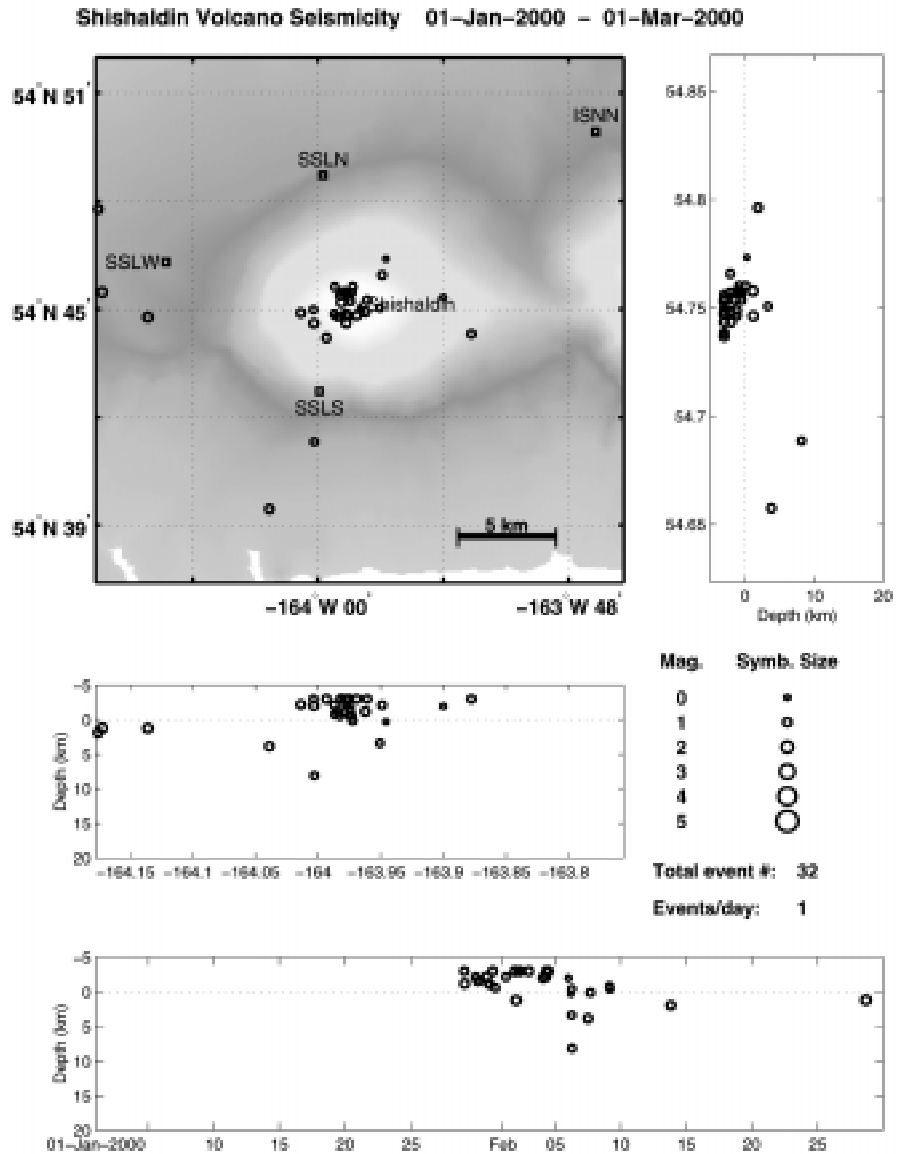


Figure 14: Located Shishaldin seismic events in space and time for the period January through February.

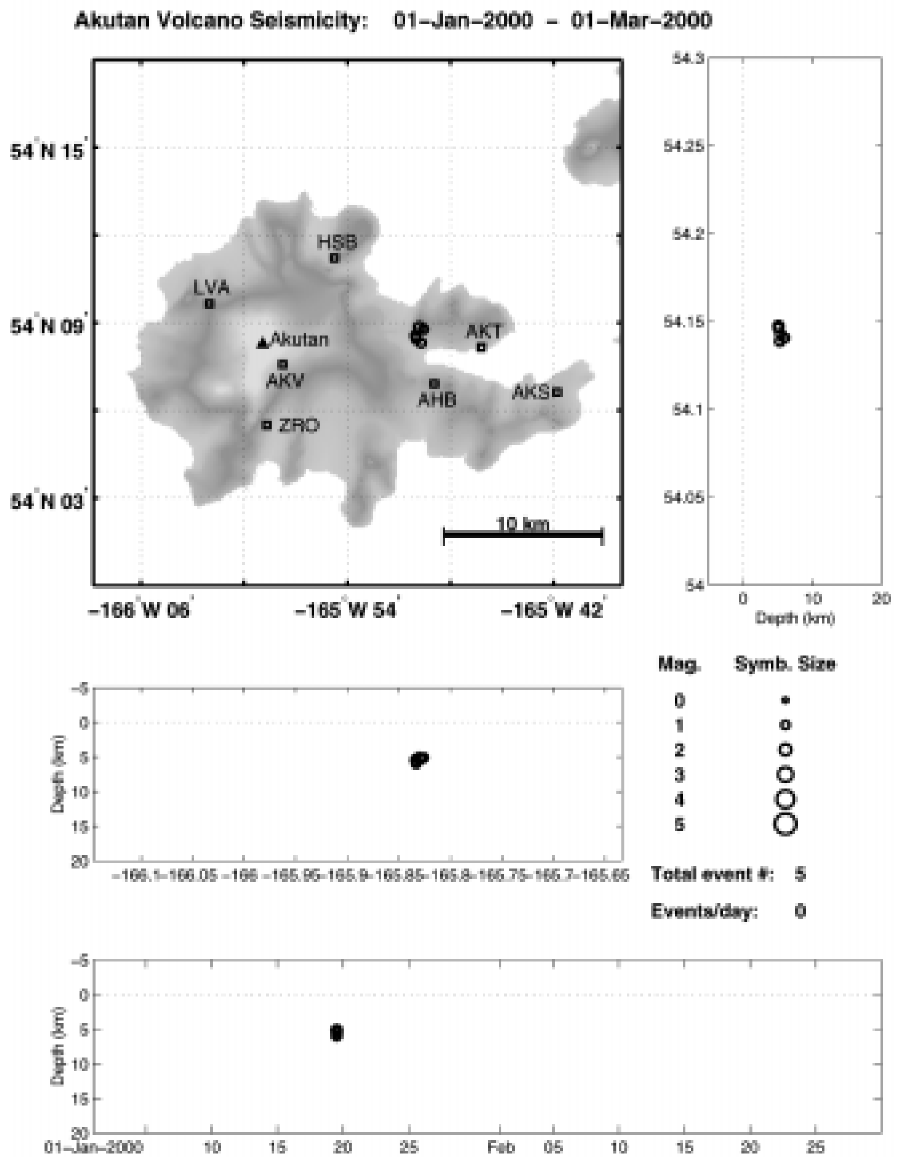


Figure 15: Located Akutan seismic events in space and time for the period January through February.

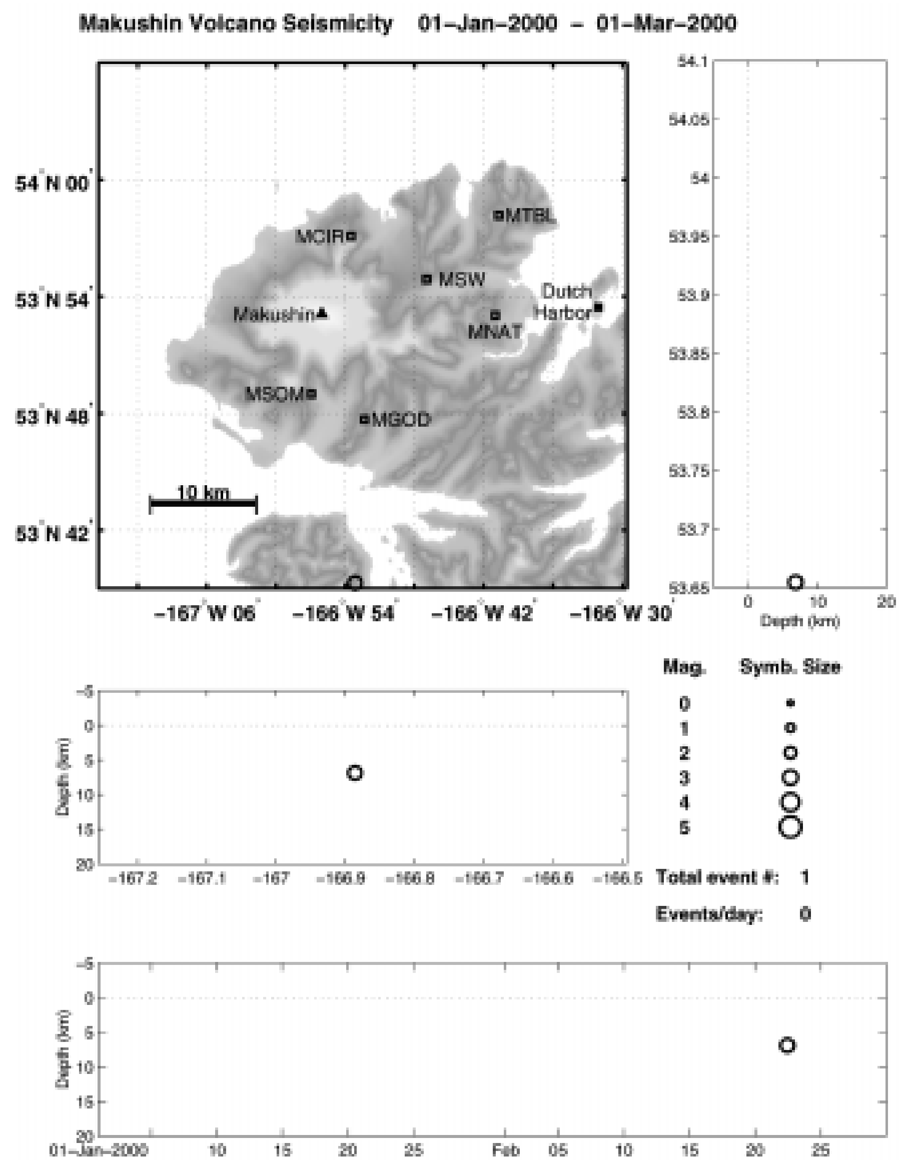


Figure 16: Located Makushin seismic events in space and time for the period January through February.

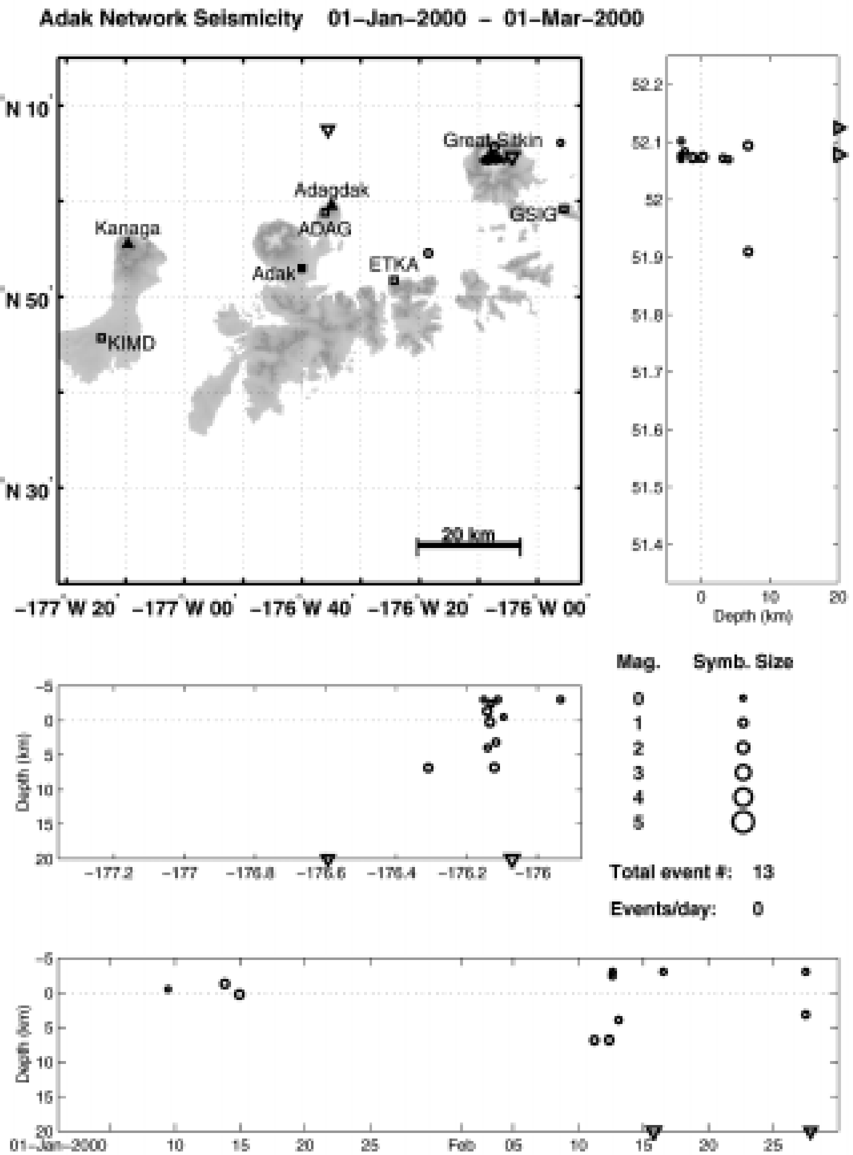


Figure 17: Located Adak seismic events in space and time for the period January through February.

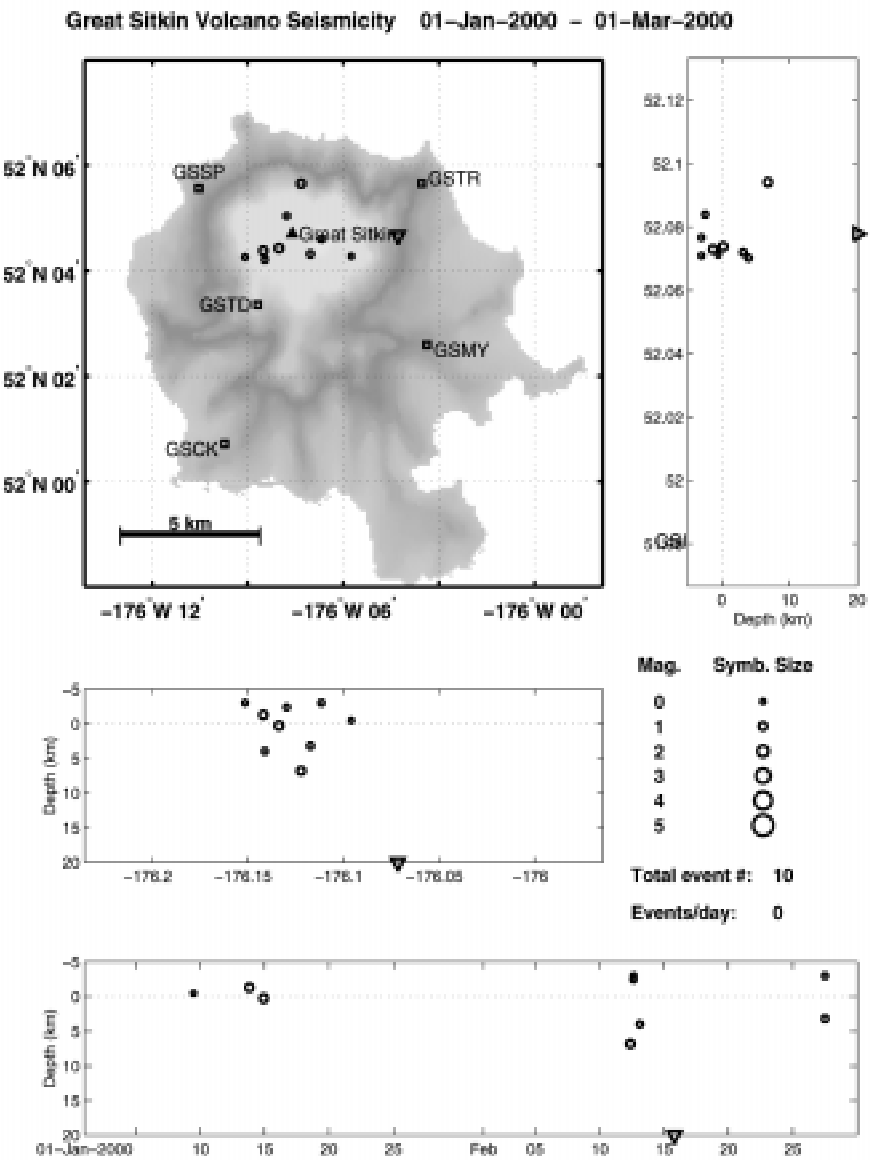
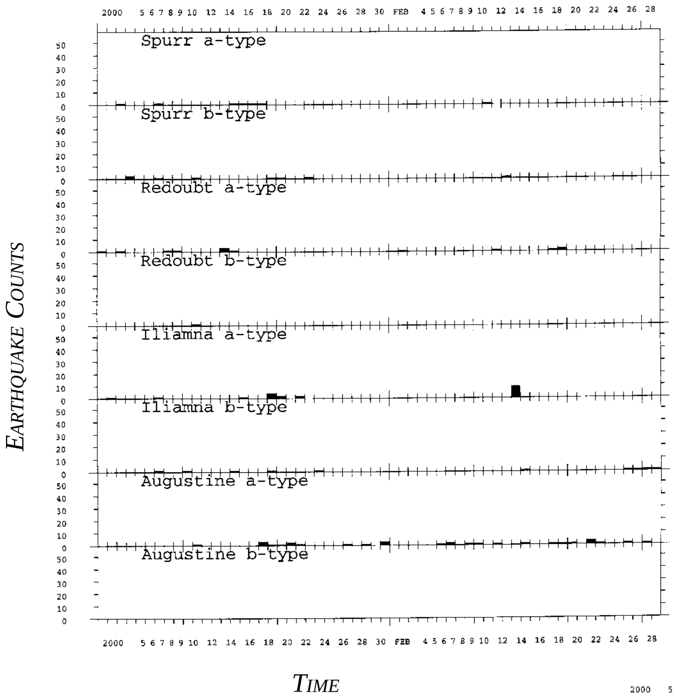
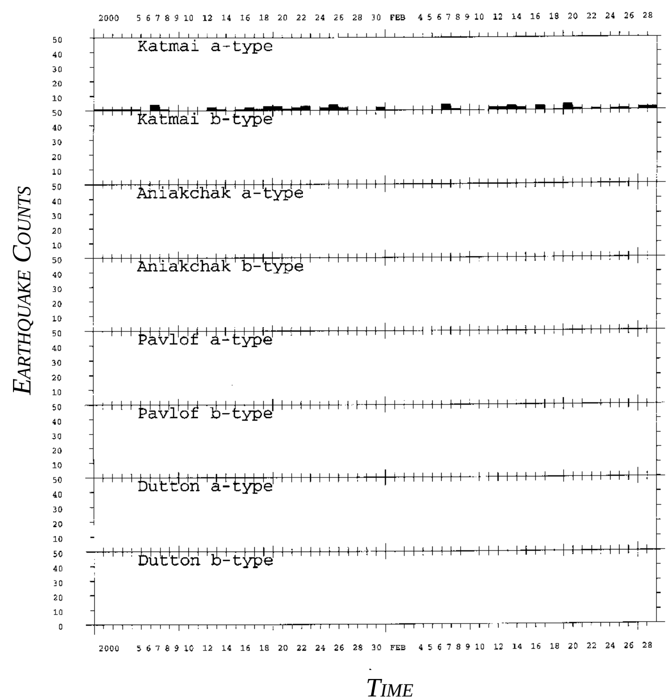


Figure 18: Located Great Sitkin seismic events in space and time for the period January through February.

EARTHQUAKE COUNTS FROM DETECTED EVENTS



EARTHQUAKE COUNTS FROM DETECTED EVENTS



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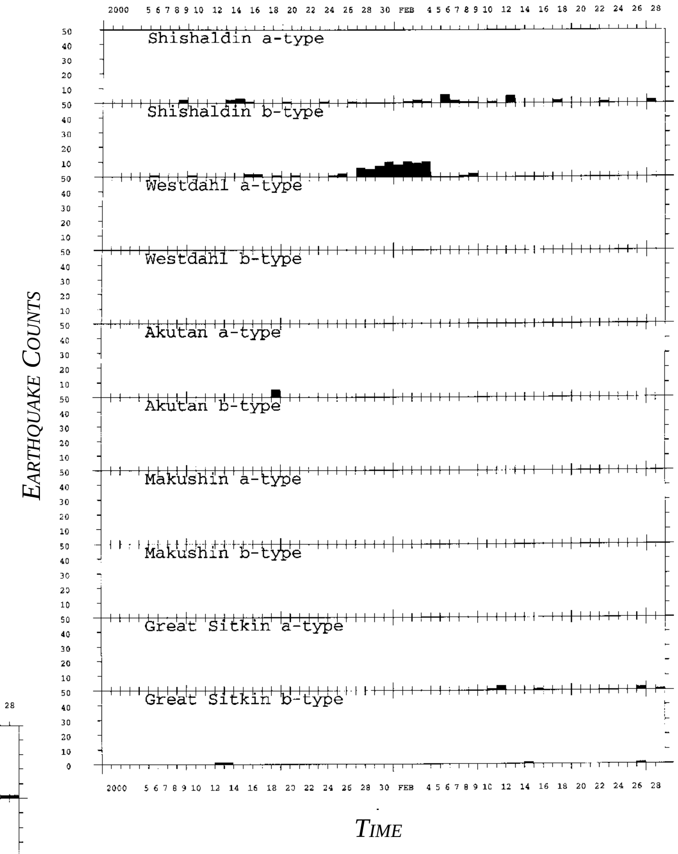

Figure 19: Histogram of computer detected ("Willie system") seismic events during January through February.