# Seismicity of Mt. Erebus Volcano, Antarctica, Recorded Digitally from November 12, 1994 to July 31, 1996

Rebecca Knight
Department of Earth and Environmental Science
New Mexico Institute of Mining and Technology
Socorro, NM 87801

Submitted in partial fulfillment of the requirements for the degree Master of Science in Geophysics from the Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology

August 1, 1996

## Table of Contents

## Table of Contents (continued)

## Table of Figures

## Table of Figures (continued)

## Table of Tables

# Abstract

The Mt. Erebus Volcano Observatory (MEVO) was established at McMurdo Station, Antarctica in 1992 to digitally record seismic events occurring on Mt. Erebus and transfer the data via ethernet to research facilities located in New Zealand (Victoria University) and the United States (New Mexcio Tech) for analysis. During the study period November 1994 to June 1996, over 3,000 events were digitally recorded at MEVO using a 9 station, telemetered network of vertical component, 1 HZ seismometers (one station was upgraded to three-component in November 1995). Helicorders are also maintained at MEVO, and a partial count of events from the 1995 analog records was made to evaluate the efficiency of the digital data acquisition system. A variety of seismic phenomena were observed and are reported on in this paper: long-period (LP) events, volcano-tectonic (VT) events, explosive (E-type) events, tremor, swarms, and ice-quakes/tornillos. Preliminary locations were found for 730 events of the best quality using *Xpick* (developed by the Geophysical Institute, University of Alaska, Fairbanks) and *HYPOELLIPSE* (Lahr, 1994). The locations are separated by type (LP, VT, and E-type) and are plotted using *Xmap8* (Lees 1994) to investigate possible location trends. Swarms may also represent patterns of seismicity that can be investigated by location trends, however the quality of swarm events is generally low and it may be more useful to examine swarms using waveform and spectral analysis.

# Introduction

Ross Island, Antarctica, is the location of the world's southernmost active volcano, Mount Erebus (Figure 1). The summit of Mt. Erebus is 3794 m above sea level and currently contains in its crater a convecting lake of anorthoclase phonolite magma -a rare variety of rock, named "kenyte", also erupted from Mts. Kenya, Kilimanjaro, and only a few other volcanoes in the world.

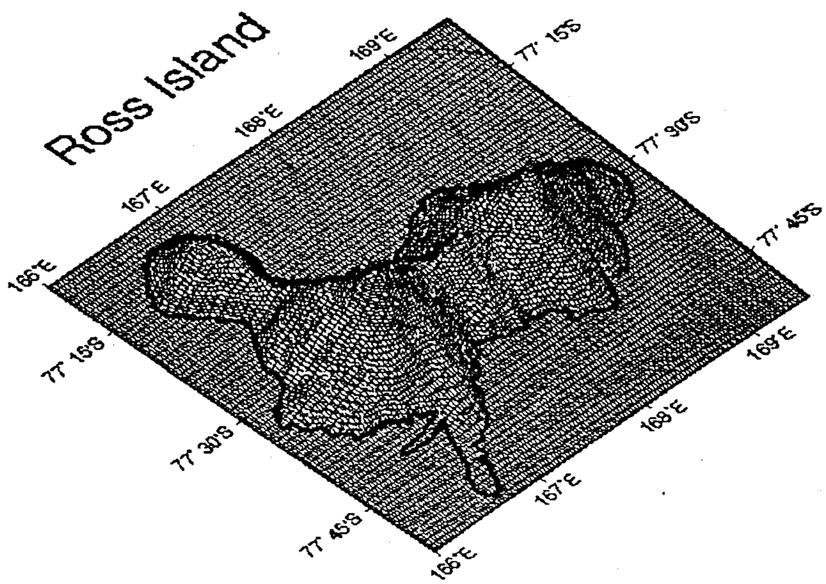



**Figure 1** – Ross Island, showing Mt. Erebus as the tallest peak (3794 m), surrounded by Mts. Terror, Terra Nova, and Byrd.

The lava lake is prone to frequent explosions which have twice during the study period produced swarms of hundreds of distinct events, but which more generally produce a few (1-3) medium sized explosion-type (E-type) earthquakes a day. The explosions are sometimes violent enough to produce signals that are recorded at the farthest seismic station (over 35 km away).

The lava lake provides a window to the Erebus magma chamber, because a direct connection exists between the surface expression (lake) and the source (chamber) (see Figures 6 and 28). Thus, the lava lake is one avenue for study of the internal plumbing of the mountain. Mt. Erebus is unique in the world with its unusual lake and the activity and rare lava associated with it. (Kyle, 1994).

While it is unique in some characteristics, Mt. Erebus it is also typical in others. In addition to the numerous explosive events, there are frequent earthquakes on Mt. Erebus of types that are commonly observed at volcanoes around the world. Long-period (LP) events and volcano-tectonic (VT) events are well characterized in the field of volcano seismology (Chouet, 1996) and are clearly recorded on Mt. Erebus. LP events are most numerous and may provide clues about the locations of internal pathways for magma, as they are driven by fluid processes. Unfortunately, LP events are often are difficult to locate because first arrivals can be quite emergent and they are usually lacking in clear S-phases. VT events are less frequent, but are generally better located (as they often have impulsive P-phase arrivals and clear S-phases). VT event locations may indicate places where shear failure has occurred as a result of stress perterbation due to magma injection. All of these events (E-type, LP, and VT), together interpreted with trends suggested by tremor and swarm activity, may indicate a pattern of seismicity that draws a picture of the internal plumbing of the mountain and can be compared to known patterns that occur at other volcanoes where eruption predictions are possible.

The mountain has been continuously active, with almost daily Strombolian eruptions since at least 1972. The first seismic recordings on Mt. Erebus were made in 1974 (Kyle et al., 1982), and the most recent are being made at this moment. This paper describes the most current data set and attempts to assimilate it into a picture that includes past work. The seismicity is broadly characterized and given a simplified interpretation, providing a base for future more focused studies.

# Background

## Tectonic Setting

The Antarctic plate is encircled by divergent plate boundaries along roughly 95% of its perimeter. Large rift structures break up a good portion of the continent, as shown in Figure 2, and a nearly plate-wide extensional tectonic regime is indicated. (LeMasurier, 1990).

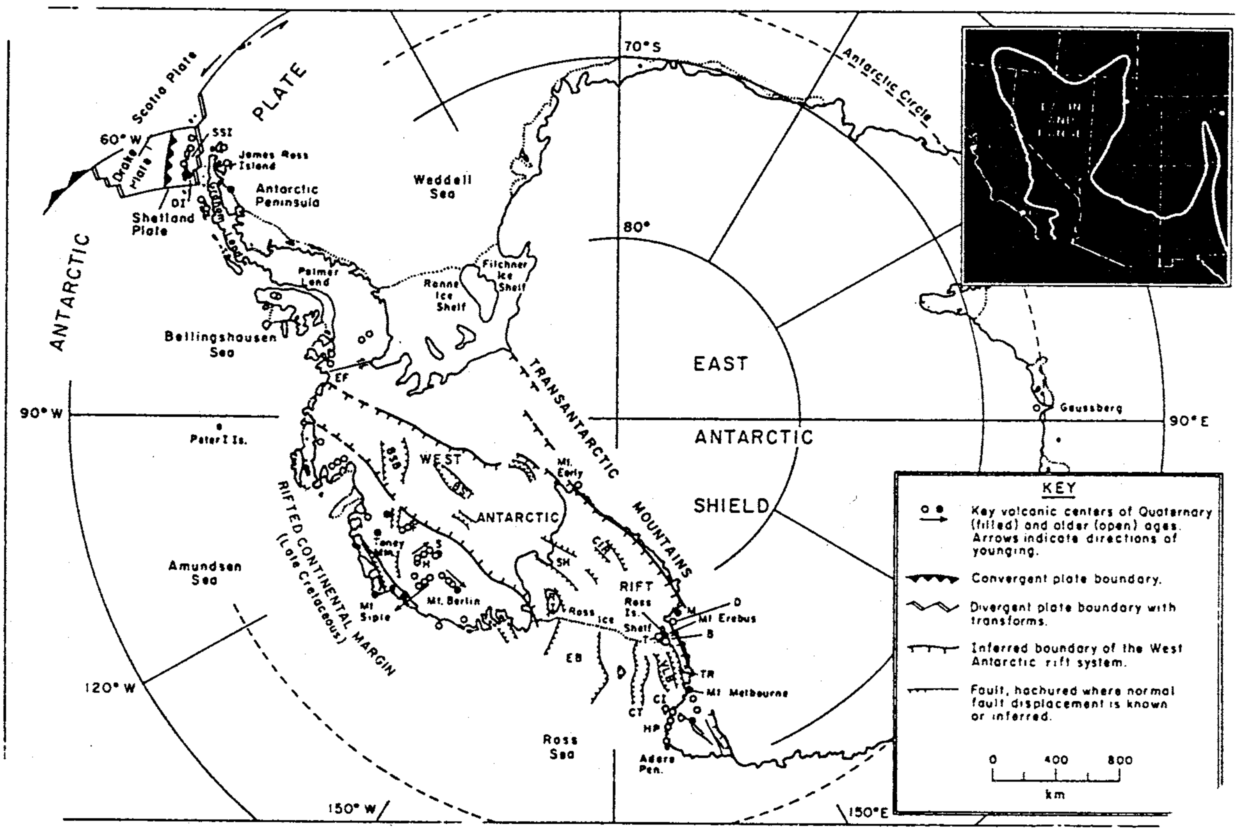



**Figure 2** – From LeMasurier (1990), showing the Antarctic continent, divided by the Transantarctic Mountians and broken by rift zones in the west.

Roughly parallel to the Transantarctic Mountains is a distribution of volcanic centers, and this fact, in conjunction with the evidence of crustal thinning and the fact that lavas from Mt. Erebus are almost identical in geochemistry to lavas from Mts. Kenya and Kilimanjaro- a rare variety of rock, appropriately named "kenyte" (Tazieff, 1994)- invites speculation on the comparison of this region to the East African rift zone (Kyle, personal communication, 1995).

East Africa is a well known actively spreading rift center with accompanying volcanics. As shown in Figure 3, alignment of the major volcanic centers with the tectonic axis is a conspicuous feature along the rift (Riaroh and Okoth, 1994), and the alignments are thought to be associated with deep axial faults which act as pathways for magma (Figure 4). It can be theorized that volcanics in Western Antarctica are present for similar reasons. Note the similarities between Figure 2 and Figure 3 regarding orientation and distribution of volcanoes.

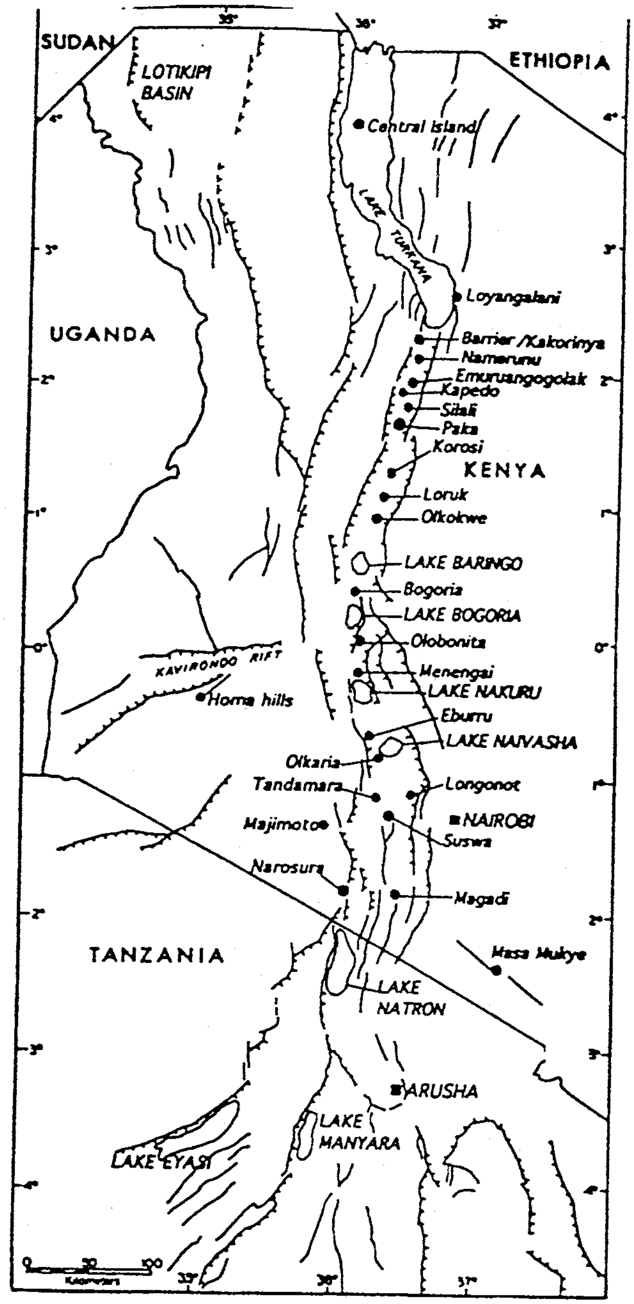



**Figure 3**– From Riaroh and Okoth (1994), showing alignment of volcanics with the major axis of the East African Rift.

The East African rift is also associated with sharply defined lithospheric thinning. Crustal thickness along the rift axis varies from as little as 20 km beneath Lake Turkana to about 35 km under the culmination of the Kenya dome near Lake Naivasha. The transition in crustal thickness occurs over a horizontal distance of about 150 km, and the change is accomplished by thinning of all layers but especially by the thinning of the lowermost crustal layer. The area of thickest crust correlates with the apex of the Kenya dome where the elevation of the rift valley floor is highest. (Keller, et al., 1994).

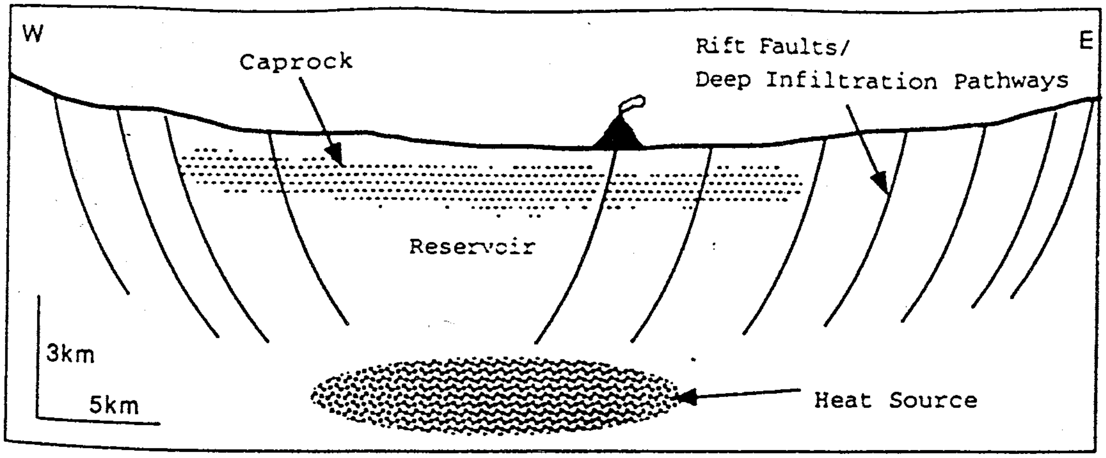



**Figure 4** – From Riaroh and Okoth (1994), showing deep axial faults which are potential pathways for magma.

---

The Ross Embayment is an extensional region within the West Antarctic rift system, where volcanism and extensional strain have been focused along a zone of lithosheric weakness (LeMasurier, 1990). "Ross Embayment" describes the combined area covered by the Ross Sea and the Ross Ice Shelf (Kyle, 1990), as shown in Figure 5.

Seismic-reflection data shows that the Victoria Land basin (seen in Figure 5) includes a 15-25 km wide rift depression which parallels the Transantarctic Mountains and is bordered on both sides by normal faults (Cooper and Davey, 1985). These faults form the rift margins and may provide pathways along which the volcanoes of the area are fed, as shown in Figure 4.

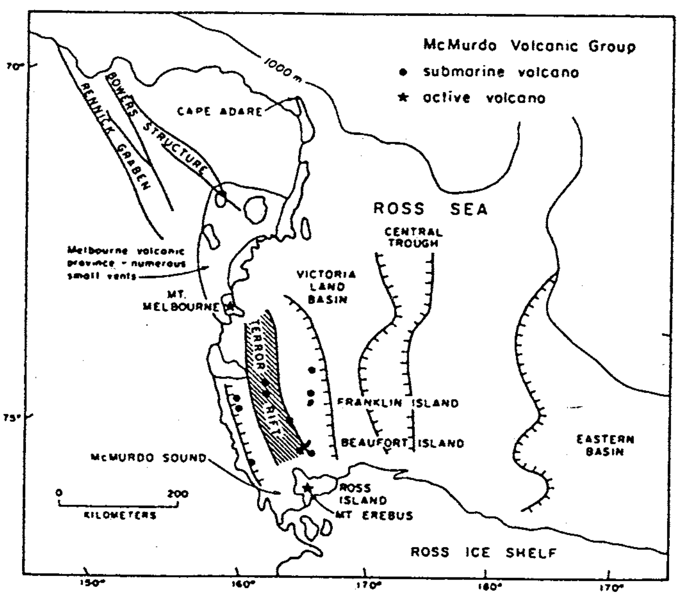



**Figure 5** – From Kyle (1990), showing a simplified tectonic map of the western Ross Embayment.

---

Lending additional evidence to the theory of the Ross Sea as a region of extension, gravity profiles done within constraints provided by another interpretation of seismic reflection data suggest that the crust beneath McMurdo Sound is being thinned. Variations in the gravity field are used to model the depth to the Moho: where the theoretical gravity does not correspond to the observed gravity around Ross Island volcanics, the difference is assumed to be due to a change in mantle depth. Crustal thickness is approximately 21 km beneath McMurdo Sound, and the crust is layered in this region to at least 14 km beneath the sound. The crust beneath the Transantarctic Mountains is layered only in the upper few km, and intracrustal layers dip away from the coast. (McGinnis, *et. al.*, 1985).

The crustal thinning interpretation is further supported by gravity data interpreted by Smithson (1972). Gravity measurements show that a negative Bouger anomaly of 130 mgal follows the Transantarctic Mountains and a maximum gradient of 7 mgal/km is found along the west side of McMurdo Sound. Surface faults cannot explain this high gravity gradient, and a deep fault offset in the Moho causes a gradient that is too small. The gravity anomaly is satisfied by a shallowing of the Moho from 40 km under the Transantarctic Mountains to 27 km under McMurdo Sound, and by a shallow, dense, 8 km thick body under McMurdo Sound.

Tessensohn and Worner (1991) propose that the Ross Sea depression and the Transantarctic Mountains are a tectonic entity and both are part of one large crustal feature: the Ross Sea rift system. The closest analogues to this are the Basin and Range Province and the East African Rift system. Both the Basin and Range Province and the East African Rift system are of similar size to the Ross Sea rift system, however the former are related to broad regional *uplift* on the scale of thousands of meters while the Ross Sea rift system has *subsided* on a similar scale. Tessensohn and Worner (1991) also propose two phases in the evolution and formation of the Ross Sea rift system: (i) phase one related to the Australia-Antarctica separation around 95 Ma was amagmatic and characterized by diffuse crustal attenuation and (ii) phase two commenced at about 50 Ma and caused more focused basin subsidence, shoulder uplift, and rift-type magmatism from 25 Ma to the present. It is this second phase that most resembles the development of the East African rift system.

Figure 6 illustrates a theory explaining the existence of the intraplate volcanics within the Ross Embayment, showing Mt. Erebus as an expression of hot-spot magmatism within the rift zone. Some substantiation for the hot-spot theory is that Ross Island is composed of three dormant volcanoes (Mts. Bird, Terra Nova, and Terror) surrounding one active volcano (Mt. Erebus), and that a similar trigonal geometry exists for the eruption centers surrounding Mt. Discovery to the south. The theory proposes that a mantle plume exists beneath Ross Island to account for the large volumes of magma erupted at Mt. Erebus. (Kyle *et al*, 1992).

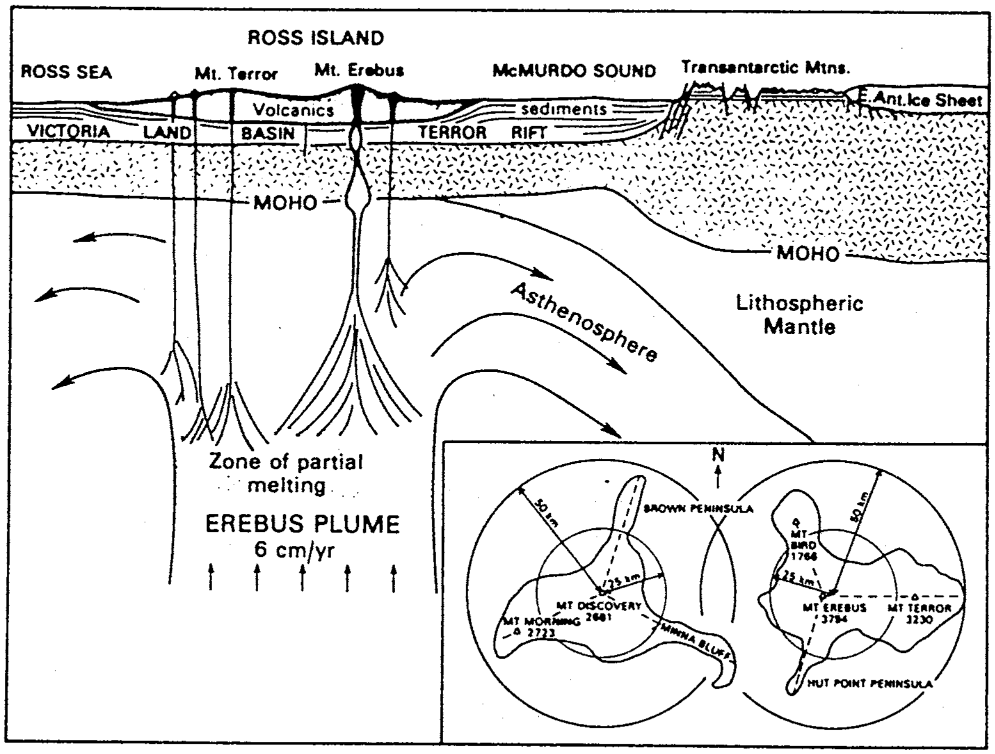



**Figure 6** – From Kyle *et al* (1992), showing the model of the Erebus mantle plume (not to scale). Inserts show the radial distribution of volcanic vents about Mt. Erebus and Mt. Discovery.

## Previous Seismic Work

Seismic studies of Mt. Erebus began in December 1974 when a temporary five-station seismic network of 2 km aperture was installed on the mountain. Dibble *et al.* (1984) used the 1974 recordings to obtain a first estimate of the shallow velocity structure of Mt. Erebus: an apparent velocity of 1.6 ± 0.2 km/s between 0.25 and 1.25 km distance from the summit.

In 1980, a permanent telemetered seismic network of 16 km aperture was installed by the International Mount Erebus Seismic Study (IMESS) project. This joint effort between Japan, New Zealand, and the United States monitored the seismic activity of Mt. Erebus until December 1986, during which time the number of seismic stations ranged between three and ten. Data were originally recorded on an analog 14-track tape recorder installed by the Japanese. Shibuya *et al.* (1983) located 162 events recorded during the 1981-1982 field season, and found that a homogeneous earth model of 2.1 km/s gave the smallest rms errors.

In the 1984-1985 field season, a large scale seismic experiment consisting of nine explosive shots was conducted at four sites greater than 4 *km* from the summit. Also, a small-scale seismic refraction survey was conducted near the summit in January 1985. The purpose of these surveys was to better determine the velocity structure of the mountain. Dibble *et al* (1994) summarizes this work, and Rowe (1988) used the results of the experiments to obtain the velocity model which is currently used for first order event locations:

$$V_p = 3.55 + (0.15)d,$$

where

$$d_{(summit)} = 0,$$

$$d_{(max)} = 7km.$$

Also,

$$velocity_{(half-space)} = 6.1 \ \ km/s,$$

and

$$\frac{V_p}{V_s} = 1.78.$$

In November 1986, a video surveillance camera and TV transmitter were installed at the crater rim . Frame by frame playback of the pictures allowed for visible explosions to be correlated to origin times of explosive events. The picture was displayed and videotaped at Scott Base and showed real time in hours, minutes, and seconds from a code generator synchronized hourly with the seismic telemetry clock. It was observed that the strombolian explosions preceded the calculated origin times of the accompanying earthquakes. For nine strong explosion earthquakes between December 16, 1986 and January 9, 1987, an apparent velocity of $4.06 \pm 0.09$ km/s was obtained for the summit region (using the six stations within 10.1 km of the summit), with an intercept time of $0.43 \pm 0.06$ s after the TV origin time. (Dibble *et al.*, 1994).

The large intercept time in the explosion experiment ocurrs because of very low velocities in and around the area of lava lake. One possible reason for this is that the magma column could be surrounded by as much as a 0.7 km radial thickness of scoria (Dibble *et al.*, 1994). Another explanation for low velocity is directly attributable to the lava: bombs show that the lava lake is vesicular, which markedly reduces seismic velocity. Dibble (1994) estimated the velocity of the lava lake using models of bubble growth in rising basaltic magmas with 0.5%, 0.75%, and 1% water and the theoretical acoustic velocity in bubbly liquids. He found the best fitting model of the lava lake has 0.5% water, 75% surface porosity, and 10 m explosion depth. The calculated velocities range from 20 m/s in the surface magma with 50% vesicles, increasing with depth at up to 100 m/s/m, to 2.3 km/s below the depth of nucleation (for basalt with 0.5% water, this is approximately 60 m). Ray paths originating from strombolian explosions at the top of the column curve strongly upward. High critical angles and reflection coefficients in the column inhibit the rays from pentrating into the rock wall.

After 1986, the network consisted of six stations used by the International Mount Erebus Eruption Mechanism Study (IMEEMS) of New Zealand and Japan. The objective of IMEEMS was to study the eruption mechanism and seismic activity of Mount Erebus. Unfortunately, as data reduction had usually been undertaken in Japan and communication was difficult to maintain between the international parties, U.S. interest in the network had lapsed by this time, and the network fell into disarray and disuse.

In December 1992, the seismic network was reactivated with the support of the National Science Foundation, and the Mount Erebus Volcano Observatory (MEVO) was born. Currently, a network of nine permanent seismic stations is in operation, and as a vast improvement over data acquisition of years past, a permanent PC-based triggered digital data acquisition system was installed in Crary Science Lab at McMurdo Station (Skov, 1994).

Seismic data are recorded at 100 samples per second at MEVO using a digital IASPEI XDETECT event-detection recording system (Lee, 1992). The data logger (PC) automatically transfers the data to a Sun Workstation at Crary Computing Center. After compression, the data files are transferred to New Mexico Tech and Victoria University of Wellington via INTERNET using the STARS communication link to Antarctica (Skov, 1994 and Skov *et al.*, 1994). See Appendix I for a more detailed description of the digital data acquisition system and the procedures involved in transferring and processing the data.

Digital data acquisition and automated INTERNET transfer have allowed for high quality data to be available for analysis in the United States and New Zealand within 1 day after being recorded at MEVO. The data base of events built with its use is the focus of this paper. Continuous analog recording is maintained to supplement the digital records and to allow for a count of small events that are not recorded by the triggered system.

Stations

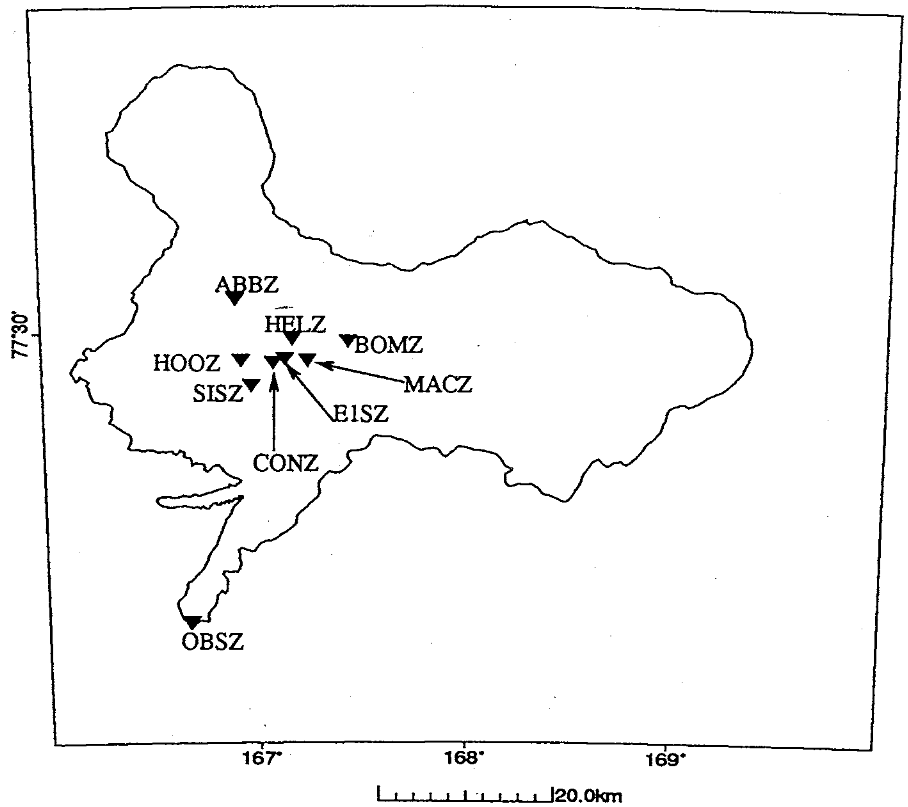



**Figure 7**– Stations in the current network.

There are a total of nine seismic stations operating in the current network, as shown in Figure 7. Eight of these stations are located on the mountain at elevations ranging from 1789 m to 3708 m, and one (OBSZ, previously named MCMZ) is on the peninsula at McMurdo Station at an elevation of 30 m. Permanent, telemetered, 1 Hz, vertical component seismometers were used to monitor the seismicity of the mountain and in the field season of 1995-1996, the seismometer at SIS was upgraded to three-components, primarily to improve estimates of S-wave arrival times and hence to better locate events in the summit region. Table 1 summarizes station information.

| Station | Latitude (degrees S) | Longitude (degrees E) | Elevation (m) | Installation Date (Da/Mo/Yr) | Carrier (MHz) | Tone (Hz) | Gain (dB) | Relay |
|---|---|---|---|---|---|---|---|---|
| ABBZ | 77.45699 | 166.90908 | 1789 | 19/12/80 | 169.825 | 1700 | 84 | HOOZ |
| BOMZ | 77.50895 | 167.44018 | 1961 | 20/11/81 | 165.809 | 2720 | 84 | MACZ |
| CONZ | 77.53463 | 167.08515 | 3453 | 11/84 | 163.809 | 680 | 72 | - |
| E1SZ | 77.53053 | 167.14075 | 3708 | 27/12/84 | 161.809 | 2720 | 72 | - |
| HELZ | 77.50538 | 167.17394 | 3309 | 30/11/94 | 154.565 | 2720 | 78 | ABBZ |
| HOOZ | 77.53159 | 166.93236 | 2121 | 19/12/80 | 164.864 | 1020 | 78 | - |
| MACZ | 77.53247 | 167.24639 | 3332 | 12/89 | 167.809 | 1020 | - | - |
| OBSZ | 77.85081 | 166.67999 | 30 | 11/94 | phone line | - | 84 | - |
| SISZ | 77.56282 | 166.97749 | 1737 | 28/11/94 | 162.809 | 1700 | 78 | - |
| SISE | 77.56282 | 166.97749 | 1737 | 28/11/95 | 162.809 | 2720 | 78 | - |
| SISN | 77.56282 | 166.97749 | 1737 | 28/11/95 | 162.809 | 1020 | 78 | - |

**Table 1**– Station information.

---

All stations except OBSZ which is a telephone circuit, use frequency modulated analog telemetry. "Relay" refers to an intermediate relay station between the geophone station and the recording station needed to achieve line of sight radio paths. "Gain" refers to the amplifier setting at the seismograph. Positive values in dB refer to Geotech amplifiers for which 0dB is a gain of 1. All vertical geophones are Mark Products L-4c with 5500 ohm coils, 1s period, EMF 27.6 V/m/s, and critical geophone damping. (Dibble, personal communication, 1996).

All 9 stations do not presently function year round due to lack of sunlight and subsequent low battery power during the winter season. Table 2 lists the months in the study period and marks which stations were functioning reliably for more than half of any given month.

Table 2 shows that station operation was more successful in the Austral winter of 1996 than in that of 1995. This is due to the installation of more batteries per station. Future upgrades may allow station coverage to continue reliably throughout the year.

| | ABBZ | BOMZ | CONZ | E1SZ | HELZ | HOOZ | MACZ | MCMZ | SISZ | SISE | SISN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nov94 | x | x | x | x | x | x | x | x | x | | |
| Dec94 | x | x | x | x | x | x | x | x | x | | |
| Jan95 | x | x | x | x | x | x | x | x | x | | |
| Feb95 | x | x | x | x | x | x | x | x | x | | |
| Mar95 | x | x | x | x | x | x | x | x | x | | |
| Apr95 | | x | x | x | x | x | x | x | x | | |
| May95 | | x | x | x | | x | x | x | x | | |
| Jun95 | | | x | x | | x | x | x | | | |
| Jul95 | | | x | x | | x | x | x | | | |
| Aug95 | | | x | | | x | | | | | |
| Sep95 | x | | x | x | | x | x | | x | | |
| Oct95 | x | x | x | x | x | x | x | x | x | | |
| Nov95 | x | x | x | x | x | x | x | x | x | x | x |
| Dec95 | x | x | x | x | x | x | x | x | x | x | x |
| Jan96 | x | x | x | x | x | x | x | x | x | x | x |
| Feb96 | x | x | x | x | x | x | x | x | x | x | x |
| Mar96 | x | x | x | x | x | x | x | x | x | x | x |
| Apr96 | x | x | x | x | x | x | x | x | x | x | x |
| May96 | x | x | x | x | x | x | x | x | x | x | x |
| Jun96 | x | x | x | x | | x | x | x | | | |

**Table 2**– Operational history of current network.

# Events of the Study Period

There were over 3,000 events digitally recorded during the study period November 12, 1994 to Julu 31, 1996. Figure 8 shows the daily number of digitally recorded events.

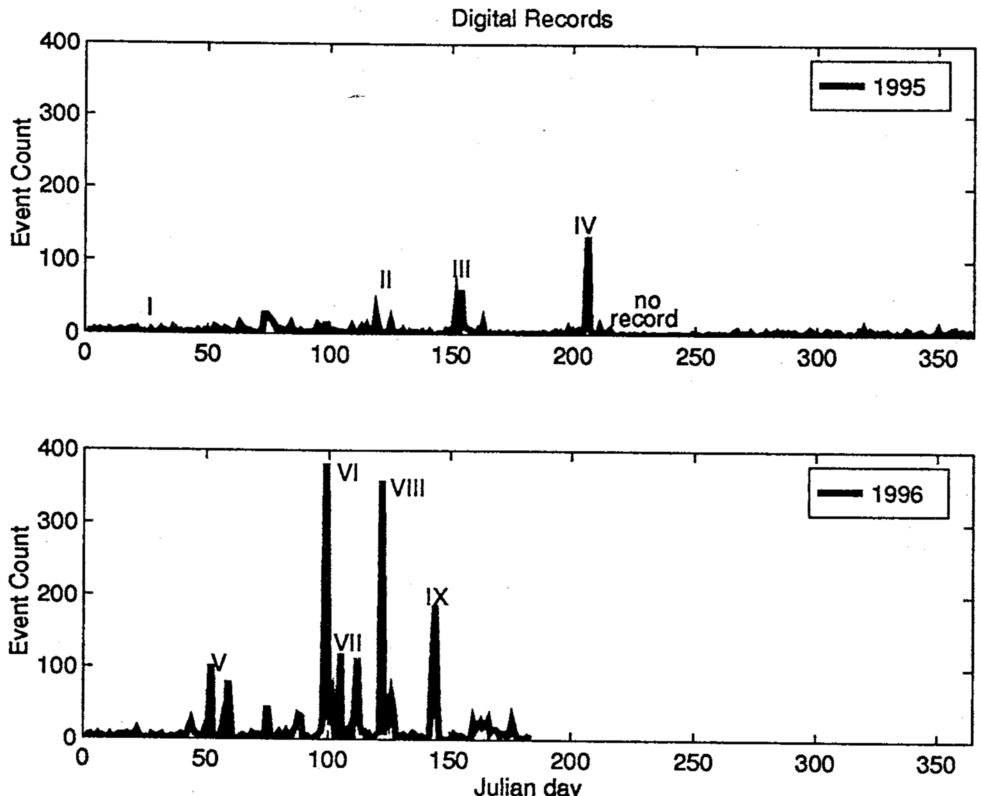



**Figure 8** – Histogram of digitally recorded events for 1995 and 1996. Swarms are numbered and discussed in the text.

Roman numeral I marks a period of tremor and Roman numerals II-IX mark swarms which are later discussed in *"Swarms"*, beginning on page 50.

To estimate the performance of the triggered system, analog events were counted on station CONZ for part of 1995 and are compared to the digital recordings for the same time period, as shown in Figure 9. Note the bias in counting statistics imposed by the digital system, which is more sensitive to swarms containing larger events that are more likely to carry the network (e.g., [III] compared to [IV]).

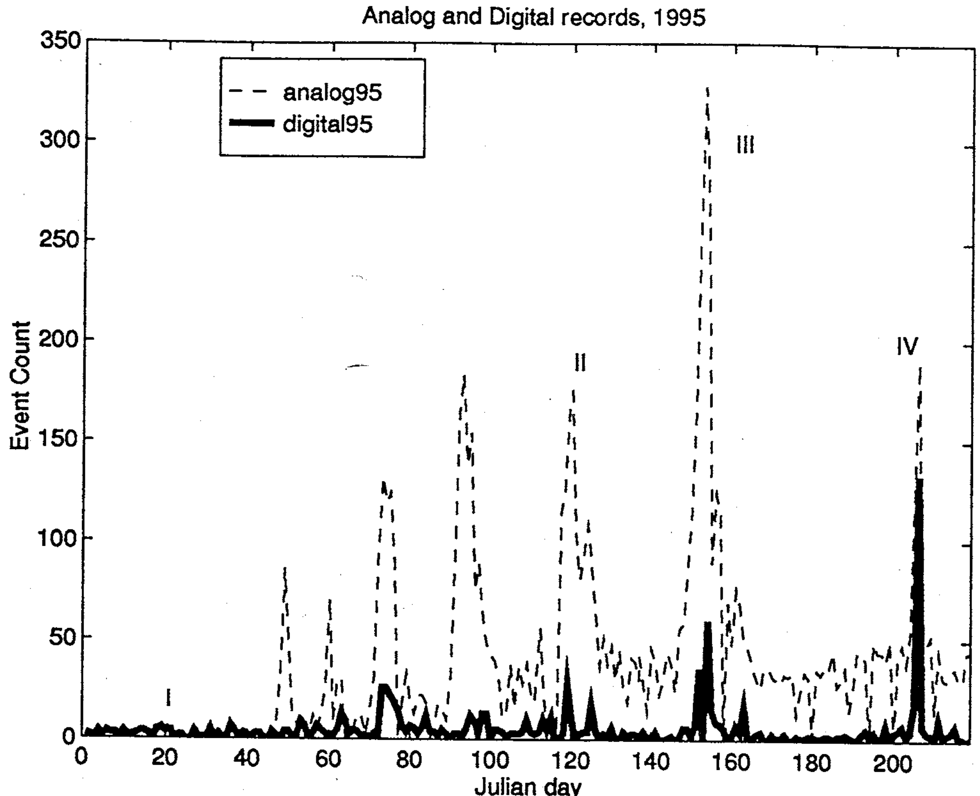



**Figure 9** – Comparison of analog and digital records for 1995.

Notice that overall, the peaks in the CONZ analog count correspond to peaks at the same time in the digital count, but that the CONZ analog count is far greater than the digital. The mean number of events per day in the analog record is ten times greater than the mean number of events recorded digitally, as summarized in Table 3. Many of these events are small, however, and would not be observed at other stations and would thus be unlocatable if recorded digitally.

| | Mean Number of Events per Day | Maximum Number of Events in One Day |
|---|---|---|
| ANALOG | 50 | 328 (swarm III) |
| DIGITAL | 5 | 133 (swarm IV) |

**Table 3**– Comparison of mean and maximum number of events for analog and digital records.

Event Classification - Overview

There are several ways documented in the literature to define the various volcanic event types. There is no unique scheme because each author prefers to define events according to personal understanding of his or her particular volcano of interest. Since volcanic events have so many similarities the world over, it is merely a matter of recognizing the type and knowing which of the various definitions match it. For example, Table 4 summarizes volcanic event types as defined by Minikami (1963), and Table 5 summarizes (essentially the same) volcanic event types as defined by Malone (1983).

| Event Type | Description |
| --- | --- |
| A | Tectonic origin, s-phases often apparent, generally deep |
| B | Indicator of internal activity of volcano, s-phase often not recorded, generally shallow |
| E | Explosion earthquake, originating near crater floor |
| Tremor | Continuous train of earthquake motion, originating from deep within the volcano |

**Table 4**– Volcanic event types as defined by Minikami (1963) .

| Event Type | Description |
| --- | --- |
| h | High-frequency, impulsive arrivals |
| m | Medium-frequency, distinct first arrival but not very impulsive, poor s-arrival |
| *l* | Low-frequency, very emergent first arrival, no distinct s-arrival |

**Table 5**– Volcanic event types as defined by Malone (1983).

Events as defined by Minakami (1963) correspond to the classification developed by Malone (1983) in the following way:

(i) A-type events are type *h*.

(ii) B- and E-type events are type *m*.

(iii) Tremor events are type *l*.

Many authors use the classic definitions given by Minikami (1963), (e.g. Dibble *et al.*, 1984), while other authors prefer to develop their own definitions (e.g. Malone, 1983).

Arguably the most descriptive classification scheme is described by Chouet (1996), and is summarized in Table 6. Chouet (1996) uses two broad categories to describe nonexplosive volcanic events, and recognizes that hybrid events show mixed characteristics of each. LP refers to long-period events which originate in fluid processes (LP tremor is thought to have the same source mechanism and differs only in duration) and VT refers to volcano-tectonic events which originate in solid rock processes.

| Event Type | Description |
|---|---|
| LP | Frequency content up to 13 Hz, peaking around 1.5 Hz; long, harmonic coda; generally originates from a particualr spatial and temporal distribution; fluid process |
| VT | Significant frequency content up to 15 Hz, peaking around 6-8 Hz; short broad-band coda; clear s-phases; may be deep or shallow and generally spread out in space and time; process of solid rock shear-failure |

**Table 6**– Volcanic event types as defined by Chouet (1996).

This modern classification according to Chouet (1996) is widely used and generally matches the classic definitions described by Minikami (1963) in that LP events are B-type events and VT events are A-type events. The two names are used interchangeably in this paper.

It is interesting to note that, although event classifications were modified and refined over the decades by various volcanoseismologists throughout the world, they have all essentially recognized the same types of events occurring at different volcanoes.

## Event Types Recognized at Erebus

The breakdown of the +3000 events recorded digitally at MEVO as of July 31, 1996 is as follows:

| Event Type | Number |
|---|---|
| LP | 2058 |
| E-type | 732 |
| VT | 96 |
| Hybrid (characteristics of both LP and VT) | 125 |
| Regionals (highly emergent and outside array) | 146 |
| Teleseisms | 14 |
| Total | 3171 |

**Table 7**– Event types and number recorded digitally at MEVO

By far the most common type of event is LP: over two-thirds of the events recorded digitally at MEVO are long-period. The high percentage is partly due to the large number of LP events that repeatedly occur during swarms, but also during normal periods it is the LP events that consistently occur, usually 3-5 per day. However, while LP may be the most frequent events, they are overall the least well located, because of severally emergent first arrivals and lack of S-phases, as will be shown in the following sections.

There are surprisingly few VT events for so large a data set. The number of VT events could be considered to be greater than the number shown here if the LP/VT hybrid-types are included, but to be consistent, only events that are undeniably rich in high frequencies and have clear s-phases are listed in Table 7 as VT.

### *Magnitudes*

Table 8 summarizes duration magnitude by event type for located events.

Duration magnitude is calculated in the *Hypoe* location program using the coda length. with the unclaibrated local formula:

$$M_d = 2log_{10}(f - p) - 1.15$$

where the $f - p$ interval is the time from the P-arrival to the point where the peak-to-peak amplitude of the signal drops below the background noise. These

Duration Magnitude

| | Mean | Max |
|---|---|---|
| VT | 1.04 | 2.20 |
| LP | 1.97 | 2.30 |
| E-type | 0.74 | 2.20 |

**Table 8**– Mean and maximum duration magnitudes for each event type.

coda magnitudes are therefore used only to measure relative event size, and have no simple physical meaning. The calculation has a very narrow range (from approximately $M_d = 0.8$ to a maximum of $M_d = 2.3$), because it is log based and because our trigger length is limited to 60 s. See the HYPOELLIPSE manual (Lahr, 1994) for more details, and also look in headopts.prm in */usr/local/src/Hypoe/Erebus* on the NMT geophysics/hydrology domain for other parameters with which *Hypoe* and *Xpick* are set.

Note that the mean duration magnitude of E-type events is 0.74 and the maximum is 2.20. These numbers are unrepresentative of large explosion events because the current de-trigger parameter terminates many of the digital records prior to the time that the coda fades into the background. Also note that while the maximum duration magnitudes for VT and LP events are approximately equal, the mean duration magnitude of LP events is nearly twice that of VT events.

## Seismograms and Spectra

One example seismogram of each event type and its corresponding frequency spectra are shown in the following sub-sections, but there are many more high quality events of interest in the digital record than can be shown here. A few more examples of each, plus interesting examples of other varieties (hybrid, the complete tremor picture, exceptional and unusual events coined "*WOW* events", swarm activity, and events that are exceedingly strong at one station) are shown in Appendix III. Hard copies of the complete digital catalogue have been maintained and are stored in MSEC 351 at New Mexico Tech.

*VT events*

Only 96 events out of the +3000 events recorded in the study period have been classified as VT. VT events are distributed in time throughout the study period and usually do not occur in swarms. It is important to note that an unusually large number of VT events did occur within a short time period after an extended period of LP activity (April-May, 1996). This is not considered "swarm" activity, however, because relative to the number of events that occur in LP swarms, the increased VT activity was modest. This increase in VT activity is discussed later in *"Interpretations"*. Although VT events have one of the overall lowest percentages of occurrence in the data set (less that 1%), they have the highest percentage of reliable locations due to impulsive arrivals and plentiful S-phases: 93% of all the VT events are considered to be well located (see *"Locations"* section, beginning on page 43). Table 9 summarizes these statistics on VT events.

| | Total VT events in data set | VT events occurring in swarms | VT events located |
|---|---|---|---|
| Number | 96 | 0 | 90 |
| Percentage | less than 1% | 0% | 94% |

**Table 9**– Breakdown of VT events recorded at MEVO from November 1994 to June 1996.

VT events occur in brittle rock around the magma reservoir and conduit and indicate the brittle response of the volcanic edifice to stress perturbations caused by the intrusion or withdrawal of fluids. Thus they differ in the origin of the local deviatoric stress from purely tectonic events, which are driven by large-scale plate motions, but their signatures are indistinguishable from those of pure tectonic microearthquakes.

Figure 10 is an example of a VT event observed at Mt. Erebus. It is characteristically quite impulsive and S-phases are distinct at ABBZ, CONZ, HOOZ, SISZ, SISN, and SISE. This event is rich in high frequency energy, as seen in Figure 11 showing spectral content at each station that recorded this event. A 10 second window beginning at the first arrival was used to obtain these spectra.

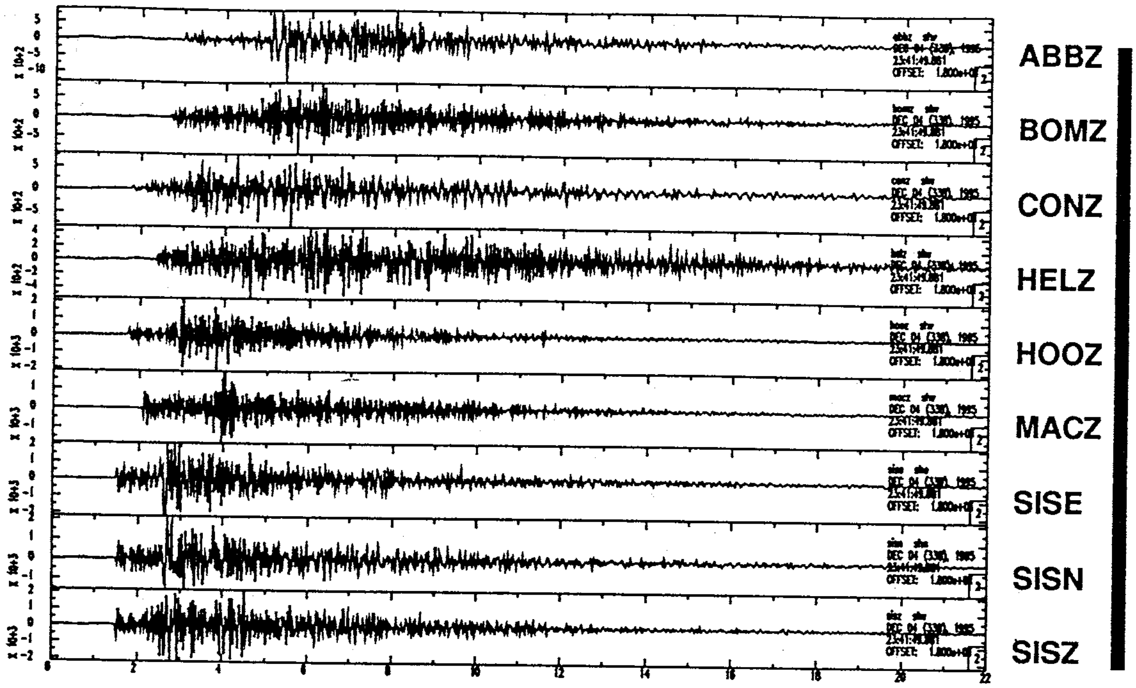



**Figure 10** – Seismogram of a VT event occurring on December 4, 1995, 23:41:49 UT; 77 S 33.31, 167 E 4.83, d = 3.05 km below sea level, duration magnitude = 1.8.

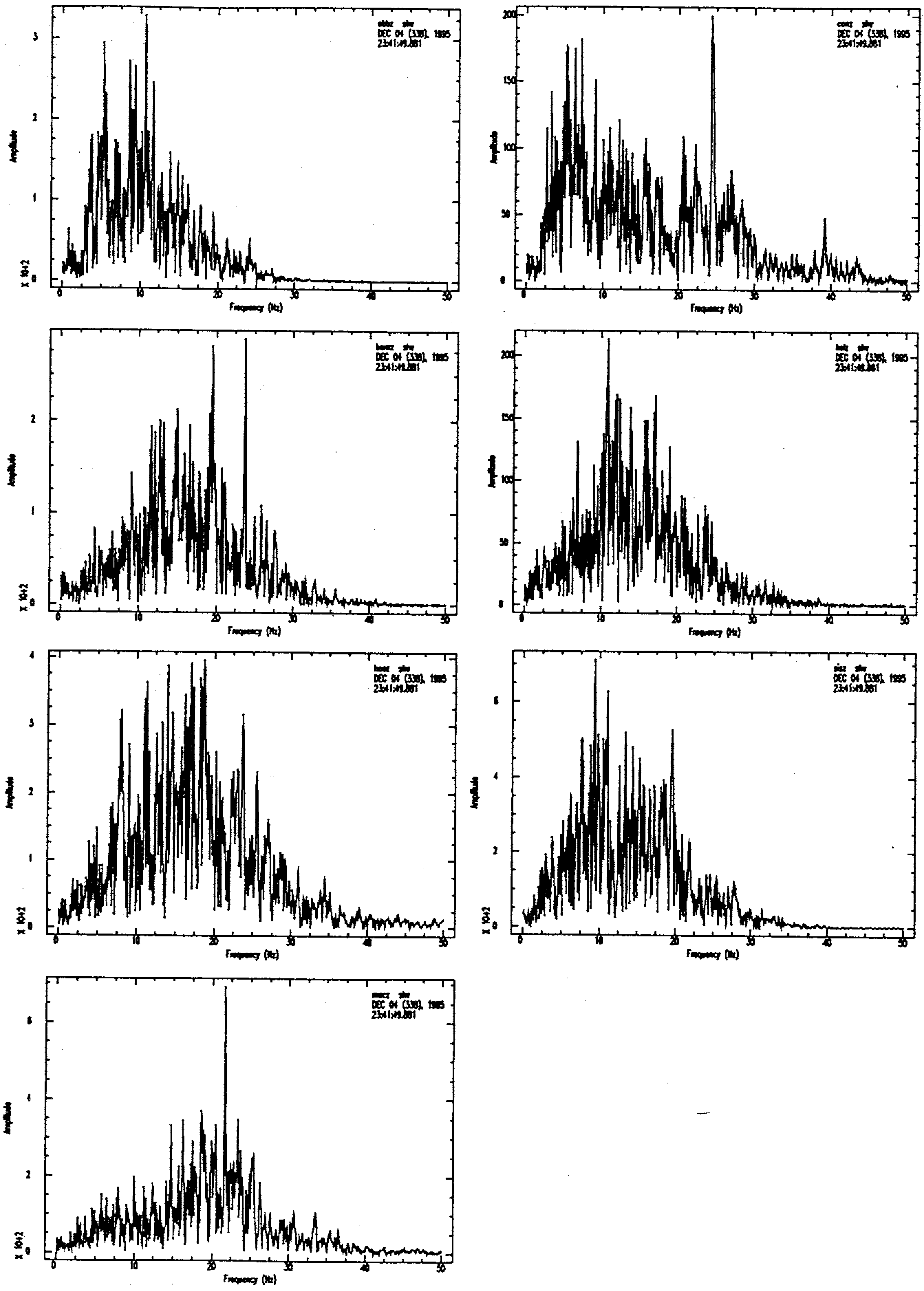


**Figure 11** – Spectral content of VT event shown in Figure 10.

*LP events*

LP events make up the largest percentage of the total data set (approximately 65%). Over 500 LP events occurred during swarms, which account for more than one-quarter of the total number of LP events. Of the 2058 events classified as LP, only 405 are considered to be well located (this is approximately 20%, the lowest location percentage of the three event types). The rest either are too emergent to be confidently picked are not well recorded at enough stations to provide a reliable location, or are significantly outside the array. Also, the events due to swarm activity are generally poor quality events (small and recorded incidentally or overlapping) and are not included in the location catalogue (see Appendix III for example seismograms of LP swarm activity). Table 10 summarizes some statistics on LP events.

| | Total LP events in data set | LP events occurring in swarms | LP events located |
|---|---|---|---|
| Number | 2058 | 535 | 405 |
| Percentage | 65% | 26% | 20% |

**Table 10**– Breakdown of LP events recorded at MEVO from November 1994 to June 1996.

---

Figure 12 shows an example of an LP event. Note the emergent first arrival, as described by Chouet (1996) for LP events, and the absence of a clear S-arrival.

It may appear that an S-arrival occurs a few seconds after the first arrival at some stations for this event. However, attempts to locate events using this as an S-phase show that this is an artifact of the fluid source (possibly a vibration, a mode, or a reflection off one of the many conduit interfaces) and not a real S-arrival. These false S-arrivals occur repeatedly for LP events, and are sometimes optimistically included as phase picks in the location solution. Usually this results in a wild solution (having an extremely large rms residual, a location in the ocean, or similar unacceptable features), and the alleged S-arrival must be discarded. It appears possible, though, for an LP event to have some shearing component, and occasionally a successful S-pick is made (although it is not clear if such arrivals are truly direct S-phases).

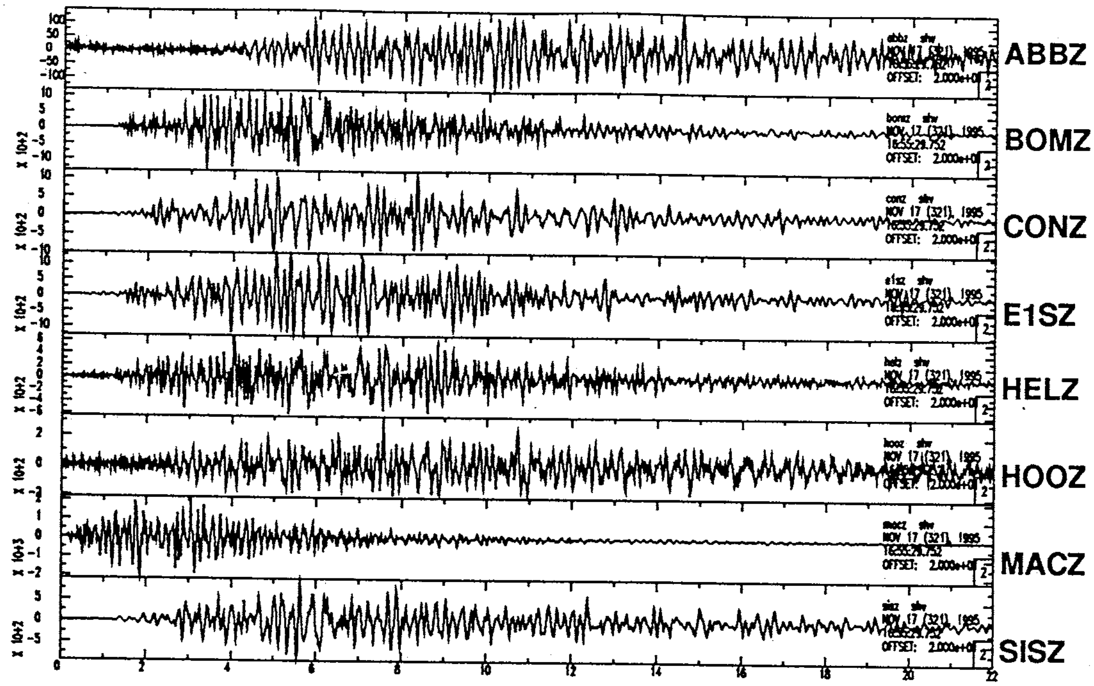



**Figure 12** – Seismogram of an LP event occurring on November 17, 1995, 16:55:29 UT; 77 s 33.15, 167 E 15.84, d = 3.01 km above sea level, duration magnitude = 1.9.

---

However, S-arrivals are picked on LP events only when they are very distinct. The installation of the horizontal seismometers SISE and SISN was useful in determining that these arrivals are not S-waves because alleged S-phases on the horizontal recordsare typically no more distinct than on the vertical.

Figure 13 shows spectrograms for a 15 second window beginning with the first arrival of this event. Chouet (1996) describes spectra of LP events peaking around 1.5 Hz, but Mt. Erebus LP events tend to peak higher than this (around 4-5 Hz). It is possible that a brittle failure source component more often accompanies fluid flow on Mt. Erebus than on other mountains, and thus contributes more high frequency energy to the event or that Mt. Erebus has a higher Q than most other volcanoes, due to its unusual phonolitic composition.

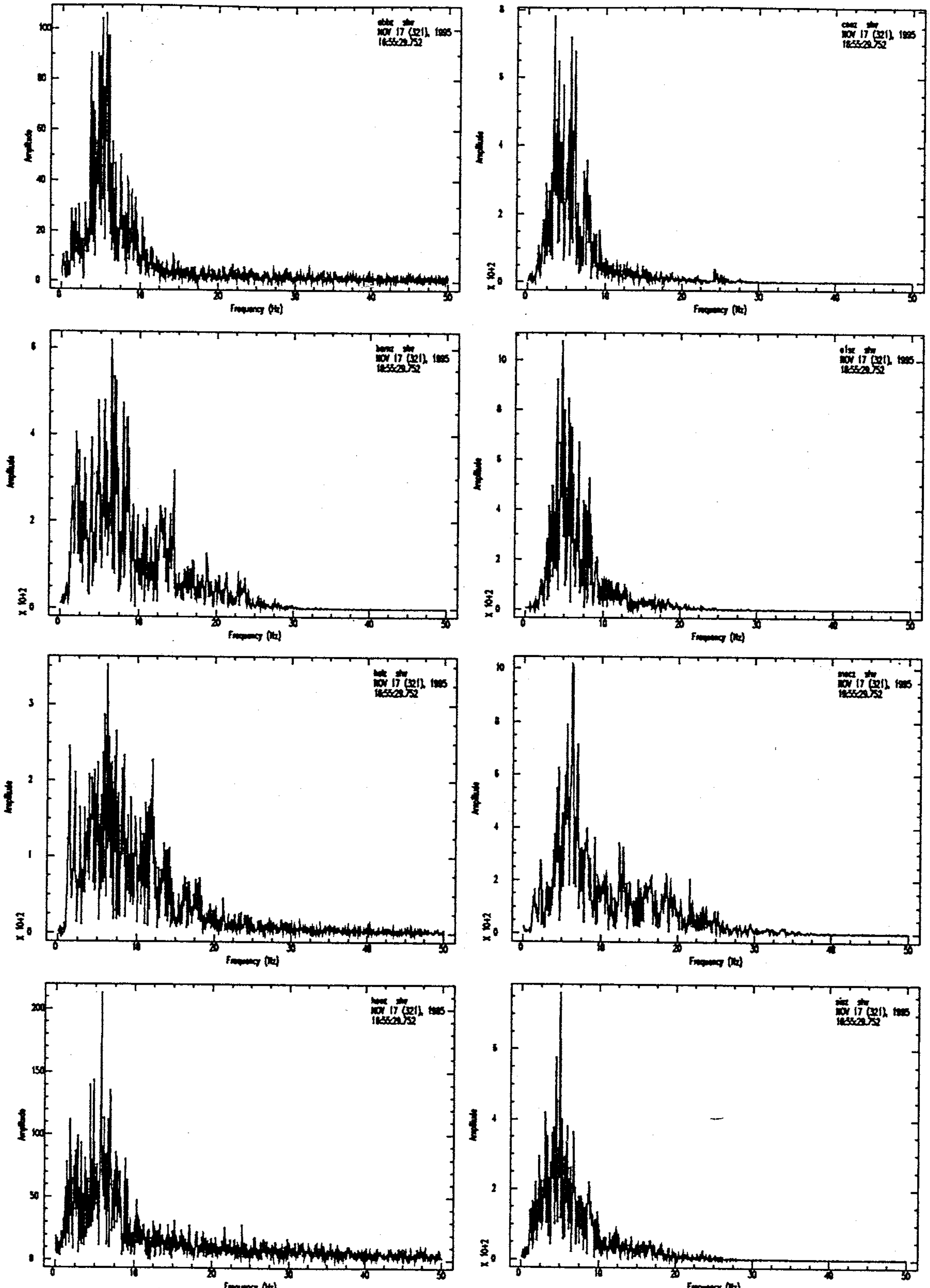



Figure 13 – Spectral content of LP event shown in Figure 12.

*E-type Events*

E-type events comprise approximately 23% of the total data set. Over 230 E-type events occurred during two main periods of explosion swarms, and this accounts for over one-third of E-type activity. Of the 732 events identified as E-type, 213 of them (approximately 29%) are well located . Table 11 summarizes the statistics for E-type events.

| | Total E-types in data set | E-types occurring in swarms | E-types located |
|---|---|---|---|
| Number | 732 | 235 | 213 |
| Percentage | 23% | 32% | 29% |

**Table 11**– Breakdown of E-type events recorded at MEVO from November 1994 to June 1996.

---

It would seem that E-type events should be successfully located because they are central to the array. However, this is not the case for at least three reasons: (1) often the p-arrival is blurred at the summit stations due to the effect of the low frequency precursor (bubble phase) and an accurate pick is difficult, (2) there are no S-phases associated with E-type events, and (3) the near-summit velocity structure may be poorly modeled (particularly the lava lake/host rock interface).

Video observations made by Dibble *et al.* (1988) have identified four categories of explosions:

(1) Strong explosions of incandescent ash and bombs from the lava lake.

(2) Medium explosions of bombs but no ash.

(3) Weak explosions in which an incandescent bubble domes up, ruptures, and folds back, with few or no bombs.

(4) Eruptions of ash from vents beside the lava lake.

Video observations show that explosions typically occur when the lava lake is not convecting, and that the glowing center of the lake begins to bulge up and glow brighter approximately 1-2 seconds before the explosion.

Figure 14 shows an example of an E-type event. This type of event is not directly described by Chouet (1996), although it is similar in spectral content to LP events. Minikami (1963) recognizes these types of events as explosion events. On Mt. Erebus, E-type events are directly attributable to gas bubble explosions in the summit lava lake (Dibble *et al.*, 1994).

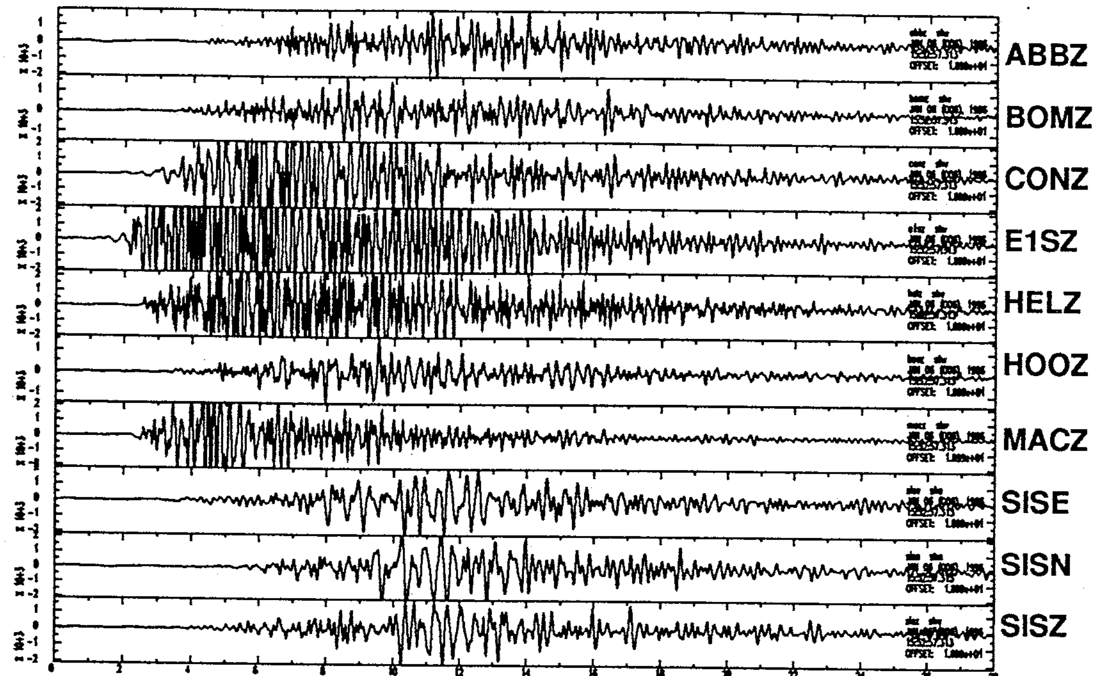



**Figure 14** – Seismogram of an E-type event occurring on January 6, 1996, 15:52:57 UT; 77 S 31.35, 167 E 9.85, d = 2.86 km above sea level, duration magnitude = 2.1.

Notice the low frequency precursor that is evident on E1SZ (the station located on the crater rim and closest to the lava lake). This signal often accompanies E-type events, and is probably due to the oscillations of exsolved lava bubbles prior to the explosion. The other key to distinguishing E-type events from LP events is that E-type events virtually always clip on E1SZ, and usually do so on the other summit stations (CONZ and HELZ) as well.

Spectra from stations that did not clip are shown in Figures 15. Notice that the spectra are roughly identical to those of LP events (Figure 13).

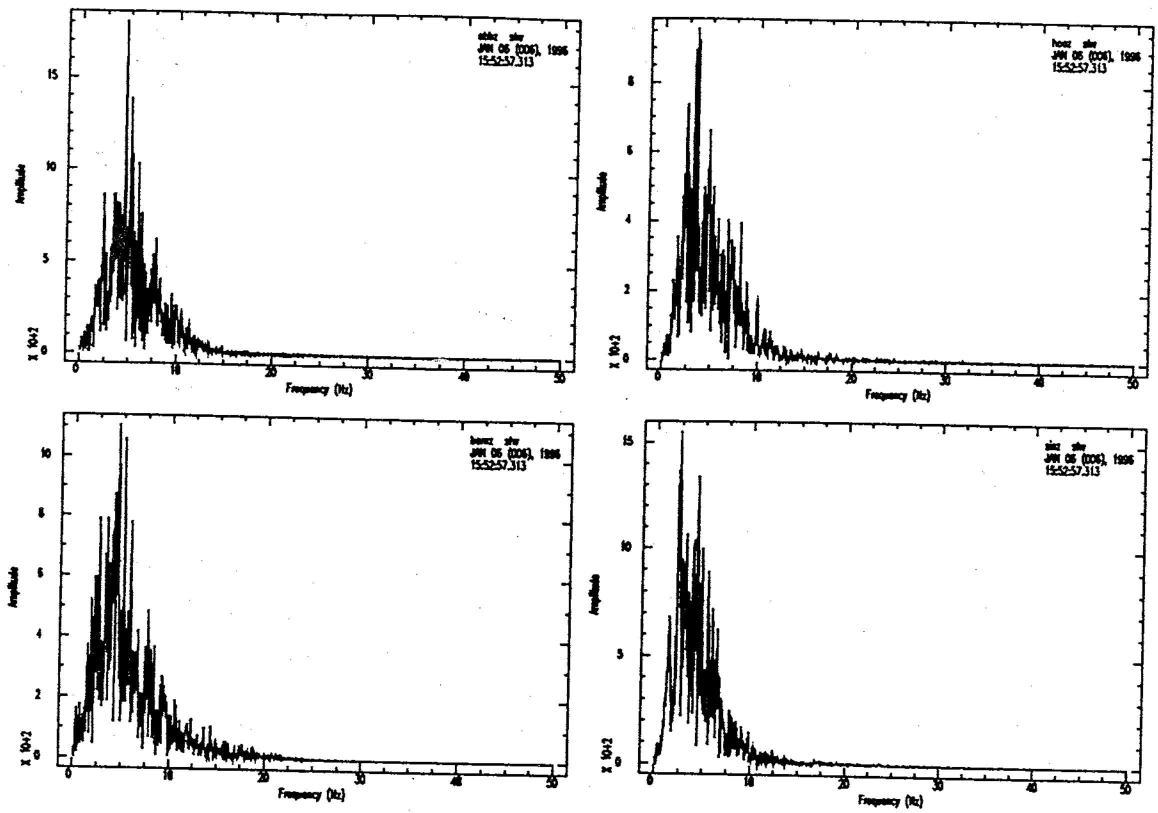


**Figure 15** – Spectral content of E-type event shown in Figure 14.

*Tremor*

Figure 16 is an example of long-period tremor that was digitally recorded for approximately 5 minutes on January 31, 1995. The dominant frequency changed over the five minutes that the tremor was recorded (from approximately 5 Hz at the start of the record to approximately 2 Hz after several minutes). This type of sustained tremor has not been digitally recorded since, however many LP events appear to be very nearly like isolated tremor.

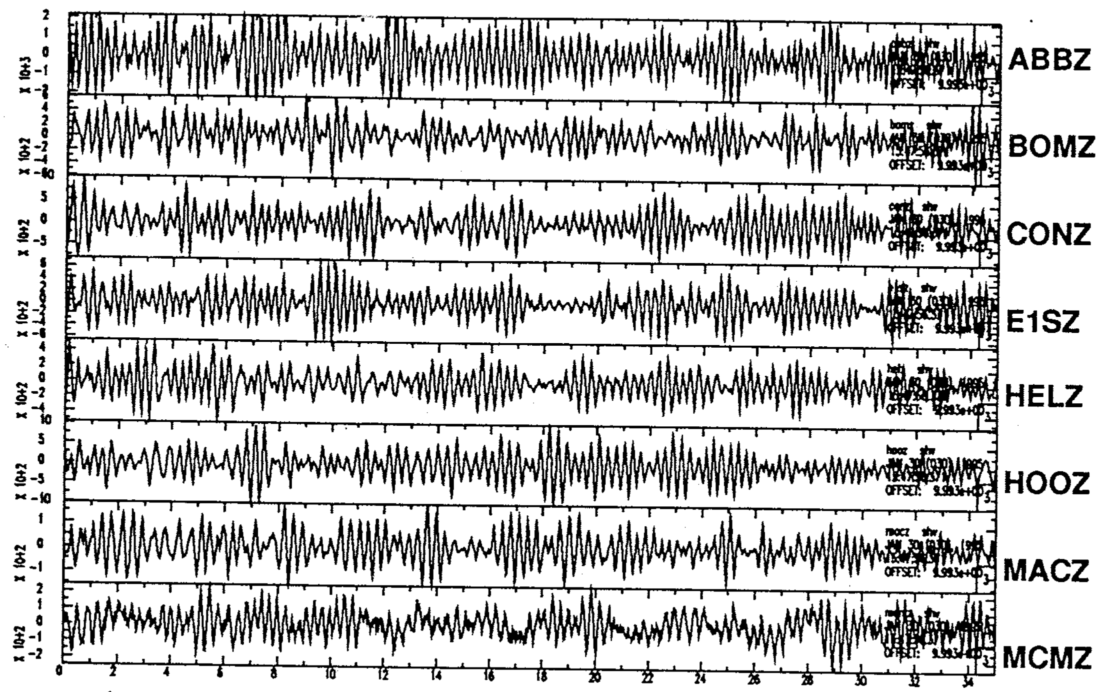



**Figure 16** – Tremor: January 31, 1995; cannot be located with travel-time analysis. Duration in digital record = approximately 5 min., duration in analog record = approximately 15 min.

It is interesting to note that this tremor was well recorded at MCMZ, 35 km away from the mountain, suggesting a deep focus and large amplitude source.

Figure 17 shows spectral content at each station.

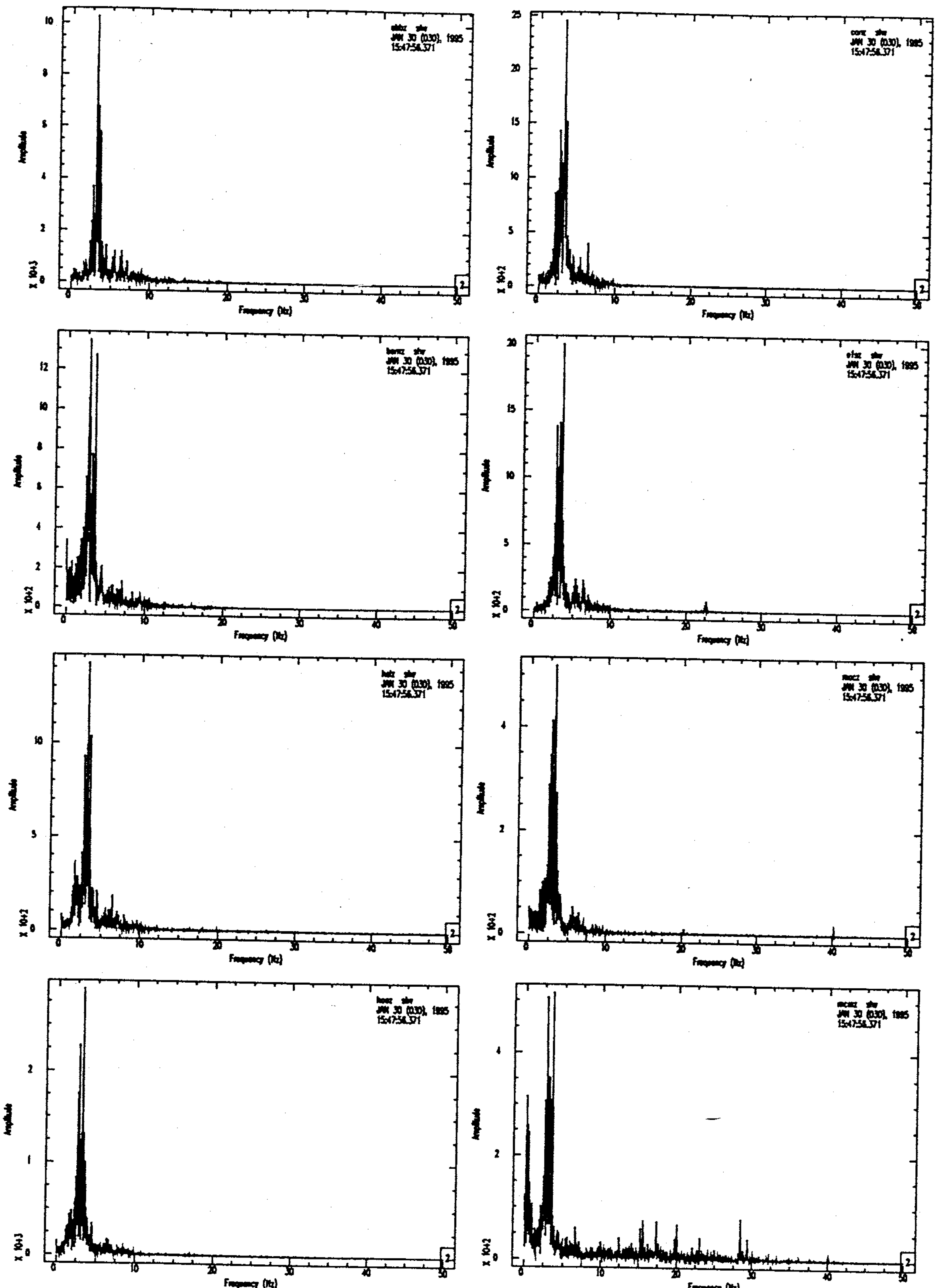


**Figure 17** – Spectral content of tremor shown in Figure 16.

Chouet (1985) states that tremor results when modes of vibration in a volcanic pipe or crack have been excited by the motion of fluid in response to a perturbation in pressure. Sustained harmonic tremor, like that in Figure 25, probably results from the superposition of the responses of a volcanic conduit to many individual pressure pulses. Thus, it is likely that this period of tremor occurred as a result of a large upwelling of magma from depth.

Ferrick *et al.* (1982) propose that the source mechanism of both tremor and LP events is unsteady fluid flow in a conduit system (unsteady fluid flow is time dependent). This fluid dynamic source model exhibits all the features attributed to tremor:

(1) The source is stationary during an individual episode.

(2) The source location can vary between episodes.

(3) A frequency spectrum with strong lines is produced.

(4) The dominant frequency of the spectrum can change during the course of the activity.

Items (3) and (4) are both true for the tremor observed at MEVO. Items (1) and (2) cannot be determined with arrival-time methods because there is no record of the onset of the tremor, but it may be possible to locate the source region using other methods (spectral, amplitude, etc.).

*Icequakes/Tornillos*

There is another type of event observed at MEVO, but one that is not necessarily associated with volcanic seismicity: icequakes. Ice-quakes have been perplexing as well as interesting in the digital record for Mt. Erebus, and their importance or irrelevance has so far not been established.

The peculiar waveform recorded at MEVO shown in Figure 18 is probably caused by an icequake. It is extremely impulsive, high frequency, and has a rapidly decaying coda. The shape of this type of event has earned it the name *"tornillo"* which means "screw" in Spanish.

Tornillo sources are very close to recording stations because they are not seen across the array (they are recorded incidentally) and they have a very high frequency (and thus low attenuation path).

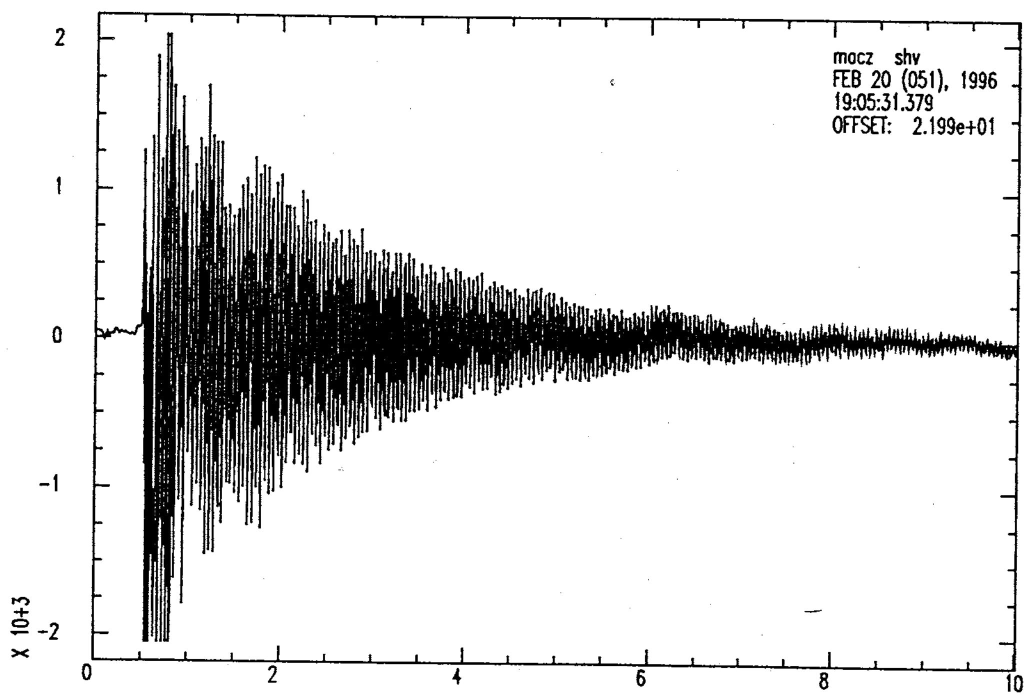



**Figure 18**– Tornillo at MACZ.

Figure 19 shows the high frequency and narrow band spectral content of the tornillo shown in Figure 18.

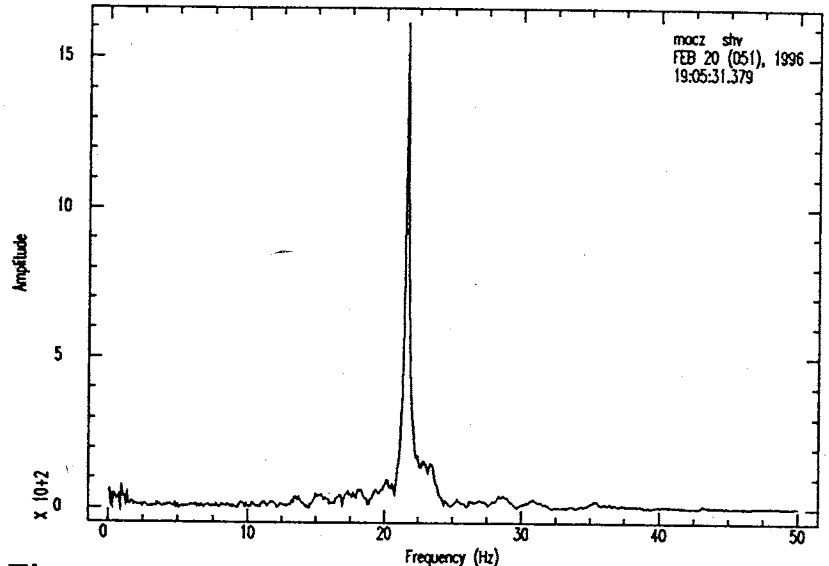



**Figure 19** – Spectral content of tornillo at station MACZ

---

Crevasses on a glacier are clear evidence that extensional faulting occurs near the surface (Neave and Savage, 1970) and it is thought that some recorded events are the result of a stick-slip type of motion taking place at the bed of the glacier (Weaver and Malone, 1979).

Weaver and Malone (1979) reported that icequakes observed on three Cascade volcanoes exhibited an annual trend, with more events being recorded in the summer than during the winter. It is tempting to look for this pattern on Mt. Erebus as well. Swarms that included numerous icequakes occurred in March and June, 1995 and again in February and May, 1996. This may suggest an annual trend in glacier-quake activity, however note that this time period represents the Austral *autumn* and is complicated by weather conditions. Further, inspection of these swarms has shown that a significant amount of volcanic seismicity occurred during this time period (see the following *"Swarms"* section). The relationship of seasonal or volcanic variations in icequakes is uncertain at this time.

It is possible that not all tornillos on Mt. Erebus result from icequakes. Torres *et al.* (1996) report swarms of tornillos were observed previous to and during the 1992-1994 eruptions of Galeras Volcano in Columbia. They propose that a direct relationship exists between the occurrence of tornillos and the volume of material ejected during the eruption. They believe that the appearance of tornillo events may be an indication of physical interaction and conditions between the fluid flow and the neighboring solid material in the conduit. The increase in the duration of the tornillo events and the lowering of the dominant frequencies before eruptions suggest an increasing impedance contrast between the surrounding solid material and the magma, which may be explained by an increase in the free gas phase in the magma. Thus, Torres *et al.* (1996) propose that the characteristics of tornillos and the observed eruptive activity may provide evidence about the essential role of gas in volcanic eruptions. Figure 20 shows examples of two tornillos and one LP event recorded at Galeras Volcano.

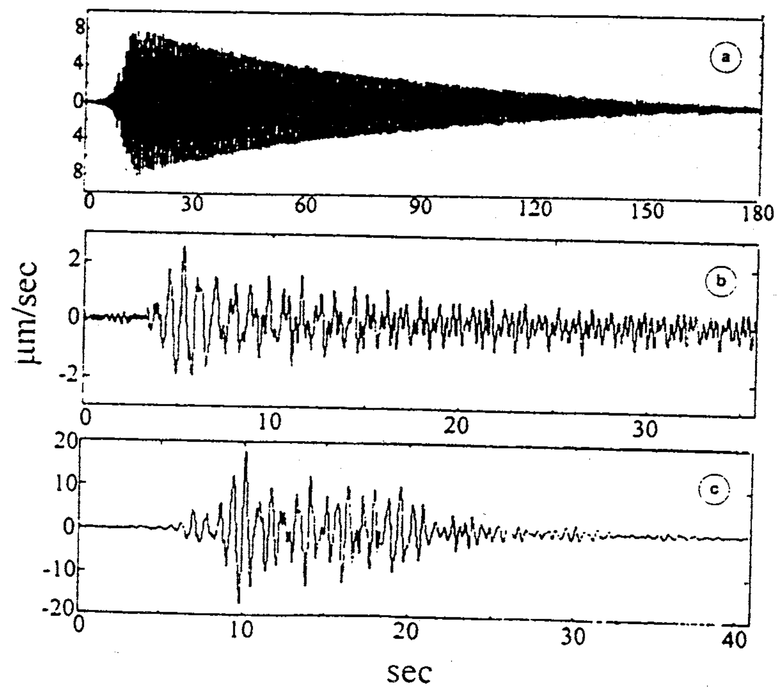



**Figure 20** – From Torres *et al.* (1996), showing examples of seismic signals at Galeras Volcano, Colombia: (a) a tornillo recorded on June 4, 1993. The duration is 206 s. (b) a tornillo observed on January 6, 1993. The duration of the signal is 53 s and the signal shows a domain of low frequencies on the onset. (c) an LP event recorded after the March 23, 1993 eruption.

Notice that the tornillo shown in Figure 20(a) is of a very long duration, much longer than that of the Mt. Erebus tornillo shown in Figure 18. No event of such duration has been recorded digitally at MEVO, however tornillos have been recorded at Mt. Erebus that exceed 30 s in duration, which is comparable to the Galeras tornillo shown in Figure 20(b).

Arcila (1996) also observed the appearance of tornillo events on Purace Volcano in Colombia. The appearance of tornillo events at Purace Volcano followed a slow increase in the number of LP events and a period of modulated tremor that began after the 1994 Paez earthquake possibly reactivated faults which cross the base of the Purace edifice. Arcila (1996) shows a seismogram of a tornillo event of approximately 60 s duration, which is comparable to some tornillos recorded on Mt. Erebus.

Glaciers do not apparently exist on the Colombian volcanoes discussed by Torres *et al.* (1996) and Arcila (1996), and they make no mention of icequakes as possible causes for tornillos. It is almost certainly true that some of the tornillos observed on Mt. Erebus result from icequake sources, but it is interesting to speculate that some Erebus tornillos might be more similar to those observed on Galeras and Purace volcanoes, and that their sources are not icequakes. It is equally as interesting to speculate that tornillos observed at MEVO are *exclusively* caused by icequakes, and thus the coincidence that icequakes produce very similar signals to those observed on non-glaciated volcanoes is even more perplexing. Further investigations should be stimulating.

## Locations

Events chosen for inclusion in the catalog of locations have met the following requirements:

(i) Seven or more stations clearly recorded the event. In the case of a particularly strong, clear, or otherwise interesting event, this requirement may be relaxed to include events recorded well at only six stations.

(ii) The first arrival is not excessively emergent (a first arrival could be picked with confidence [estimated picking error no greater than 0.25 s] at a minimum of 5 stations).

(iii) The hypocenter solution is well modeled by the preliminary 1-D velocity model (see page 8) (an rms residual value not greater than 0.2 s).

(iv) The hypocenter solution is well constrained in that the size of the largest $1\sigma$ error ellipse does not exceed 10 km in any dimension (x-, y-, or z-direction).

(v) The event occurs within or nearly within the network, so that overall, the mean azimuthal gap for each event type does not exceed 200 degrees.

The event is considered to be "well located" if it meets all of the above five criteria. Figures 22,24, and 26 show location maps by event type for 710 well located events that occurred during the study period.

The criteria that the event is recorded at seven or more stations excludes many events from the location catalogue. For example, all of the more than 150 explosions of the July 25, 1995 swarm are excluded because only four stations were operational through the austral winter; and for that matter, all events between early-May and mid-September, 1995 are also excluded due to lack of station coverage. Requiring adequate station coverage is the best first-pass quality control measure on the data set.

Criteria (ii) excludes most LP events (because they are too emergent), and all events with low signal-to-noise ratio.

Criteria (iii) and (iv) permit only the most reliable locations to be included in the catalogue.

Criteria (v) is not a strict control, because the network has a very small aperture and azimuthal gap is often quite large. Table 12 summarizes the mean and max azimuthal gap for each event type.

| | Azimuthal Gap Mean | Max |
|---|---|---|
| VT | 173 | 336 |
| LP | 199 | 356 |
| E-type | 113 | 295 |

**Table 12**– Azimuthal gap of located events by event type .

It might be ideal if azimuthal gap could be constrained to 200 degrees or less, but this would exclude too many events that are otherwise reasonably well located. Thus, while gap is a concern, it is generally a relaxed criteria.

Event locations were obtained using the gradient over a half-space velocity model estimated from refraction data by Rowe (1988), discussed on page 8 of this paper. Phases were picked using *Xpick* and locations were obtained using *HYPOELLIPSE* (Lahr, 1994).

## Phases

The number and types of phases used in the location procedure have an important effect on the result. In particular, depth estimates are poorly constrained when only P-arrivals are used (e.g., Billings *et al.*, 1994) and, as a result, the determination of focal depth is not as accurate as the epicentral location (e.g., Lomnitz, 1982). Table 13 summarizes the statistics on number of phases picked, rms, and depth.

| | Average Number of Phases Picked | Average rms (s) | Average depth (km) |
|---|---|---|---|
| VT | 11 | 0.0851 | 0.80 |
| LP | 9 | 0.112 | -2.14 |
| E-type | 8 | 0.123 | -3.37 |

**Table 13**– Average number of phases picked, average rms, and average depth for each event type .

The relative weight assigned to each phase pick used in the location procedure is dependent on an integer weight-code, which can range from 0 for the most impulsive P-arrival, to 4 for arrivals that are too uncertain to be used in the hypocentral solution. Weight codes of 0, 1, 2, and 3 are assigned to picks with reading uncertainties ranging up to 0.02, 0.04, 0.10, and 0.20 seconds respectively. Table 14 summarizes these uncertainties.

| Weight Code | Reading Uncertainty | Computed Weight |
|---|---|---|
| 0 | 0.02 sec | 1.0 |
| 1 | 0.04 sec | 1 / 25 |
| 2 | 0.10 sec | 1 / 100 |
| 3 | 0.20 sec | 1 / 400 |
| 4 | infinite | 0.0 |

**Table 14**– Weight codes, reading uncertainties, and corresponding computed weight in *HYPOELLIPSE* for picked phases.

The weight code is assigned to the phase pick in *Xpick* using error bars. The error bars are the same distance on either side of the picked arrival time. Figure 21 illustrates the error bar lengths around a picked phase.

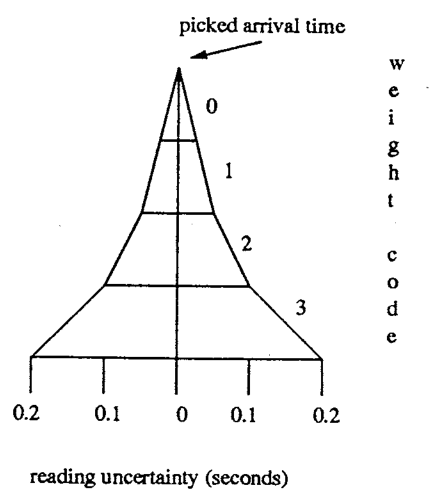



**Figure 21**– Weight codes assigned according to limits of reading uncertainty in seconds (from Lahr, 1994).

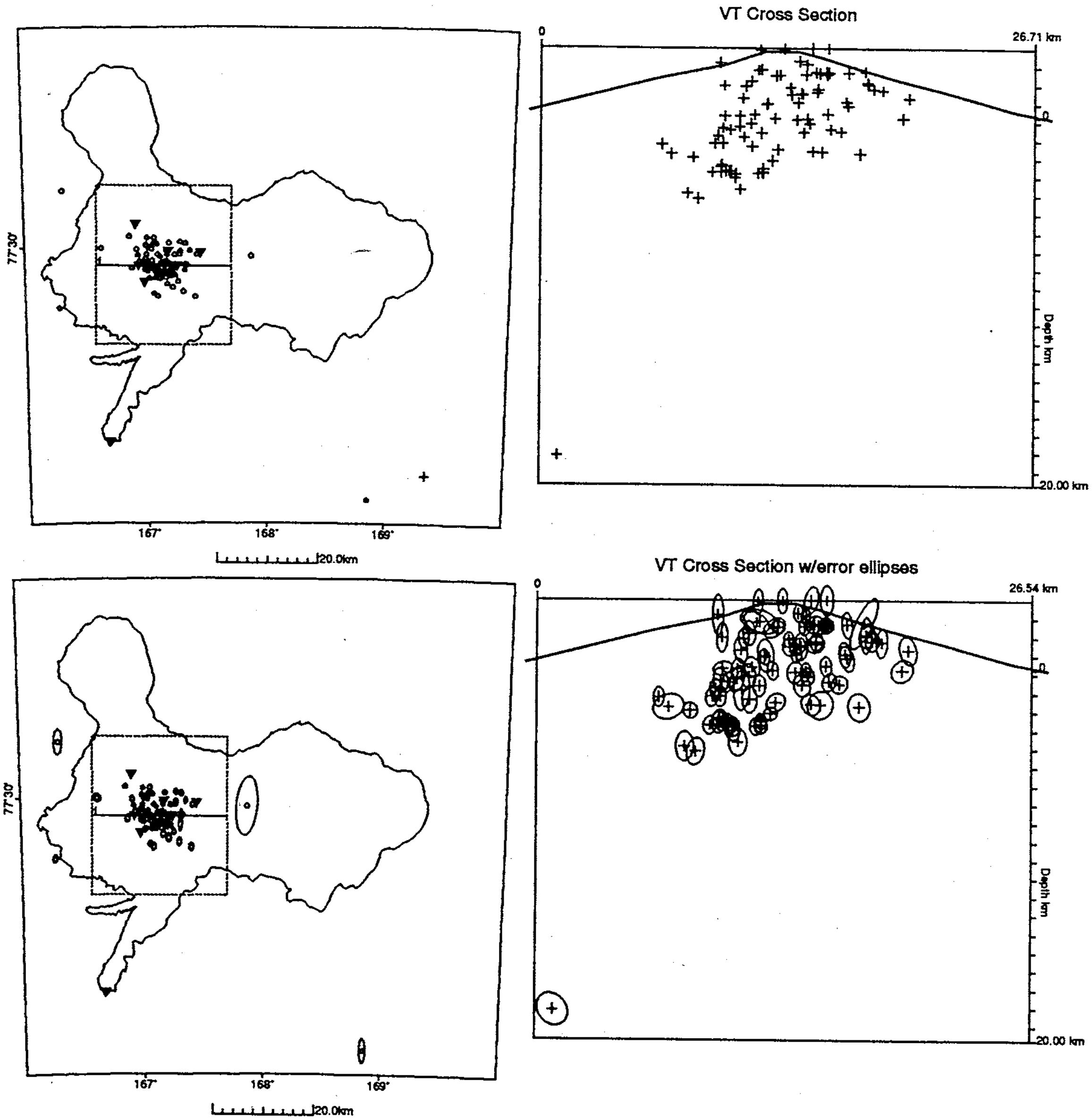



**Figure 22** – 90 well constrained VT event locations (upper), and with $1\sigma$ error ellipses (lower),
in map view (right) and cross-section (left).

Figure 23 shows the temporal distribution of located VT events. The period of zero located events that occurred from March through September of 1995 is due to inadequate station coverage (see Table 2) and not necessarily a result of a lack of occurrence of VT events.

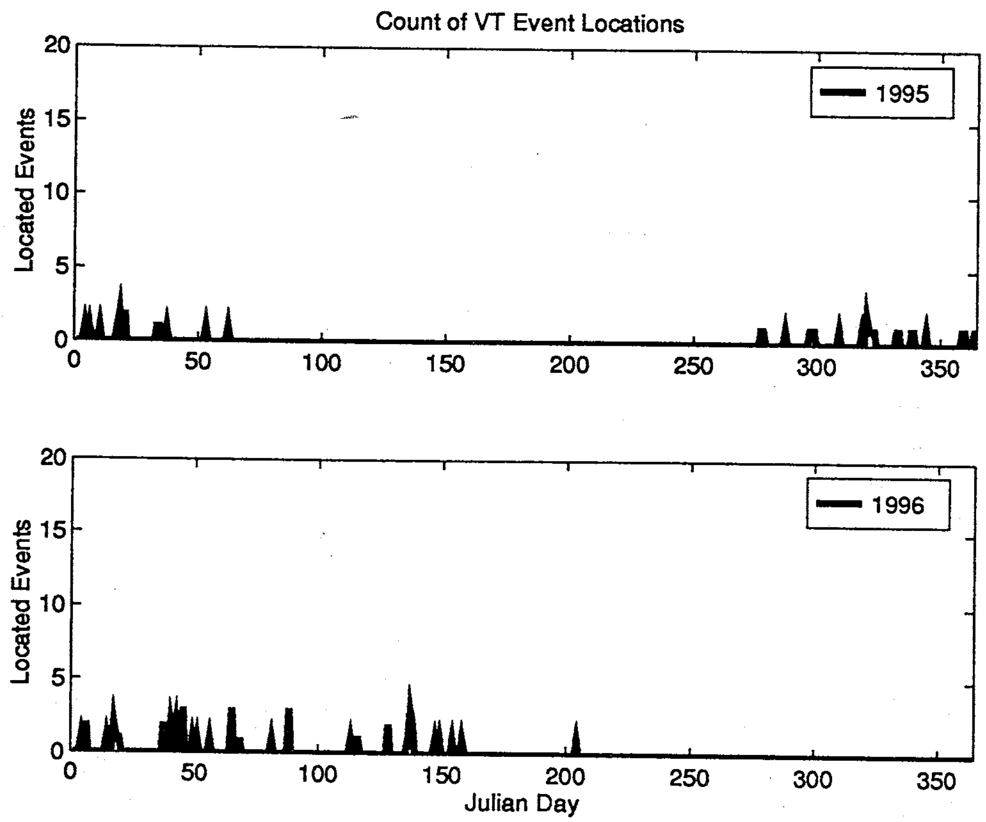



**Figure 23**– VT event locations per day.

Notice that overall, VT events are generally evenly distributed in time. There is a noticeable clustering during February 1996, however, and a slight increase in VT activity in May, 1996. Both increases are likely a result of fracturing that occurred during and after the LP swarm activity of Austral summer and autumn, 1996.

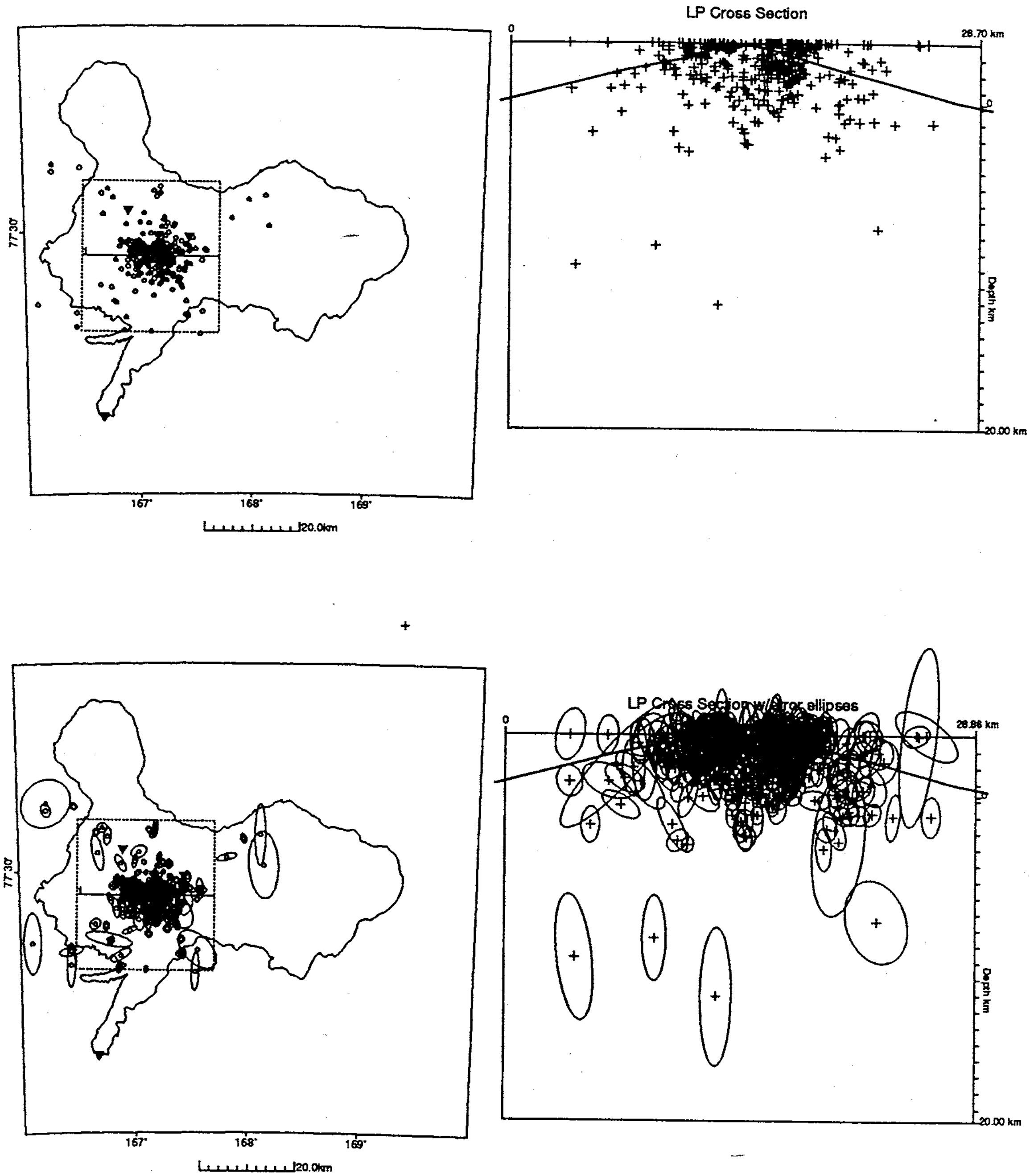



**Figure 24** – 405 well constrained LP event locations (upper), and with $1\sigma$ error ellipses (lower),
in map view (right) and cross-section (left).

Figure 25 shows the temporal distribution of located LP events. Again, the Austral winter months of 1995 lack located events because of poor station coverage (Table 2) and not because of non-occurrence of LP events.

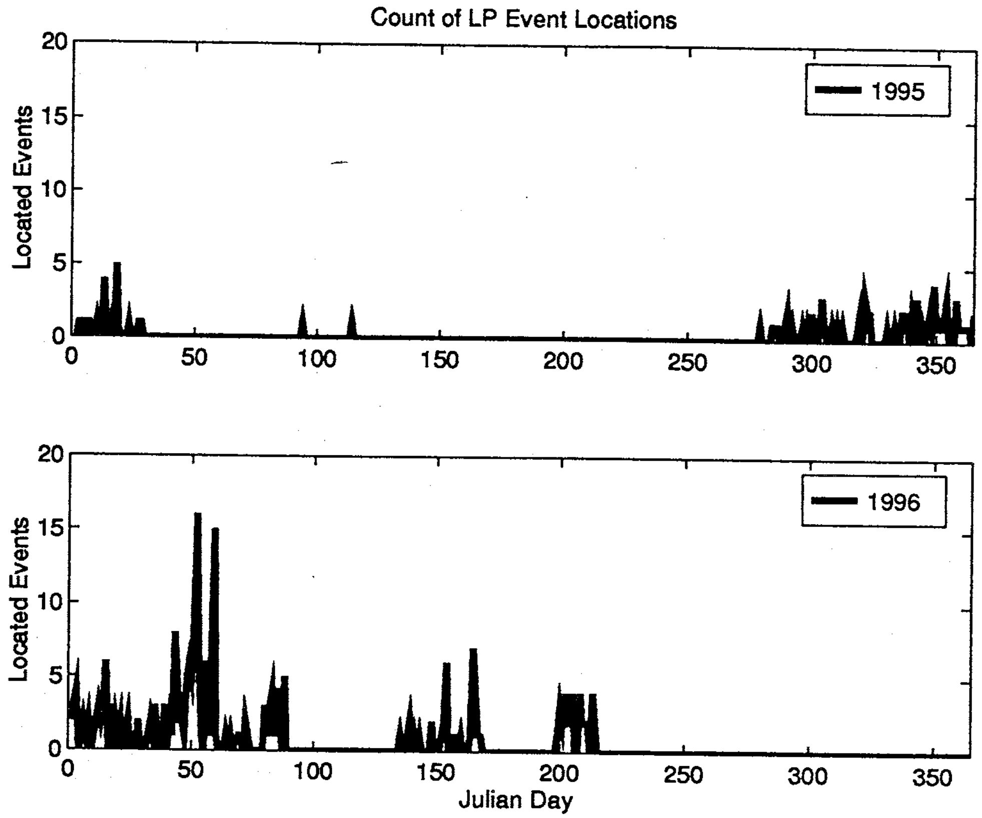



**Figure 25**– LP event locations per day.

Overall, there are many more located LP events than any other type. Notice that prior to the swarm episodes of Austral summer/autumn, 1996, the number of located LP events per day was generally consistent. The February, 1996 swarm episode produced a large increase in the number of located LP events. Many of these events occurred near station HOOZ. There is a significant lack of LP events in the weeks following both swarm episodes of February and May, 1996.

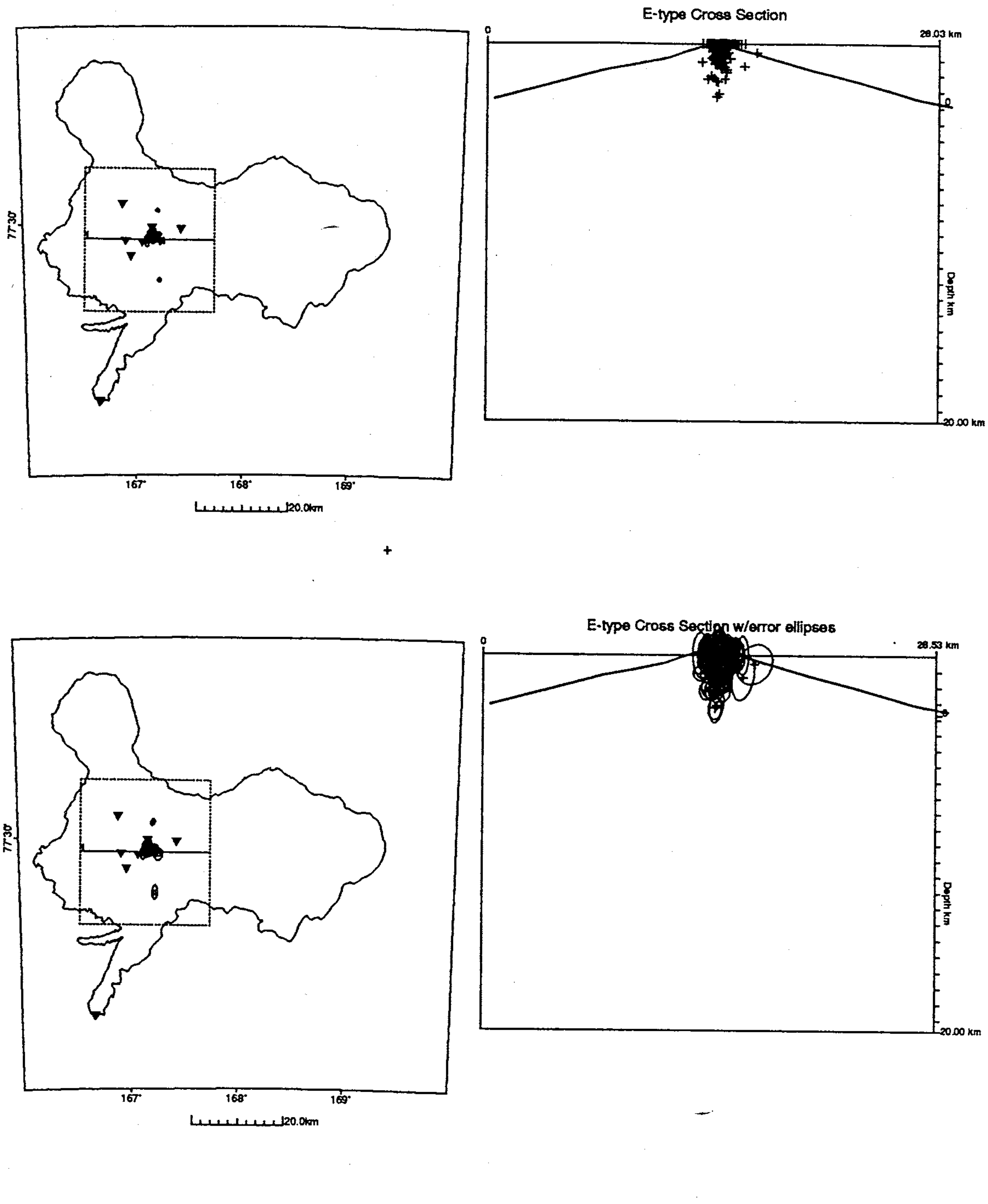



**Figure 26** – 213 well constrained E-type event locations (upper), and with $1\sigma$ error ellipses (lower),
in map view (right) and cross-section (left).

Figure 27 shows the temporal distribution of explosive events throughout the study period. The swarm of E-type events that occurred in July, 1995 is not indicated in Figure 27 because at that time, only 4 stations were operational.

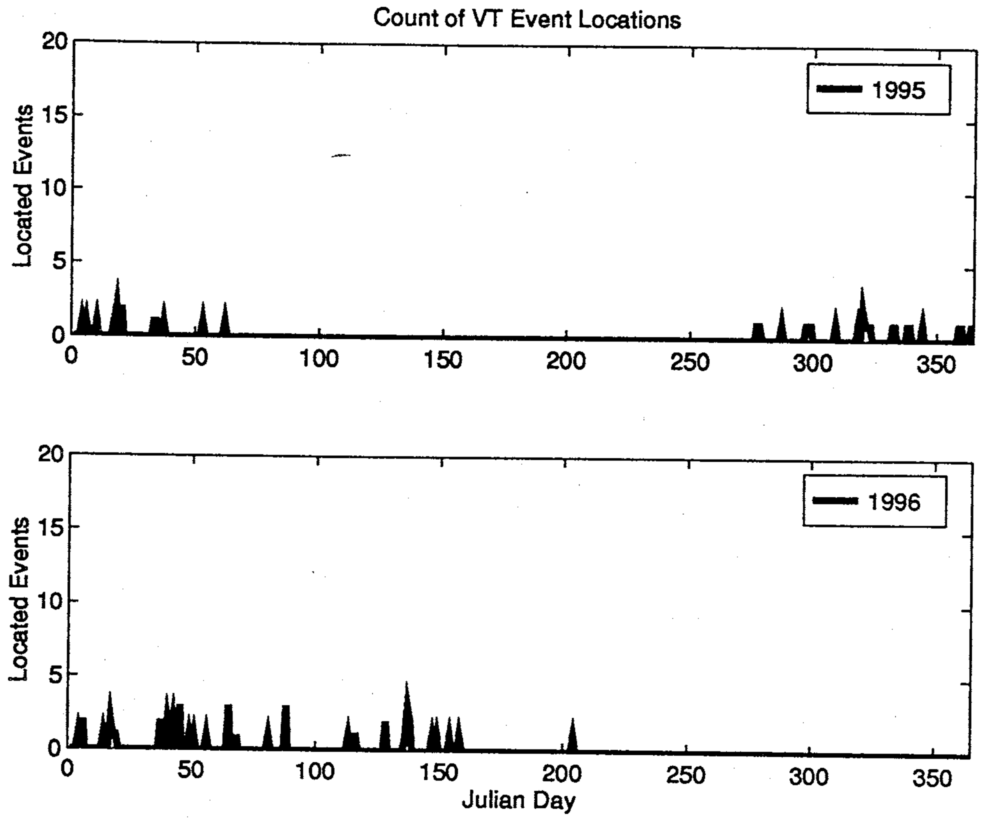



**Figure 27**– E-type event locations per day.

---

The E-type swarms of April 1996 are not shown because locations were not determined for so many events due to time constraints on the analyst. Other than during swarm periods, the occurrence of E-type events is generally consistent. Notice, however, that similar to the temporal patterns exhibited by LP events after swarm periods, there is a significant decrease in the number of located E-type events in the weeks following the swarm episodes.

## Velocity Model Uncertainties

The gradient velocity model used in *HYPOELLIPSE* and given on page 8 of this paper, is represented schematically in Figure 28.

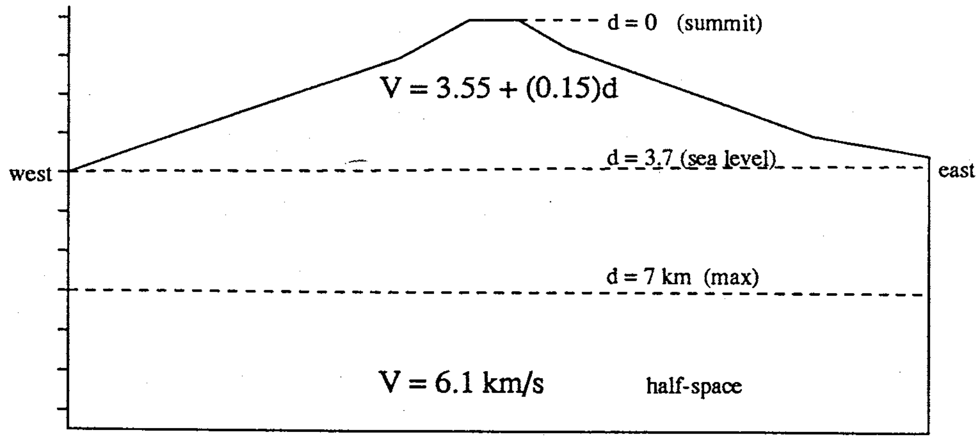



**Figure 28**– Simplified gradient velocity model

Compare this gradient model to a more realistic model proposed by Rowe (1988), shown in Figure 29 (page 49). This model uses geologic and geophysical data that indicates assymetry in the layers and a "fast" center of the volcano (Rowe, personal communication). A comparison to Kilauea Volcano in Hawaii provides the basis for this velocity structure. Kilauea has well documented rift systems extending radially from its summit crater and lava lake area, which can be considered similar to the rifts on Ross Island extending radially from Mt. Erebus to the flanking volcanoes, Mts. Bird and Terra Nova, and to Hut Point Peninsula.

Thurber (1987) provides some observations from his model for the velocity structure of Kilauea which may apply to Mt. Erebus:

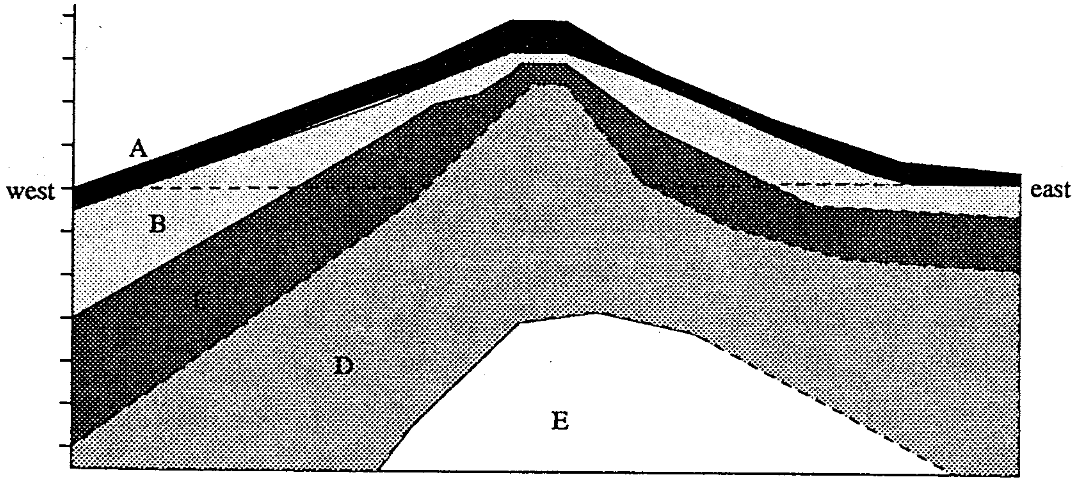
i. The core of the volcano has a higher velocity than the outer material.
ii. Fault and rift zones exhibit velocity highs.
iii. An anomalously slow region exists immediately below the summit crater, coincident with the inferred location of the magma reservoir.
iv. Flank material exhibits slower velocities than the competent rocks of rifts and dikes.

Comparison to Kilauea provides one set of guidelines for the velocity model proposed by Rowe (1988), and the sequence of geologic events in the formation if Mt. Erebus provides another. Table 17 summarizes this sequence of geologic events.

| Description of Events | Date |
|---|---|
| Deposition of pillow lavas on the floor of McMurdo Sound. | 1.4 Ma |
| Activity at the present Erebus volcanic center, eruptions along a northwest trending rift. | 1.0 - 0.8 Ma |
| Large volumes of phonolite erupted, building a shield volcano which forms the lower slopes of Erebus. Vent eruption builds a cone on top of this shield. | 0.94 - 0.68 Ma |
| Cone collapses (forming Fang Ridge), other cones develope (Abbott Peak, Bomb Peak). | 0.7 Ma |
| Eruption of short phonolite flows, building a steep summit cone which collapses, forming the present summit caldera. | 0.69 Ma |
| Caldera fills with phonolite. Flank eruptions form Hooper's Shoulder and Three Sisters Cones. | 0.15 Ma |
| Building of present summit cone. | 0.01 Ma |

**Table 17**– Sequence of geologic events in the formation of Mt. Erebus, providing guidelines for the development of an improved velocity model.

The layered model of Figure 28 is too simplified to describe adequately the true three-dimensional velocity structure of the mountain, but because the lateral inhomogeneities of a structure like that shown in Figure 26 cannot be incorporated into *HYPOELLIPSE* (except crudely, through static station corrections) the simplified model is presently used. All locations obtained with its use can thus be considered first approximations only. A significant component of the $1\sigma$ error ellipses shown in Figures 22, 24, and 26 are driven by timing residuals as a result of using the laterally homogeneous model.




A - 1.2 to 2.5 km/sec
B - 2.5 to 3.0 km/sec
C - 3.0 to 4.0 km/sec
D - 4.0 to 5.0 km/sec
E - 5.0 to 6.1 km/sec

**Figure 29**– Alternative velocity structure for Mt. Erebus, from Rowe (1988), based on comparison to Kilauea Volcano and on the sequence of geologic events in the formation of Mt. Erebus.

## Swarms

Swarms are significant because they indicate transient periods of substantial increase in seismicity related to eruption and/or magmatic injection. Few events that occur during swarm episodes are well located (because of incidental recording of small and/or overlapping events as mentioned previously). There is no obvious pattern in the locations of events that both occurred during swarm episodes and meet the five criteria on page 36. Recalling the histogram of daily events (Figure 8 on page 11), the following swarms are indicated by spikes:

(II)- a possible swarm of long-period events around March 14-16, 1995 that was partially obscured by high winds.

(III)- a swarm of long-period events around June 3-5, 1995 that again coincided with high winds, and also unfortunately occurred immediately after a change in the trigger configuration. It was difficult to determine to what degree the detection of this swarm was an artifact of the new trigger configuration (only 3 stations needed to trigger an event) and the fact that so few stations were recording at this time (only 4 stations operational). A count of events for this same time period on the analog records produced a very large peak (as shown in Figure 8), suggesting that this is a real swarm of small events but also possibly complicated by winds.

(IV)- a swarm of explosions occurring on July 25, 1995. The system was triggered over 130 times, and some traces included double and triple events. Overall, they were small but very frequent explosions. Unfortunately, only 4 stations were operating at this time.

(V)- swarms of long-period events that occurred in February, 1996.

(VI)- a huge swarm of long-period events that started on April 7, 1996 and continued at least into the next day, but was then obscured by high winds. Over 480 events were recorded on April 7 and 8. The best description is given by notes taken on the 7th:

> *960407 B-types swarm, LOTS! of events (+240), shallow, scattered, some reasonably well located at first but then deteriorated into smaller scattered ones. Possible ice-quakes dispersed throughout, but definately a lot of B-types in there. Joe Petit reported no harsh weather or high winds for this day.*

Unfortunately, Petit did report winds increasing on the following day. The rest of the swarm may be obscured by this, but even so, it is clear that a significant amount of seismicity persisted for at least another day.

(VII)- a swarm of explosions that occurred on April 14, 1996. There were 120 traces triggered, with 31 of those recording double events, 12 recording triple events, and one trace recording a quadruple (!) event for a total of 163 explosions. There were 13 explosions that were big enough to be recorded at MCMZ, 35 km from the summit. The trend of this swarm is again best described from notes:

> *960414 explosion swarm, see swarmE14.comments for details This swarm had a total of at least 163 events. Starting out as strong explosions occurring very rapidly in the first few hours, and then tapering off in occurrence and getting smaller, tending to look more B-type by the end.*

This explosion swarm was much better recorded than that of July 25, 1995, because all 9 stations were operational here.

(VIII)- another very large swarm that occurred throughout May 1-5, 1996. The pattern of this swarm began with numerous and frequent LP events and gradually tended towards VT events among the LP events. This is again best fully described directly from the notes:

> *960501 swarm day of over 270 events! yow. I looked at the first 60 so far, it looks to be the same pattern: B-types. NOT ice quakes. This B swarm is a bit different in nature from that of the 960505 (lacking the A-type component)*
> *960503 swarm day of over 50 events, mostly B types, not actually a lot of ice-quakes (even though this is in the icequakes subdir.) There were 10 reasonably well located events outta this lot, probably could get a few more, but these are generally outside the array and not doing well on the location front. One very obvious EXPLOSION in the lot, which actually seems very anomalous, because the nature of most of these is that noisy "swarmy" look.*
> *960505 swarm day with 96 events in xfiles. Closer inspection found 8 events that located well and were generally deep. mostly A/B and A type. There were 13 events that showed very good ice-quake examples (tornados and smaller impulsive ones.) The rest were very noisy and mostly weird. Hard to categorize, some doubles, some very strong but noisy and/or emergent.*

It is interesting to observe that deeper VT events occurred later in the swarm. Also notice that by the end of this period, the quality of events had deteriorated to "noisy" and "weird".

(IX)- another swarm of LP events. Events in this swarm tended to have too low of a signal-to-noise ratio to be of immediate interest.

Ray Dibble has also analyzed the April/May 1996 period of swarm activity. He has generously provided the following summary of his study:

> *"In the first three months of 1996, the frequency of A and B-type earthquakes triggering the Erebus seismic net did not exceed 25 per day. However, swarms of events we call ice-quakes occurred on 21 February (104 events) and 28 February (82 events). These ice-quakes were characterized by large ringing signals of high frequency (c20Hz) at stations near them, and very small signals at other stations. Many occurred near the stations on the rim of the Summit Plateau. The Q of the sources were high, suggesting that they were very shallow pull-apart sources, such as crevassing in the ice which mantles Erebus. Sometimes the four triggers within 10 seconds necessary for a record were caused by separate events each near a different station. Usually more than one event was present on each 60 second recording. Hence the count is very conservative.*

*On 8 April a major swarm of 490 ice-quakes commenced soon after 00 hours UT, reaching 18 per hour by 06 hours, and jumping to 31 per hour at 07 hours UT. The frequency then decreased gradually to near zero by 04 hours on 9 April. Similar occurrences had been recorded in the Austral autumn of 1995, and were thought to be caused by decreasing temperatures of the surface ice as winter approached.*

*On 14 April a swarm of 100 B-type earthquakes began in the vicinity of the active crater. They commenced after 13 hours UT, and reached a frequency of 29 per hour by 15 hours, before decreasing to zero by 09 hours UT on 15 April. Their waveforms resembled the explosion earthquakes proven by TV-surveillance in 1986 and 1989. As in those years, the 1996 B-type earthquakes formed a family of similar waveforms, but they were different from previous families.*

*Another similar swarm of 165 B-type earthquakes began on 20 April at 16 hours UT, mostly of a new family together with the previous one. The peak was 14 per hour at 03 hours UT on 21 April, and a few events per day occurred until 25 April. The b-value of 0.45 for the two swarms combined is very low, as was the value of 0.6 found for explosion earthquakes by Dibble (1984, 1988), and there was again a truncation in the distribution at the high magnitude end. Both McMurdo and Scott Base science staff were alerted to the possibility of visible explosions in the Crater of Erebus, but no sightings were reported.*

*Further swarms of ice-quakes began at 03 hours UT on 1 May 1996, with 358 recordings by the end of the day, and a further 273 on 2 May, 158 on 4 May, and 123 on 22 May. The fact that the swarm of ice-quakes on 8 April included 18 B-type earthquakes, and preceded major swarms of B-types raised doubts about the interpretation as ice-quakes. Unfortunately no weather recordings are made on Erebus at present, but the data from the automatic weather stations at Marble Point (W of Erebus) and Minna Bluff (S of Erebus at 920m ASL), kindly supplied by AMRC at the University of Wisconsin, were compared with the ice-quake frequency. No correlation was obvious between the commencement times of swarms, and rapid decreases in temperature at the selected weather stations. It is possible that there was a correlation with decreases in temperature at the elevation of the seismic network (above 2000m) but no data is available.*

*The weather data were raw readings at 10 minute intervals, and showed surprisingly large variations from day to day, even in May."*

(Dibble, personal communication).

## Interpretations

One possible interpretation of the seismicity observed at MEVO throughout the study period is outlined below:

(1) E-type events define the summit lava lake area and possibly mark the upper portion of the main conduit. Kaminuma *et al.* (1988) propose that for strong explosions, two phases may be recorded on one seismogram which represent different depths along the main conduit beneath the lava lake: a deeper initial phase and a shallower second phase. Attempts to obtain different depths by making alternate picks of these estimated phases were unsuccessful using the digital data of this study period (Kaminuma, personal communication, 1996). However the hypothesis that both the summit lava lake and the upper conduit are defined by E-type locations remains reasonable. The deeper first phase may be indicated by the low-frequency precursor that is sometimes clear at E1SZ (referred to as the "bubble phase", as it is thought to represent the movement of exsolved gas bubbles prior to explosion), and the shallower second phase may be indicated by the impulsive arrival of seismic energy as the lava dome explodes.

(2) VT events show areas of rock fracture where deviatoric stress is sufficiently altered by the injection or withdrawal of magma and brittle faulting occurs. Presently, there is not a general trend in VT event locations.

(3) LP events define areas of magmatic flow, and they appear to be widely scattered throughout the mountain (although locations are frequently problematic). This suggests that the mountain is criss-crossed with numerous small pathways and conduits for movement of magma, which corresponds well with the geologic evidence of numerous flank eruptions (R. P. Esser, personal communication, 1996) summarized in Table 18.

At least six episodes of large (on the order of $4km^3/ky$) flank eruptions are well dated, four of them occurring within the last 60 ka. The shallow depths of many LP events may indicate that magma continues to move along the flanks of Mt. Erebus though small pathways.

(4) Tremor occurred prior to the digital record of the swarms in this study period and clearly shows that large volumes of magma are moving throughout the mountain. This tremor episode of January 30, 1995 may indicate ei-

| Areas of Flank Eruptions | Age |
|---|---|
| Hooper's Shoulder | 121 ± 7 ka |
| Hooper's Shoulder | 110 ± 6 ka |
| William's Cliff | 57 ± 5 ka |
| Hooper's Shoulder | 40 ± 3 ka |
| Cape Evans | 40 ± 3 ka |
| Three Sisters Cones | 26 ± 2 ka |

**Table 18** – Summary of dated flank eruptions, from R. P. Esser.

ther a refilling of a deep magma chamber or a large movement of magma along the main conduit.

(5) Patterns of seismicity near station ABBZ are suggestive of a regional trend in stress orientations. There are numerous seismograms in the data set that show ABBZ as very impulsive and as the closest station to the event, a spectacular example of which is shown in Figure 30.

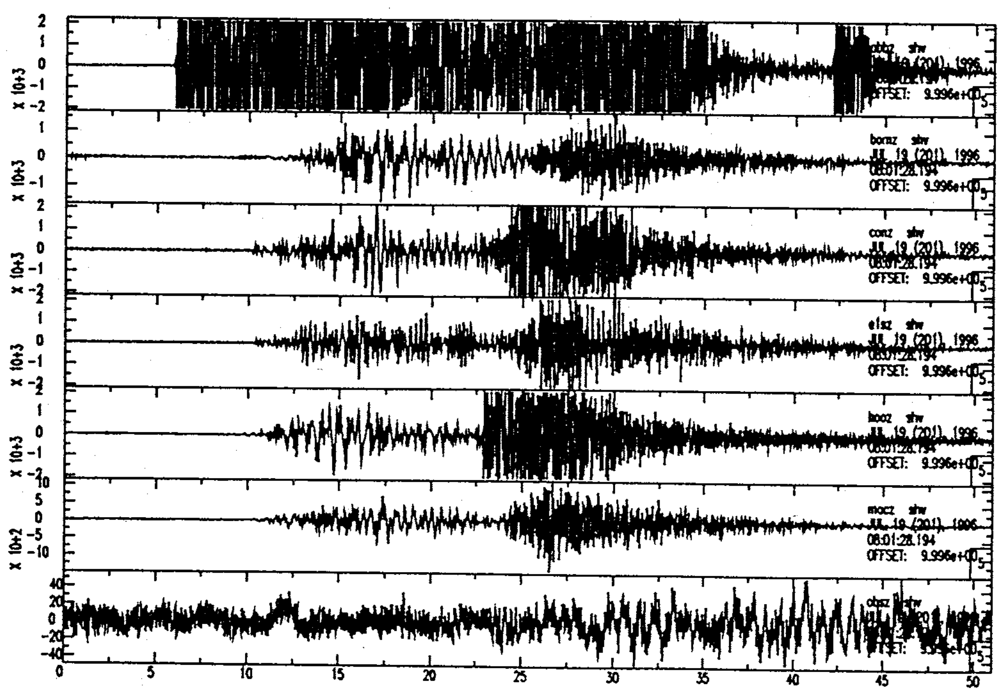



**Figure 30** – Seismogram showing the commonly recorded impulsive arrival at ABBZ, suggesting that the region near ABBZ is frequently subjected to injection.

Kaminuma *et al.* (1985) and Rowe (1988) reported on a swarm of over 700 events occurring within a 48 hour period in October 1982 in this same region around ABBZ (known as Abbott Peak). Rowe (1988) hypothesized that this swarm may have resulted from magmatic dike injection at depth, as indicated by the tight linear feature represented by the hypocentral distribution she obtained for some of the events in this swarm. Thus, well recorded past activity together with continued recordings of activity near Abbott Peak suggest brittle material properties in the area and frequent injection activity.

Figure 31 summarizes the interpretation discussed above in a simplified cartoon of what the internal magmatic plumbing of Mt. Erebus might look like in the.

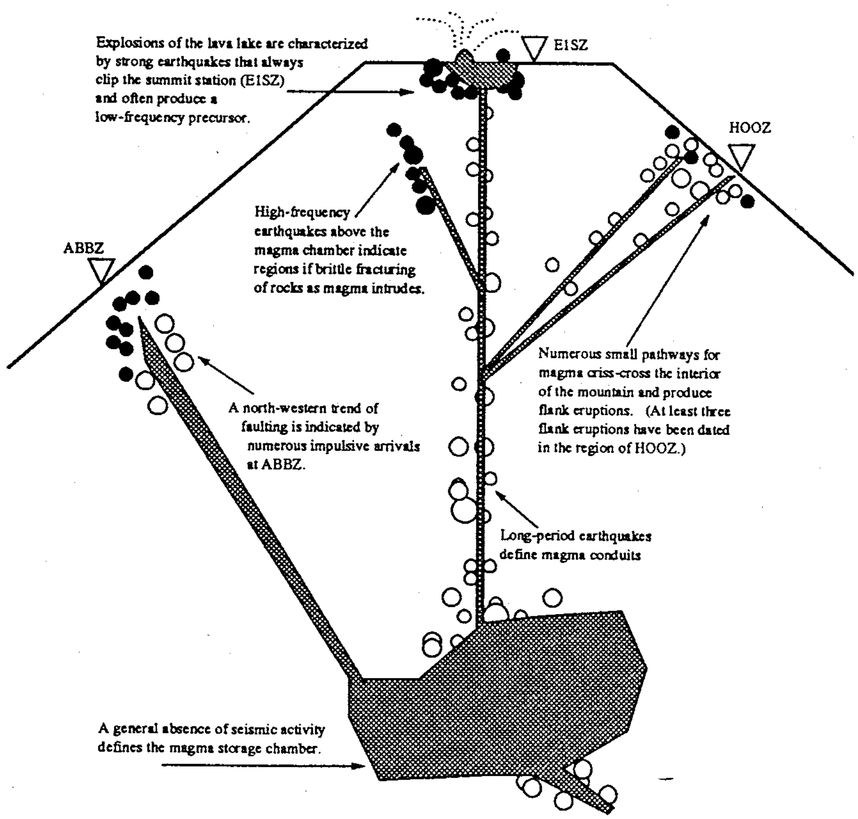



**Figure 31** – Cartoon showing a simplified volcanic plumbing system, modified from Coch (1995) to explain seismicity patterns on Mt. Erebus.

---

Kaminuma (1994) considered observations made during five years of analog data recording and suggested that an aseismic zone possibly representing a magma reservoir exists to the southwest at approximately 5-8 km depth below the summit. However, a region lacking seismicity is not obvious based on the locations of the evnts in this study period.

## Summary

The observed occurrence of events throughout the study period and a speculative interpretation of them that corresponds to the event types and their trends illustrated in the model of the previous section is:

---

Jan 1995: tremor observed. A very large volume of magma is moving and either filling the chamber at depth or ascending from the chamber into the main conduit.

Feb 1995: storms and high winds. Very strong miscroseismic noise is recorded for several weeks making seismic observations difficult.

Mar-Jun 1995: LP swarms observed. Movement of the newly released magma and associated stress release occurs. There are probable complications due to weather and unknown contributions due to ice-quakes.

Jul 1995: explosion swarm. This is the first major release of pressure due to the magma build-up/movement that occurred in January.

Aug-Sep 1995: poor record (Austral winter).

Oct-Dec 1995: no unusual activity. Average number and types of events per day.

Jan 1996: storms and high winds. High levels of microseismic noise present throughout the digital record.

Feb 1996: LP swarms. Many shallow events occur and several tornillo events are well recorded. Magma is moving within the mountain, especially along the flank near Hooper's Shoulder.

Mar 1996: Normal daily activity. Approximately 5 located LP events per day, 1-2 located E-type events per day, and 1-2 located VT events per week. (See Figures 23, 25, and 27.)

Apr 1996: explosion swarms. Second major release of pressure since the large scale movement of magma in January of 1995. There is a decreased number of E-type events per day during the weeks following this swarm.

May 1996: continued LP and tornillo swarms as well as an increased number of VT and deep events. More brittle fracture than usual is occurring as a result of the stress rearrangement that follows the period of LP swarms.

---

# Future Work

## Source Mechanisms

Focal mechanisms derived from first-motion polarities are indicative of the principal stress directions, and thus may be used to determine the local, and possibly regional, stress states of Mt. Erebus. The source mechanism for non-explosion earthquakes is not fully studied for volcanoes in general, and is not well studied for Mt. Erebus in particular. The emergent first arrival of most events on Mt. Erebus allows few definite first motion determinations. Further difficulties arise because of the complex nature of the velocity structure of volcanoes, a reliable velocity model must be obtained in order to produce accurate source locations (hypocenters) and directions from which seismic rays leave the source (azimuths and incidence angles). Currently, the problem of an inadequate velocity model is the biggest obstacle to obtaining meaningful focal solutions for Mt. Erebus. (However, see *"Tomography"* below for a possible future remedy to this situation.)

One volcano that has been well studied in terms of seismicity and source mechanisms is Kilauea Volcano. Thousands of locatable earthquakes occur each year on Kilauea, the volcano is covered with a dense network of seismic stations, the velocity structure is well modeled in three dimensions, and the accumulated seismic data for the volcano goes back nearly 100 years. All these advantages make Kilauea and excellent natural laboratory for investigating the relationships between the stress state of the mountain, its seismicity, and the migration of magma within it. Thurber (1987) concluded that the state of stress within Kilauea Volcano results from a complex relationship between crustal density variations, magma pressure, surface loading, and failure along zones of weakness. Li and Thurber (1988) studied directivity, complexity, rupture duration, rupture direction, and stress drop by deconvolving the source-time functions from microearthquake seismograms recorded at the volcano.

While conclusions concerning these relationships for Mt. Erebus are not yet possible, some preliminary work has been done (O'Brien, 1992), and it may eventually be possible to make a more definitive statement about the stress state and related features of the mountain and region.

## Families

Determination of earthquake families may prove useful in identifying patterns of seismicity, as well as aiding in focal mechanism studies. Families (also called "multiplets") are events of the same type that have nearly identical waveforms and locations. On Mt. Erebus, they may occur in clusters of up to several dozen events and often, after some time, the family will die out and a different family will begin. This pattern may indicate that a region that was subjected to a particular stress perturbation, has adjusted to it, has changed all local stress orientations, and will no longer produce events of those same waveforms, focal mechanisms, etc. (Dibble, personal communication).

Fremont and Malone (1987) recognized that multiplets are a common feature of the seismicity associated with extrusive eruptions of Mt. St. Helens, and they summarized the characteristics of a multiplet as follows:

(i) Waveforms of a multiplet are very similar at all stations, spectral shapes do not vary, and time domain details may vary slightly.

(ii) Earthquakes of a multiplet share a common focal mechanism.

(iii) Each multiplet exists over a narrow magnitude range.

(iv) A multiplet occurs over a limited period of time.

(v) Earthquakes within a multiplet take place within a volume no more than a few tens of meters in diameter (the order of the source size for any individual event).

(vi) There is no obvious spatial migration over time within a multiplet.

Work on cross-correlation of similar Mt. Erebus events is in progress by Ray Dibble and Rick Aster.

## Spectral Analysis

A thorough spectral analysis of volcanic events on Mt. Erebus may prove interesting and useful for further interpretations about its magmatic system. For this study, minimal spectral analysis was done: only a few events ($< 20$) were analyzed (using *SAC*, Tull (1989)) to obtain the approximate frequency content of each event type. Lahr *et al.* (1994) included a more detailed study of the spectral content of earthquakes in their study of the seismicity of Redoubt Volcano, Alaska. For their study, they divided a seismogram into windows. The spectral amplitudes of the vertical component of ground velocity were computed for each window and contoured for a specified frequency and time range. These contour plots (called *spectrograms*) are useful in appraising the spectral content of body phases and later coda waves. This procedure, applied to a number of events recorded on Mt. Erebus, and interpreted within the framework set down by location patterns, may provide clues about areas within the volcano that are particularly attenuative, and thus likely to contain significant partial melt.

### Magnitude and Seismic Energy Release

Lahr *et al.* (1994) also included a more thorough interpretation of their location distribution by examining the effect of decreasing magnitude. They observed LP events defining a vertical cylindrical region beneath the crater floor of Redoubt which was appealing in terms of possibly defining a vertical conduit, but which could not be reconciled with the observation that the waveforms and spectra of the events were all nearly identical. When the events were subdivided into groups by magnitude range, the scatter in the locations was observed to increase with decreasing magnitude. This led them to conclude that the overall distribution of hypocenters was influenced by progressively greater difficulties in picking the phase onsets of events of decreasing magnitude. A similar effort can be made for events occurring on Mt. Erebus if the amplitude-based magnitude in *Xpick* is used. (Currently, an unclaibrated duration magnitude scale is used, and this is often problematic because the current de-trigger parameter terminates many of the digital records prior to the time that the coda fades into the background). Travel time residuals as a function of magnitude can be checked in the manner of Lahr *et al.* (1994) to determine if the scatter in B-type events is real or merely an artifact of greater picking errors with smaller magnitudes.

### Trigger Algorithm

A more sophisticated trigger algorithm (e.g., Withers *et al.*, 1995) could be incorporated to allow the digital records to more faithfully represent the true seismicity without recording an unacceptable large number of false triggers.

### Tomography

A collaborative effort with Jim Clippard of the University of Alaska, Fairbanks to produce a three-dimensional velocity model of Mt. Erebus and revised source locations is currently underway. Clippard is using the picks of the +700 events in the location catalogue and the code that he developed to do a tomographic inversion as part of his Ph.D. dissertation. It is too early in the project to report success, but it is hoped that this work will result in a robust model of the velocity structure of the central, cone-shaped region of the mountain and the realistic incorporation of mountain topography. With such an improved velocity model, it will be possible to undertake in earnest studies of focal mechanisms, families, swarms, and other phenomena which will greatly enhance the overall understanding of Mt. Erebus volcano.

# Acknowledgments

I would like to sincerely thank Drs. Richard Aster, Philip Kyle, and Allan Sanford for being a supportive and encouraging committee, as well as for collectively being the most valuable resource of knowledge and experience that has been my privilege to encounter.

I thank Joe Petit for his helpful work as the technician at McMurdo Station.

Mike Skov set up the whole digital data acquisition and transfer system, and none of the work in this paper would have been possible without his work and the loss of his wisdom teeth.

I sincerely thank Ray Dibble for his comments and instructions over the months. His knowledge and experience on this subject are far greater than mine, and he can almost be considered a ghost-author on this work, as I have drawn so much from his past papers and personal communications.

I am deeply indebted to Charlotte Rowe for copious personal communications which guided me through Xpick and beyond, and for her master's thesis which is the first work I read about Mt. Erebus and which was a manual for me.

Finally, I warmly thank and enthusiastically salute my fellow NMT Geophysics graduate students: Robert Balch, Joe Duncan, Kwo-Wan Lin, George Slad, and Mitch Withers. Every one of these guys showed me a thing or two, and the occasions that I learned something from each are too many to mention. I particularly thank Mitch Withers for so generously and patiently sharing his geophysics knowledge and computer skills, he is the best in the business.

The research was funded by National Science Foundation award number OPP-9419267.

## References


Arcila, A. (1996). Geophysical monitoring of the Purace volcano, Colombia, *Annali di Geofisica,* **xxxix:2,** 265-272.

Billings, S. D., M. S. Sambridge, and B. L. N. Kennett (1994). Errors in hypocenter location: picking, model, and magnitude dependence, *Bulletin of the Seismological Society of America,* **84,** 1978-1990.

Coch, N. K. (1995). Geohazards- Natural and Human, Prentice Hall, Englewood Cliffs, New Jersey,

Chouet, B. A. (1985). Excitation of a buried magmatic pipe: a seismic source model for volcanic tremor, *Journal of Geophysical Research,* **90,** 1881-1893.

Chouet, B. A. (1996). Long-period volcano seismicity: its source and use in eruption forecasting, *Nature,* **380,** 309-316.

Cooper, A. K. and F. J. Davey (1985). Episodic rifting of phanerozoic rocks in the Victoria Land Basin, Western Ross Sea, Antarctica,, *Science,* **229,** 1085-1087.

Dibble, R. R. (1994). Velocity modeling in the erupting magma column of Mount Erebus, Antarctica, *Antarctic Research Series,* **66,** 17-33.

Dibble, R. R., S. I. D. Barret, K. Kaminuma, S. Miura, J. Kienle, C. A. Rowe, P. R. Kyle, and W. C. McIntosh (1988). Time comparisons between video and seismic signals from explosions in the lava lake of Erebus Volcano, Antarctica, *Bulletin of Disaster Prevention Research Institute, Kyoto University,* **38,** 147-161.

Dibble, R. R., J. Kienle, P. R. Kyle, and K. Shibuya (1984). Geophysical studies of Erebus volcano, Antarctica, from 1974 December to 1982 January, *New Zealand Journal of Geology and Geophysics,* **27,** 425-455.

Dibble, R. R., B. O'Brien, and C. A. Rowe (1994). The velocity structure of Mount Erebus, Antarctica, and its lava lake, *Antarctic Research Series,* **66,** 1-16.

Ferrick, M. G., A. Qamar, and W. F. St. Lawrence (1982). Fluid dynamic analysis of volcanic tremor, *US Government Report, CRREL 82-32,*

Fremont, M. and S. D. Malone (1987). High precision relative locations of earthquakes at Mount St. Helens, Washington, *Journal of Geophysical Research,* **92:B10,** 10,223-10,236.

Kaminuma, K. (1994). The seismic activity of Mount Erebus in 1981-1990, *Antarctic Research Series,* **66,** 35-50.

Kaminuma, K., M. Satoshi, and R. R. Dibble (1988). A process of Mount Erebus eruption, *Antarctic Geoscience,* **2,** 7-16.

Kaminuma, K., S. Ueki, and J. Kienle (1985). Volcanic earthquake swarms at Mt. Erebus, Antarctica, *Tectonophysics,* **114,** 357-369.

Keller, G. R., C. Prodehl, J. Mechie, K. Fuchs, M. A. Khan, P. K. H. Maguire, W. D. Mooney, U. Achauer, P. M. Davis, R. P. Meyer, L. W. Braille, I. O. Nyambok, and G. A. Thompson (1994). The East African rift system in the light of KRISP 90, *Tectonophysics,* **236,** 465-483.

Kyle, P. R. (1990). McMurdo Volcanic Group, Western Ross Embayment- Introduction, *Antarctic Research Series,* **48,** 19-25.

Kyle, P. R., R. R. Dibble, W. F. Giggenbach, and J. Keys (1982). Volcanic activity associated with the anorthoclase phonolite lava lake, Mount Erebus, Antarctica, *Antarctic Geoscience,* C. Craddock (ed.), University of Wisconsin Press, Madison, 734-745.

Kyle, P. R., J. A. Moore, and M. F. Thirlwall (1992). Petrologic evolution of anorthoclase phonolite lavas at Mt. Erebus, Ross Island, Antarctica, *Journal of Petrology,* **33:4,** 849-875.

Lahr, J. C. (1994). HYPOELLIPSE/Version3.0: A computer program for determining local earthquake hypocentral parameters, magnitude, and first motion pattern, *USGS Open File Report,*

Lahr, J. C., B. A. Chouet, C. D. Stephens, J. A. Power, and R. A. Page (1994). Earthquake classification, location, and error analysis in a volcanic environment: implications for the magmatic system of the 1989-1990 eruptions of Redoubt Volcano, Alaska, *Journal of Volcanology and Geothermal Research,* **62,** 137-151.

Lee, W. H. K. (1992). The Xdetect Program: A course on PC-Based Networks, *U.S.G.S Open-File Report 92-441,* W. H. K. Lee and D. A. Dodge (eds.), 138-151.

Lees, J. M. (1995). Xmap8: Three-dimensional GIS for geology and geophysics, *Seismological Research Letters,* **66:4,** 33-37.

LeMasurier, W. E. (1990). Late Cenozoic volcanism and the Antarctic Plate- An Overview, *Antarctic Research Series,* **48,** 1-17.

Li, Y. and C. H. Thurber (1988). Source properties of two microearthquakes at Kilauea Volcano, Hawaii, *Bulletin of the Seismological Society of America,* **78:3,** 1123-1132.

Lomnitz, C. (1982). An uncertainty principle of earthquake locations, *Bulletin of the Seismological Society of America,* **72,** 669-670.

Malone, S. D. (1983). Volcanic earthquakes: examples from Mount St. Helens, *Earthquakes: Observation, Theory, and Interpretation,* H. Kanamori and E. Boschi (eds.), Elsevier, 608pp.

Minikami, T. (1963). Earthquakes originating from volcanoes, *Geophysical Papers Dedicated to Professor Kenzo Sassa, Kyoto University Geophysics Institute,* 277-283.

McGinnis, L. D., R. H. Bowen, J. M. Erikson, B. J. Allred, and J. L. Kreamer (1985). East-West Antarctic boundary in McMurdo Sound, *Tectonophysics,* **114,** 341-356.

Neave, K. G. and J. C. Savage (1970). Icequakes on the Athabasca Glacier, *Journal of Geophysical Research,* **75:8,** 1351-1361.

Nicolas, A., U. Achaver, and M. Daignieres (1994). Rift initiation by lithospheric rupture, *Earth and Planetary Science Letters,* **123,** 281-298.

O'Brien, B. (1992). Seismicity, velocity structure, and eruption mechanism of Erebus Volcano, Ross Island, Antarctica, *Unpublished thesis for Master of Science with Honours in Geophysics, Victoria University of Wellington, New Zealand,* 268 pp..

Rowe, C. A. (1988). Seismic velocity structure and seismicity of Mount Erebus Volcano, Ross Island, Antarctica, *M.S. thesis, University of Alaska, Fairbanks,* 156 pp.

Riaroh, D. and W. Okoth (1994). The geothermal fields of the Kenya rift, *Tectonophysics,* **236,** 117-130.

Shibuya, K., M. Baba, J. Kienle, R. R. Dibble, and P. R. Kyle (1983). Study of the seismic and volcanic activity of Mount Erebus, Antarctica, 1981-1982, *Proceedings of 3rd Symposium on Antarctic Geoscience, Memorial National Institute for Polar Research Tokyo, Special Issue,* **28,** 54-66.

Skov, M. J. (1994). Digital seismic data acquisition and processing as applied to seismic networks in the Rio Grande Rift and on Mt. Erebus, Antarctica, *M.S. paper, NMIMT,* 97 pp.

Skov, M. J., P. R. Kyle, and R. C. Aster (1994). Seismic monitoring of the active Erebus volcano, Ross Island, Antarctica, using digital data acquisition, *Seismological Research Letters,* **65,** 57.

Smithson, S. B. (1972). Gravity interpretation in the TransAntarctic Mountains near McMurdo Sound, Antarctica, *Geological Society of America Bulletin,* **83,** 3437-3442.

Tazieff, H. (1994). Volcanological and Environmental Studies of Mount Erebus, Antarctica: Foreward, *Antarctic Research Series,* **66,** xi-xii.

Tessensohn, F. and G. Worner (1991). The Ross Sea rift system, Antarctica: structure, evolution and analogues, *Geological Evolution of Antarctica,* 273-277.

Thurber, C. H. (1987). Seismic structure and tectonics of Kilauea Volcano, *USGS Professional Paper 1350*, 919-934.

Torres, R. A., D. M. Gomez, and L. M. Narvaez (1996). Unusual seismic signals associated with the activity at Galeras Volcano, Colombia, from July 1992 to September 1994, *Annali di Geofisica,* **xxxix:2**, 299-310.

Tull, J. E. (1989). SAC - Seismic Analysis Code, Users Manual, *Lawrence Livermore National Laboratory, informal report,*

Weaver, C. S. and S. D. Malone (1979). Seismic evidence for discrete glacier motion at the rock-ice interface, *Journal of Glaciology,* **23:89**, 171-183.

Withers, M. M., R. C. Aster, and C. Young (1995). A comparative review of select seismic prefilter and trigger algorithms, *EOS trans. AGU,* **76**, 396.

# Appendix I *(dedicated to Agbeli Ameko)*

Because the whole system of data collection and transfer is automated, it may all seem like a magical mystery when it appears and disappears. But it is not magic: there is a regular procedure that is followed before the data gets into your hands in a format that can be analyzed. Figure 32 is a simple flow chart showing the steps taken between an earthquake occurring on Mt. Erebus and your final result of plotting it up to make a pretty picture.

There is a particularly magical part, where the earthquake itself gets converted into a signal that is sent across the air-waves (Step 3 in Figure 32), and this is shown in more detail in Figure 33.

Skov's (1994) I.S. is a very good reference to get all the details on the data transfer. His explanation of the whole system stops right about where you, the analyst, will begin. He describes the automated end of it, you pick it up once the data is on */mk1* and ready to be analyzed.

There is a lot of data, it gets out of hand in a hurry if you are not organized. In general, the best procedure is:

(1) Make good notes and comments. (They will come in useful for your future work, and the work of others.)

(2) Stay organized.

(3) Stick with a meaningful directory structure.(This is necessary to stay organized: scripts where you can find them, lists where you need them, notes where you can remember.)

(4) Keep up with the daily accumulation of data. (The processing, and even the locating, is not too big of a deal if you do a little each day. Maybe over vacations, things will pile up on you, but usually with no more than an hour a day, you should be able to stay current.)

(5) No spazzing.

There are two main phases to keeping current with the data: (1) the initial processing and (2) a first pass at picking and locating. With time, experience, and a regularly funded job or research project, you can think about fine-tuning the locations to the best of your abilities as well as applying other phases to the scope of the project, like using *Xmap8* to plot locations and error ellipses and dreaming up new schemes to do amazing things with the data (see the section on "Future Work").

1) An earthquake occurs on Mt. Erebus.

↓

2) The seismometers at the various stations (ABBZ, BOMZ, CONZ, etc.) "feel" it.

See Figure 33.

↓

3) Radio signals from the seismographs at each station are telemetred to the PC at Crary Lab, McMurdo Station.

↓

4) The PC reboots at midnight, McMurdo time, and copies the data to the Sun work station in the Crary Computing Center, mcmsun5.

← The PC is continuously receiving. It is triggered, and records an event when the signal to noise ratio goes above a set threshold within a certain time window on 4 or more stations.

↓

5) mcmsun5 ftp's the data to griffy at 1am Mcmurdo time (5am MST). The data are in suds format

↓

6) The automatic pre-processing program, erebusauto, converts the suds data into temporary ps files at 7pm local time, which can be viewed by the analyst.

↓

7) The analyst steps in now, no more automation. Run erebusproc to preview the data and convert saved events to Xpick format.

← The format of data in Xpick is ah.

↓

8) Use the programs Xpick and Hypoellipse to make picks and get locations. Other information includes amplitude, frequency and coda length. Remember to keep good notes and make accurate comment entries.

↓

9) Use fortran programs to pull out the pertinent information from the pickfiles and put it into files that Xmap8 can read.

↓

10) Use Xmap8 periodically to make pretty plots out of the location information.

**Figure 32** – Flowchart following the data from the occurrence of the event to determination of its location.

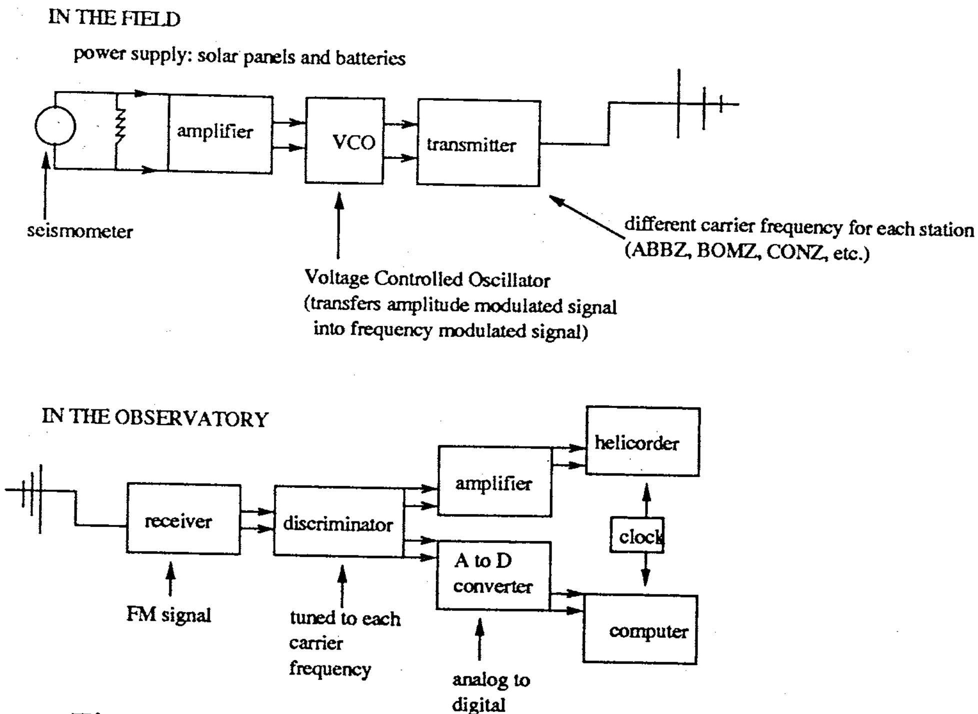



**Figure 33** – The path of the signal, from field to helicorder/computer.

## Initial Processing

The daily processing is usually no sweat: you can expect an average of 5-10 events per day. (However, a swarm day can run you up to hundreds of events, so be on the look-out. Those are the most interesting times!) The best procedure is to keep up with the daily processing: just take a few minutes each day to do it. The program *erebusproc* processes the daily data *yymmdd*, designating the year, month, and day of the events. (I recommend Skov's I.S. for a complete explanation of the whole pre-processing procedure.) After logging in as *erebus*:

*example> cd data*
*example> erebusproc 960505*

and you are off and running. A *ghostview* plot of the event will appear, and for each event, the program will query you on several items:

*Save the event? (y or n)*
*Number of stations?*
*Event quality (h,m,l)*
*Print the event? (y or n)*

Quick answers to the questions will kill that *ghostview* and bring up the next event. When you have gone through them all, the process automatically quits. You will then see a lot of weird messages fly by the screen, which means that the data is being resampled and converted to *Xpick* format. This is a good time to make notes on what you just processed. The notes should include the date, the number of events, and pertinent comments like if a station died or a particularly interesting event occurred. For example, *notes95* and *notes96* are two files in */mk1/usr/erebus/Becky/notes* that summarize the daily activity. (This information is highly useful for making histograms in *matlab*! See the *matlab* scripts in */mk1/usr/erebus/Becky/histogram.*) I kept these notes daily by just adding one line per day immediately after processing.

Now you can go on to the next step (picking and locating), or you can go to class and pick later when you have more time.

## Locations

There are two procedures here: (1) getting the locations, by picking and locating with *Xpick/Hypoellipse*, and (2) plotting the locations using *Xmap8* and various scripts and programs created just to make easier the job of sorting out the pick information.

### Xpick

Read the manual.

For other tips, look in */mk1/usr/erebus/Becky/README/README_xpick*. This is an explanation of almost everything you need to get you started, but remember: whenever in doubt, refer to the manual.

One important feature of *Xpick* is that it allows you to make a summarizing comment about the event, which will be saved in the pickfile along with the rest of the pick and location information. (See the *README_xpick* file for the standardized format of a comment line.) The comment lines in the pickfiles are particularly useful because they provide quick information about numbers and types of events. For example, the command:

*example > grep "(C)" /mk1/usr/erebus/data/xfiles/*/*/*p > comments.mk1*

will pull all the comment lines out of the pickfiles on mk1, and put them in the file *comments.mk1*. You can then *grep* on this file to look for all the lines that contain the word "wow" for example, and you then have a count of the events that were spectacular enough to provoke a "wow" out of the analyst! Of course, you can also *grep* for more official information. For example,

*example > grep B comments.mk1 | grep 8sta > Btypes*

will get you a list of B-type events that were recorded at 8 stations and will put that list in a file called *Btypes*.

### Xmap8

Look in */mk1/usr/erebus/Becky/README/README_hype2xmap* to get a handle on plotting locations in Xmap8. The basics are: you need an origin file (that plots the origin of your map, like latitude 78° S and longitude 166° E will get you the corner of the map you want to see Ross Island on), a map file (to stick the map of Ross Island on there), a stations file (that contains the latitude and longitude of the stations), and finally the location file (which contains date, time, latitude, longitude, depth, and magnitude all in a specific format). A fortran program is given in the appendix that pulls the location info out of the pickfiles and puts it into the format that Xmap8 wants. The other files you need (like org.erebus, stations.loc, and outline.map) are all in */mk1/usr/erebus/Becky/xmap*.

Sorting out error ellipse plotting is a bit more hairy, look in */mk1/usr/erebus/Becky/README/README_pickfiles* to get started. It is similar to what you have to do for location files. There is a fortran program provided in Appendix II that will sort out the ellipse info from the pickfiles for you, do the calculations, and put it in the format that Xmap8 need to have to plot error ellipses.

## Manual Transfer

Sometimes mcmsun5 gets clogged up with events and a complete transfer doesn't happen. Be on the look-out for this on swarm days, and for a couple days after swarms. You can telnet to mcmsun5 by using the handy feature built right into the third mouse button (when you are logged on as erebus, of course): click on telnet, then click on EREBUS, then click on mcmsun5. In a couple seconds, a telnet window will come up and you will be queried for a user and password. You can also telnet with a command line, by typing

*griffy> telnet mcmsun5.mcmurdo.gov*

You will get the same query for user and password. The user is s081, which is an historical number from an original NSF grant, and the password is *confidential, check with The Authorities if you must do this.* You can ls right away to see what you have, and then cd to wvmfiles. In there you can ls and you will find five backup directories. Backup1 will be the most recent, and backup5 will be the oldest. To create space on the disk, you can start by deleting .wvm files and the wvmtar from the oldest directories. Make sure they were processed previously on griffy, though, before you nuke them here. If you want to transfer something from mcmsun5 to griffy, use ftp. Here is an example:

*mcmsun5> cd wvmfiles*
*mcmsun5> cd backup2*
*mcmsun5> ls*

At this point, you will see all the .wvm files and the wvmtar file listed. To manually transfer them to griffy:

*mcmsun5> ftp 129.138.15.200*

*mcmsun5> bin* (for binary transfer)

*mcmsun5> mput *.wmv* (to put all the .wvm files on griffy)

And one at a time you will be queried if you want to transfer each one (y or n). You will probably want the wvmtar, too:

*mcmsun5> mput wvmtar*

And when you are done:

*mcmsun5> bye*

# Appendix II *(also dedicated to Agbeli Ameko)*

The following pages contain hard copies of the notes, lists, *README* files, *matlab* scripts and fortran programs mentioned in Appendix I. These are provided here because someday they may no longer be available in the directories given in Appendix I.

72. notes94- notes made right after the daily processing.
73. notes95- just like for notes94.
77. notes96- again, just like above. The daily counts recorded here are used in the *matlab* files to make histograms.
80. dig95.m- a *matlab* script defining the data given in notes95. The days and counts are defined as vectors.
81. dig96.m- a *matlab* script like above, using the data in in notes96.
82. digital.m- a *matlab* script using the dig95.m and dig96.m files to produce a histogram like the one in Figure 8. This particular script is well commented, and most of the other *matlab* scripts are just variations of this.
83. analog- a matlab data file containing counts that Agbeli made of the analog records.
85. anadig95.m- a *matlab* script that loads Agbeli's analog data and reads the digital data, and plots it all up together, like Figure 9.
86. *REAMDE_xpick-* a helpful file to get you started on running *Xpick*. See the *Xpick* manual for more info, it isn't too bad.
87. *REAMDE_pickfiles-* a helpful file that attempts to begin sorting out the cryptic mess of cyber-information known as "pickfiles". The variables described here are used in the fortran programs discussed below. This barely begins to explain it all, I recommend you try to wade through the *Hypoellipse* manual. It is not exactly user-friendly, but it does help.
88. atypes.best- notes made as I went along picking and locating. I kept track of the best locations with a list like this for A-type events. There is space for comments, but notice that the general format is to start the line with *yymmddhhmmss*. This is so that the list can be read in the fortran programs given later. Good idea to keep this same standardized type of list for the best events, it will make it much easier to deal with getting the pick and location information out of the directory structure.
89. btypes.best- notes similar to above, but for B-type events. Kept track of while doing *Xpick* and *Hypoellipse* each day.
93. explosions.best- again, like the lists above. All three tend to be edited daily with the addition of one or two more good events.
95. *swarm_notes* - notes summarizing the swarms of Spring 1996
96. swarmE14.comments- detailed notes per event, made as I looked at the *xfiles* of the explosion swarm of April 14, 1996.
97. swarmB7.comments- similar to above, for the B-type swarm of April7/8, 1996
98. xfile2raid4 - a script that moves xfiles from /mk1 to /raid4. This is the way to make the best events easily accessible. It is only well located events that are stored on /raid4, and all other events are stored on /mk1.
99. readloc.f- a fortran program that gets the location information out of the pickfiles and puts it into a format that *Xmap8* can read. Notice, it uses the type.best list to create the directory structure of the xfiles on the list. (This produces the location information ready to plot of the *best* events.)
100. readellipse.f-a fortran program that gets the error ellipse information out of the pickfiles and puts it into a format that *Xmap8* can read. See the Event Bulletin in Appendix IV for hard copies of the location and error ellipse files that are read by *Xmap8*.

101. xmap.A - the script that calls all the necessary files to get a plot of A-type events in *Xmap8*. You can use this same format to plot B- and E-type events (just use Btypes.loc instead of Atypes.loc). Notice that an *Xmap8* plot requires an origin file (org.erebus - a file that contains the latitude and longitude of the corner point of the map), a station file (stations.loc - a file that contains the latitude and longitude of the seismic stations), and a map file (outline.map - a file that contains the coordinates of the outline of Ross Island). All of these files can be found in /mk1/usr/erebus/Becky/xmap, and also are discussed in the *Xmap8* manual.
102. xmap.ellipseA - a script similar to the above mentioned, but this one plots error ellipses for A-type events in *Xmap8*.
103. xmap2histo.c- a well commented C program that counts events per day by event type from Xmap8 files. Courtesy of Mitch Withers at the 11th hour.

| E | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 4 | | | | |
| 9 | 77 | 68 | 30 | stormy weather |
| 10 | 52 | 29 | 22 | |
| 11 | 18 | 16 | 13 | calmed down now |
| 12 | 13 | 10 | 6 | |
| 13 | 11 | 9 | 8 | |
| 14 | 17 | 12 | 8 | |
| 15 | 10 | 9 | 6 | |
| 16 | 12 | 11 | 6 | look at event 9411160a!!!wow! |
| 17 | 17 | 16 | 7 | |
| 18 | 13 | 13 | 12 | look at 9411180d |
| 19 | 7 | 7 | 6 | look at 94111904 and 06 |
| 20 | 7 | 4 | 4 | |
| 21 | 6 | 6 | 5 | 06 good, the rest kinda junky |
| 22 | 12 | 12 | 11 | 0a and 0d look real good |
| 23 | 28 | 23 | 11 | |
| 24 | 1 | 1 | 1 | |
| 25 | 7 | 7 | 5 | |
| 26 | 6 | 6 | 6 | all 6 look quite good |
| 27 | 9 | 9 | 7 | |
| 28 | 9 | 9 | 7 | all real good, 07 REALLY good! |
| 29 | 13 | 13 | 12 | WOW! some big stuff here |
| 30 | 4 | 4 | 4 | |
| 1 | 3 | 2 | 2 | 3 stations down |
| 2 | 7 | 7 | 7 | 04 looks real good! |
| 3 | 3 | 3 | 3 | |
| 4 | 4 | 4 | 4 | } -processed after |
| 5 | 7 | 7 | 7 | } return from AGU |
| 6 | 2 | 2 | 2 | } |
| 7 | 12 | 12 | 12 | } -all good lookin' stuff |
| 8 | 11 | 11 | 11 | } |
| 9 | 6 | 6 | 6 | this data came on the 10th |
| 10 | 8 | 8 | 7 | data came on the 11th |
| 11 | 5 | 5 | 5 | data came on the 12th,new stations |
| 12 | 3 | 3 | 3 | arrived on time now, 8 stations |
| 13 | 5 | 5 | 5 | 8 and 9 stations, looks great |
| 14 | 4 | 4 | 4 | " " |
| 15 | 2 | 2 | 2 | " " |
| 16 | 2 | 2 | 2 | " " |
| 17 | 11 | 11 | 11 | " " |
| 18 | 2 | 2 | 2 | " " |
| 19 | 6 | 6 | 6 | etc. |
| 20 | 4 | 4 | 4 | |
| 21 | 4 | 4 | 4 | |
| 22 | 6 | 6 | 6 | |
| 23 | - | - | - | no data |
| 24 | 1 | 1 | 1 | |
| 25 | 1 | 1 | 1 | |
| 26 | 12 | 11 | 11 | |
| 27 | - | - | - | no events |
| 28 | 12 | 12 | 12 | |
| 29 | 4 | 4 | 4 | |
| 30 | 2 | 2 | 2 | |
| 31 | 2 | 2 | 2 | |

| : | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 3 | 3 | 3 | |
| 2 | 2 | 2 | 2 | |
| 3 | 1 | 1 | 1 | |
| 4 | 4 | 4 | 4 | |
| 5 | 2 | 2 | 2 | |
| 6 | 4 | 4 | 4 | |
| 7 | 3 | 3 | 3 | |
| 8 | 3 | 3 | 3 | |
| 9 | 1 | 1 | 1 | starting here: |
| 10 | 4 | 4 | 4 | data coming in the day |
| 11 | 2 | 2 | 2 | after, instead of the |
| 12 | 2 | 2 | 2 | day of |
| 13 | 3 | 3 | 3 | |
| 14 | 4 | 4 | 4 | |
| 15 | 4 | 4 | 4 | |
| 16 | 3 | 3 | 3 | |
| 17 | - | - | - | no events |
| 18 | 6 | 6 | 5 | |
| 9 | 7 | 7 | 6 | |
| 0 | 4 | 4 | 4 | |
| 1 | 9 | 9 | 6 | |
| 2 | - | - | - | no events |
| 3 | 2 | 2 | 2 | event 00 looks real good! and |
| 4 | 2 | 2 | 2 | plots look great now, with blank channels outta there |
| 5 | - | - | - | |
| 6 | - | - | - | no events |
| 7 | 7 | 7 | 4 | |
| 8 | 4 | 4 | 1 | some station problems |
| 9 | 3 | 3 | 1 | more of the same Antarctica problems |
| 0 | 1 | 1 | 1 | looks good |
| 1 | 5 | 5 | 5 | WOW! take a look at this! volcanic tremor |

| | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | - | - | - | no events |
| 2 | 3 | 3 | 3 | nothing exciting |
| 3 | 1 | 1 | 1 | |
| 4 | 1 | 1 | 1 | |
| 5 | 7 | 7 | 7 | one possible tremor |
| 6 | 187 | 102 | 4 | very noisy, they had a storm |
| 7 | 1 | 1 | 1 | |
| 8 | 3 | 3 | 3 | |
| 9 | 1 | 1 | 1 | good event! |
| 0 | 2 | 2 | 2 | |
| 1 | 3 | 3 | 3 | a bit wobbly |
| 2 | 3 | 3 | 3 | |
| 3 | 1 | 1 | 1 | not a very good one |
| | - | - | - | no events |
| | 4 | 4 | 4 | |
| | 2 | 2 | 2 | |
| | - | - | - | no events |
| | 4 | 4 | 4 | |
| | 4 | 4 | 4 | |
| | 2 | 2 | 1 | |
| | 3 | 2 | 2 | |
| | 11 | 11 | 9 | |

| | | | | |
|---|---|---|---|---|
| Feb 25 | 3 | 3 | 3 | |
| Feb 26 | 7 | 7 | 7 | |
| Feb 27 | 6 | 5 | 5 | data came late |
| Feb 28 | 3 | 3 | 3 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Mar 1 | 2 | 2 | 2 | |
| Mar 2 | 2 | 2 | 2 | |
| Mar 3 | 6 | 6 | 5 | |
| Mar 4 | 15 | 13 | 13 | 2 possible volcanic tremors |
| Mar 5 | 17 | 17 | 9 | some pretty noisy |
| Mar 6 | 9 | 9 | 3 | noisy stuff again |
| Mar 7 | 6 | 6 | 5 | |
| Mar 8 | 4 | 4 | 4 | |
| Mar 9 | 2 | 2 | 2 | |
| Mar 10 | 2 | 2 | 2 | |
| Mar 11 | 1 | 1 | 1 | |
| Mar 12 | 3 | 3 | 3 | |
| Mar 13 | 2 | 1 | 1 | |
| Mar 14 | 36 | 36 | 26 | windy in Antarctica for a few days |
| Mar 15 | 32 | 32 | 26 | some noisy, some good impulsive stuff |
| Mar 16 | 31 | 29 | 22 | still windy, still pretty noisy |
| Mar 17 | 24 | 23 | 19 | |
| Mar 18 | 16 | 14 | 14 | |
| Mar 19 | 7 | 7 | 7 | |
| Mar 20 | 4 | 4 | 4 | ABBZ dying a slow death |
| Mar 21 | 7 | 7 | 7 | |
| Mar 22 | 6 | 6 | 6 | |
| Mar 23 | 3 | 3 | 3 | |
| Mar 24 | 6 | 6 | 6 | ABBZ back briefly |
| Mar 25 | 13 | 13 | 12 | ABBZ lost again, then back-but touchy |
| Mar 26 | 6 | 4 | 4 | lost HELZ |
| Mar 27 | 4 | 4 | 4 | |
| Mar 28 | 2 | 2 | 2 | |
| Mar 29 | 5 | 5 | 5 | some good impulsive stuff |
| Mar 30 | 3 | 3 | 3 | HELZ back briefly, then gone |
| Mar 31 | 0 | 0 | 0 | no events |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Apr 1 | 3 | 3 | 3 | ABBZ mostly dead, only very strong events |
| Apr 2 | 3 | 3 | 3 | |
| Apr 3 | 2 | 2 | 2 | a couple impulsives |
| Apr 4 | 6 | 6 | 6 | HELZ back for strong events, but mostly dead |
| Apr 5 | 12 | 12 | 12 | |
| Apr 6 | 9 | 9 | 9 | |
| Apr 7 | 3 | 3 | 3 | |
| Apr 8 | 14 | 14 | 13 | |
| Apr 9 | 370 | 14 | 13 | |
| Apr 10 | 135 | 1 | 1 | |
| Apr 11 | 6 | 5 | 5 | |
| Apr 12 | 5 | 5 | 5 | |
| Apr 13 | 4 | 4 | 4 | |
| Apr 14 | 2 | 2 | 2 | |
| Apr 15 | 3 | 3 | 3 | |
| Apr 16 | 3 | 3 | 3 | |
| Apr 17 | 3 | 3 | 3 | |
| Apr 18 | 4 | 4 | 4 | |
| Apr 19 | 10 | 10 | 10 | |
| Apr 20 | 4 | 4 | 4 | |
| Apr 21 | 3 | 3 | 3 | |

| | | | | |
|---|---|---|---|---|
| 24 | 5 | 5 | 5 | |
| 25 | 13 | 13 | 11 | |
| 26 | 3 | 0 | 0 | |
| 27 | - | - | - | no events |
| 28 | 3 | 3 | 3 | |
| 29 | 27 | 27 | 27 | |
| 30 | 11 | 11 | 11 | |

| : | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | |
| 2 | 3 | 3 | 3 | |
| 3 | 5 | 4 | 4 | |
| 4 | 5 | 4 | 4 | |
| 5 | 86 | 18 | 17 | lots of noise and junk |
| 6 | 21 | 7 | 5 | |
| 7 | 1 | 1 | 1 | |
| 8 | 3 | 3 | 3 | |
| 9 | 5 | 2 | 2 | ABBZ crosstalking |
| 10 | 7 | 6 | 6 | |
| 11 | 1 | 1 | 1 | |
| 12 | - | - | - | no events |
| 13 | 4 | 4 | 4 | |
| 14 | 2 | 2 | 2 | |
| 15 | 3 | 3 | 3 | |
| 16 | 3 | 3 | 3 | |
| 17 | 2 | 2 | 2 | |
| 18 | 5 | 4 | 4 | |
| 19 | 1 | 1 | 1 | SISZ dead |
| 20 | 1 | 1 | 1 | BOMZ dead |
| 21 | 5 | 4 | 4 | |
| 22 | - | - | - | no events |
| 23 | - | - | - | " |
| 24 | 1 | 1 | 1 | |
| 25 | 69 | 2 | 2 | very noisy stuff |
| 26 | 2 | 0 | 0 | blips |
| 27 | 1 | 1 | 1 | |
| 28 | 6 | 6 | 6 | |
| 29 | 6 | 6 | 6 | |
| 30 | 4 | 4 | 2 | new configuration: only 3 stations |
| 31 | 7 | 7 | 7 | needed to trigger an event |

| | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 38 | 36 | 36 | |
| 2 | - | - | - | no events |

n: (?) hard to tell with only 4 stations

| | | | | |
|---|---|---|---|---|
| 3 | 130 | 126 | 60 | high winds but still a lot of real |
| 4 | 91 | 85 | 16 | events due to trigger config. |
| 5 | 215 | 20 | 9 | |

.y of real events in there, but unduly triggered by wind or the
ıer config., maybe?

| | | | | |
|---|---|---|---|---|
| 6 | 16 | 15 | 8 | |
| 7 | 7 | 6 | 6 | looks much better |
| 8 | 120 | 2 | 1 | lots of noise |
| 9 | 2 | 2 | 2 | |
| 0 | 11 | 8 | 7 | |
| 1 | 4 | 4 | 4 | |
| 2 | 16 | 16 | 16 | mini-swarm of E-types |
| 3 | 2 | 2 | 2 | |
| 4 | 1 | 1 | 1 | |

| | | | | |
|---|---|---|---|---|
| Jun 16 | 4 | 4 | 4 | |
| Jun 17 | 0 | 0 | 0 | no data to process |
| Jun 18 | 0 | 0 | 0 | no data... |
| Jun 19 | 3 | 3 | 3 | |
| Jun 20 | 1 | 1 | 1 | |
| Jun 21 | 1 | 1 | 1 | |
| Jun 22 | 4 | 4 | 3 | One event rated High |
| Jun 23 | 0 | 0 | 0 | |
| Jun 24 | 0 | 0 | 0 | |
| Jun 25 | 2 | 2 | 2 | |
| Jun 26 | 1 | 1 | 1 | |
| Jun 27 | 1 | 1 | 1 | |
| Jun 28 | 2 | 2 | 2 | |
| Jun 29 | 3 | 2 | 2 | |
| Jun 30 | 1 | 1 | 1 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Jul 1 | 1 | 1 | 1 | |
| Jul 2 | 3 | 3 | 2 | |
| Jul 3 | 2 | 2 | 2 | |
| Jul 4 | 1 | 1 | 1 | |
| July 5 | 2 | 2 | 2 | |
| July 6 | 2 | 2 | 2 | |
| July 7 | 3 | 3 | 3 | |
| July 8 | 2 | 2 | 2 | |
| July 9 | 2 | 1 | 1 | |
| July 10 | 0 | 0 | 0 | no events |
| July 11 | 4 | 4 | 3 | |
| July 12 | 21 | 5 | 5 | |
| July 13 | 2 | 2 | 2 | |
| July 14 | 4 | 4 | 4 | |
| July 15 | | | | |
| July 16 | | | | |
| July 17 | 7 | 7 | 7 | |
| July 18 | | | | |
| July 19 | 4 | 4 | 4 | |
| July 20 | 5 | 5 | 5 | |
| July 21 | 7 | 7 | 7 | |
| July 22 | 2 | 2 | 2 | |
| July 23 | 4 | 4 | 4 | |
| July 24 | 18 | 18 | 18 | MACZ going bad |
| July 25 | 113 | 113 | 133 | a swarm of E- and B-types! some doubles and lots of aftershocks. |
| July 26 | 7 | 7 | 7 | |
| July 27 | 4 | 4 | 4 | MACZ gone |
| July 28 | 3 | 3 | 3 | |
| July 29 | 1 | 1 | 1 | E1SZ gone |
| July 30 | 17 | 10 | 10 | MACZ and E1SZ back on |
| July 31 | 2 | 2 | 2 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Aug 1 | 3 | 3 | 3 | |
| Aug 2 | 4 | 4 | 4 | |
| Aug 3 | 7 | 7 | 7 | |
| Aug 4 | 1 | 1 | 1 | |
| Aug 5 | 1 | 1 | 1 | E1SZ and MACZ dead-- this means we are down to 2 stations (CONZ and HOOZ) |
| Aug 6 | - | - | - | no events |
| Aug 7 | 1 | 1 | 1 | |
| Aug 8 | 1 | 1 | 1 | |

| | | | | |
|---|---|---|---|---|
| 10 | 1 | 1 | 0 | |
| 11 | 1 | 1 | 1 | |
| 12 | 0 | 0 | 0 | |
| 13 | 1 | 1 | 1 | |
| 14 | 1 | 1 | 1 | |
| 15 | 7 | 3 | 0 | everything noisy |
| 16 | 0 | 0 | 0 | |
| 17 | 2 | 2 | 2 | |
| 18 | 0 | 0 | 0 | |
| 19 | 0 | 0 | 0 | |
| 20 | 1 | 1 | 1 | |
| 21 | 1 | 1 | 1 | |
| 22 | - | - | - | no events |
| 23 | 1 | 0 | 0 | |
| 24 | 1 | 0 | 0 | |
| 25 | 1 | 0 | 0 | |
| 26 | 1 | 0 | 0 | mostly deadness |
| 27 | 2 | 1 | 1 | |
| 28 | 2 | 1 | 1 | |
| 29 | 2 | 1 | 1 | |
| 30 | 2 | 1 | 1 | |
| 31 | 3 | 1 | 1 | |

ıry: August was a bleak month

| -- | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| l | 1 | 1 | 1 | |
| 2 | 0 | 0 | 0 | no events |
| 3 | 2 | 0 | 0 | |
| 4 | 27 | 0 | 0 | |
| 5 | 6 | 0 | 0 | |
| 6 | 13 | 3 | 3 | |
| 7 | 4 | 1 | 1 | |
| 8 | 3 | 2 | 2 | |
| 9 | 3 | 0 | 0 | |
| .0 | 2 | 0 | 0 | |
| .1 | 2 | 1 | 1 | |
| 2 | 5 | 2 | 2 | |
| .3 | 5 | 4 | 2 | MACZ & EISZ coming in sporadically |
| .4 | 6 | 1 | 1 | |
| .5 | 8 | 2 | 1 | |
| .6 | 3 | 1 | 1 | ABBZ making an appearance, NOT crosstalking! |
| .7 | 28 | 2 | 2 | |
| .8 | 5 | 1 | 1 | |
| 9 | 5 | 2 | 2 | |
| '0 | 3 | 0 | 0 | |
| 1 | 1 | 0 | 0 | ?? one is printed there, with 6 stations up SISZ up, ABBZ crosstalking |
| 2 | 4 | 2 | 2 | |
| 3 | 10 | 6 | 5 | ABBZ ok on strong signal |
| 4 | 7 | 7 | 7 | noisy, stations intermitent |
| 5 | 2 | 2 | 2 | all 7 stations up for an explosion! great! |
| 6 | 4 | 3 | 3 | AGAIN! all 7 stations back for an explosion |
| 7 | 1 | 1 | 0 | |
| 8 | 3 | 3 | 3 | disk trouble and strangeness, redid the processing up to Oct 8. |
| 9 | 1 | 1 | 1 | |
| 0 | 11 | 5 | 5 | SISZ sporadic and ABBZ sometimes still crosstalking |

| EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|
| 14 | 2 | 2 | 5 stations up for two good events |

| | | | | |
|---|---|---|---|---|
| Oct 3 | 2 | 1 | 1 | only CONZ and HOOZ |
| Oct 4 | 3 | 2 | 2 | 7 up for an explosion (only BOMZ down) and an A-type |
| Oct 5 | 2 | 2 | 2 | |
| Oct 6 | 5 | 5 | 5 | |
| Oct 7 | 4 | 3 | 1 | |
| Oct 8 | 2 | 2 | 2 | |
| Oct 9 | 5 | 4 | 4 | |
| Oct 10 | - | - | - | |
| Oct 11 | 5 | 5 | 5 | all 8 up for a strong B |
| Oct 12 | 2 | 2 | 2 | |
| Oct 13 | 5 | 5 | 5 | |
| Oct 14 | 4 | 4 | 4 | |
| Oct 15 | 5 | 5 | 5 | tremor for 2 traces |
| Oct 16 | 3 | 3 | 3 | |
| Oct 17 | 4 | 4 | 4 | |
| Oct 18 | 4 | 4 | 4 | possible tremor |
| Oct 19 | 2 | 2 | 2 | |
| Oct 20 | 2 | 2 | 2 | |
| Oct 21 | 4 | 3 | 2 | " |
| Oct 22 | 1 | 1 | 1 | |
| Oct 23 | 5 | 5 | 5 | |
| Oct 24 | 8 | 8 | 8 | |
| Oct 25 | 6 | 6 | 6 | strong A, maybe deep |
| Oct 26 | 5 | 5 | 5 | another strong A(3 of them) |
| Oct 27 | 3 | 3 | 3 | very strong low freq. BOMZ event |
| Oct 28 | 2 | 2 | 2 | |
| Oct 29 | 1 | 1 | 1 | |
| Oct 30 | 4 | 4 | 4 | |
| Oct 31 | 7 | 7 | 7 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Nov 1 | 6 | 6 | 6 | HELZ not always working |
| Nov 2 | 0 | 0 | 0 | no events |
| Nov 3 | 2 | 2 | 2 | |
| Nov 4 | 5 | 5 | 5 | |
| Nov 5 | 5 | 5 | 5 | |
| Nov 6 | 2 | 2 | 2 | |
| Nov 7 | 1 | 1 | 1 | |
| Nov 8 | 0 | 0 | 0 | |
| Nov 9 | 4 | 3 | 3 | |
| Nov 10 | 3 | 3 | 3 | |
| Nov 11 | 157 | 1 | 1 | wind storm |
| Nov 12 | 438 | 1 | 1 | more wind |
| Nov 13 | 6 | 6 | 6 | |
| Nov 14 | 2 | 2 | 2 | |
| Nov 15 | 10 | 10 | 10 | a very interesting day! all good events- strong E's, a good A, some long B's |
| Nov 16 | 3 | 3 | 3 | |
| Nov 17 | 2 | 2 | 2 | an excellent A-type!! (8 stations) |
| Nov 18 | 7 | 7 | 7 | |
| Nov 19 | 5 | 5 | 5 | |
| Nov 20 | 0 | 0 | 0 | no events |
| Nov 21 | 12 | 4 | 4 | |
| Nov 22 | 14 | 2 | 2 | |
| Nov 23 | 60 | 4 | 4 | Ray down there doing stuff |
| Nov 24 | 0 | 0 | 0 | |
| Nov 25 | 5 | 5 | 5 | |
| Nov 26 | 3 | 3 | 3 | longer time on traces, and first appearance of SISE and SISN (just noise so far) |
| Nov 27 | 2 | 2 | 2 | SISE coming in |

30 - - - no data

| E | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|

tormy, noisy month (Phil said one of the stormiest in a long time)
data polluted with noise

| | | | | |
|---|---|---|---|---|
| 1 | - | - | - | no data |
| 2 | 4 | 4 | 4 | 2 strong explosions, and noisy stuff |
| 3 | 8 | 8 | 8 | a strong BOMZ double, & a strong SIS double |
| 4 | 6 | 6 | 6 | |

Z down

| | | | | |
|---|---|---|---|---|
| 5 | 1 | 1 | 1 | an excellent A-type w/good 3d |
| 6 | 1 | 1 | 1 | |
| 7 | 4 | 4 | 4 | |
| 8 | 5 | 5 | 5 | |
| 9 | 6 | 6 | 6 | SIS down |
| 10 | 3 | 3 | 3 | WOW! strong A-type |
| 11 | 2 | 2 | 2 | |
| 12 | 1 | 1 | 1 | SIS back up |
| 13 | 1 | 1 | 1 | overlapping double, interesting |
| 14 | 3 | 3 | 3 | good ones, not too noisy for a change |

. back up

| | | | | |
|---|---|---|---|---|
| 15 | 3 | 3 | 3 | " " |
| 16 | 9 | 9 | 9 | a strong Double ABBZ, other good ones(beats?) |
| 17 | - | - | - | |
| 18 | 4 | 4 | 4 | |
| 19 | 3 | 3 | 3 | |
| 20 | 5 | 5 | 5 | very strong BOMZ (twice) |
| 21 | 6 | 2 | 2 | |
| 22 | 11 | 8 | 8 | 3 A-types, and something with strong beats |
| 23 | 9 | 9 | 9 | another beat thing |
| 24 | 4 | 4 | 4 | |
| 25 | 6 | 6 | 6 | teleseism |
| 26 | 7 | 7 | 7 | WOW BOMZ, 3 strong explosions and an ABBZ |
| 27 | 5 | 5 | 5 | |
| 28 | 3 | 3 | 3 | |
| 29 | 5 | 5 | 5 | |
| 30 | 2 | 2 | 2 | 1 A-type with strong s at ABBZ |
| 31 | 5 | 5 | 5 | a strong BOMZ and a strong ABBZ |

l stormy and noisy

| E | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 5 | | | | |
| 1 | 7 | 7 | 7 | teleseism and an A-type |
| 2 | 5 | 5 | 5 | |
| 3 | 6 | 6 | 6 | noisy tremor |
| 4 | 2 | 2 | 2 | |
| 5 | 3 | 3 | 3 | A-type and 2 good explosions |
| 6 | 6 | 6 | 6 | a noisy A-type or 2 in there |
| 7 | 1 | 1 | 1 | a perfect textbook explosion |
| 8 | 4 | 4 | 4 | |
| 9 | 2 | 2 | 2 | a beat looking thing |
| 10 | 1 | 1 | 1 | |
| 11 | 5 | 5 | 5 | strong ABBZ and BOMZ, and a WOW event!! |
| 12 | 1 | 1 | 1 | |
| 13 | 3 | 3 | 3 | one strong ABBZ |
| 14 | 5 | 5 | 5 | |
| 15 | 6 | 6 | 6 | one good A-type and a strong SIS |
| 16 | 6 | 6 | 6 | noisy, strong SISZ |
| 17 | 6 | 6 | 6 | a huge WOW!!! event |
| 18 | 7 | 7 | 7 | 2 good A-types |
| 19 | 4 | 4 | 4 | |
| 20 | 6 | 6 | 6 | 1 good A-type, and 1 HUGE E-type (clipped EVERY station!) |
| 21 | 4 | 4 | 4 | noisy |
| 22 | 11 | 11 | 11 | very noisy |
| 23 | 3 | 3 | 3 | |
| 24 | 2 | 2 | 2 | |
| 25 | 2 | 2 | 2 | a strong BOMZ |
| 26 | 45 | 2(1) | 2(1) | noisy |
| 27 | 134 | 0 | 0 | |
| 28 | 37 | 6 | 6 | |
| 29 | 83 | 4 | 3 | |
| 30 | 3 | 3 | 3 | noisy |
| 31 | 4 | 4 | 4 | |

1 noisy

| - | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 7 | 6 | 5 | all very noisy stuff |
| 2 | 2 | 2 | 2 | a good MACZ event |
| 3 | 2 | 2 | 2 | |
| 4 | 3 | 3 | 3 | |
| 5 | 4 | 4 | 4 | a WOW explosion |
| 6 | 3 | 3 | 3 | |
| 7 | 4 | 4 | 4 | |
| 8 | 2 | 2 | 2 | |
| 9 | 7 | 7 | 7 | |
| .0 | 6 | 6 | 6 | |
| .1 | 7 | 5 | 5 | |

swarm near Helio Cliffs, next couple of days:
eported by Joe Petit from what he observed on the heliocorder records)

| | | | | |
|---|---|---|---|---|
| 2 | 13 | 13 | 13 | some really good ones, strong, still noisy |
| 3 | 23 | 23 | 5 | VERY noisy stuff |
| 4 | 14 | 11 | 11 | |
| 5 | 7 | 7 | 7 | |
| 6 | 6 | 6 | 6 | |
| 7 | 6 | 6 | 5 | teleseism, strong E-type |

| | | | | |
|---|---|---|---|---|
| Feb 19 | 18 | 17 | 3 | noticing lots of CONZ events |
| Feb 20 | 9 | 9 | 0 | |
| Feb 21 | 102 | 102 | 12 | WOW! swarms of ice quakes! |
| Feb 22 | 10 | 10 | 2 | |
| Feb 23 | 4 | 4 | 1 | |
| Feb 24 | 3 | 3 | 1 | |
| Feb 25 | 6 | 6 | 3 | some strong explosions |
| Feb 26 | 23 | 23 | 4 | all real events with ice-quakes still happening |
| Feb 27 | 0 | 0 | 0 | |
| Feb 28 | 80 | 80 | 29 | WOW! lots more ice quakes! |
| Feb 29 | 28 | 28 | 5 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Mar 1 | 0 | 0 | 0 | no events |
| Mar 2 | 2 | 2 | 0 | noisy |
| Mar 3 | 0 | 0 | 0 | no events |
| Mar 4 | 4 | 4 | 0 | |
| Mar 5 | 6 | 6 | 3 | 1 strong explosion and 1 good A-type |
| Mar 6 | 4 | 4 | 3 | again, strong explo. and good A-type |
| Mar 7 | 2 | 2 | 0 | |
| Mar 8 | 4 | 4 | 0 | |
| Mar 9 | 16 | 9 | 1 | a lot of noise |
| Mar 10 | 8 | 8 | 1 | |
| Mar 11 | 1 | 1 | 1 | |
| Mar 12 | 7 | 7 | 5 | several very long duration ones |
| Mar 13 | 6 | 6 | 2 | |
| Mar 14 | 0 | 0 | 0 | |
| Mar 15 | 45 | 45 | 5 | swarm of ice quakes |
| Mar 16 | 17 | 17 | 3 | |
| Mar 17 | 433 | 0 | 0 | big wind storm |
| Mar 18 | 2 | 2 | 2 | |
| Mar 19 | 7 | 6 | 3 | |
| Mar 20 | 10 | 10 | 7 | |
| Mar 21 | 6 | 6 | 2 | |
| Mar 22 | 5 | 5 | 4 | WOW!! a HUGE one at ABBZ and all stations |
| Mar 23 | 11 | 11 | 7 | several big explosions and a strong CONZ |
| Mar 24 | 5 | 5 | 2 | WOW! an explosion that clipped every station and showed up at OBSZ! |
| Mar 25 | 5 | 4 | 4 | |
| Mar 26 | 13 | 13 | 4 | SIS starting to die, seems ok later |
| Mar 27 | 17 | 17 | 8 | |
| Mar 28 | 35 | 34 | 9 | |
| Mar 29 | 32 | 32 | 9 | |
| Mar 30 | 245 | - | - | wind storm |
| Mar 31 | 0 | 0 | 0 | |

END OF DATA SET FOR I.S. (R. L. KNIGHT)

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Apr 1 | 4 | 4 | 4 | |
| Apr 2 | 24 | 2 | 1 | |
| Apr 3 | 0 | 0 | 0 | |
| Apr 4 | 5 | 5 | 5 | a couple good A-types in there |
| Apr 5 | 7 | 7 | 6 | |
| Apr 6 | 11 | 11 | 3 | SIS off at end of day |
| Apr 7 | 31 | 31 | 6 | SIS ok |

's from Joe Petit: windy on Apr 9, which accounts for the noise, but the
'nts on Apr 8 are real, no wind storm

| | | | | |
|---|---|---|---|---|
| 10 | 20 | 20 | 14 | BOMZ and MACZ looking weak |
| 11 | 65 | 44 | 9 | BOMZ in trouble, noisy stuff (wind), still a lot of strong events- higher than usual seismicity... some kinda swarm here! |
| 12 | 113 | 3 | 3 | very noisy trash |
| 13 | 6 | 2 | 1 | HELZ going bad, BOMZ having trouble |
| 14 | 140 | 119 | 59 | WOW!!! huge swarm of explosions! double and triple explosions on some traces. Some very strong ones carrying McMurdo!! |
| 15 | 253 | 4 | 2 | wind noise, BOMZ nearly dead, HELZ in big trouble |
| 16 | - | - | - | |
| 17 | 13 | 10 | 8 | |
| 18 | 17 | 17 | 13 | |
| 19 | 5 | 5 | 4 | |
| 20 | 77 | 46 | 32 | some big explosions, BOMZ still hanging in there, but getting very noisy (still ok for big events) ABBZ starting to look troubled |
| 21 | 113 | 113 | 48 | WOW!!! more swarming! |
| 22 | 24 | 24 | 24 | CONZ getting spikey, very bad then dead all other stations still hanging in there |
| 23 | 11 | 11 | 11 | CONZ dead for half, then came back on spikey, one very strong event, almost a WOW |
| 24 | 12 | 12 | 12 | CONZ dead at end of day, all stations on for strong events, a big explosion and one good A-type, and a regional that carried McMurdo |
| 25 | 3 | 3 | 3 | |
| 26 | 7 | 7 | 7 | |
| 27 | - | - | - | no events |
| 28 | 6 | 6 | 6 | a couple good lookin' deep ones |
| 29 | 32 | 11 | 8 | noisy, BOMZ dead at night |
| 30 | 13 | 13 | 13 | |

| - | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 358 | 358 | 80 | ICE QUAKE SWARM!! process killed in the middle, first half not converted to xfiles, go back later and fix |
| 2 | 8 | 8 | 6 | more ice quakes |
| 3 | 48 | 48 | 46 | a lot of ice-quakes, but plenty of real events, too. Big ones, mostly B-types |
| 4 | 32 | 32 | 32 | ditto! |
| 5 | 57 | 57 | 57 | wow, again, ditto! lots of this stuff! |
| 6 | 40 | 40 | 39 | geeze! again, ditto! possible some tremor in there too. Definately a long, big swarm |
| 7 | 4 | 4 | 4 | |
| 8 | 4 | 4 | 4 | |
| 9 | 7 | 7 | 7 | BOMZ,HELZ weak and noisy, but still recording for large events |
| 10 | 8 | 8 | 8 | |
| 11 | 4 | 4 | 4 | |
| 12 | 1 | 1 | 1 | |
| 13 | 5 | 5 | 5 | all deep! interesting! |

| | | | | |
|---|---|---|---|---|
| | | | | SIS are noisy |
| May 14 | 10 | 10 | 10 | all real good ones! one explosion, a couple deep ones like yesterday |
| May 15 | 8 | 8 | 8 | more good ones like yesterday, and one big explosion |
| May 16 | 5 | 5 | 5 | again, good ones, deep like the past couple of days, and one strong B-type double, very strong at SIS |
| May 17 | 1 | 1 | 1 | a big explosion, carried at McMurdo |
| may 18 | 5 | 5 | 5 | all good ones again like the past several |
| May 19 | 3 | 3 | 3 | one very TREMOR like event |
| May 20 | 3 | 3 | 3 | good deep ones again |

SISZ-N-E dead on May 21

| | | | | |
|---|---|---|---|---|
| May 21 | 7 | 7 | 7 | SIS DEAD, 7 stations still working, one big explosion in there, another tremor piece |
| May 22 | 122 | 105 | 63 | alot of good events, but some really noisy |
| May 23 | 191 | 187 | 116 | more Bswarm, noisy but good |
| May 24 | 54 | 54 | 53 | very noisy, but still plenty of real Btypes |
| May 25 | 4 | 4 | 4 | |
| May 26 | 3 | 3 | 3 | a piece of tremor in there |
| May 27 | - | - | - | |
| May 28 | 1 | 1 | 1 | strong ABBZ |
| May 29 | 2 | 2 | 2 | |
| May 30 | 3 | 3 | 3 | |
| May 31 | 9 | 9 | 9 | |

| DATE | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| Jun 1 | 7 | 7 | 7 | |
| Jun 2 | 3 | 3 | 3 | |
| Jun 3 | 6 | 6 | 6 | |
| Jun 4 | 4 | 4 | 4 | |
| Jun 5 | 2 | 2 | 2 | |
| Jun 6 | 3 | 3 | 3 | |
| Jun 7 | 4 | 4 | 4 | |
| Jun 8 | 25 | 25 | 25 | HELZ going dead |
| Jun 9 | 15 | 15 | 15 | HELZ on/off, totally flakey |
| Jun 10 | 21 | 21 | 21 | |
| Jun 11 | 26 | 26 | 26 | |
| Jun 12 | 18 | 18 | 18 | |
| Jun 13 | 20 | 20 | 20 | getting pretty noisy |
| Jun 14 | 49 | 27 | 24 | SIS came back on! |
| Jun 15 | 11 | 11 | 11 | |
| Jun 16 | 16 | 16 | 16 | BOMZ, HELZ very sick |
| Jun 17 | 15 | 15 | 15 | very strong teleseism that went for 3 traces recorded well at 8 stations, only HELZ bad |
| Jun 18 | 12 | 12 | 12 | |
| Jun 19 | 6 | 6 | 6 | |
| Jun 20 | 9 | 9 | 9 | |
| Jun 21 | 10 | 10 | 10 | |
| Jun 22 | 6 | 6 | 6 | |
| Jun 23 | 8 | 8 | 8 | HELZ and BOMZ not sick now |
| Jun 24 | 26 | 26 | 26 | noisy stuff and HELZ sick again |
| Jun 25 | 20 | 14 | 14 | |
| Jun 26 | 10 | 6 | 6 | |
| Jun 27 | 3 | 3 | 3 | HELZ dead |
| Jun 28 | 3 | 3 | 3 | SIS pretty much dead too |

30 - - -

| : | EVENTS | SAVED | PRINTED | COMMENTS |
|---|---|---|---|---|
| 1 | 8 | 8 | 8 | |
| 2 | 8 | 3 | 3 | |
| 3 | 6 | 6 | 6 | |
| 4 | 7 | 7 | 7 | |
| 5 | 5 | 4 | 4 | |
| 6 | 2 | 2 | 2 | |
| 7 | 8 | 8 | 8 | |
| 8 | 34 | 34 | 34 | B swarm! |
| 9 | 78 | 78 | 78 | lots of real stuff. B-types. |
| 10 | 71 | 71 | 71 | more swarming! noisy, too though |
| 11 | 144 | 28 | 27 | mostly trashy wind noise |
| 12 | 10 | 10 | 10 | |
| 13 | 4 | 4 | 4 | |
| 14 | 10 | 10 | 10 | |
| 15 | 10 | 10 | 10 | |
| 16 | 11 | 11 | 11 | |
| 17 | 9 | 9 | 9 | |
| 18 | 17 | 17 | 17 | |
| 19 | 20 | 20 | 14 | Big action at ABBZ! Wow events! |
| 20 | 40 | 40 | 40 | |
| 21 | 31 | 31 | 28 | swarmy stuff a couple days, but noisy |
| 22 | 16 | 16 | 15 | |
| 23 | 75 | 14 | 14 | very noisy stuff |
| 24 | 16 | 16 | 16 | |
| 25 | 11 | 11 | 11 | |
| 26 | 7 | 7 | 7 | |
| 27 | 8 | 8 | 8 | |
| 28 | 4 | 4 | 4 | |
| 29 | 3 | 3 | 3 | |
| 30 | 5 | 5 | 5 | |

```
95 = [1:365];


nts95 = [3,2,1,4,2,4,3,3,1,4,2,2,3,4,4,3,0,5,6,4,6,0,2,2,0,0,4,1,1,1,5,0,3,1,1,7,4,1,
,2,3,3,1,0,4,2,0,4,4,1,2,9,7,0,3,7,5,3,2,2,5,13,9,3,5,4,2,2,1,3,1,26,26,22,19,14,7,4,
,3,6,12,4,4,2,5,3,0,3,3,2,6,12,9,3,13,13,1,5,5,4,2,3,3,3,4,10,4,3,4,10,5,11,0,0,3,27,
1,3,4,4,17,5,1,3,2,6,1,0,4,2,3,3,2,4,1,1,4,0,0,1,2,0,1,6,6,2,7,36,0,60,16,9,8,6,1,2,7
16,2,1,3,4,0,0,3,1,1,3,0,0,2,1,1,2,2,1,1,2,2,1,2,2,3,2,1,0,3,5,2,4,0,0,7,0,4,5,7,2,4,
133,7,4,3,1,10,2,3,4,7,1,1,0,1,1,1,0,1,0,1,1,0,0,2,0,0,1,1,0,0,0,0,0,1,1,1,1,1,1,0,0,
,3,1,2,0,0,1,2,2,1,1,1,2,1,2,0,0,2,5,7,2,3,0,3,1,5,2,0,1,2,2,5,1,2,4,0,5,2,5,4,5,3,4,
,2,2,1,5,8,6,5,3,2,1,4,7,6,0,2,5,5,2,1,0,3,3,1,1,6,2,10,3,2,7,5,0,4,2,4,0,5,3,2,0,3,0
4,8,6,1,1,4,5,6,3,2,1,1,3,3,9,0,4,3,5,2,8,9,4,6,7,5,3,5,2,5];
```

```
96 = [1:212];
nts96 = [7,5,6,2,3,6,1,4,2,1,5,1,3,5,6,6,6,7,4,6,4,11,3,2,2,2,0,6,4,3,4,6,2,2,3,4,3,4
7,6,5,13,23,11,7,6,6,7,17,9,102,10,4,3,6,23,0,80,28,0,2,0,4,6,4,2,4,9,8,1,7,6,0,45,17
2,6,10,6,5,11,5,4,13,17,34,32,0,0,4,2,0,5,7,11,31,381,85,20,44,3,2,119,4,0,10,17,5,46
3,24,11,12,3,7,0,6,8,13,358,8,48,32,57,40,4,4,7,8,4,1,5,10,8,5,1,5,3,3,7,105,187,54,4
0,1,2,3,9,7,3,6,4,2,3,4,25,15,21,26,18,20,27,11,16,15,12,6,9,10,6,8,26,14,6,3,3,3,0,8
5,7,4,2,8,34,78,71,28,10,4,10,10,11,9,17,20,40,31,16,14,16,11,7,8,4,3,5];
```

```
is is a matlab script that plots up histograms
'or the digital data.

rst, load in the data. There are "events" and "days"
or both 1995 and 1996.

95
96

ow, plot it up. This will put 1995 data in the top
bplot, and 1996 data in the bottom subplot.

plot(211),plot(day95,events95,'linewidth',3)
le('Digital Records')
bel('Event Count')
s([0 365 0 400])
end('1995')
t(200,150,'IV')
t(25,35,'I')
t(120,75,'II')
t(150,90,'III')
t(225,50,'no')
t(215,25,'record')

plot(212),plot(day96,events96,'linewidth',3)
el('Event Count')
el('Julian day')
([0 365 0 400])
nd('1996')
(103,370,'VI')
(102,135,'VII')
(52,105,'V')
(125,350,'VIII')
(140,200,'IX')

t is a handy way to label things right on the plot.
e command text(140,200,'IX') puts the number IX
roximately on the x-y coordinate 140,200
```

| |
|---|
| 9 |
| 34 |
| 86 |
| 49 |
| 11 |
| 8 |
| 11 |
| 9 |
| 0 |
| 12 |
| 5 |
| 12 |
| 27 |
| 71 |
| 8 |
| 31 |
| 29 |
| 0 |
| 0 |
| 5 |
| 13 |
| 11 |
| 2 |
| 17 |
| 32 |
| 95 |
| 132 |
| 119 |
| 124 |
| 89 |
| 0 |
| 18 |
| 33 |
| 20 |
| 13 |
| 22 |
| 22 |
| 18 |
| 0 |
| 8 |
| 18 |
| 15 |
| 10 |
| 31 |
| 89 |
| 164 |
| 184 |
| 138 |
| 154 |
| 75 |
| 89 |
| 61 |
| 48 |
| 42 |
| 40 |
| 32 |
| 11 |
| 14 |
| 38 |
| 16 |
| 37 |
| 28 |

| | |
|---|---|
| 111 | 19 |
| 112 | 51 |
| 113 | 65 |
| 114 | 28 |
| 115 | 0 |
| 116 | 0 |
| 117 | 0 |
| 118 | 124 |
| 119 | 136 |
| 120 | 176 |
| 121 | 104 |
| 122 | 81 |
| 123 | 93 |
| 124 | 108 |
| 125 | 87 |
| 126 | 62 |
| 127 | 37 |
| 128 | 51 |
| 129 | 38 |
| 130 | 47 |
| 131 | 30 |
| 132 | 45 |
| 133 | 26 |
| 134 | 19 |
| 135 | 41 |
| 136 | 39 |
| 137 | 30 |
| 137 | 42 |
| 139 | 14 |
| 140 | 46 |
| 141 | 39 |
| 142 | 23 |
| 143 | 31 |
| 144 | 44 |
| 145 | 37 |
| 146 | 24 |
| 147 | 56 |
| 148 | 58 |
| 149 | 84 |
| 150 | 116 |
| 151 | 165 |
| 152 | 262 |
| 153 | 328 |
| 154 | 258 |
| 155 | 89 |
| 156 | 124 |
| 157 | 115 |
| 158 | 0 |
| 159 | 69 |
| 160 | 48 |
| 161 | 76 |
| 162 | 67 |
| 163 | 50 |
| 164 | 46 |
| 165 | 38 |
| 166 | 31 |
| 167 | 26 |
| 168 | 36 |
| 169 | 37 |
| 170 | 32 |
| 171 | 30 |
| 172 | 28 |

34
13
24
34
31
0
35
33
37
35
45
27
30
36
14
26
45
44
40
0
50
44
44
39
51
0
43
48
38
53
122
191
51
48
52
13
44
31
30
35
36
30
29
44
45

```
d analog
95short
days = analog(:,1);
events = analog(:,2);
t(anadays,anaevents,'--')
d on
t(day95,events95,'-','linewidth',3)
d off
bel('Event Count')
bel('Julian day')
s([0 219 0 350])
le('Analog and Digital records, 1995')
xt(20,20,'I')
xt(120,190,'II')
xt(160,300,'III')
xt(200,200,'IV')
end('analog95','digital95')
```

```
re are some notes to get you started on xpick:

:st, always refer to the manual about buttons etc, it is very helpful.

 get xpick started:

ınxpick_erebus 960401

ı general, that is yymmdd :
.r month day)

ın wait a minute for ıt to get hooked up, then it will pop up on the screen.
.ck any button on this first opening window to get the event list for the
'. You will see something like:

'401123456        NO PICKFILE FOR THIS EVENT
401152345         NO PICKFILE FOR THIS EVENT

 general, those listings are yymmddhhmmss :
r month day hour min sec )

PICKFILE FOR THIS EVENT will appear if you have not yet looked at the event.
you have picked stuff on before, the location information will appear here.
en if you made no picks, and only made a comment line for it, a bunch of
nk lines will appear as the location information.)

 the first button to click on an event to select it (it will then be
hlighted), and then click the third button to call up the event you just
hlighted. It will then show all the traces for the event.

your picking.

 HYPOE.

e I said, refer to the manual as much as you want. I cannot stress the
ortance of getting to know the manual, and just trying stuff. There are lots
button combinations and tricks.

t the event with a comment line of the standard:

ıt type, number of stations, number of s picks, rms, extra comments

 example:

3sta. w/3d, 4s, rms=.05, very deep(2.5km)

3sta., 0s, rms=.30, noısy

ər the number of stations part: include w/3d if you have made s picks at
:ions SISN and SISE (this means we have 3-component data for the event).
/ou have not made s picks at SISN and SISE, then do not say w/3d.

.s not always necessary to add extra comments, but here are some examples
:ommon ones:

' impulsive CONZ
›ped 4 stations
ıly emergent
ıor-like
 quake on HOOZ
›ng ABBZ
›ng BOMZ
ıy
    sometimes I get bored in noisy swarms and come up with clever comment
    lines! If you did not locate it, or it was complete garbage, you don't
    have to even try picking it. Just give a garbage type comment line.
ice quake swarm
wind noise
WOW! very strong, clipped all

and so forth. Just anything unusual looking, try to note it if there is space
in the comment line. It is very useful to grep on "ice" and "BOMZ" for example,
to find out how many events show ice quakes and how many events occurred closest
to BOMZ.


Deep events get an extra comment.

VERY deep (for any positive depth-that means below sea level: 0km, 1km, 2km etc)
very deep (for depths between 0km and -1km)
deep      (for depths between -1km and -2.5km)
below     (for below summit, -2.5km to -3.6km)

if it is -3.71km, or around there, that is the summit, and it does not need a
depth comment. That number comes up all the time.

Good luck! Have fun.
Remember, when in doubt, refer to the manual.
```

```
there are multiple pick files then the most recent is *p.

an event has been located there will be a pick file
ı the xfiles that is named for the trace start time
ı a letter on the end.  The files ending in p are the
: recent pickfiles and are the ones that xpick displays.
 first line contains the location information.  It can
read and reformatted with printhyps.f.  The read variables are:

te,khr,kmn,secs,lat,nors,latmin,lon,eorw,lonmin,depth1,prefmag,no,gap,d1,rms,eaz1,edp
l1,eaz2,edp2,el2,xmag,fmag,pste,el3,qual,magtyp,nswt,slash,instr,mrun,yrun,etype,fli,
num,smp,zup,zdn,vpvs,nrd,depth2

ng the format statement:

nat(i6,i2,i2,f4.2,i2,a1,f4.2,i3,a1,f4.2,f5.2,f2.1,i3,i3,f3.0,f4.2,i3,i2,f4.2,i3,i2,f4
f2.1,f2.1,a1,f4.2,a1,a1,i2,a1,a4,i2,i2,a1,i1,a5,f4.2,f2.0,f2.0,f4.2,i2,f5.2)    115 t
. elements

 line might look something like this:

'101349153034N 673106W4975  62511 18 81 12  10259 0   6169 8  10  11*  31AF 9/     99
      173.2.1 171 0  625


ıll list of these variables begins on page 2-48 of the hypoe manual

.e = date = 950910 = 10 SEP 1995
 = hour of origin time = 13
 = min of origin time = 49
  = seconds of origin time = 1530 = 15.30 s
 = degrees latitude = 34
  = north or south = N
.in = minutes of latitude = 673 = 06.73 minutes
 = longitude = 106
' = east or west = W
in = minutes of longitude = 4975 = 49.75 minutes
.h1 =  event depth (if negative, set to 0) =    625 = 006.25 km
mag = preferred magnitude = 11 = 1.1
: number of p and s picks = 18 = 018
 = azimuthal gap = 81 = 081 degrees
: distance to closest station = 12 = 012 km
 = rms value in seconds = 10 = 00.10 s
  = azimuth of axis 1 of error ellipsoid (degrees)= 259
  = dip of axis 1 (degrees) = 0 = 00
 = length of ellipsoid semi-axis 1 (km) = 6 = 00.06
  = azimuth of axis 2 of error ellipsoid (degrees) = 169
  = dip of axis 2 (degrees) = 8 = 08
 = length of ellipsoid semi-axis 2 (km) = 10 = 00.10
  = average xmag (amplitude magnitude) = 0.0
  = average fmag (coda length magnitude) = 11 = 1.1
  = processing state =  a single character
   like *  for more data to be added
        P  for preliminary
        F  for final location determined
= length of ellipsoid semi-axis 3 (km) = 31 = 00.31
 = quality = A = a single character
    based on rms and seh and sez (errors in horiz. and vert.)
    like letter grades, quality A is best and D is worst
    see page 2-40,41
ype = magnitude type = F = a single character
   xpick for erebus uses coda length magnitude
 = number of s picks used in solution = 0 = 00
```

```
             record, subsequent records will have a / = a single character
instr = instruction record =    = four characters that are blank here
mrun = month data was run = 9 = 09
yrun = year data was run = 95
etype = event type  = a single character
        like  E  local or regional
              T  teleseism
              R  Regional
              N  nuclear explosion (??!!)
              G  glacier event
              X  volcanic (like for tremor)
              a  high freq.
              B  low freq
fli = fixed location indicator  = 0
      this is one of the menu options you can try to force a location
      out of lousy data, to give you an idea of what is wrong with
      your picks. I don't know, it is a trick- and if I ever set the
      depth to fiddle with locations and see what picks it wants, I
      always un-set it back, and let it run regular. This should always
      be zero I think (not fair to have a set depth or a set anything)
seqnum = sequence number = five empty characters in this case
smp = s-p time at closest station used in solution =  = 00.00
zup = yea, I don't get this either = .2 = don't understand
zdn = guess me = .1 = don't understand
vpvs = vp/vs ratio = 171 = 01.71
nrd = number of readings weighted out = 0 = 00
depth = allowed to be negative = 625 = 006.25 km

Within each event file there are lines for each station that might look
something like this:
BAR IVu0 9509101349 1879 190 77 2129ns 0113        348  2    0  C      49.2    3  2    -4
  0  0  0    11MMM M0

BAR = Station
I   = impulsive, emergent, etc
V   = vertical component
u   = first motion up
0   = pick quality factor
9509101349 = Sep 10 1995 10:13:49 UT
1879 = P-arrival in seconds X 100
190 = distance between event and station in kilometers X 10
77  = azimuth of station from event (or other way round)
2129 = S-arrival in seconds X 100
ns 0  = S remarks pick quality of 0
113 = angle of incidence
```

```
s is a list of good A-type events, with 7 or more stations:
 at least one good s-pick
-------------------------------------------------------------
129043250      wow, very strong, clipped 5 stations (so could not
                 pick s- but still looks great) very deep(2.95km)
.29043352
205044953
205000248
208220635
210214352
211210549
215072738
228090106
104072348       good, deep(-2.84km)
.06094205
.10042425
.17185857
18143043
18195813        wow, this is a particularly interesting one, deep, strong!
.20211226
.20112713
:02071958       another deep one, cool!
:03042151       strong BOMZ, deep
:06053507       s at ABBZ, deep
:22024347       s at E1 and CONZ, deep, clipped most stations
:03204201       s at ABBZ, depth=-1.84km, clipped BOMZ
04024733
05211133        only 5 stations, but this is a good one. deep
14174756
24143239        6 stations, very deep (4.16 km)
25145105
26071759
28134028        5 stations, and SISE and SISN
05015133        excellent!
14232747        excellent, very deep (3.28 km)
16234052
16101407        deep (0.62km)
17225418        deep (2.23km)
18115327
19065517
29080456
04234149
05130216        at the summit??!!
10072305        clipped 3 stations
25180120        very interesting! SUPER DEEP!!
26083439
30003549
31232030
04170745        deep: 3.32km
06051808
06061805
14224936        deep: 2.71km
17115206        deep: 2.62km
17210127        close and strong at HELZ
18112006        very deep and far! 24.39 km
19161125        deep: 3.02km
)6150745
)6163543
)9011452
)9011548
10172130
11230337
11230802
```

```
960214001657
960214125723
960214160226
960218180450
960220161117   WOW! an excellent one, deep: 1.80km, strong- clipped SIS, MACZ,
                 HOOZ, and BOMZ, really interesting and coming right in the
                 middle of the 102 event ice-quake swarm (related?)
960225122941
960305104708
960305170050   cool! this looks lower freq. but I think it is a deep A that
               lost its high freq. on the way to the stations: clear s phases
               at several stations. Possible regional, but doesn't have the
               look. Also, strong- clipped ABBZ!
960305203535 another good, strong, deep one. 5 clear s phases including SISE&N
960308185646
960321001111
960328030945
960328040804
960328064622
960421061329
960423231914
960424155004
960505025949     A-type
960505062719     A-type, deep(-1.93km)
960513112852   A, deep(-2.22km)
960514063249   A, good, deep(-2.36km)
960514064916   another A, very deep(1.89km)
960514210803   A, deep (-1.48km)
960515081158   A, deep(-2.39km)
960515092101   A, deep(-2.41km)
960524192044   A, deep(0.41km), good
960526102054   A, at the summit
960531231130   A, real good, deep(-1.60km), 3s
960603031944   A, deep(-1.22km), 3s
960718054055   A, real good!, 2s, very deep(-0.79km)
```

```
s is a list of B-type events that carried on 7 or more stations
, sometimes 6 if they are really good) AND that are not too emergent.
ld get good p picks and hopefully an s pick or two:

112024443
112025727
113014151
113024200
113072446
113091656
113133838
115121954
115194226
115210730
116224031
117012133
118170343
121000029
122192443
.23002712
.28021730
.28133942
.28142259
.29022819
202230407
203062109
207043432
207050608
207093907
:07152359
:07225005
:08220635
:09215055
:11214936
:12042353
:12151723
:13054255
:13180951
:15010349
:15072738
:17024922
:17092907
 17093006
 17104148 a real good one, 2 s-picks
 19215037
 20072451
 21112153
 21192627
 24061642
 25134035
 25230616
 25235700
 26011016
 26024549 really good! looks pretty, and it's deep(-1.44km)
 26035351
 27153928
 27193011
 27194604
 28035122
 28053209
 29033822
 29145432
```

```
950104171220
950106071456
950107134101
950110080249
950113003827
950113054424
950113081205
950113144702
950116044107
950118014308
950118062126
950118122952
950118135426
950118231023
950123085600
950127055148
950128155623
950404233415
950424041639
951006030133
951011051820
951012061046
951013235831
951016071941
951017025018
951017073340
951019045634
951023045313
951025054127   WOW! very deep, a regional, very strong! Cool
951025133338   again, just like the above
951027024118
951027130541
951030210646
951031000546
951031131234
951031183031
951101085930
951104204306
951106093157
951108124005
951114165557
951115085743
951115121153
951117101255
951117165529
951117185352
951118083352
951118221509
951119085753
951119092218
951126024945
951129041109
951202014016
951202210926
951203104921
951203130220
951204010315
951204090103
951206111757
951206125457
951207021640
951208093653
```

```
1210085058
1212033443
.213023554
.213174008
.214132500
215110745
215110940
215162039
215184504
216033148
217182609
218164849
219182141
219183904
220003839
220075312   strong at BOMZ, carried at OBSZ
220203934
224092624
224163328
224224410
225075249
226043523
227160332
228184758
229071319
231015905
231061653   strong ABBZ
101055430
101081102
102061337   noisy and only 6sta., but looks interesting
102064602
102085803
103015544
103025839
103075159
103224350
105181117
106033006
106070925
107124251  deep(-1.85km)
108004124
.08095629
.10141247
.11050026
.11052123
.12133359
.12140708
.12212456
.13120708
.13165555  strong BOMZ
.14062743
.14075952
14151701
15000138
15092830
15111418
15141252
15141450
15161733
17020341
17095029
17211110
19012248
```

```
960120041321
960121052749
960121195853
960123013148
960124081859
960124193912
960128172127
960128205957
960201163822
960202001641
960202233600
960203202842
960204065821
960204102156
960204145644
960205121725
960208044212
960208090541
960208132450
960210052400
960210185445
960211184639
960212000203
960212014124
960212050148
960212152056
960212221004
960212222651
960212230638
960212234139
960213012908
960213013243
960213021321
960213072336
960213164438
960214011248
960214073612
960215021744
960215195404
960216224820
960217144946
960217153012
960217194005
960217223543
960217225337
960218060509
960218130428
960218201303
960218211254
960218231401
960218233357
960219002530
960219010322
960219013800
960219041610
960219174028
960220014132
960220122140
960220130837
960220160306
960220173234
960220174601
```

```
220211329
220235914
221004756
221011322
221012705
221013959
221032029
221040452
221050154
221053138
221055355
221060338
221064748
221072908
221210810
221213017
221214038
221231130
222063310
222074710
222084944
222133821
222211957
223003458
225010359
225175529
225202655
225215848
225220813
225221748
226024033
227124233
227204920
227212115
227215915
227221926
227224525
227224645
228004414
228010236
228011543
228012151
228021719
228023507
228030849
228052407
228074928
28111819
28125311
28131622
28151211
28183131
28193041
29032813
04213629
06231548
08012157
09230935
10142054
12113809
12123618
13020757
```

```
960320140505
960321071420
960322002340  strong ice-quake preceeding event at BOMZ
960322092846
960322165810
960323035004  could be some A in there
960323041839  strong CONZ (maybe ice?)
960323140621
960323214357  regional, very deep (0.04km)
960324121552
960325100459
960325103020
960325160614
960325164201
960326053801
960326135944
960326182444
960326220737
960328040437
960328100749
960328155200
960328190207
960328233027
960512163926    B, deep(-2.09km)
960515214745    B, very big and deep
960516032641    B, deep(0.14km)
960516062510    B, deep(-2.98km), 4s, looks pretty good
960518203707    B/tremor, beautiful!! deep(-2.05km)
960520234411    B, strong at HOOZ
960525043603    B
960525081605    B, deep(-2.50km)
960529031219    B
960530065348    B, deep(-2.67km)
960530093027    B, deep(-2.77km)
960531001540    B, deep(-1.27km), tremor like
960531002154    B, deep(-0.20km)
960531045039    B, deep(-0.06 km), tremor like
960531091507    B, deep(-1.58km)
960531142423    B, deep(-2.50km), check out this rms: 0.01
960531151317    B, deep(-2.18km)
960602014314    B, bit of tremor in there, deep(-2.55km)
960603152330    B, double, big, very interesting
960605200349    B, deep(-2.02km), tremor like
960609220346    B, very deep(0.31km), 7 stations
960610064207    B, 6sta., very deep(1.77km)
960610103903    B, very deep(3.29km), only 6 sta.
960610141539    B, very impulsive HOOZ, deep(-1.02km)
960610141539    B, very impulsive HOOZ, deep(-1.02km)
960610143049    B, 6sta., deep(-1.03km)
960610143401    B, deep(0.22km), only 6sta.
960610170434    B, deep(0.21km), only 6sta.
960610182540    B, deep(-1.48km), only 6sta.
960610194821    B, deep(-2.39km), only 6sta.
960611004940    B, only 6 stations
960611015204    B, very deep(9.98km)
960611020929    B, very deep(-0.84km), only 6sta.
960611083922    B, deep(-2.37km)
960612150610    B, very deep(-0.93km) 7 stations
960613015619    B, very deep(2.82km)
960713083702    B, below summit(-3.30km)
960714162431    B, deep(-1.77km)
960714185441    B, deep(-2.93km)
```

```
715180643     B, regional, wow! excellent!, very deep(1.24km)
716141514     B, in the mountain(-3.54km)
716162348     B, noisy on 2 sta
716190710     B, good one, deep(-2.30km)
716193834     B, (-3.37km)
717063719     B, too deep(12.39km)
717224205     B, deep(0.60km)
718073632     B, deep(-1.98km)
718101128     B, deep(-1.50km)
719151022     B, WOW! Cool, shows up at OBSZ, very deep(0.94km)
719190447     B, icequake obscuring HOOZ pick
719215511     B, in the mountain (-3.19km)
719220036     B, deep(-2.31), looks great!
722000137     B, very deep(8.79km)
722021814     B, cool!, long double, deep(-2.79km)
722054539     B, deep(-2.47km), similar to the above event
722233827     B, very deep(3.28km)
723111618     B, deep(-2.91km)
723143951     B, summit
724040345     B, deep(-1.23km)
724151925     B, summit
725145034     B, very impulsive at MACZ
725174258     B, deep(-2.11km)
727012202     B, deep(-0.98km)
727073224     B, very deep(1.12km)
727094118     B, deep(-1.03km)
727215820     B, summit
728071732     B, deep(-1.59km)
728165950     B, summit
```

re is a list of explosive events with 7 or more stations:
r sometimes 6 stations if there are really strong and good)

1207080024
.208151047
.209092049
.209184422
.209223541
.209235258
.210080554
.210084845
.210211132
.211033329
.211214936
.212161648
.216113821
216215906
217025455
217061515
217092907
217104710
217150243
218135716
219054934
219063225
219080406
219194201
220032932
220153107
221110937
221165716
225161105
225230616
226022109
227142440
229145432
103191224
104064400
104121208
105204122
106121426
106175414
.06181044
.07203232
.14214223
.15045904
23235830
08005343
17221935
19050025
22032631
22134714
22155642
23060202
23104010
25005742
25045730
25142407
26024359
26032435
26051905
26082527

950228074725
950301015435
950302053828
950303050140
950304023209
950304134539
950305044050
950306134813
950308042130
950309030950
950310065544
950310202122
950313153854
950314171542
950315020733
950315081820
950315084845
950315092414
950317061950
950317131812
950317144701
950317155645
950318020101
950319010604
950319221922
950320124439
950322024432
950322130257
950322233143
950323022940
950323232927
950324081726
950324140925
950324223107
950325073106
950325164254
950326022122
950329011103
950329044608
950925013200
950926042034
951004013239
951008065601
951017212637
951024024927
951029200010
951030193627
951031162215
951101072142
951114094820
951114132153
951114134511
951115015409
951115052557
951118073021
951201205955
951202022241
951203014052
951203132554
951206121330
951207213637
951208023719

951216091155
951217143210
951218054755
951219185302
951220130550
951221170337
951222025205
951222043346
951223013321
951223095103
951223153555
951223234326
951224145433
951225113325
951225182734
951226061253
951226225516
951227044422
951227095445
951228051815
951228132947
951229103613
951229182312
951230141416
951230170443
960103094138
960103160342
960104211209
960104212055
960105233351
960106155257
960108014845
960109055635
960113150816
960117131338
960118010328
960118083835
960119044012 small, E/B
960119142417
960119193336 very big! clipped ALL stations! below summit(-3.05km)
960121094730
960121235119
960128102207
960131031028
60131053607
60206014633
60209094214
60212025121
60212033717
60213054319
60213182723
60213195344
60214055942
60214133259
60215003654
60215124928
60216012204
60217002208
60217084613
60217230935
60223130718
60224230513
60225032418

960227180637
960228045859
960229032132
960305100037
960306091320 clipped all stations! depth=-3.10km
960311191209
960322152923
960322174152
960328125351
960328145936
960328153655
960514013526 explosion
960514211645 explosion, a big one!
960516170306 E
960520233618
960602033953 E, good one, below(-3.40km), big(MCMZ shows up)
960603061132 E, good one, a bit of precursory tremor
960607043009 E, difficult to pick on CONZ(some interference there), deep
960608031107 E, deep(-3.29km)
960608065950 E
960608071123 E
960714195343 E
960717071639 E
960725103640 E, below summit

960407 B-types swarm, LOTS! of events (+240), shallow, scattered, some reasonably well located at first but then deteriorated into smaller scattered ones. Possible ice-quakes dispersed throughout, but definately a lot of B-types in there. Joe Petit reported no harsh weather or high winds for this day.

960408 more of the same as on the 7th!! One heck of a B-swarm again, over 240 events

960409 more of the same type, but only 20 events

960410 again, more of the above mentioned deal, 27 events

960411 getting noisy, but more of the same as above

960414 explosion swarm, see swarmE14.comments for details
This swarm had a total of at least 163 events. Starting out as strong explosions occurring very rapidly in the first few hours, and then tapering off in occurence and getting smaller, tending to look more B-type by the end.

960501 lives in /raid4/data/Erebus/xfiles_swarms/icequakes
swarm day of over 270 events! yow.
I looked at the first 60 so far, it looks to be the same pattern: B-types. NOT ice quakes. This B swarm is a bit different in nature from that of the 960505 (lacking the A-type component)

960503 lives in /raid4/data/Erebus/xfiles_swarms/icequakes
swarm day of over 50 events, mostly B types, not actually a lot of ice-quakes (even though this is in the icequakes subdir.)
There were 10 reasonably well located events outta this lot, probably could get a few more, but these are generally outside the array and not doing well on the location front. One very obvious EXPLOSION in the lot, which actually seems very anomalous, because the nature of most of these is that noisy "swarmy" look.

960505 lives in /raid4/data/Erebus/xfiles_swarms/icequakes
swarm day with 96 events in xfiles. Closer inspection found 8 events that located well and were generally deep. mostly A/B and A type.
There were 13 events that showed very good ice-quake examples (tornados and smaller impulsive ones.) The rest were very noisy and mostly weird.
Hard to categorize, some doubles, some very strong but noisy and/or emergent.

60513 lives in /mk1/data/xfiles
5 events this day, all deep, all appear to be approximately the same location. A/B and A type, similar to those observed on the 960505 swarm day, except that today there was no swarm, and these are all clean events. Strange variations in frequency, while looking to be otherwise similar events.

```
April 14, 1996- explosion swarm

number of xfiles: 120
-----------------------------------------------------------------------

traces that show double events:

960414015105
960414022920
960414025654
960414025955 not a strong double, more like just a strong precursor
960414030938
960414031123 both small
960414032154 (first one big, also seen at McMurdo)
960414033942 a very good example! both sharp and strong, look the same
960414034338
960414034442 small
960414035315 first one very strong, seen at McMurdo
960414035744 both small
960414040349 first one very strong, seen at McMurdo
960414040742
960414041654
960414402018
960414042322
960414042520
960414042637
960414042730
960414043252
960414045540  both small (E/B), and a very small third one
960414051424  both small (E/B)
960414052220  both small (E/B)
960414052955
960414054006  both small(E/B)
960414055346  more like B types
960414060516  second one very strong, seen at McMurdo
960414094112
960414105837
960414110057

-----------------------------------------------------------------------
traces that show triple events:

960414024415
960414024653
960414024807
960414033005
960414034150  (actually a quadruple!)
960414034746  first one very strong, seen at McMurdo

-----------------------------------------------------------------------
events that carred McMurdo station:

960414022733
960414023933
960414025137
960414025545
960414030044   very big!!, clipped all stations
960414031528
960414032009   clipped all stations, long forerunner on E1SZ, beat like
960414033334
960414060658   long forerunner on E1SZ
-----------------------------------------------------------------------
```

```
 31 (doubles)
 12 (6x2 triples)
---
163

number of events big enough to show on OBSZ: 13
```

```
the swarm that started on April 7 and continued for 5 days:

these are the reasonable well located events

960407005128  deep(-2.9km)
960407024513  very impulsive CONZ
960407044749  beat looking component to this one, purty!
960407044858
960407051259
960407053734
960407073813  below summit (-3.55km)
960407100503  deep, outside array
960407112139  pretty deep(-2.63 km)
960407112407  very impulsive CONZ
960407121135  huge ice-quake on MACZ!! that coincidentally occurs where the
              seismic signal should be- makes the real event completely
              swamped over!!
960407124117  good
960407124743  impulsive MACZ
960407125944  deep(-1.48km)
960407133510
960407141404
960407142433  depth=-3.31
960407154506  very strong HELZ
```

```
#!/bin/tcsh

#move files from this list
set list = '/mk1/usr/erebus/Becky/best/last.list'

#loop over filenames in atypes.list
#but only use the first column
#you will have to edit title lines and make sure that
#there are no lines without a directory name like 940511135555
foreach file (`gawk '{print $1}' "$list"`)
  #get the first directory
  set ymd = `echo $file | colrm 7`

  #get the whole path
  set fromdir = `echo /mk1/usr/erebus/data/xfiles/$ymd/$file`

  #get the new path
  set todir = `echo /raid4/data/Erebus/xfiles_loc/$ymd/$file`

  #tell me what you are doing
  echo working on $ymd/$file

  #make the new directories
  mkdir /raid4/data/Erebus/xfiles_loc/$ymd
  mkdir /raid4/data/Erebus/xfiles_loc/$ymd/$file

  #move the files
  mv $fromdir/* $todir
  #echo moving $fromdir/ to $todir

end
```

```
c       Read the location summary lines
c       Reference Hypoellipse Manual, pp. 2-48 -> 2-50
        character*6 ymd
        character*6 hms
        character*12 ymdhms
        character*13 pickfile
        character*30 path
        character*72 bigpath
        character*2 nors,eorw,pste,qual,magtyp,slash,etype
        character*5 instr
        character*6 seqnum
        character*6 date
        character*4 hrmn
        integer gap,eaz1,edp1,eaz2,edp2,yrun,fli
        integer ilatmin,ilonmin
        real secs,latmin,lonmin
        integer lat,lon
c
c
5        format(a6,a6)
         open(unit=1,file='atypes.list',status='old')
10       read(1,5,end=999) ymd,hms
26       format(a6)
27       format(a6,'/',a12)
         ymdhms=ymd//hms
         pickfile=ymdhms//'p'
         path='/raid4/data/Erebus/xfiles_loc/'
         bigpath=path//ymd//'/'//ymdhms//'/'//pickfile
30         open(unit=2,file=bigpath,status='append')
31         open(unit=3,file='../../Atypes.loc',status='unknown')
100     format(a6,a4,f4.2,i2,a1,f4.2,i3,a1,f4.2,
     &   f5.2,f2.1,i3,i3,f3.0,f4.2,i3,i2,f4.2,i3,i2,f4.2,f2.1,f2.1,
     &   a1,f4.2,a1,a1,i2,a1,a4,i2,i2,a1,i1,a5,
     &   f4.2,f2.0,f2.0,f4.2,i2,f5.2)
        read(2,100)date,hrmn,secs,lat,nors,latmin,lon,
     &                     eorw,lonmin,depth1,prefmag,no,gap,
     &                     d1,rms,eaz1,edp1,el1,eaz2,edp2,el2,
     &                     xmag,fmag,pste,el3,qual,magtyp,nswt,slash,
     &                     instr,mrun,yrun,etype,fli,seqnum,
     &                     smp,zup,zdn,vpvs,nrd,depth2
:        write(6,*)lat,latmin
:        write(6,*)lon,lonmin
        ilatmin=100*latmin
        ilonmin=100*lonmin
:        write(6,*)ilatmin
:        write(6,*)ilonmin
200     format('A',x,a6,a4,x,f5.2,x,i2,'S',i4,x,i3,'E',i4,x,
     &         f5.2,2x,f3.1,24x,'00.0AA')
        write(3,200)date,hrmn,secs,lat,ilatmin,lon,ilonmin,
     &              depth2,fmag
        write(6,200)date,hrmn,secs,lat,ilatmin,lon,ilonmin,
     &              depth2,fmag


        goto 10
99       stop
        end
```

```
      character*6 ymd
      character*6 hms
      character*12 ymdhms
      character*13 pickfile
      character*30 path
      character*72 bigpath
      character*2 nors,eorw,pste,qual,magtyp,slash,etype
      character*5 instr
      character*6 seqnum
      character*6 date
      character*4 hrmn
      integer gap,eaz1,edp1,eaz2,edp2,yrun,fli
      real latmin,lonmin,declat
      real e1x,e1y,e1z,e2x,e2y,e2z,e3x,e3y,e3z
      real xx,xy,xz,yy,yz,zz
      real pi
c
c
5      format(a6,a6)
       open(unit=1,file='etypes.list',status='old')
10     read(1,5,end=999) ymd,hms
26     format(a6)
27     format(a6,'/',a12)
       ymdhms=ymd//hms
       pickfile=ymdhms//'p'
       path='/raid4/data/Erebus/xfiles_loc/'
:28     format(a30,a6,'/',a12,'/',a13)
:       write(6,28)path,ymd,ymdhms,pickfile
       bigpath=path//ymd//'/'//ymdhms//'/'//pickfile
:29     format(a72)
:       write(6,29)bigpath
30       open(unit=2,file=bigpath,status='append')
31       open(unit=3,file='../../newlips.E',status='unknown')

100   format(a6,a4,f4.2,i2,a1,f4.2,i3,a1,f4.2,
     &  f5.2,f2.1,i3,i3,f3.0,f4.2,i3,i2,f4.2,i3,i2,f4.2,f2.1,f2.1,
     &  a1,f4.2,a1,a1,i2,a1,a4,i2,i2,a1,i1,a5,
     &  f4.2,f2.0,f2.0,f4.2,i2,f5.2)

      read(2,100)date,hrmn,secs,lat,nors,latmin,lon,
     &                    eorw,lonmin,depth1,prefmag,no,gap,
     &                    d1,rms,eaz1,edp1,el1,eaz2,edp2,el2,
     &                    xmag,fmag,pste,el3,qual,magtyp,nswt,slash,
     &                    instr,mrun,yrun,etype,fli,seqnum,
     &                    smp,zup,zdn,vpvs,nrd,depth2

      pi=3.14159267
      e1x=sin((eaz1*2.0*pi)/360.0)*cos((edp1*2.0*pi)/360.0)
      e1y=cos((eaz1*2.0*pi)/360.0)*cos((edp1*2.0*pi)/360.0)
      e1z=sin((edp1*2.0*pi)/360.0)
      e2x=sin((eaz2*2.0*pi)/360.0)*cos((edp2*2.0*pi)/360.0)
      e2y=cos((eaz2*2.0*pi)/360.0)*cos((edp2*2.0*pi)/360.0)
      e2z=sin((edp2*2.0*pi)/360.0)
      e3x=(e1y*e2z)-(e1z*e2y)
      e3y=(e1z*e2x)-(e1x*e2z)
      e3z=(e1x*e2y)-(e1y*e2x)
      xx=(e1x*e1x*el1)+(e2x*e2x*el2)+(e3x*e3x*el3)
      xy=(e1y*e1x*el1)+(e2y*e2x*el2)+(e3y*e3x*el3)
      xz=(e1z*e1x*el1)+(e2z*e2x*el2)+(e3z*e3x*el3)
      yy=(e1y*e1y*el1)+(e2y*e2y*el2)+(e3y*e3y*el3)
      yz=(e1z*e1y*el1)+(e2z*e2y*el2)+(e3z*e3y*el3)
      zz=(e1z*e1z*el1)+(e2z*e2z*el2)+(e3z*e3z*el3)
      declat=lat+latmin/60
300   format(a6,2x,f10.6,2x,f10.6,2x,f5.2,2x,
     &        f8.5,2x,f8.5,2x,f8.5,2x,f8.5,2x,f8.5,2x,f8.5)
      write(6,300)date,declat,lon+lonmin/60,depth2,
     &              xx,xy,xz,yy,yz,zz
      write(3,300)date,declat,lon+lonmin/60,depth2,
     &              xx,xy,xz,yy,yz,zz

      goto 10
999    stop
      end
```

```
xmap8 org.erebus stations.loc Atypes.loc -M outline.map
```

xmap8 org.erebus stations.loc Atypes.loc -M outline.map -E newlips.A

```c
/************************************************************************
*  xmap2histo     Mitch Withers Aug 1996                               *
*                                                                      *
*  program to convert Xmap input hypocenter file to two columns of     *
*  data (julian day, number of events) suitable for plotting a histogram *
*                                                                      *
*  requires no special subroutines or libraries so compile with:       *
*  cc -o xmap2histo xmap2histo.c                                       *
*                                                                      *
*  requires a parameter file called filename.par and if you don't like *
*  this name you'll have to change it the parfile string and recompile. *
*                                                                      *
*  filename.par must be very specific ONLY TWO CARRIAGE RETURNS. The first *
*  line is the path to the xmap file, it can be absolute or relative to *
*  the location of this executable and it can be any number of characters *
*  long but make sure that it is all one line (screen wraps are okay). *
*  Ditto for the second line which is the name of the Xmap file.       *
*                                                                      *
*  if the format of the Xmap input files change this program is broke. *
*                                                                      *
*  and don't expect the cool stars on the sides for comments in the rest *
*  of the program cause they're a pain in my butt.                     *
*                                                                      *
*  Note that this program is a first pass at the problem and could be  *
*  much more efficient (like using pointers instead of indexes and     *
*  putting stuff like year, month, day into a structure) and I would   *
*  be happy to improve it for $65 an hour.                             *
************************************************************************/
#include <stdio.h>
#include <math.h>

int main()
{
 FILE *fid;  /* a pointer for a file on disk */
 char *FileToOpen,*FilePath,*FileName,*outfile; /* filename pointers */
 int tmp,NumPath,NumName; /* number of characters in Path and Name */
 int i,NumLines; /* number of Lines in the file */
 char tmpchar[2];
 int *year,*month,*day; /* the integers we care about */
 int tmpyr,minyr,maxyr,currentyr,j; /* other usefule stuff */
 static int monthdays[12]={31,28,31,30,31,30,31,31,30,31,30,31}; /* guess */
 int *julday,*numperday,k; /*first output column is julday, numperday second*/
 char tmpstr[2];
 int NumDaysInYear; /*could be 365 or 366*/
 static char parfile[]="filename.par\0"; /*the parameter file*/

 /***********************************
  Open the parameter file for reading
 ***********************************/
 if((fid=fopen(parfile,"r"))==NULL){
   printf("Could not open parameter file:%s\n",parfile);
   exit(-1);
 }

 /*****************************************************************
  first step through the first line with getc and count the number of
  characters, then do the same for the second line.
 *****************************************************************/
 NumPath=NumName=0;
 while((tmp=getc(fid))!='\n')NumPath++;
 while((tmp=getc(fid))!='\n')NumName++;
 /***************************************************************
 ****************************************************************/
 FilePath=(char *)calloc(sizeof(char),NumPath);
 FileName=(char *)calloc(sizeof(char),NumName);
 FileToOpen=(char *)calloc(sizeof(char),NumPath+NumName);

 /*****************************************************************
  reopen the parameter file (rewind would be better but I didn't feel like
  looking up how to use it).
 *****************************************************************/
 freopen(parfile,"r",fid);

 /*********************************************************
  read the first line knowing there are NumPath characters in it.
 *********************************************************/
 for(i=0; i<NumPath; i++){
   fscanf(fid,"%c",FilePath+i);
 }

 /******************************************************************
  now skip 1 byte past the current fid position (ie skip over the new line
  control character not visible to the non-binary eye).
 ******************************************************************/
 fseek(fid,1,1);

 /********************
  read the second line.
 ********************/
 for(i=0; i<NumName; i++){
   fscanf(fid,"%c",FileName+i);
 }

 /*************************************************************
  concatenate the path and file name onto the name to open string.
 *************************************************************/
 strcat(FileToOpen,FilePath);
 strcat(FileToOpen,FileName);

 /************************
  close the parameter file.
 ************************/
 fclose(fid);

 /*************************************************************
  open the data file and check to see if we did it, if not you're
  outta here.
 *************************************************************/
 if((fid=fopen(FileToOpen,"r"))==NULL){
    printf("Could not open file %s\n",FileToOpen);
    exit(-1);
 }
 printf("Will read %s\n",FileToOpen);

 /***************************************************************
  step throught the data file character by character with getc until
  the end is found, counting the number of lines all the while.
 ***************************************************************/
 NumLines=0;
 while((tmp=getc(fid)) != EOF){
   if(tmp == '\n'){
     NumLines++;
   }
 }
```

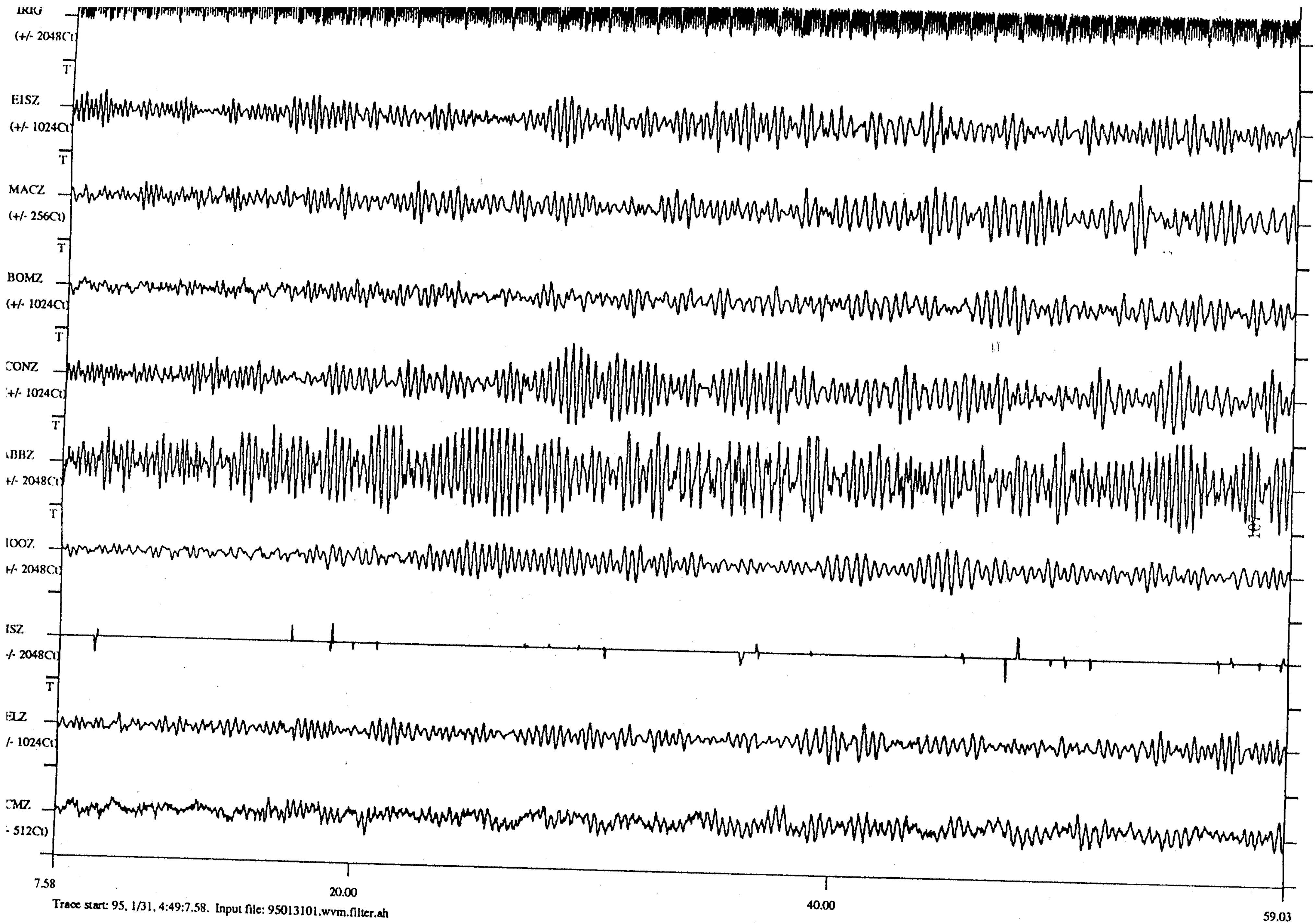
```
/****************************************************************
 allocate space for the characters we'll read (year, month, and day),
 and for the julday which we'll use to convert from month and day.
****************************************************************/
year=(int *)calloc(sizeof(int),NumLines);
month=(int *)calloc(sizeof(int),NumLines);
day=(int *)calloc(sizeof(int),NumLines);
julday=(int *)calloc(sizeof(int),NumLines);

/*******************************************************************
 reset the fid; again rewind would be better but whaddya want for nuthin.
 *******************************************************************/
freopen(FileToOpen,"r",fid);

/*******************************************************
 Loop through the each line reading the year, month, and day.
 *******************************************************/
for(i=0; i<NumLines; i++){

  /**********************************************
   skip the first really stupid and useless A in Xmap files.
   **********************************************/
  fseek(fid,2,1);

  /******************************************************
   Unlike fortran if we want a specific number of characters in C
   we have to go character by character then convert to an integer
   using sscanf.
   ******************************************************/
  fscanf(fid,"%2c",tmpchar);
  sscanf(tmpchar,"%d",&year[i]);

  fscanf(fid,"%2c",tmpchar);
  sscanf(tmpchar,"%d",&month[i]);

  fscanf(fid,"%2c",tmpchar);
  sscanf(tmpchar,"%d",&day[i]);

  /******************************************************
   search for a new Line (note we don't need the goofy AA in Xmap
   to do this.
   ******************************************************/
  while((tmp=getc(fid))!='\n'){
    /* mark time */
  }
}

/*******************
 close the data file.
 *******************/
fclose(fid);

/*****************************************
 find the range of years we have to work with.
 *****************************************/
minyr=100;
maxyr=0;
for(i=0; i<NumLines; i++){
  tmpyr=year[i];
  if(tmpyr>maxyr)maxyr=tmpyr;
  if(tmpyr<minyr)minyr=tmpyr;
}
```

```
 loop over the range of years
 **************************/
for(i=0; i<maxyr-minyr+1; i++){
  currentyr=minyr+i;

  /***********************************************
  Check for a Leap year in the data set for which this
  program was written.
  ***********************************************/
  if (currentyr==96){
    NumDaysInYear=366;
    for(j=1; j<12; j++){
      monthdays[j]++;
    }
  }
  else{
    NumDaysInYear=365;
  }

  /****************************************
   allocate for the number of events per day
   ****************************************/
  numperday=(int *)calloc(sizeof(int),NumDaysInYear);
  if (currentyr < 93 || currentyr > 99){
     printf("Warning I only accounted for the 1996 leap year\n");
  }

  /************************
  loop over each line in file
  ************************/
  for(j=0; j<NumLines; j++){

    if(year[j]==currentyr){

      /*****************************************************
      found a record in current year, reset julday and loop over
      months up to the one on the jth line
      *****************************************************/
      julday[j]=0;
      for(k=0; k<month[j]; k++){
        if(month[j]==k+1){

          /**********************************************
          found the month so add in the rest of the days
          **********************************************/
          julday[j]+=day[j];
        }
        else{

          /**********************************************
           didn't find the month yet so add a whole month's
           worth of days.
           **********************************************/
          julday[j]+=monthdays[k];
        }     /*end month if*/
      }       /*end month loop*/
    }         /*end year if*/
  }           /*end line loop*/
 printf("Working on currentyr = %d\n",currentyr);

 /*********************************
  loop over the number of lines again
  *********************************/
```

```
    /*********************************************************
     loop over the number of days in the year
     and increment the number of events per day if appropriate.
     Okay so this is really bad but as I mentioned, efficiency
     is expensive.
     *********************************************************/
    for(k=0; k<NumDaysInYear; k++){
      if(julday[j]==k+1 && year[j]==currentyr){
        numperday[k]++;
      } /*end day if*/
    }   /*end day loop*/
  }     /*end line loop*/

  /**************************************************
   allocate memory for the string that holds the name
   of the output file, create the string, make sure
   it isn't the same as the input file, and open it.
   **************************************************/
  outfile=(char *)calloc(sizeof(char),NumPath+NumName+2);
  strcat(outfile,FilePath);
  strcat(outfile,FileName);
  sprintf(tmpstr,"%d",currentyr);
  strcat(outfile,tmpstr);
  if((strcmp(outfile,FileToOpen))==0){
    printf("Output File,%s is the same as the input file, %s\n",
            outfile,FileToOpen);
  }
  printf("Will write to %s\n",outfile);
  fid=fopen(outfile,"w+");

   /*******************************************************
    write then data then close the file and free the output
    data vectors.
    *******************************************************/
  for(j=0; j<NumDaysInYear; j++){
    fprintf(fid,"%d %d\n",j+1,numperday[j]);
  }
  fclose(fid);
  free(outfile);
  free(numperday);
} /*end year loop*/

/****************
 We be done babe.
 ****************/
```

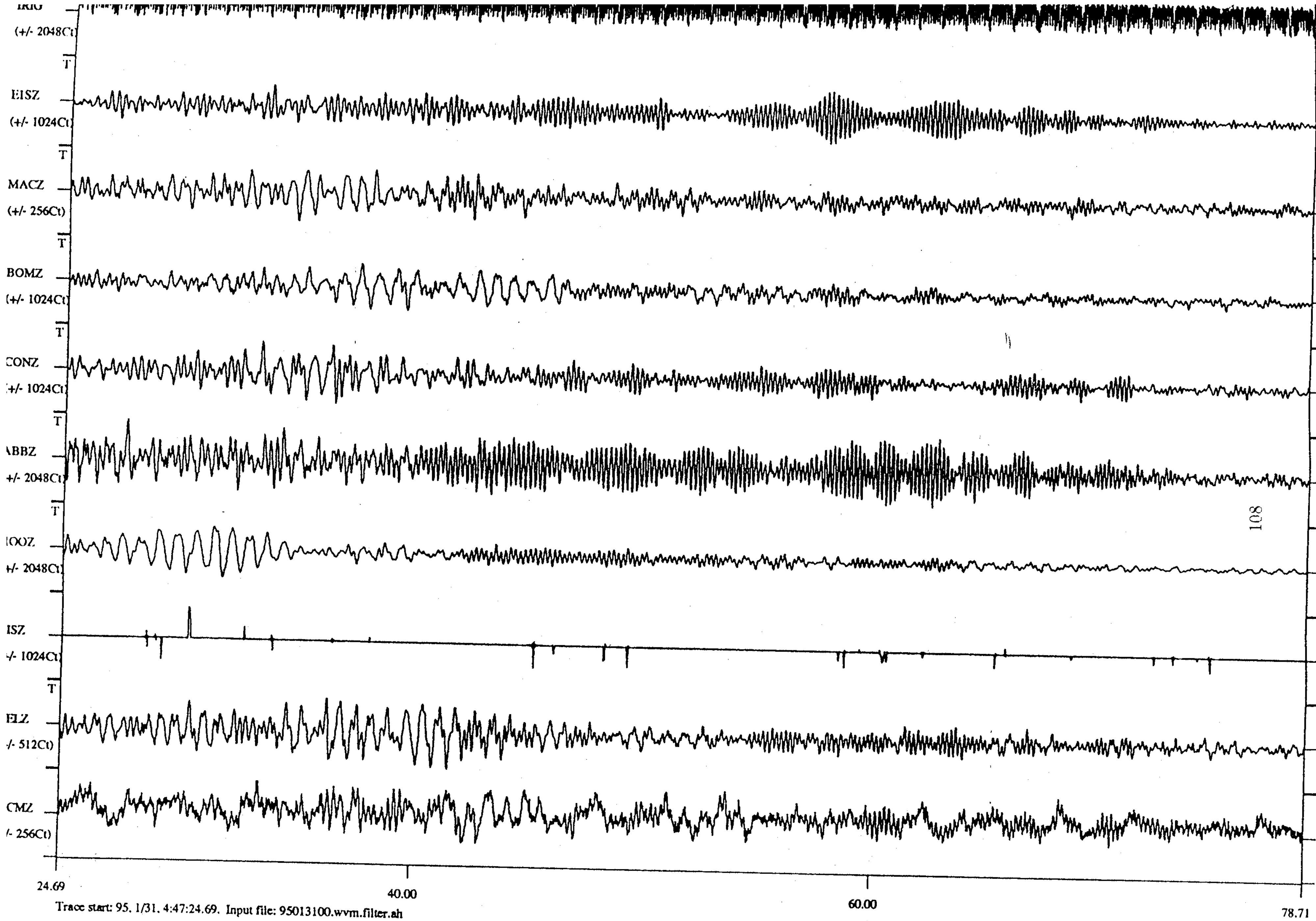
# Appendix III

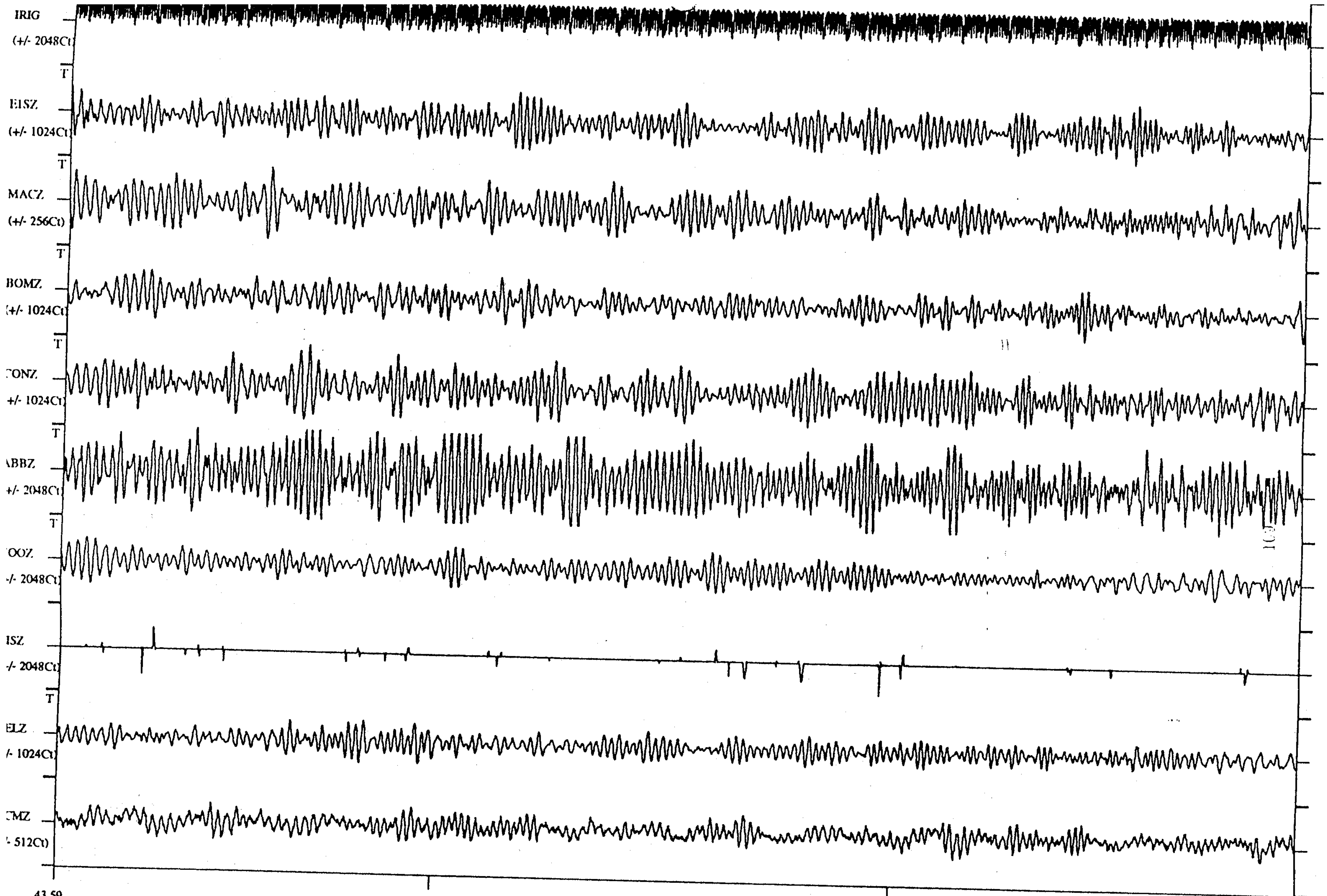
The following pages contain examples of different event types:
107-111: All 5 traces of the tremor that was digitally recorded on January 31, 1995
112-116: E-type events
117-121: LP events
122-126: VT events
127-131: Hybrid events (characteristics of both LP and VT events)
132-135: LP swarm activity- April 8, 1996
136-141: E-type swarm activity- April 14, 1996
142-146: events that are unusually strong at a particular station
147: a "*WOW*" event



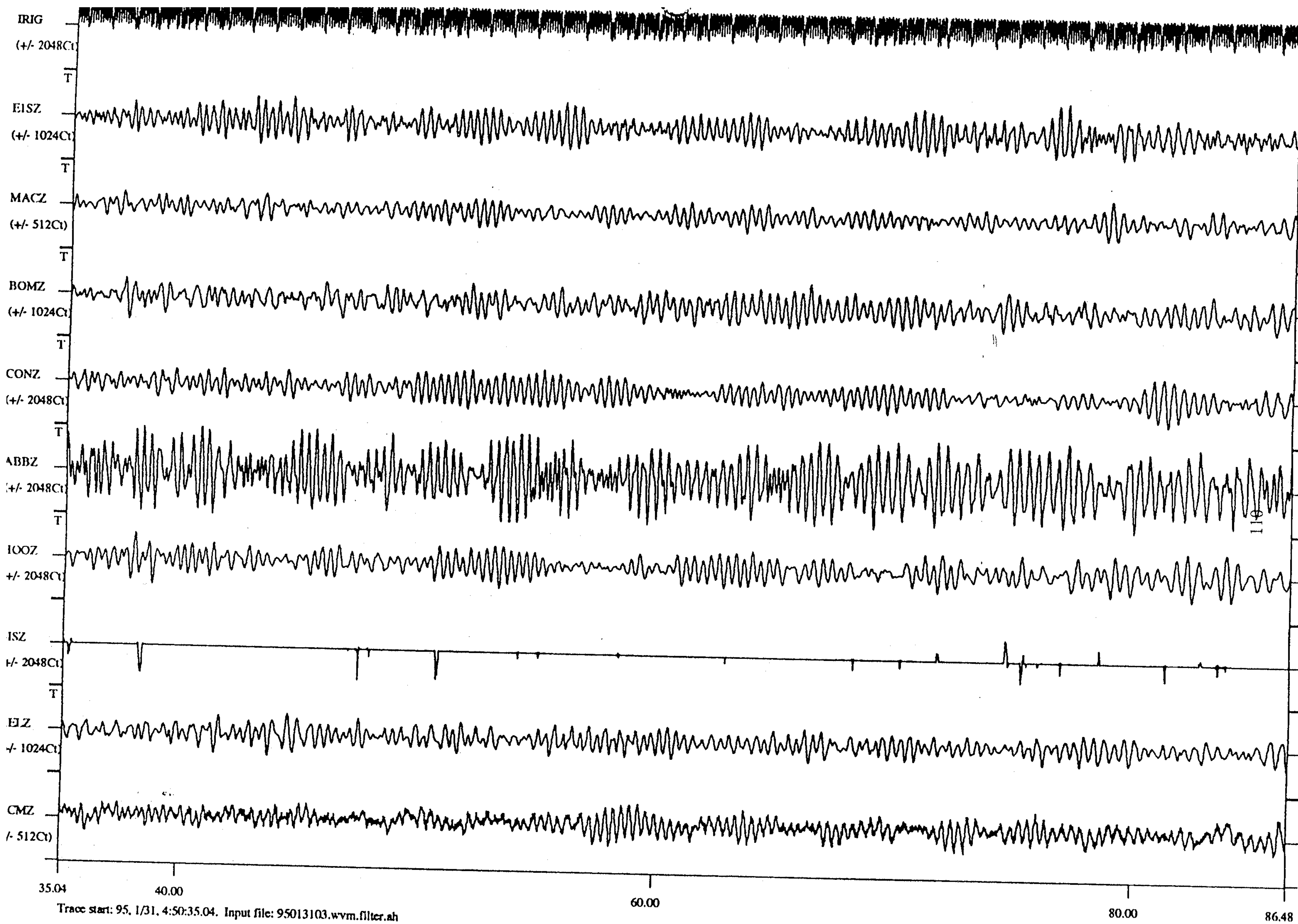
Trace start: 95. 1/31. 4:49:7.58. Input file: 95013101.wvm.filter.ah

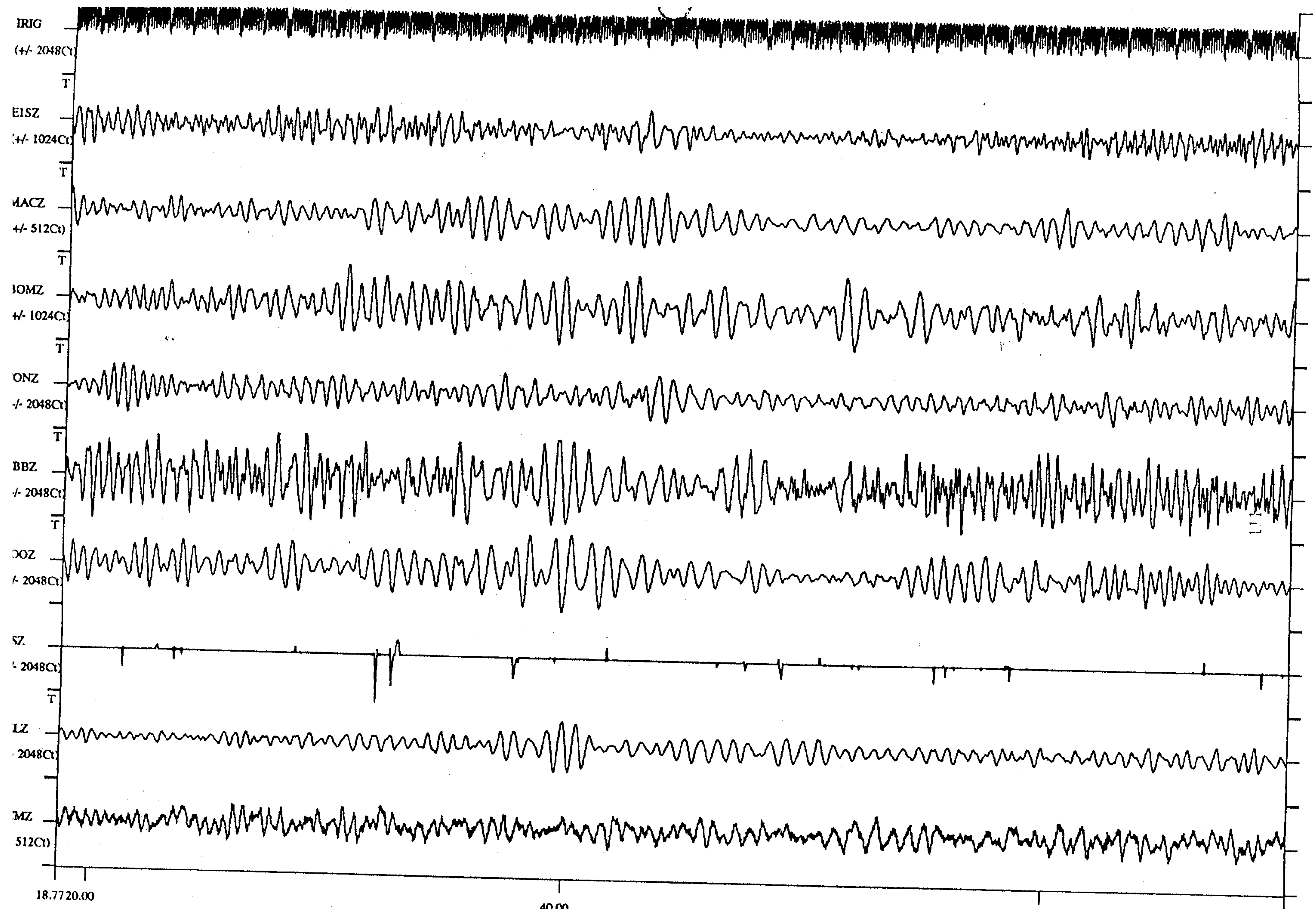
107


IRIG
(+/- 2048Ct)
EISZ
(+/- 1024Ct)
MACZ
(+/- 256Ct)
BOMZ
(+/- 1024Ct)
CONZ
(+/- 1024Ct)
ABBZ
+/- 2048Ct)
IOOZ
+/- 2048Ct)
ISZ
+/- 1024Ct)
ELZ
+/- 512Ct)
CMZ
+/- 256Ct)
T
24.69
40.00
60.00
78.71
Trace start: 95. 1/31. 4:47:24.69. Input file: 95013100.wvm.filter.ah

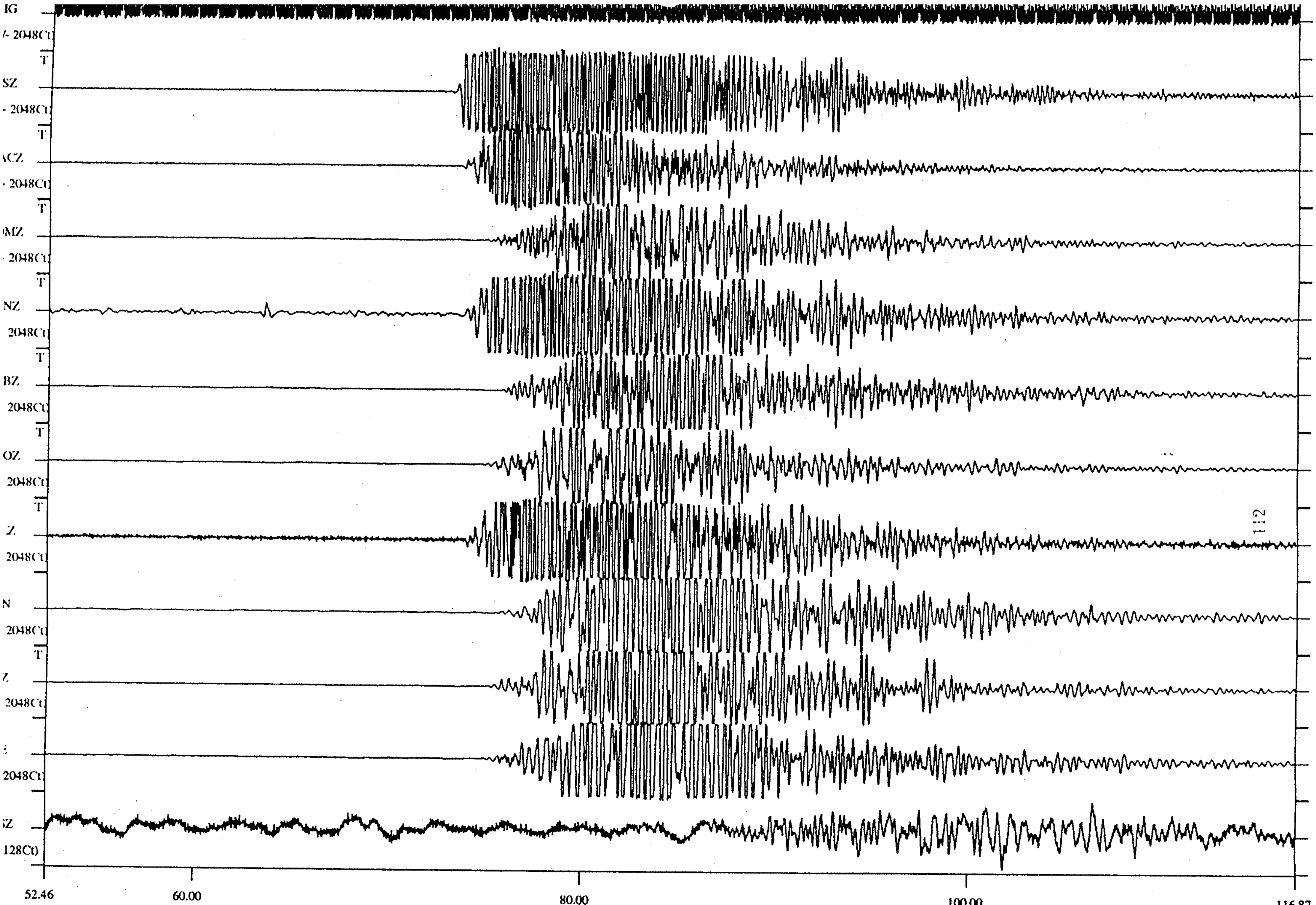



Trace start: 95. 1/31. 4:49:43.59. Input file: 95013102.wvm.filter.ah

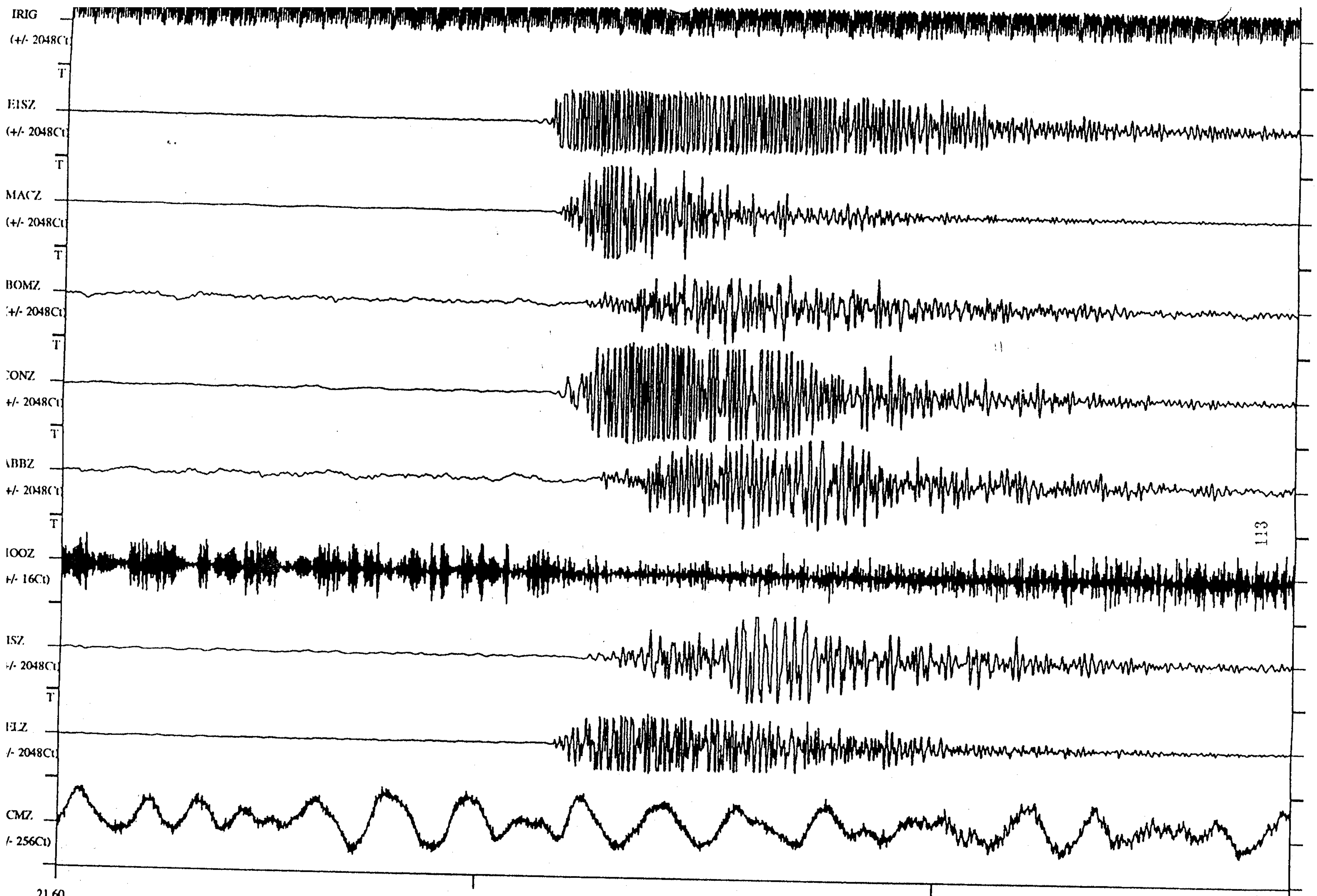

IRIG
(+/- 2048Ct)
EISZ
(+/- 1024Ct)
MACZ
(+/- 512Ct)
BOMZ
(+/- 1024Ct)
CONZ
(+/- 2048Ct)
ABBZ
(+/- 2048Ct)
IOOZ
+/- 2048Ct)
ISZ
+/- 2048Ct)
ELZ
+/- 1024Ct)
CMZ
/- 512Ct)
T
35.04
40.00
60.00
80.00
86.48
Trace start: 95. 1/31. 4:50:35.04. Input file: 95013103.wvm.filter.ah



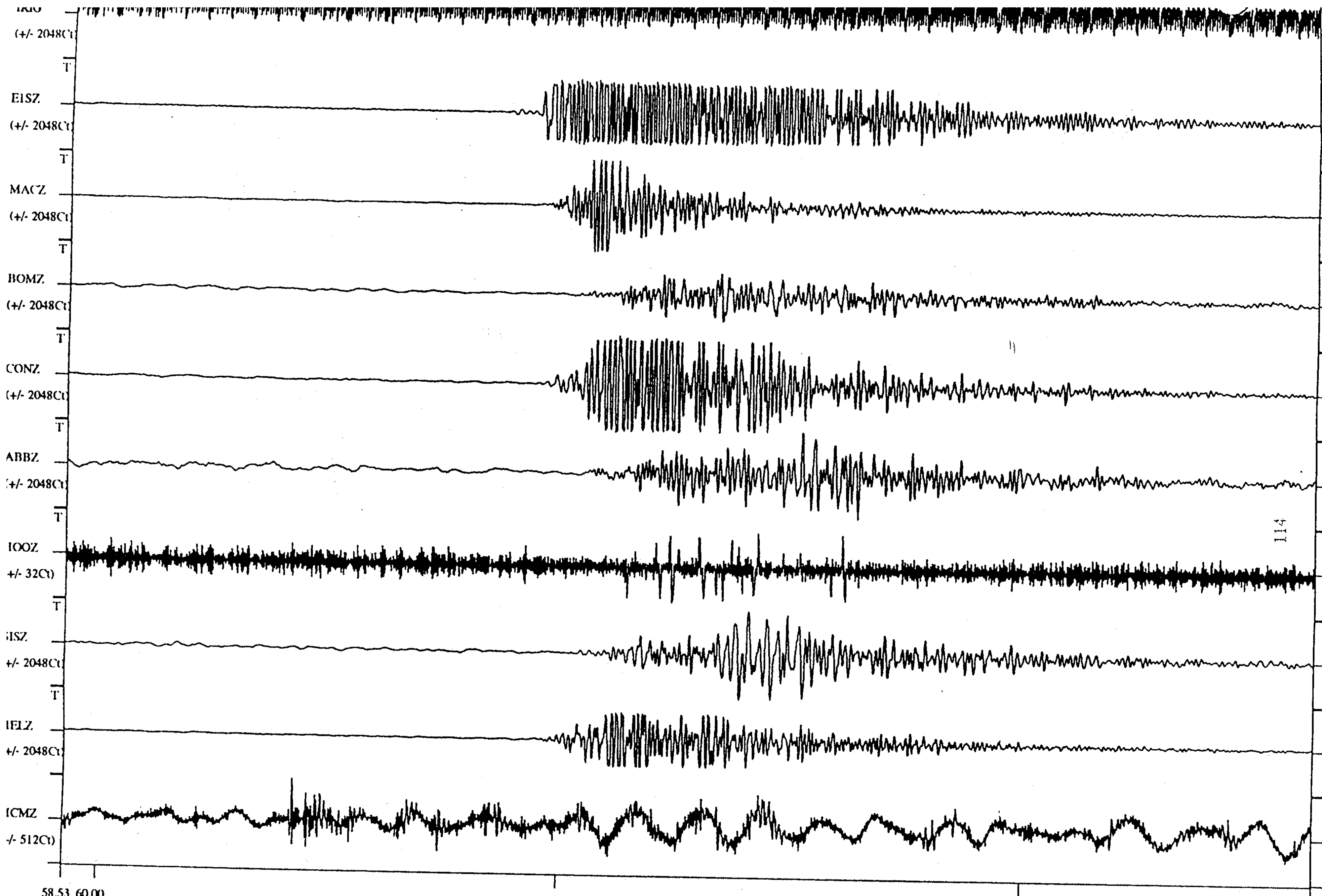
Trace start: 95. 1/31. 4:51:18.77. Input file: 95013104.wvm.filter.ah



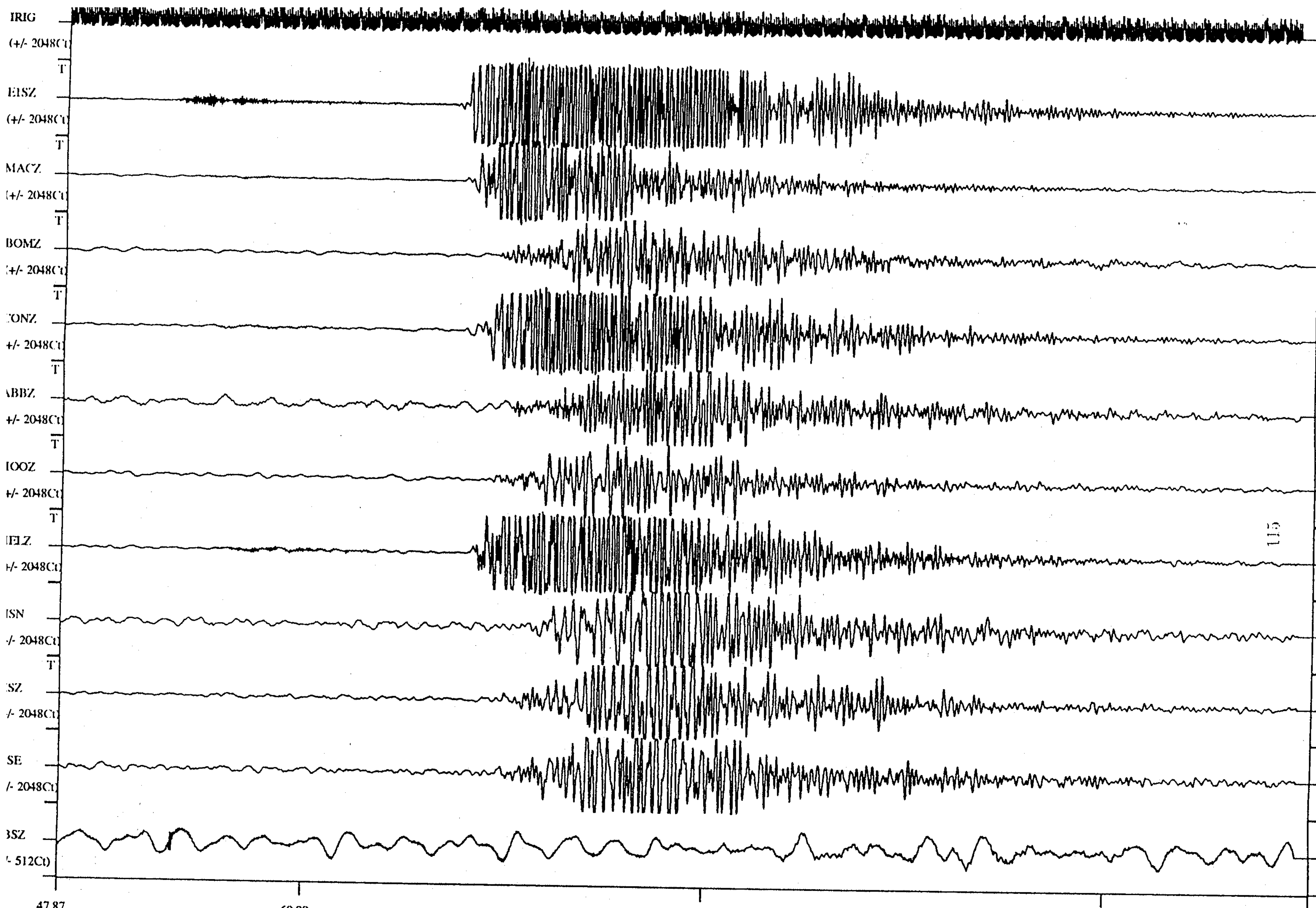
Trace start: 96, 3/24, 15:25:52.46. Input file: 96032404.wvm.filter.ah



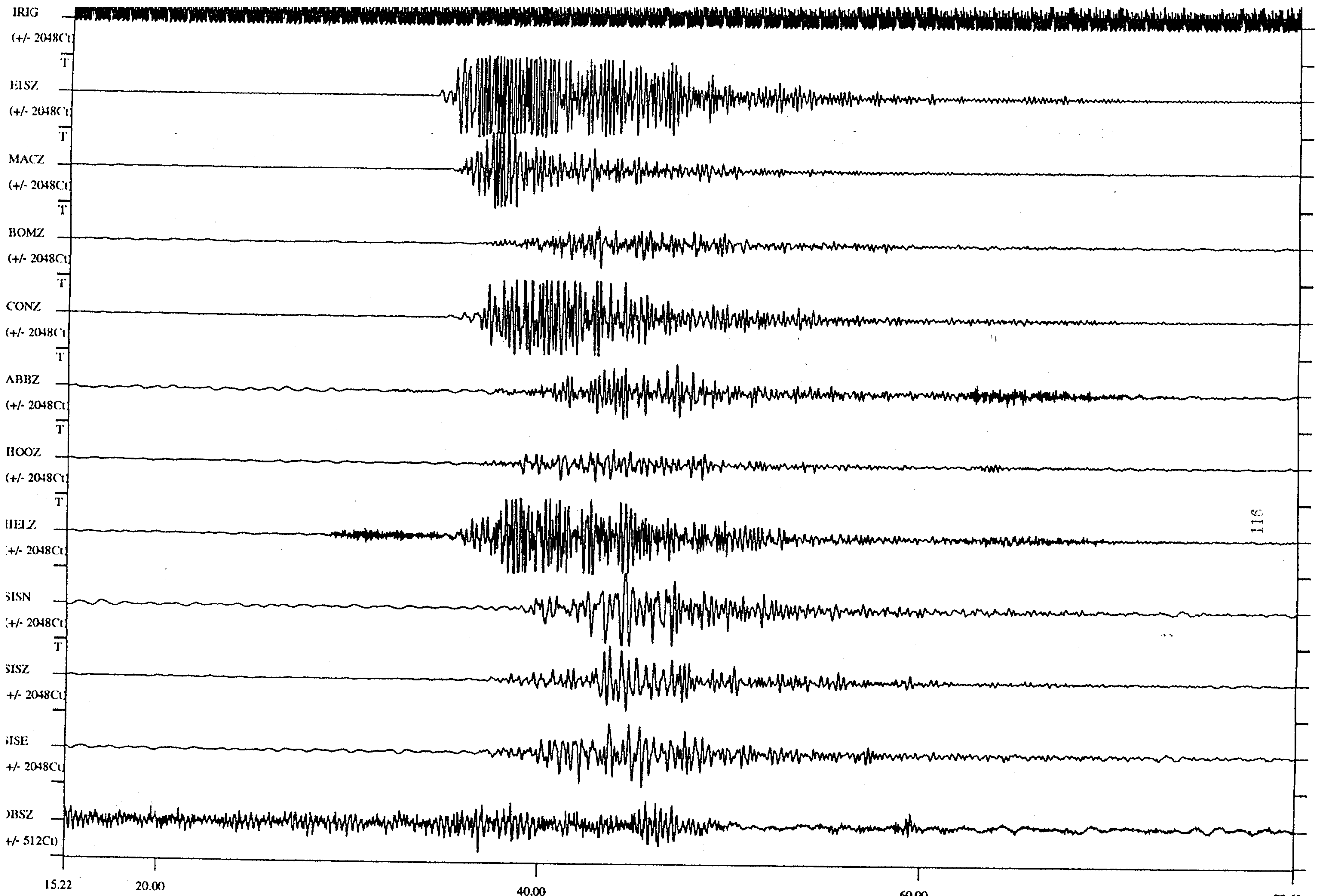
Trace start: 95. 2/28. 20:55:21.60. Input file: 95022802.wvm.filter.ah



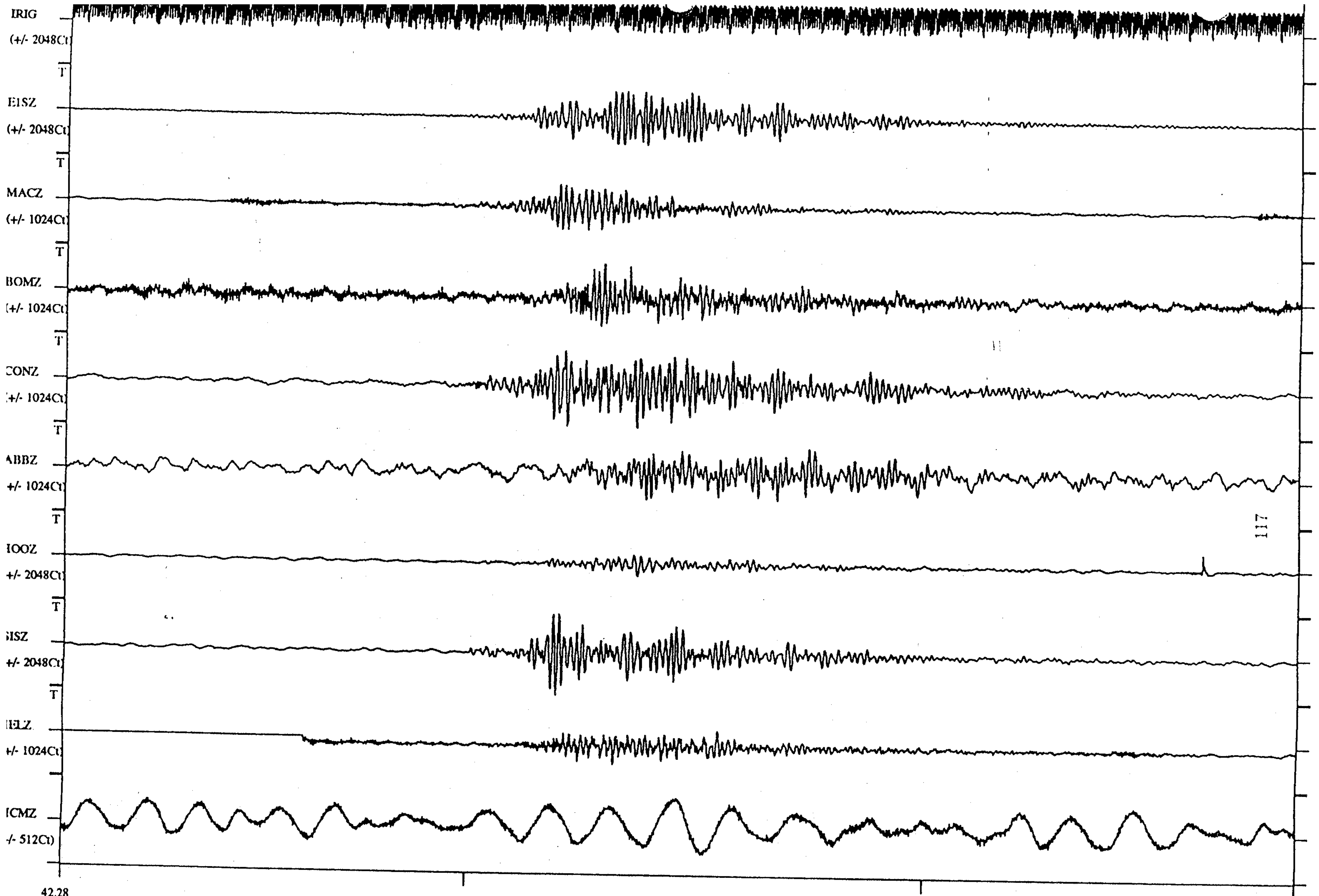

Trace start: 95. 3/9. 16:15:58.53. Input file: 95030901.wvm.filter.ah



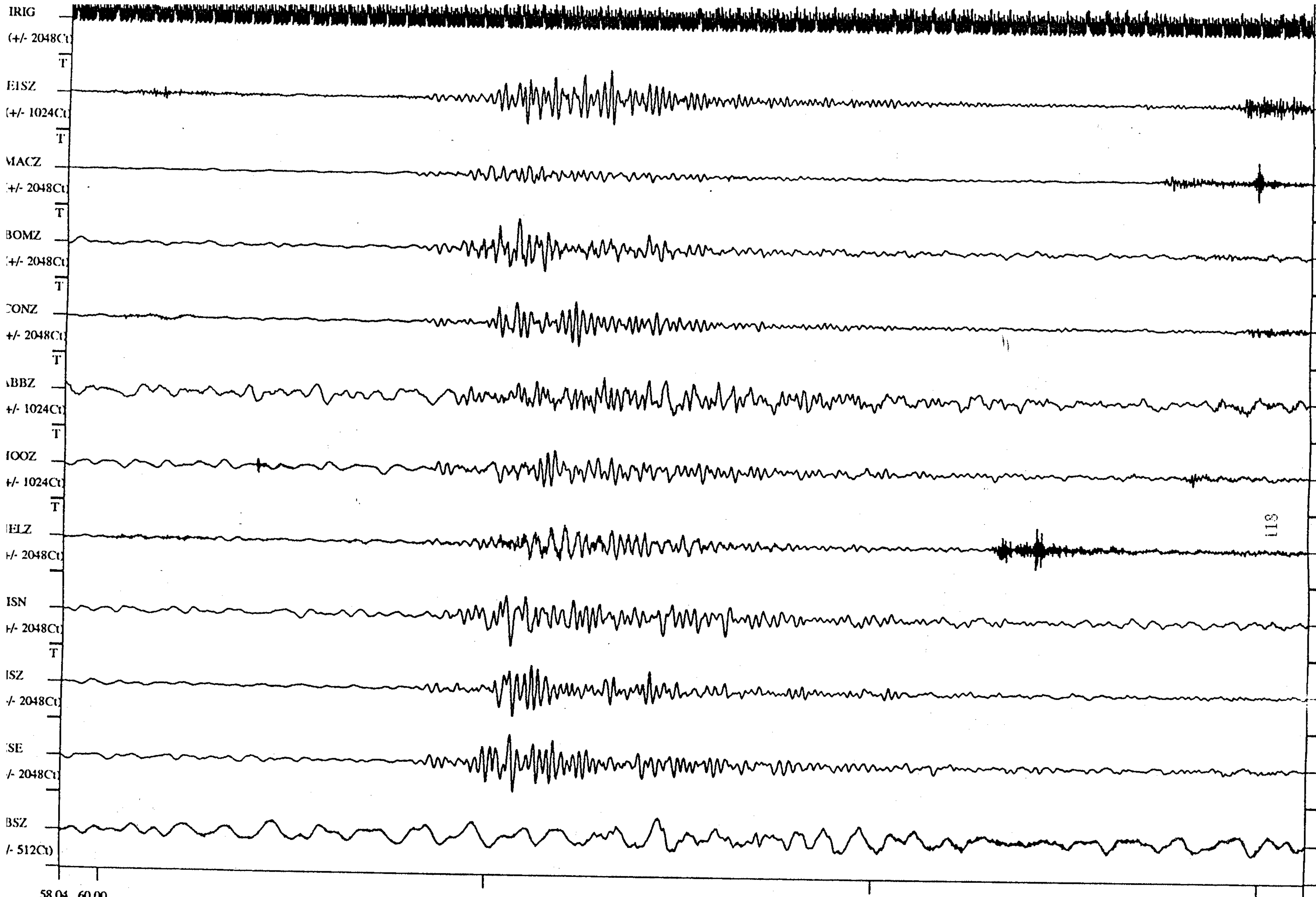
Trace start: 96. 3/6. 22:21:47.87. Input file: 96030603.wvm.filter.ah



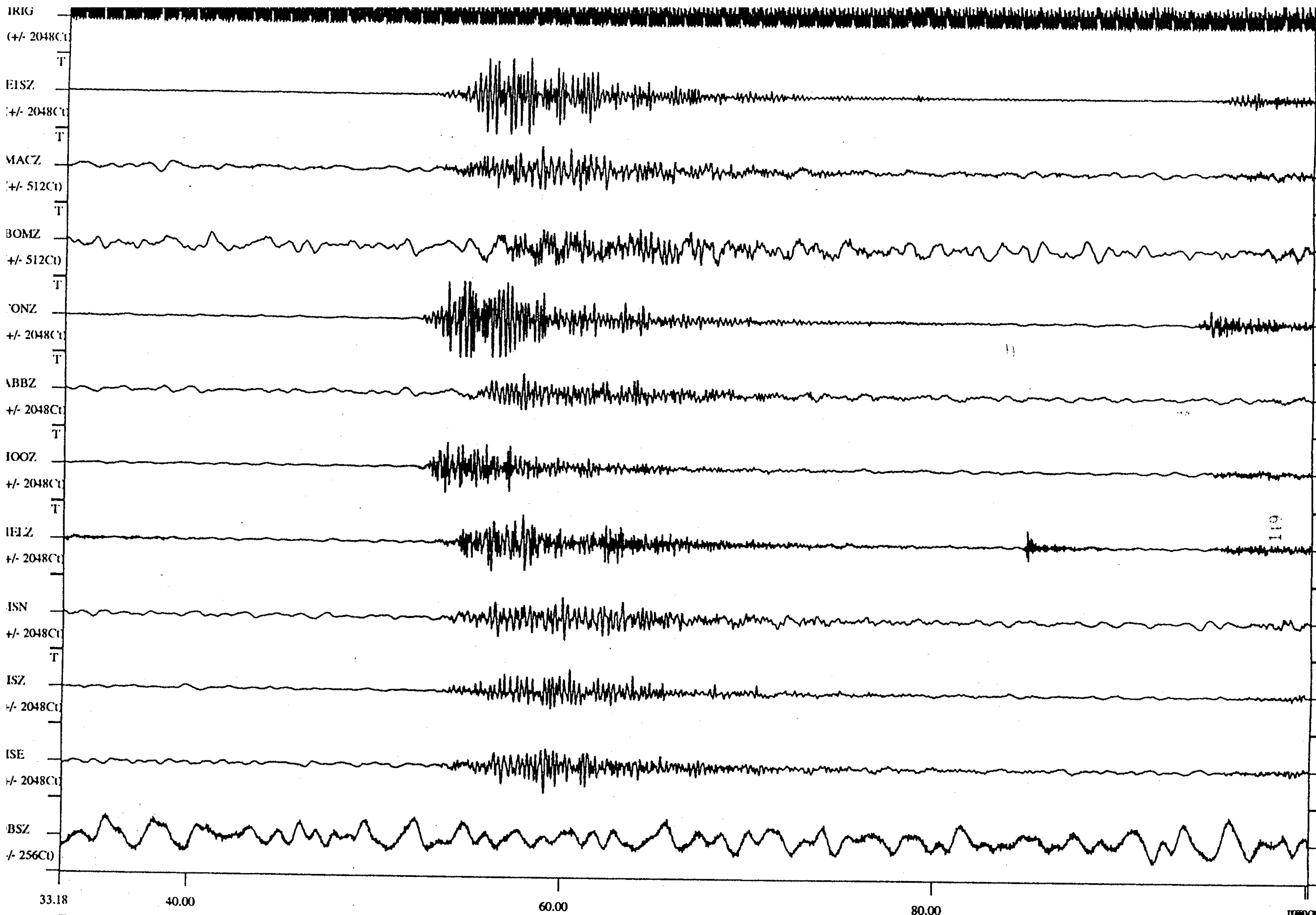
Trace start: 96, 3/12, 8:15:15.22. Input file: 96031201.wvm.filter.ah



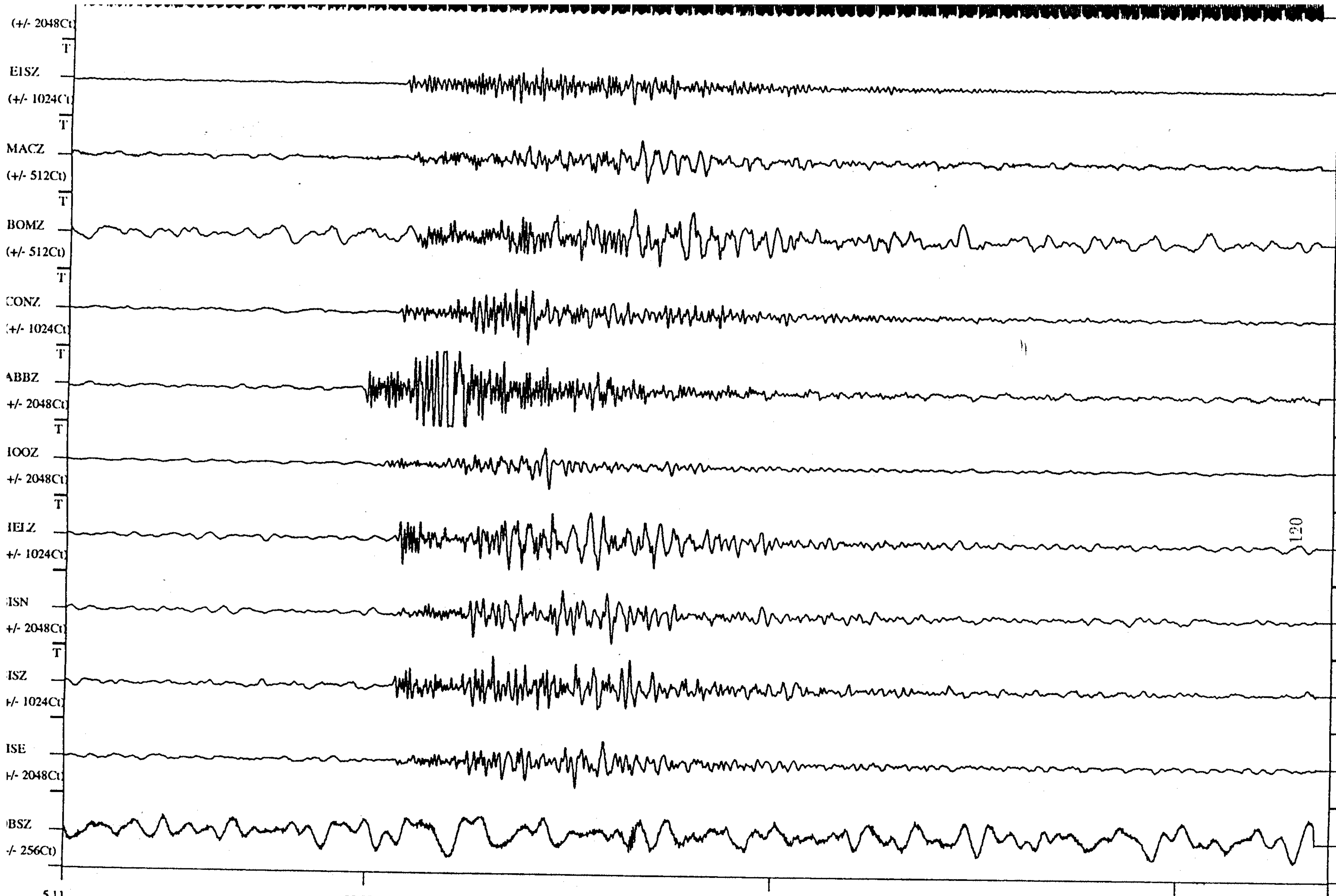
Trace start: 95. 3/5. 7:27:42.28. Input file: 95030506.wvm.filter.ah



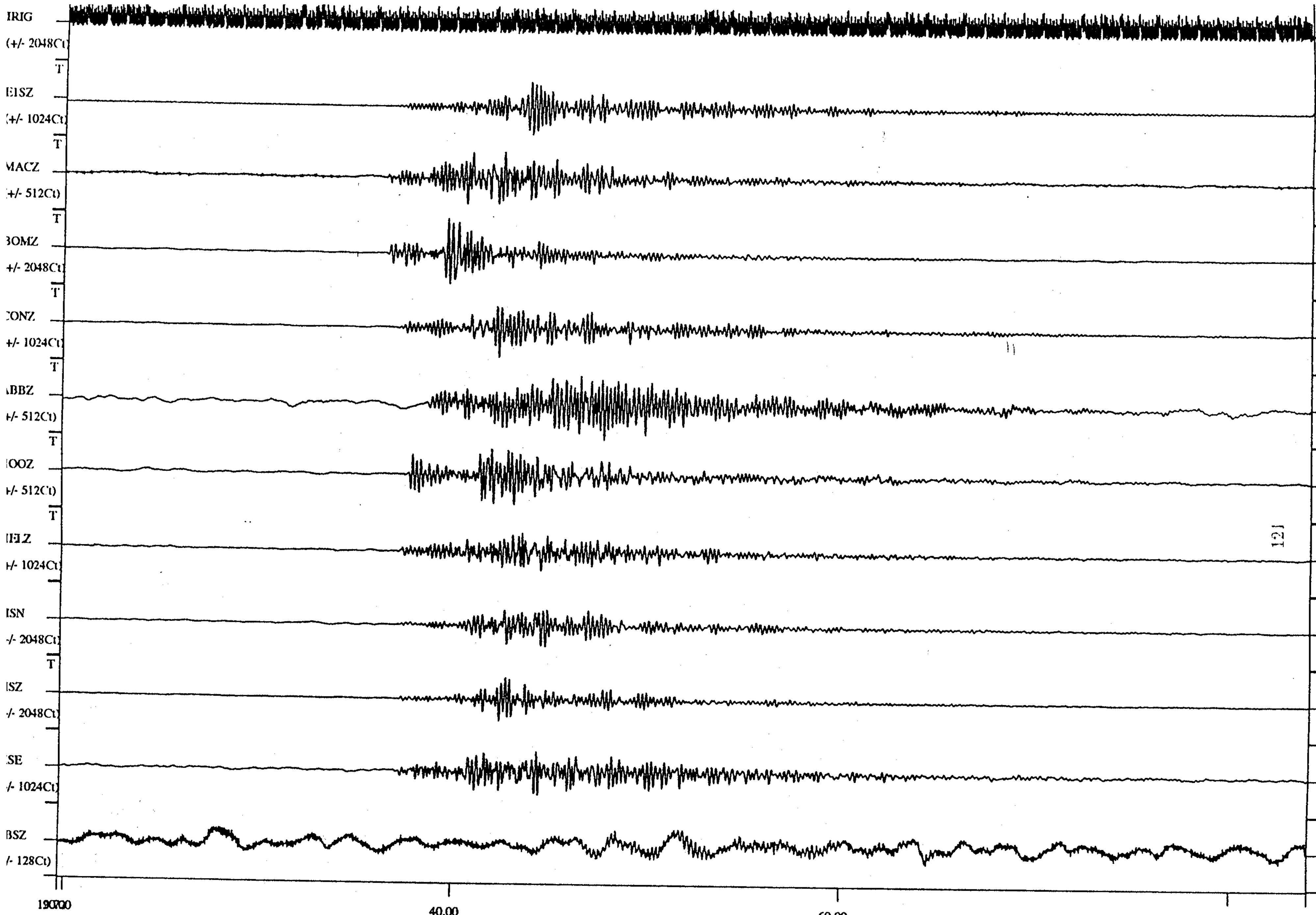

Trace start: 96, 2/21, 10:15:58.04. Input file: 9602211h.wvm.filter.ah



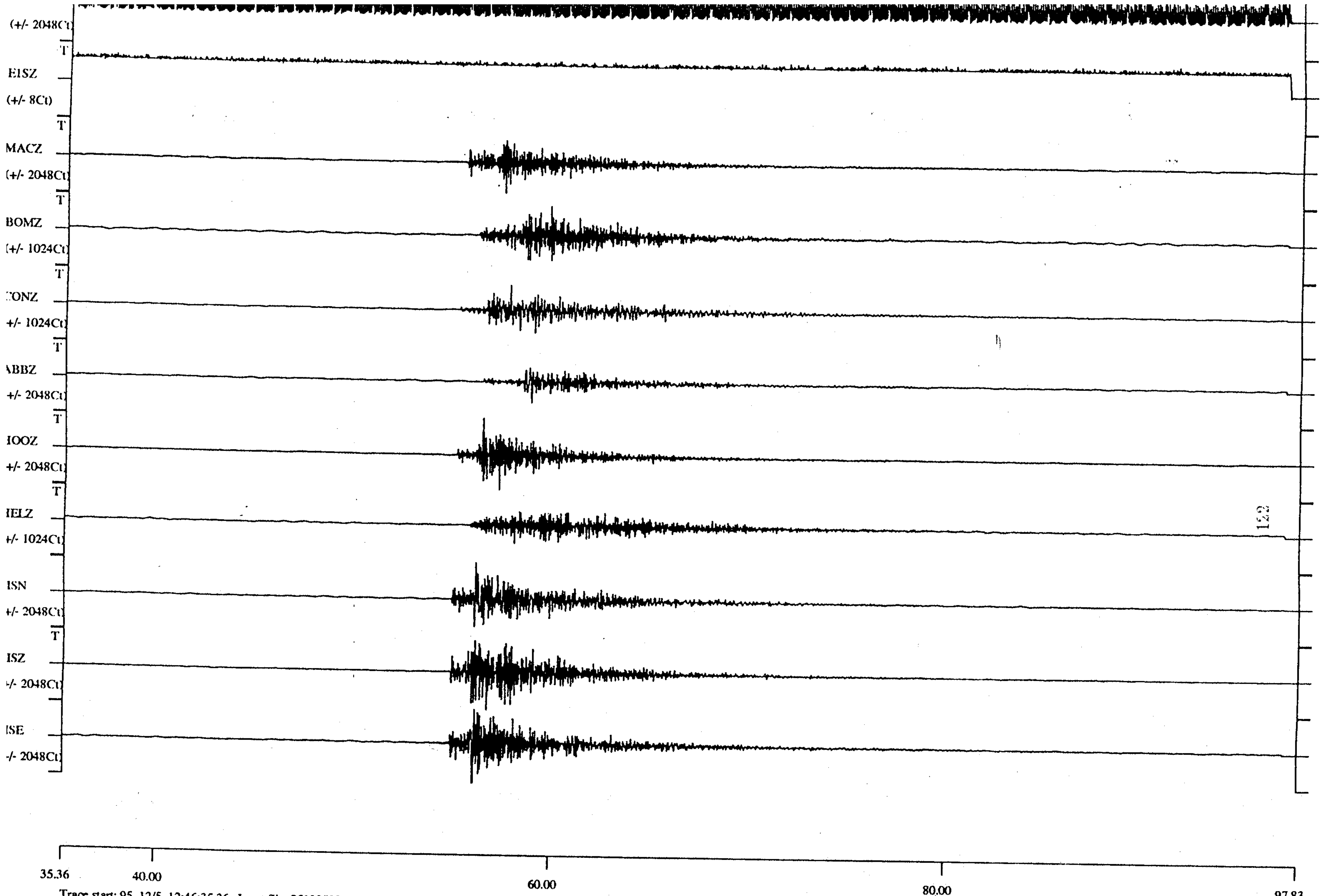
Trace start: 96. 2/21. 14:32:33.18. Input file: 9602212f.wvm.filter.ah



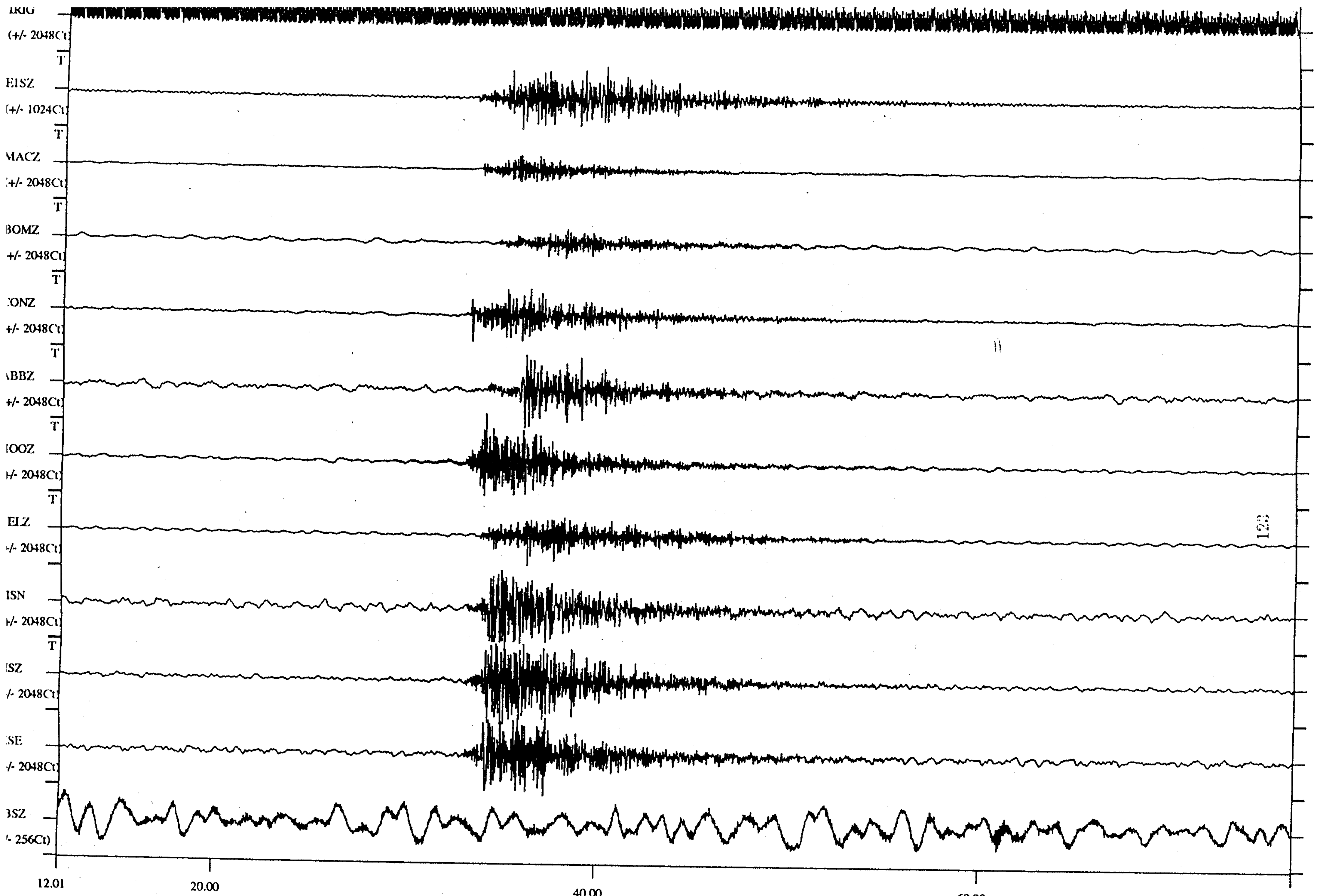
Trace start: 96, 3/6, 6:3:5.11. Input file: 96030600.wvm.filter.ah



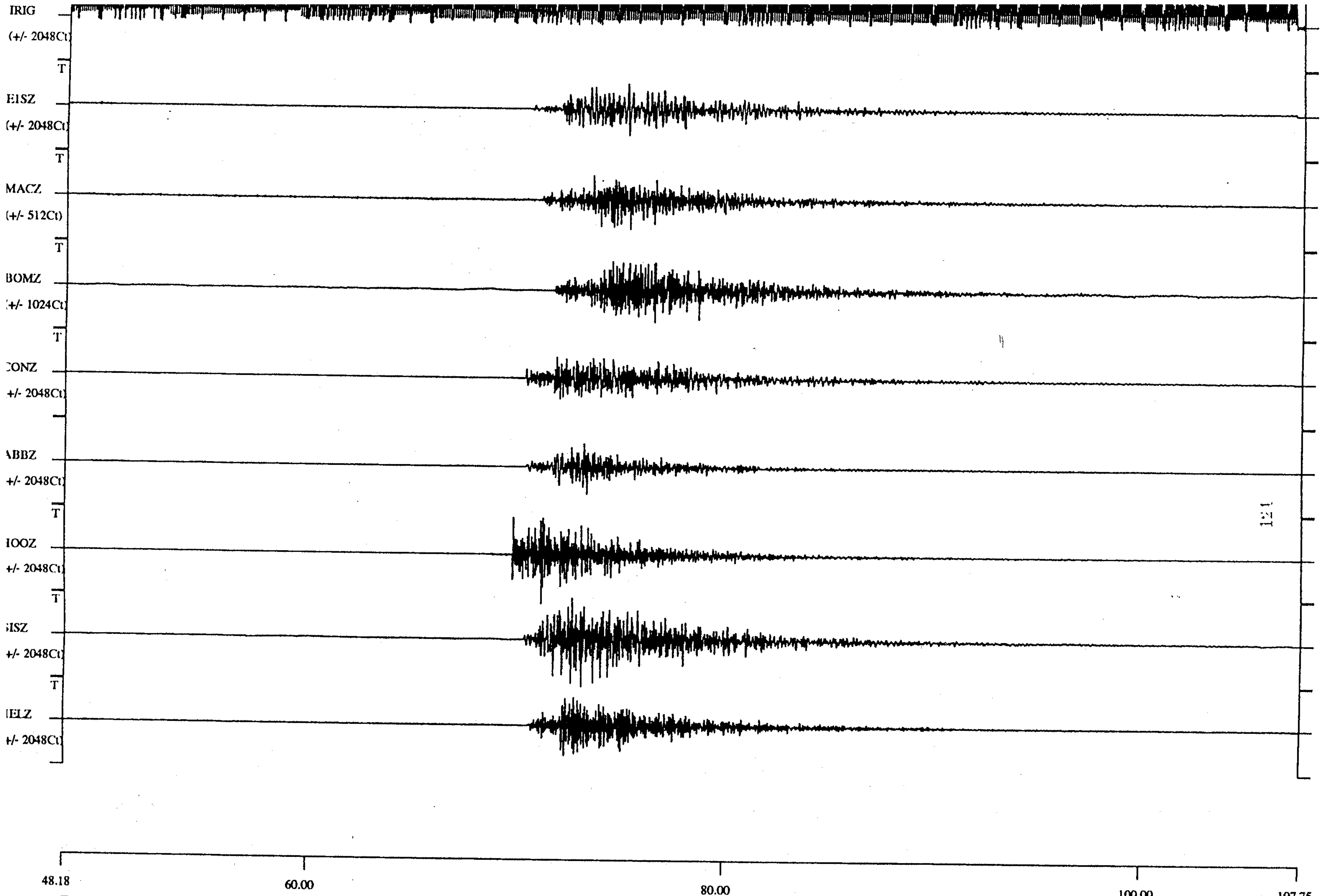

Trace start: 96. 3/20. 21:24:19.72. Input file: 96032009.wvm.filter.ah



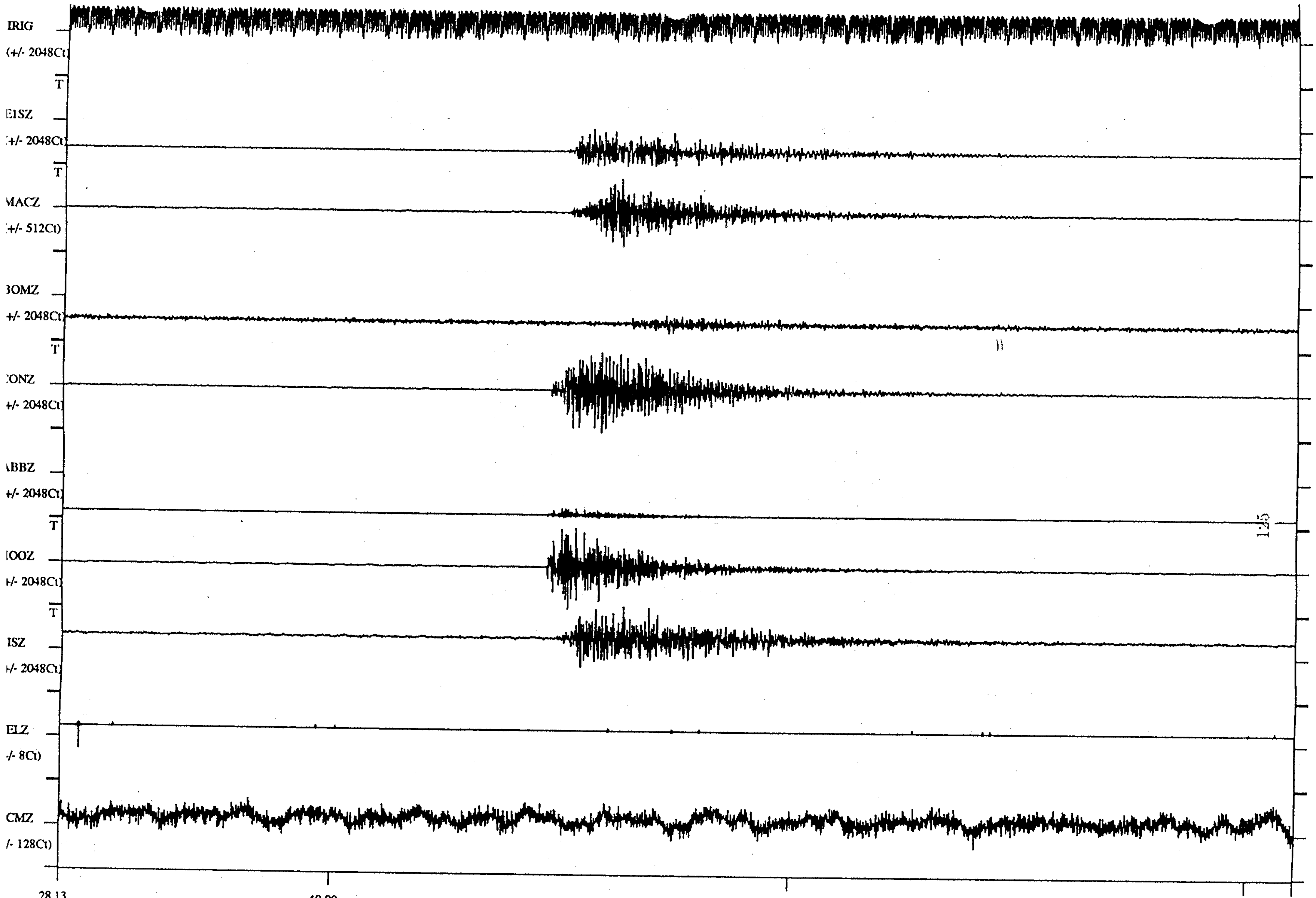
Trace start: 95, 12/5, 12:46:35.36. Input file: 95120500.wvm.filter.ah



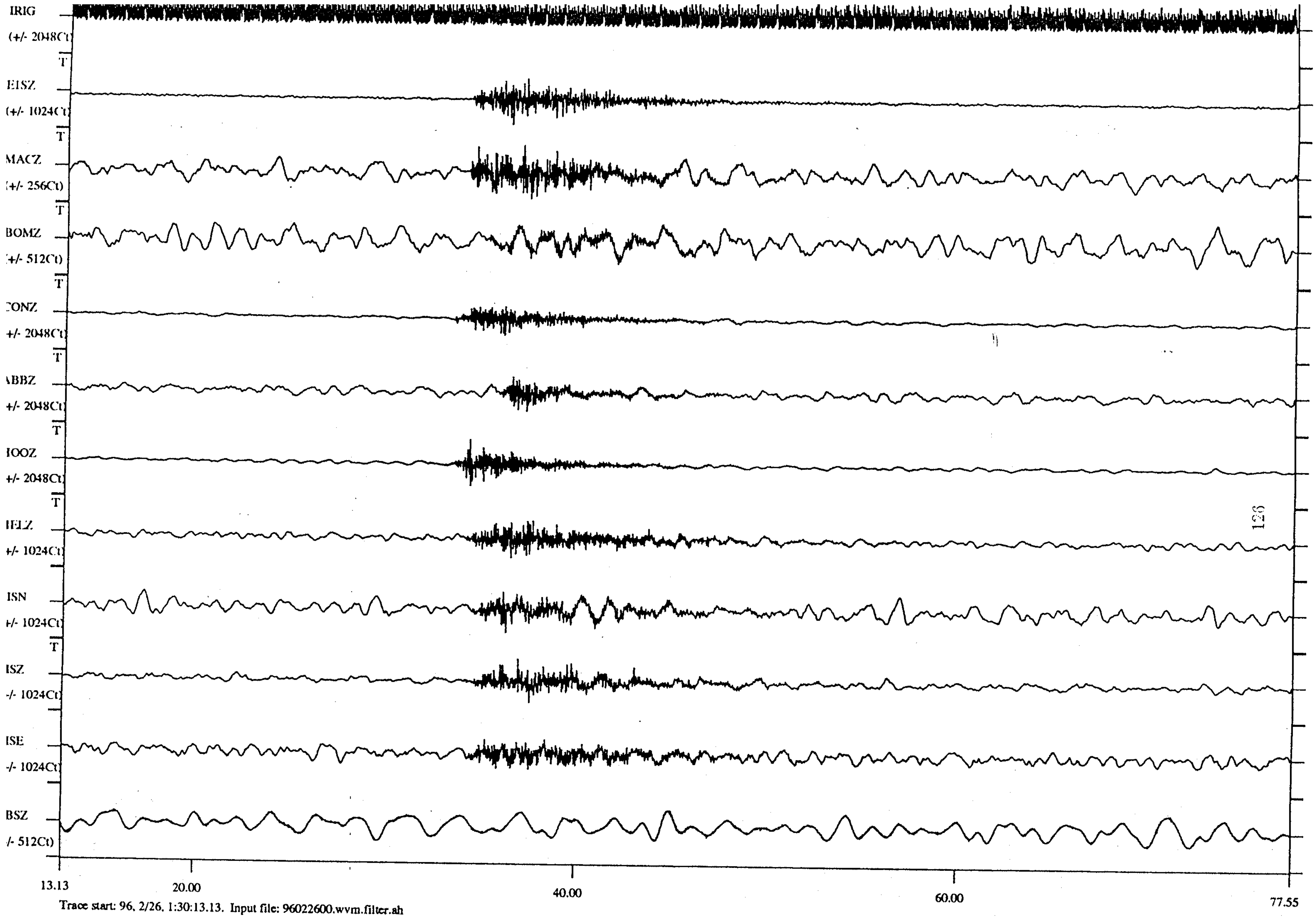
Trace start: 96, 3/6, 9:39:12.01. Input file: 96030601.wvm.filter.ah

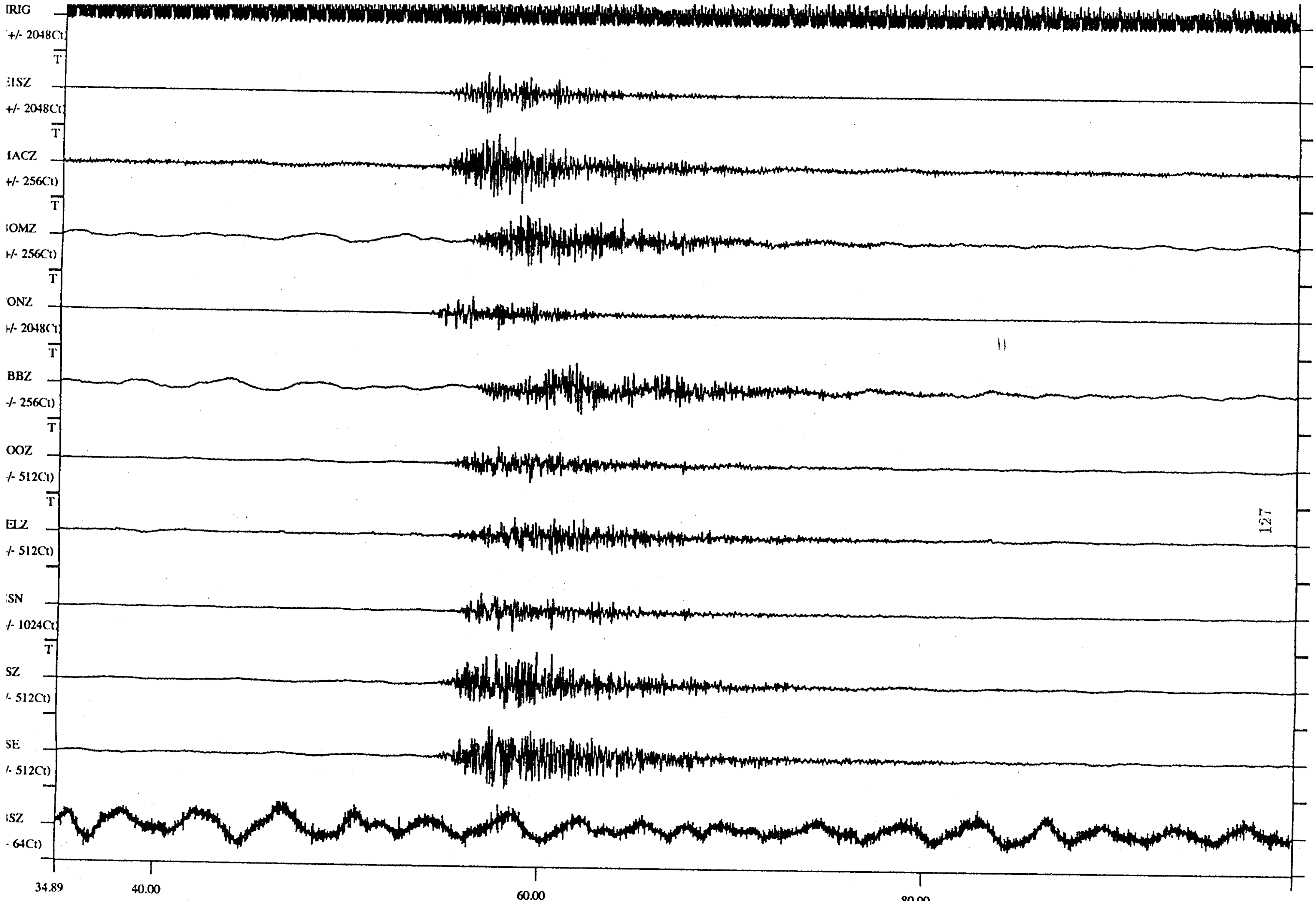


Trace start: 95, 11/18, 11:58:48.18. Input file: 95111803.wvm.filter.ah

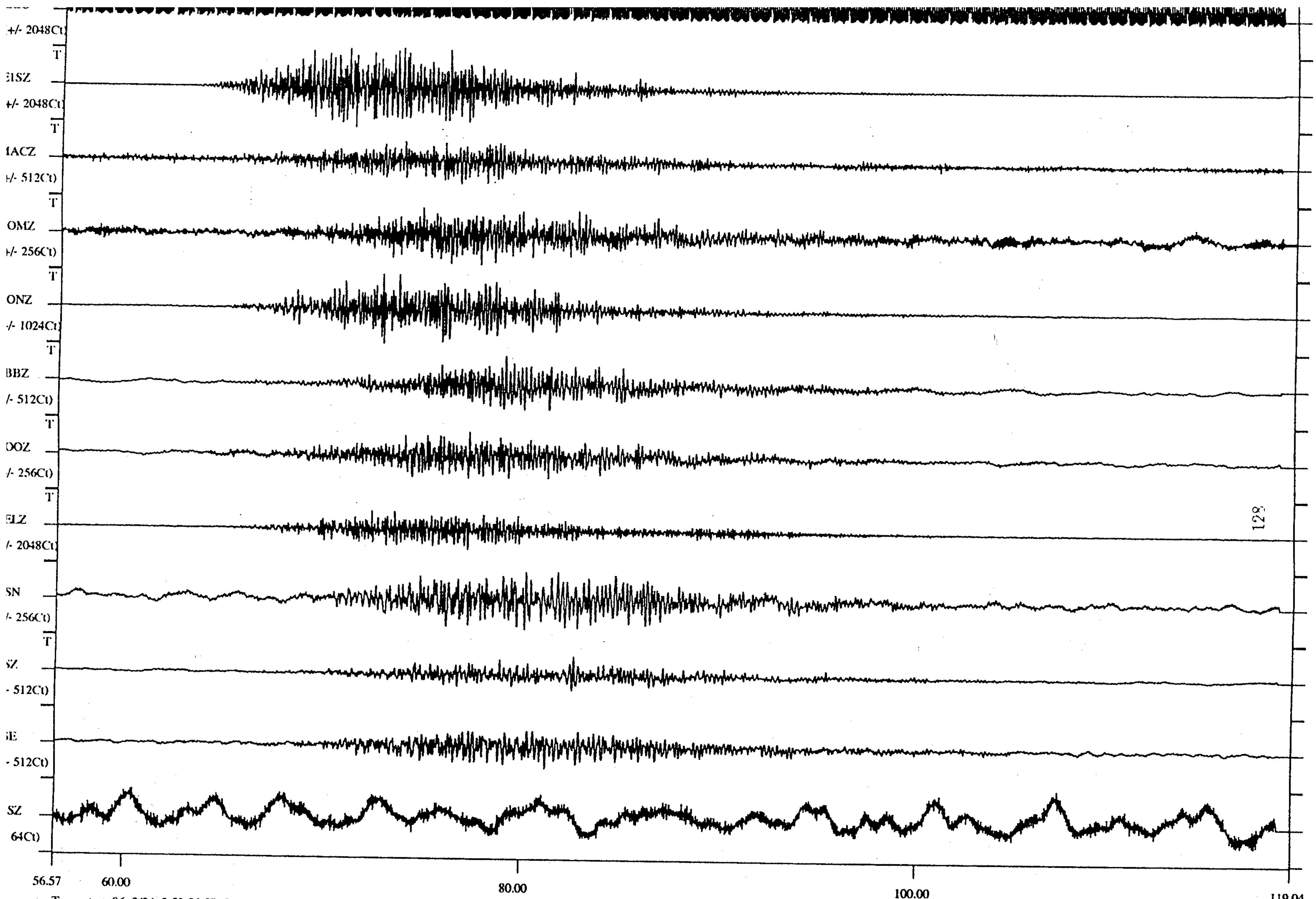


Trace start: 95, 10/15, 6:50:28.13. Input file: 95101500.wvm.filter.ah

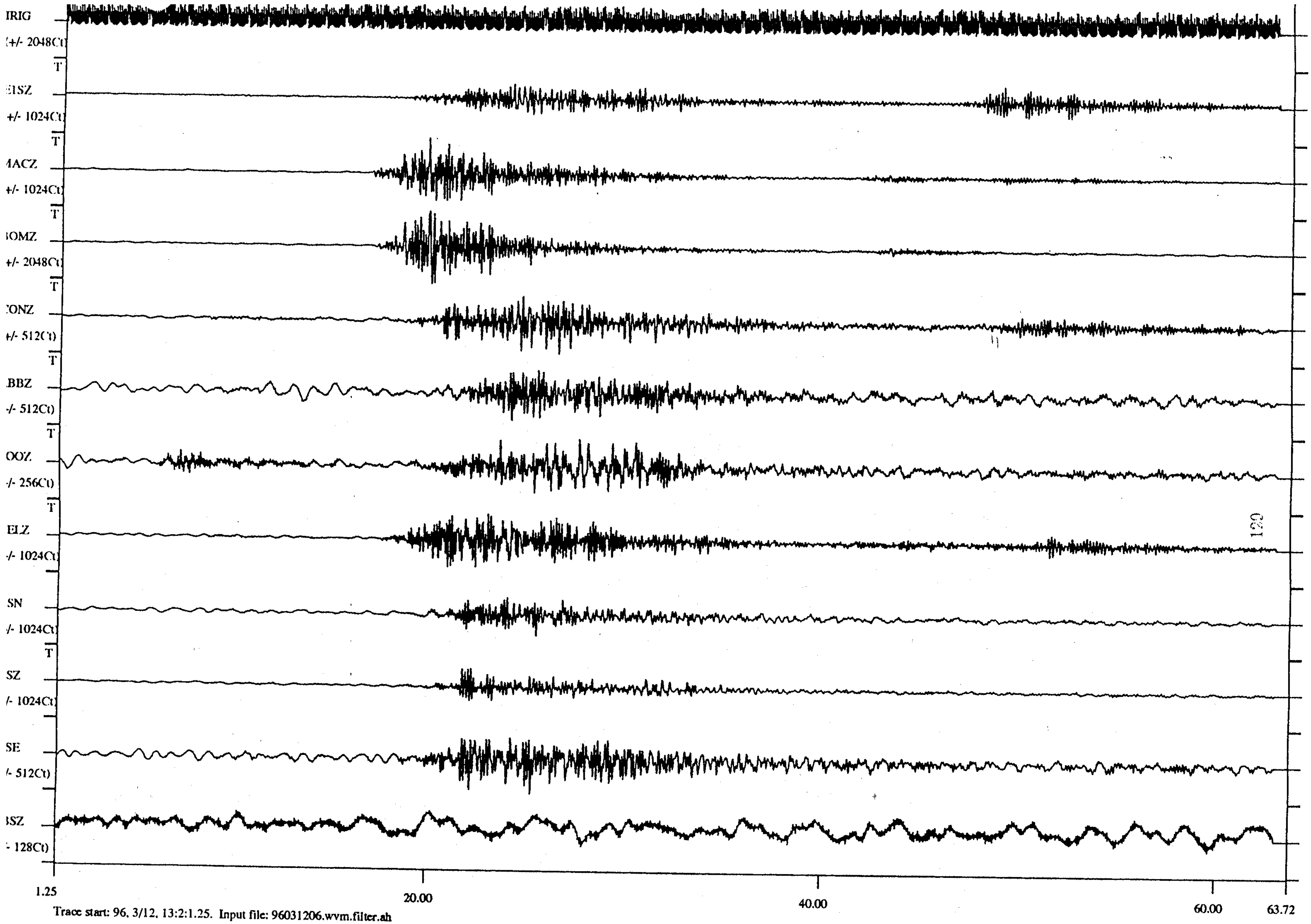

IRIG
(+/- 2048Ct)
EISZ
(+/- 1024Ct)
MACZ
(+/- 256Ct)
BOMZ
(+/- 512Ct)
CONZ
+/- 2048Ct)
ABBZ
+/- 2048Ct)
HOOZ
+/- 2048Ct)
HELZ
+/- 1024Ct)
ISN
+/- 1024Ct)
ISZ
-/- 1024Ct)
ISE
-/- 1024Ct)
BSZ
/- 512Ct)
13.13
20.00
40.00
60.00
77.55
Trace start: 96, 2/26, 1:30:13.13. Input file: 96022600.wvm.filter.ah

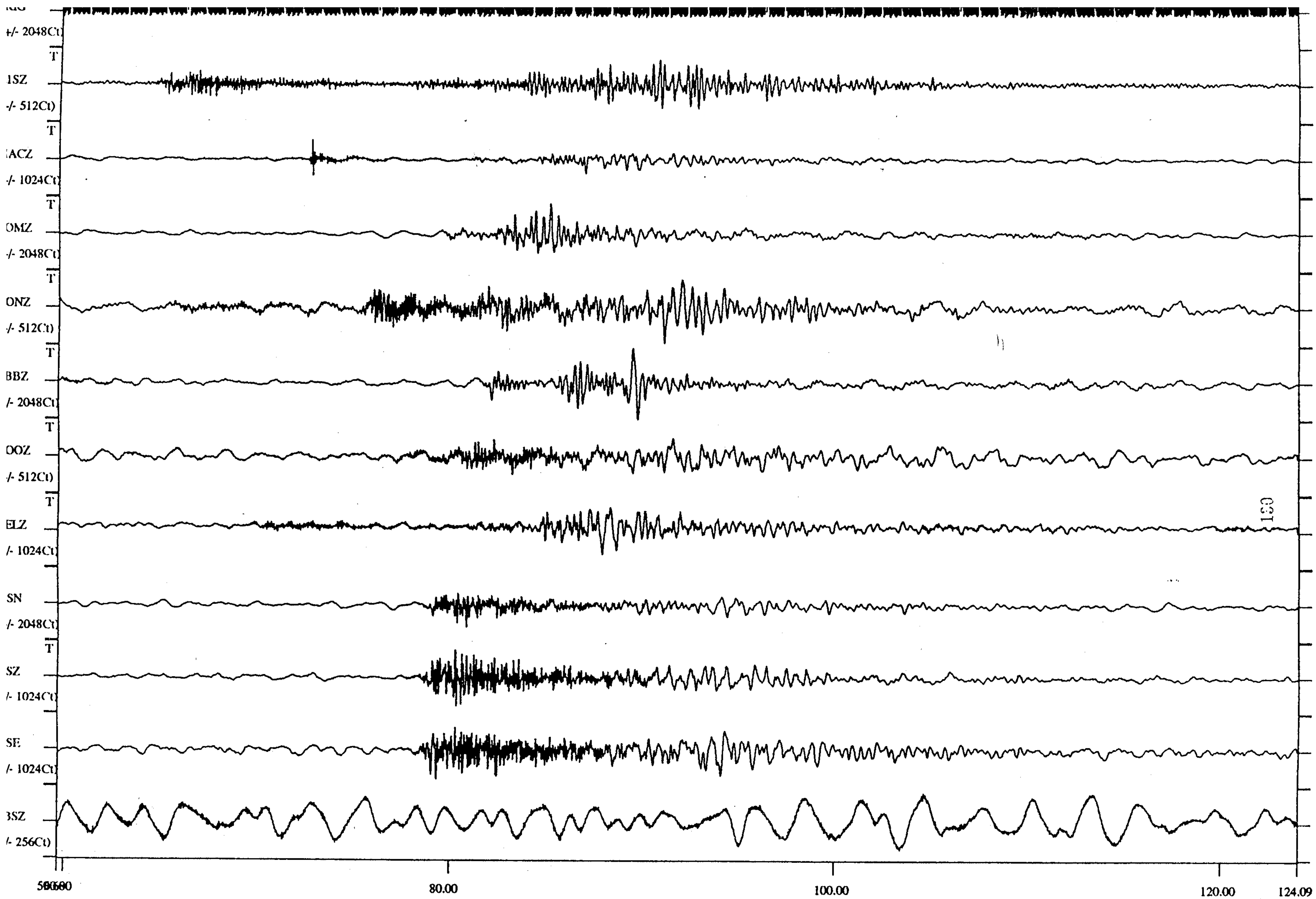


Trace start: 96. 4/4. 18:14:34.89. Input file: 96040402.wvm.filter.ah

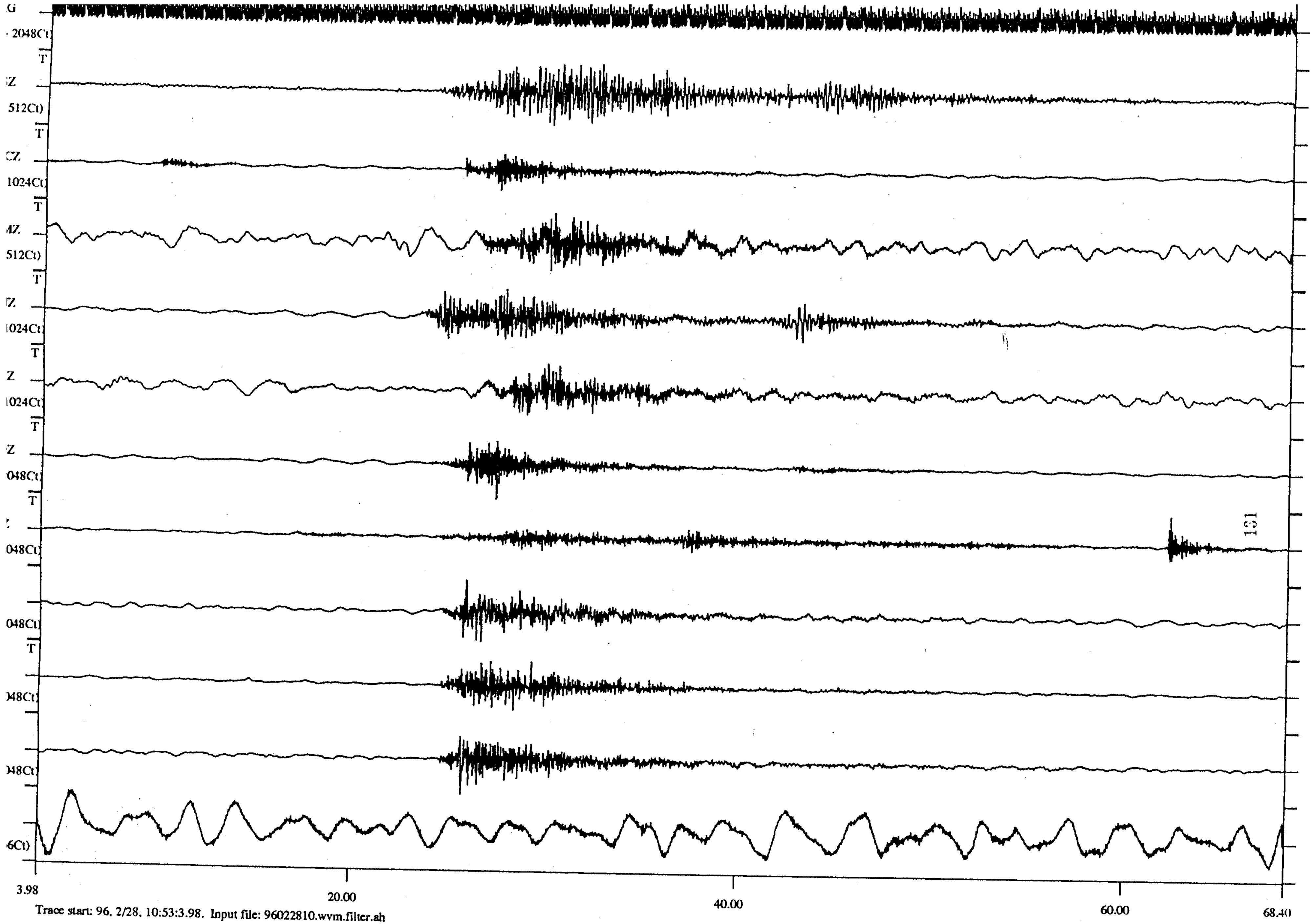


Trace start: 96. 3/24. 3:52:56.57. Input file: 96032402.wvm.filter.ah

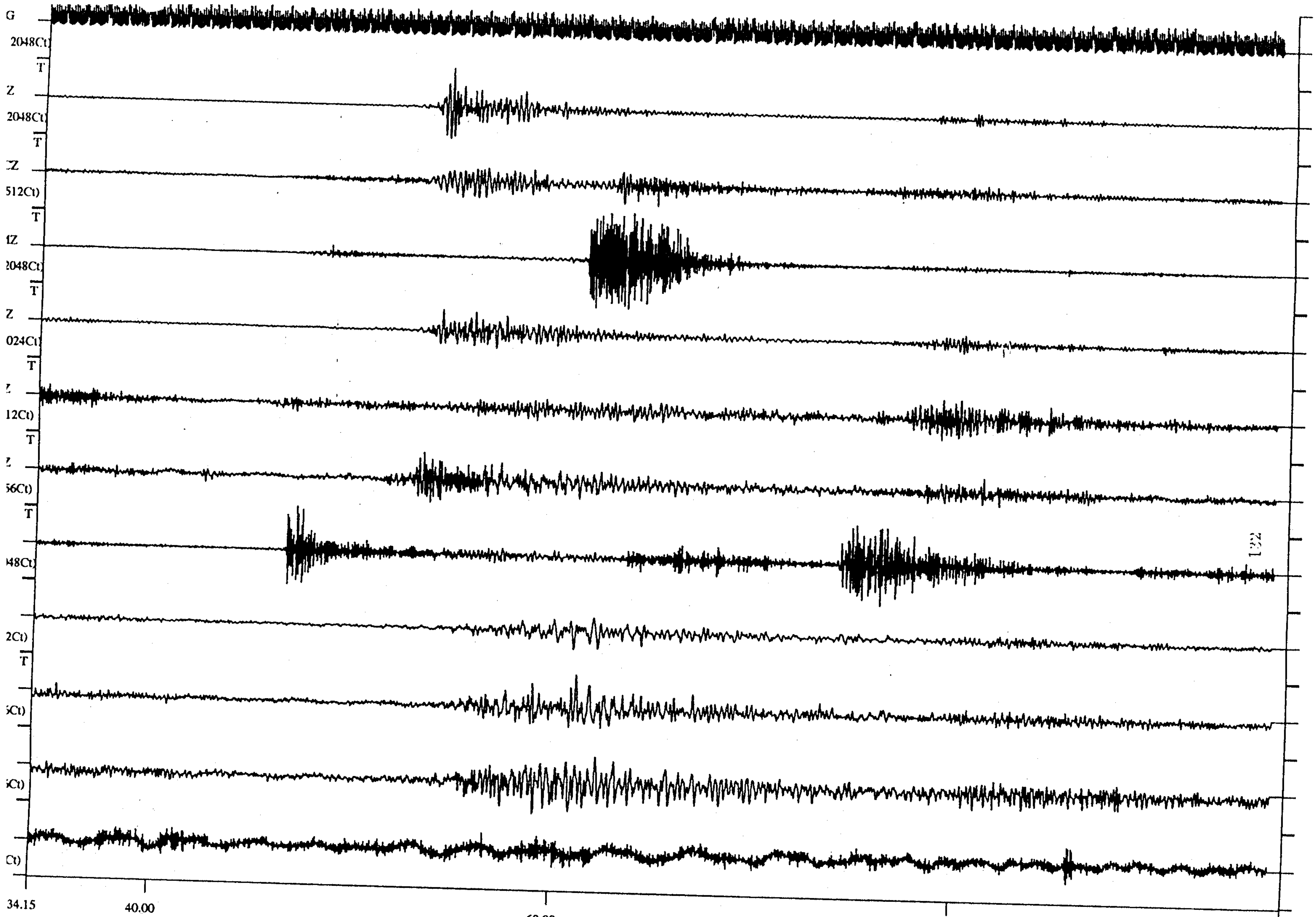

IRIG
(+/- 2048Ct)
T
E1SZ
+/- 1024Ct)
T
4ACZ
+/- 1024Ct)
T
3OMZ
+/- 2048Ct)
T
CONZ
+/- 512Ct)
T
BBZ
-/- 512Ct)
T
OOZ
-/- 256Ct)
T
ELZ
-/- 1024Ct)
SN
-/- 1024Ct)
T
SZ
/- 1024Ct)
SE
/- 512Ct)
3SZ
- 128Ct)
1.25
20.00
40.00
60.00
63.72
Trace start: 96, 3/12, 13:2:1.25. Input file: 96031206.wvm.filter.ah



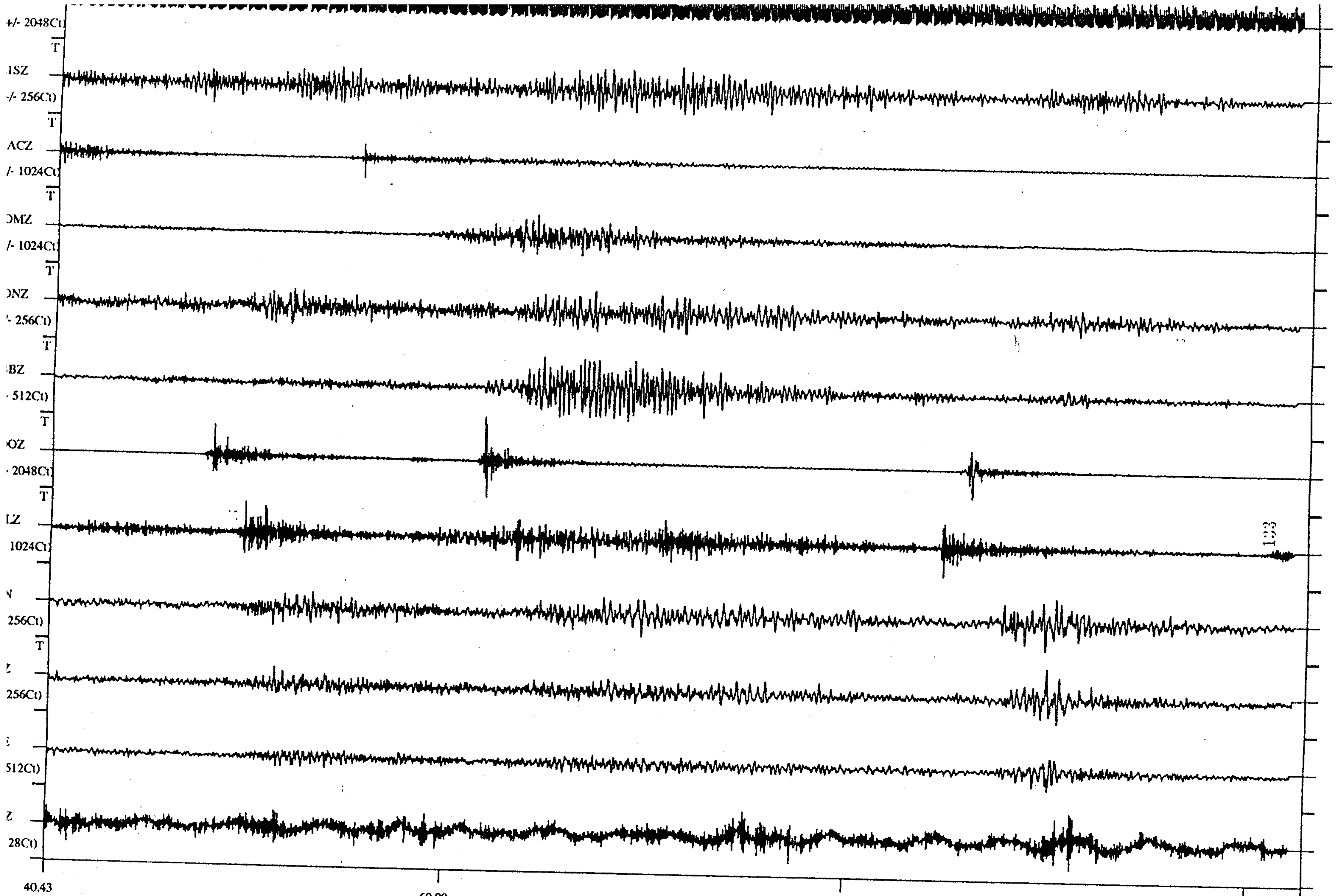
Trace start: 96, 2/28, 20:7:59.68. Input file: 96022823.wvm.filter.ah



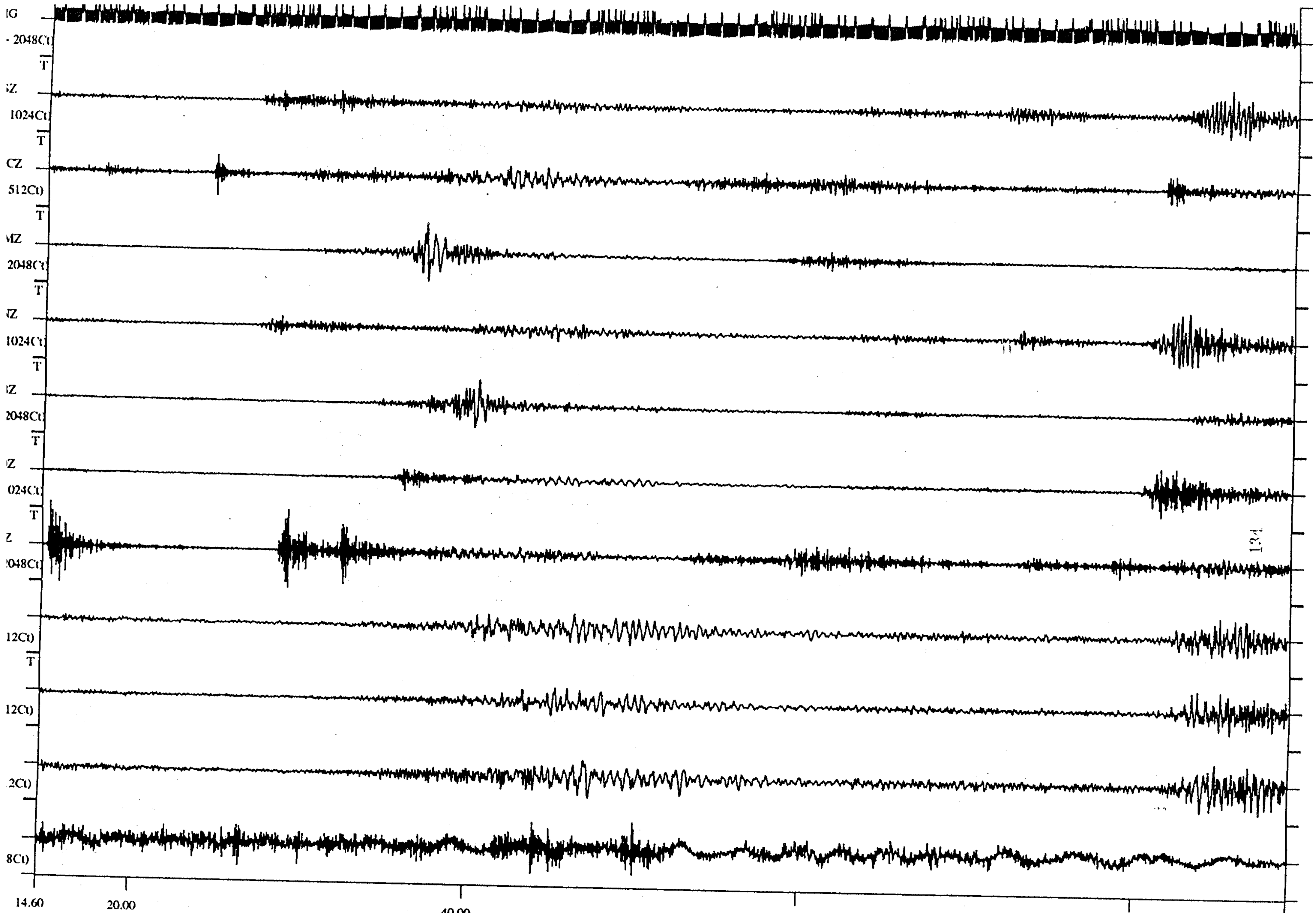

Trace start: 96, 2/28, 10:53:3.98. Input file: 96022810.wvm.filter.ah



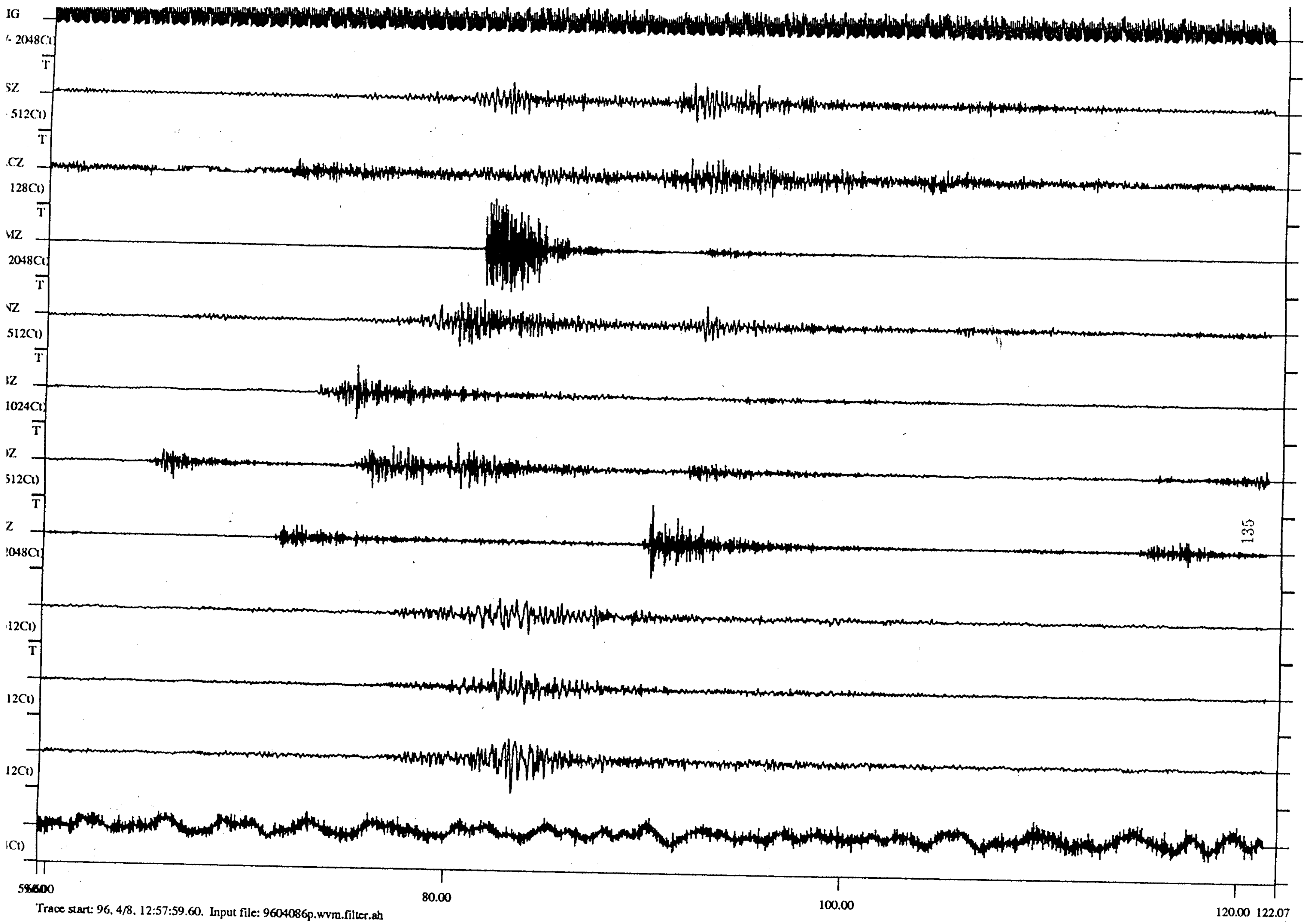

Trace start: 96, 4/8, 9:37:34.15. Input file: 9604084o.wvm.filter.ah

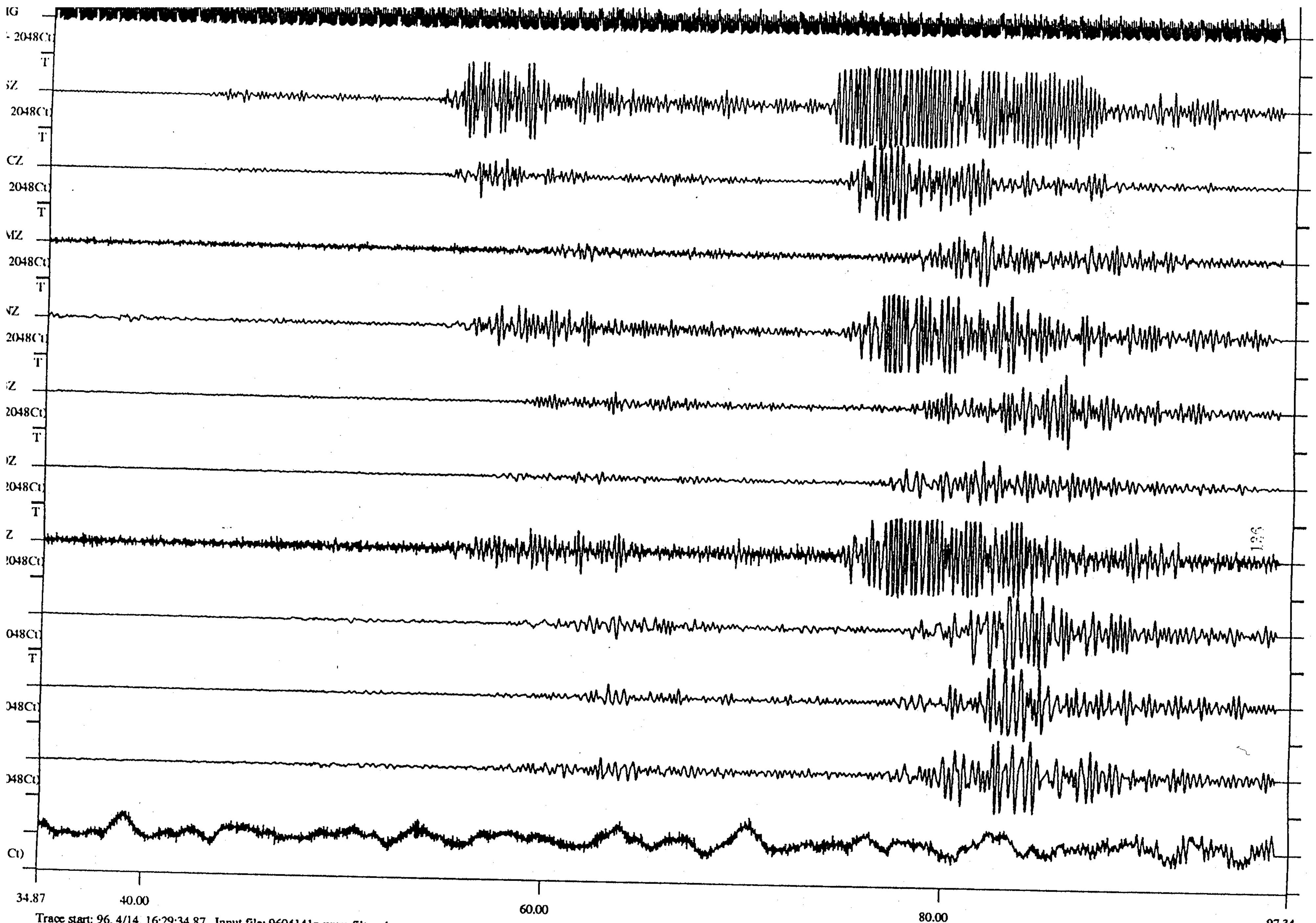



Trace start: 96. 4/8. 9:51:40.43. Input file: 9604084t.wvm.filter.ah

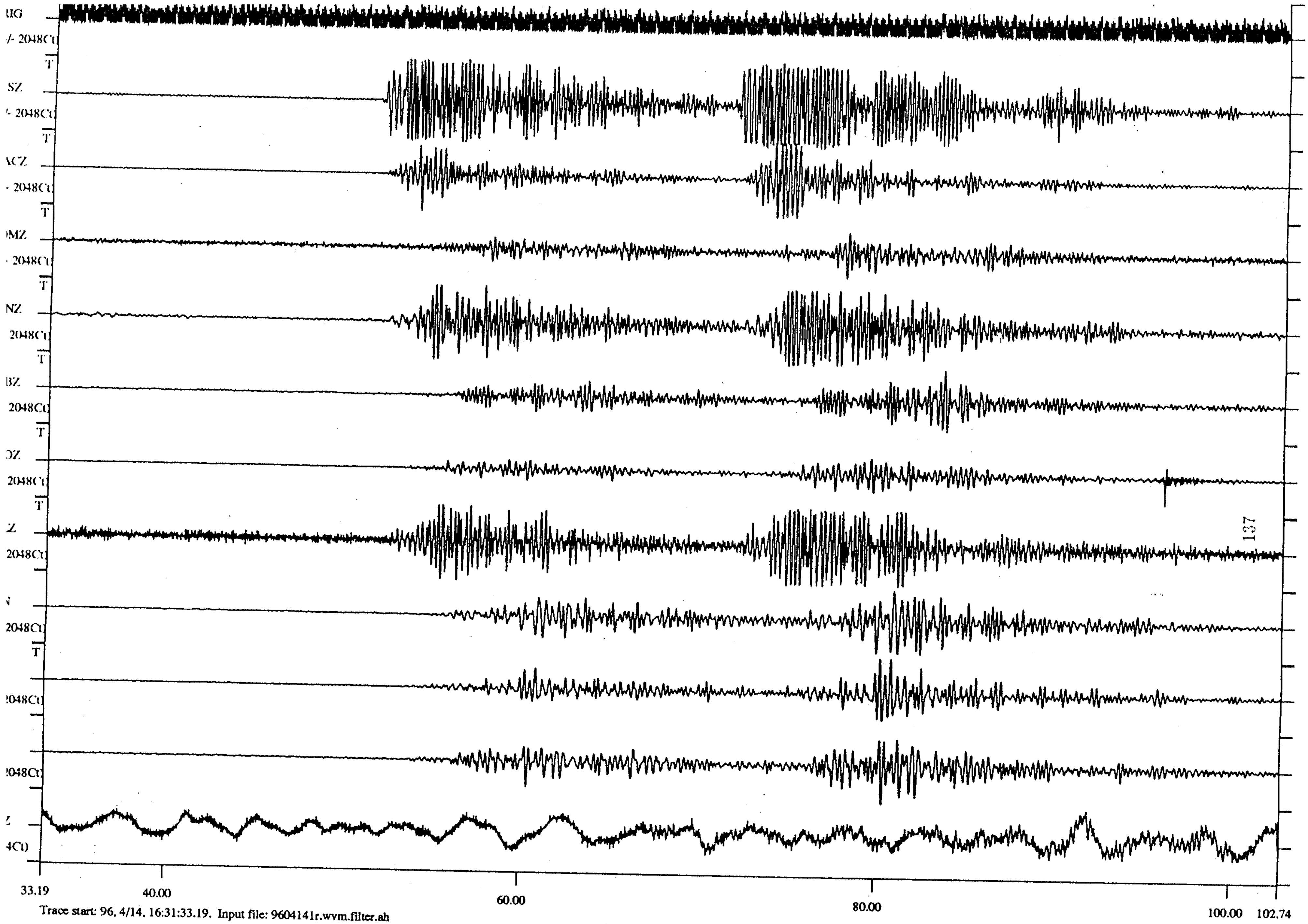


Trace start: 96. 4/8, 10:28:14.60. Input file: 96040855.wvm.filter.ah

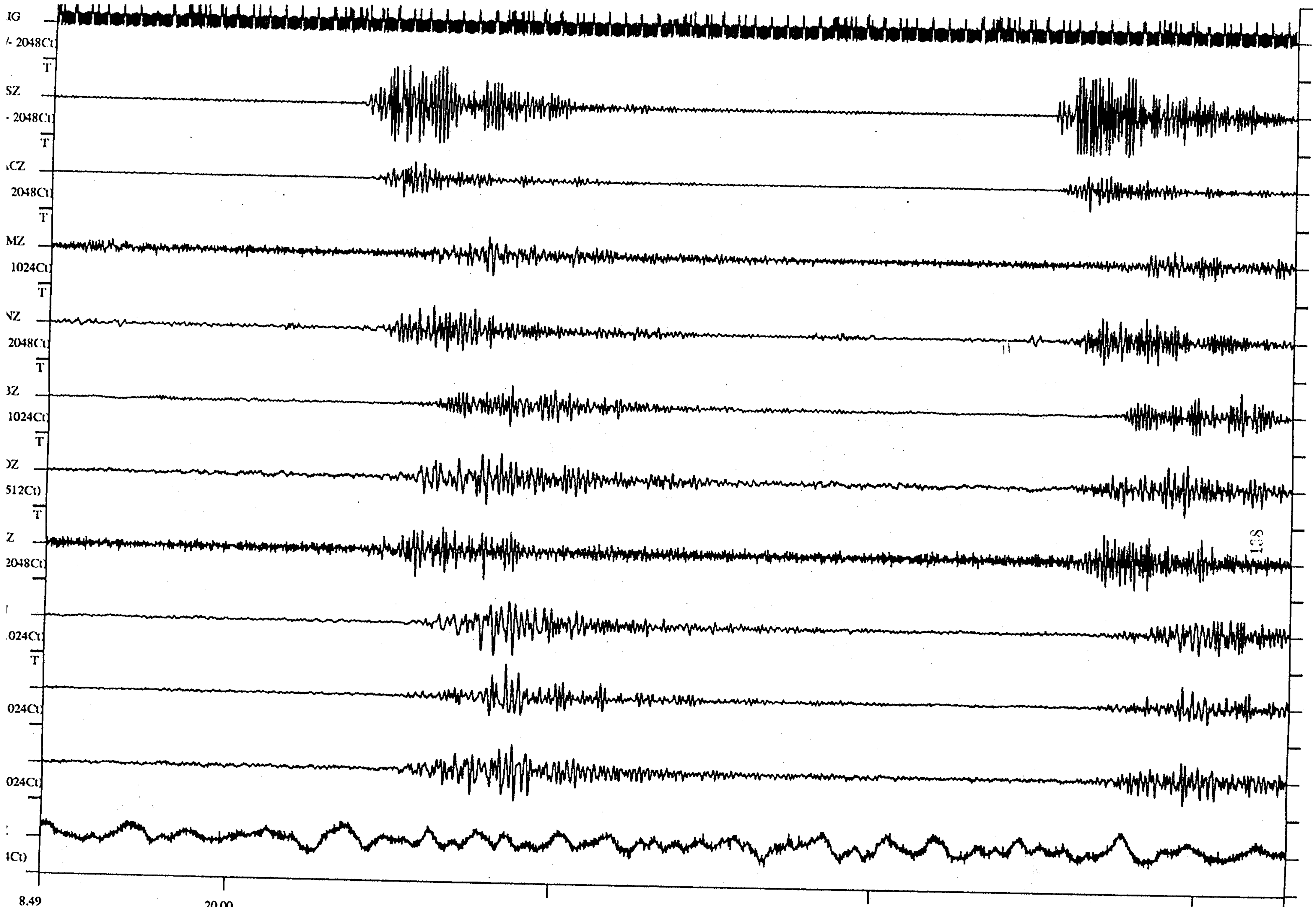

IG
2048Ct)
SZ
512Ct)
CZ
128Ct)
MZ
2048Ct)
NZ
512Ct)
1024Ct)
512Ct)
Z
2048Ct)
12Ct)
12Ct)
12Ct)
Ct)
T
80.00
100.00
120.00 122.07
Trace start: 96. 4/8. 12:57:59.60. Input file: 9604086p.wvm.filter.ah



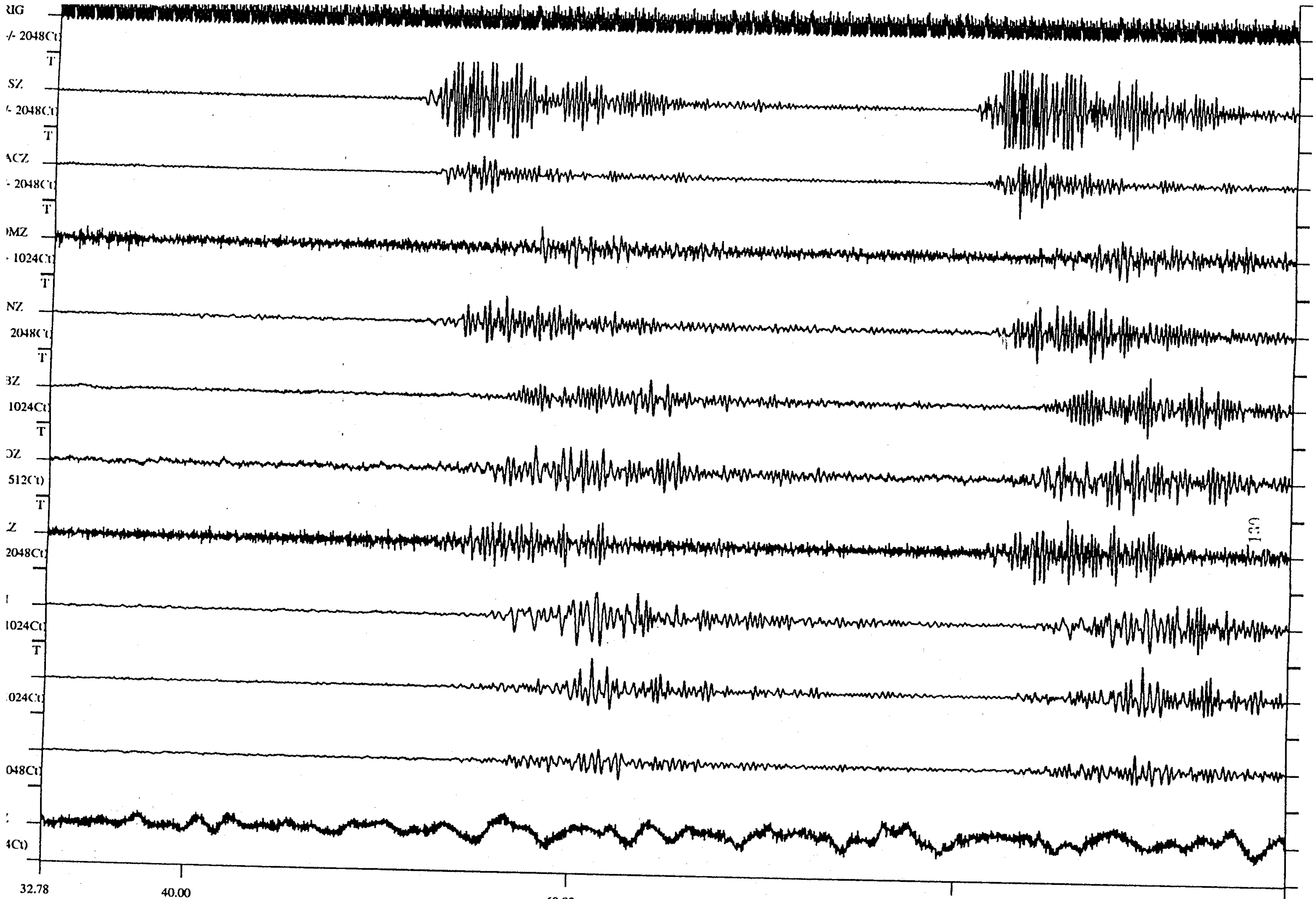
Trace start: 96, 4/14, 16:29:34.87. Input file: 9604141p.wvm.filter.ah



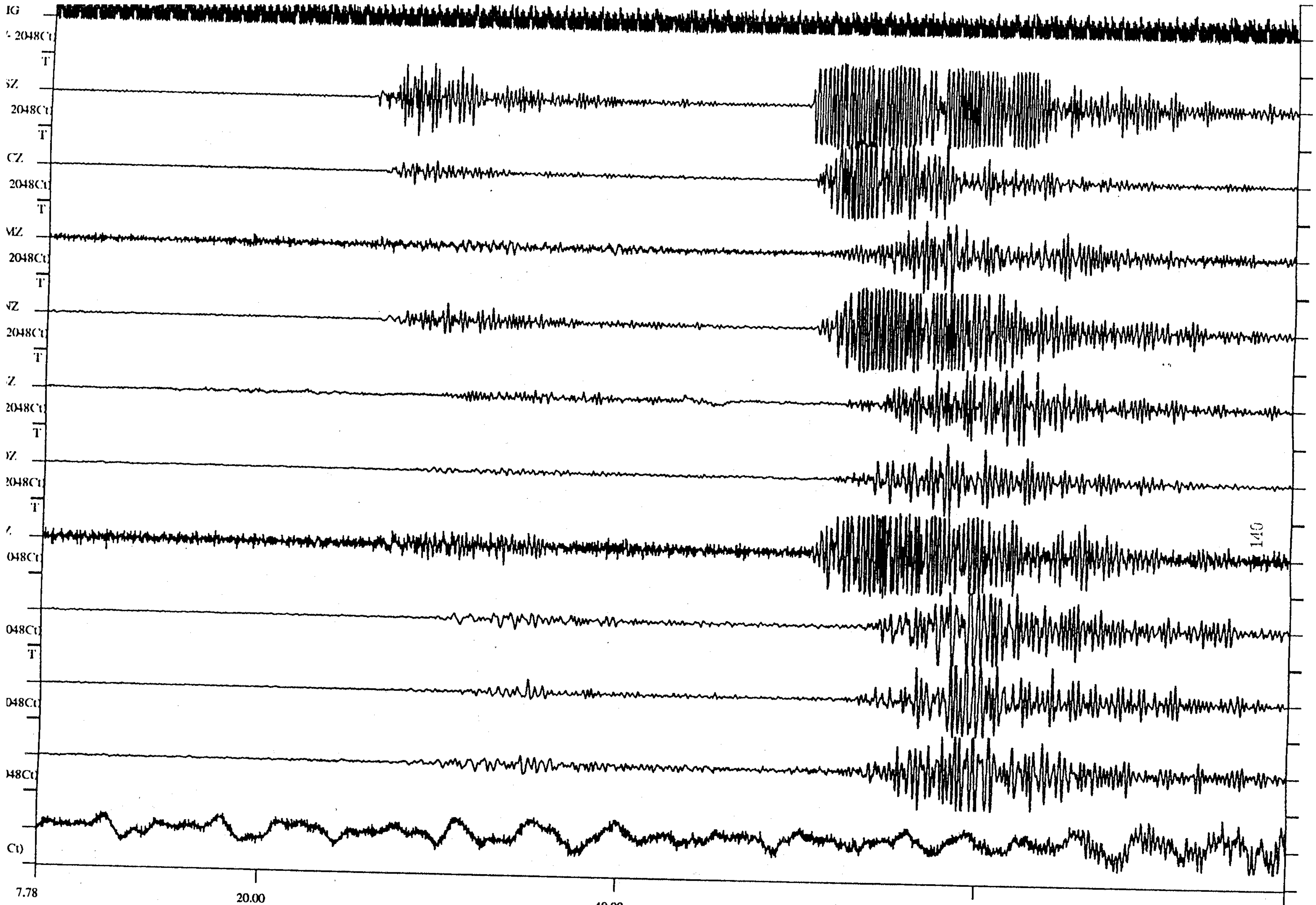
33.19
40.00
60.00
80.00
100.00
102.74
Trace start: 96, 4/14, 16:31:33.19. Input file: 9604141r.wvm.filter.ah



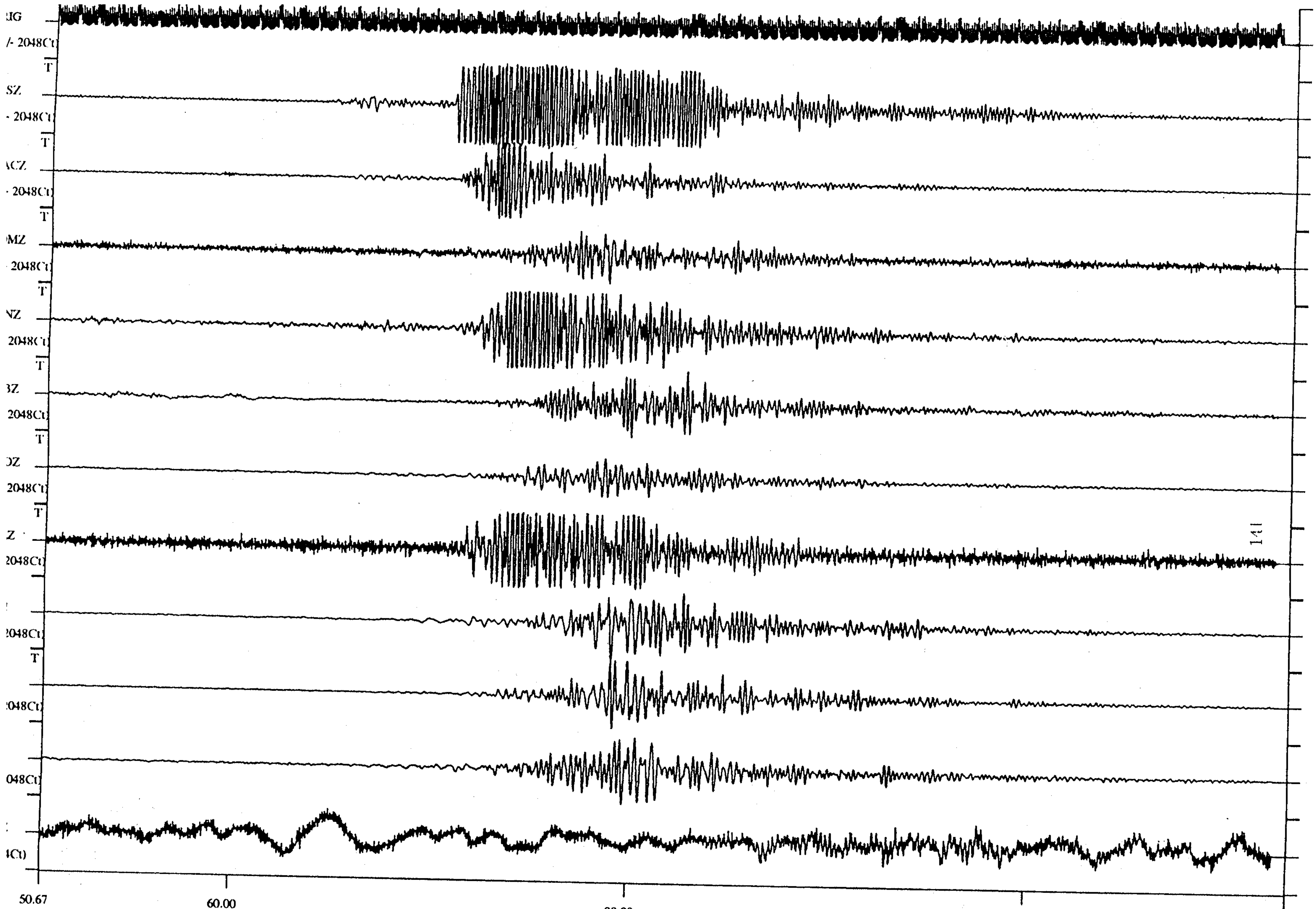
Trace start: 96, 4/14, 16:39:8.49. Input file: 9604141v.wvm.filter.ah



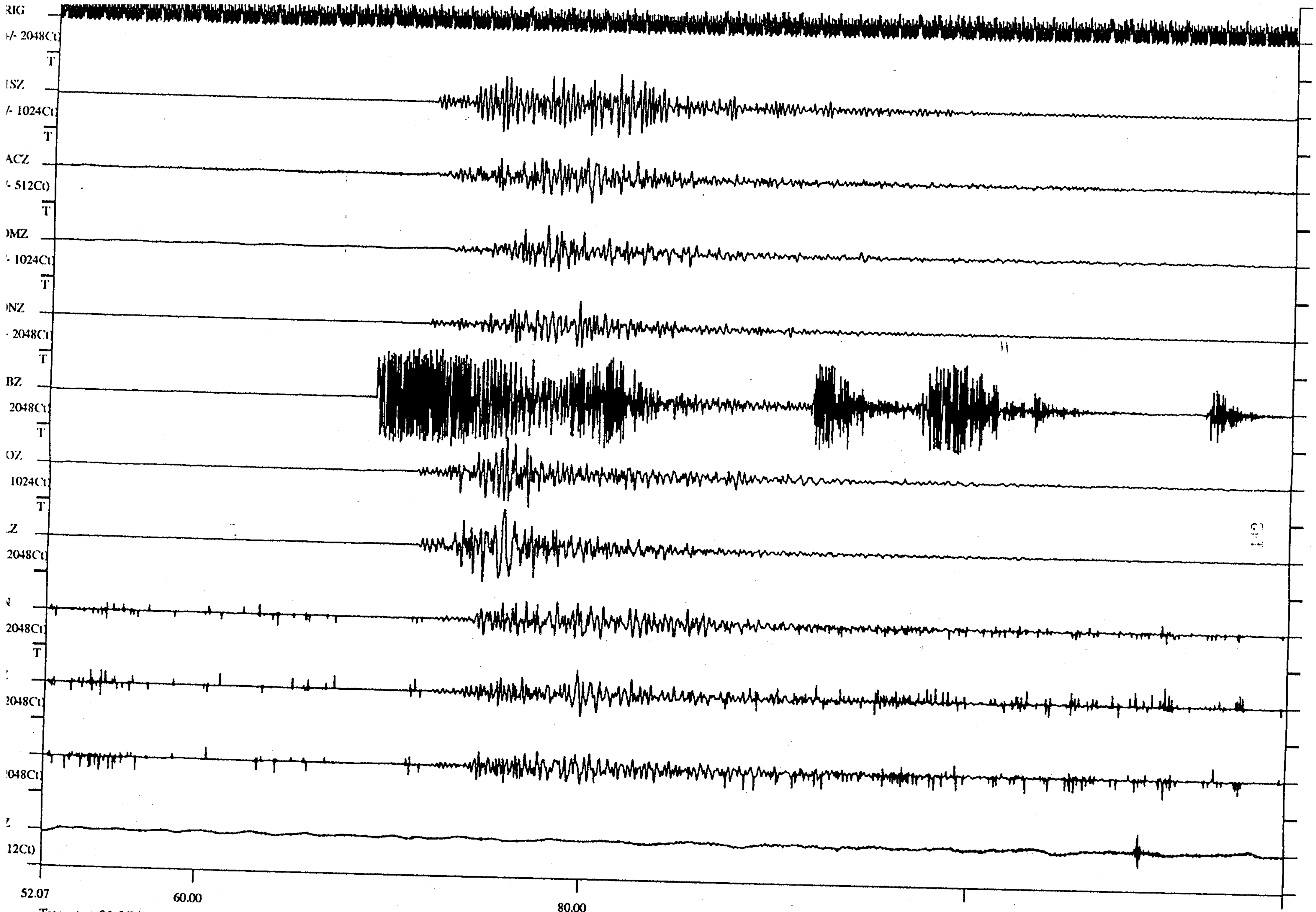
Trace start: 96, 4/14, 17:36:32.78. Input file: 9604142f.wvm.filter.ah



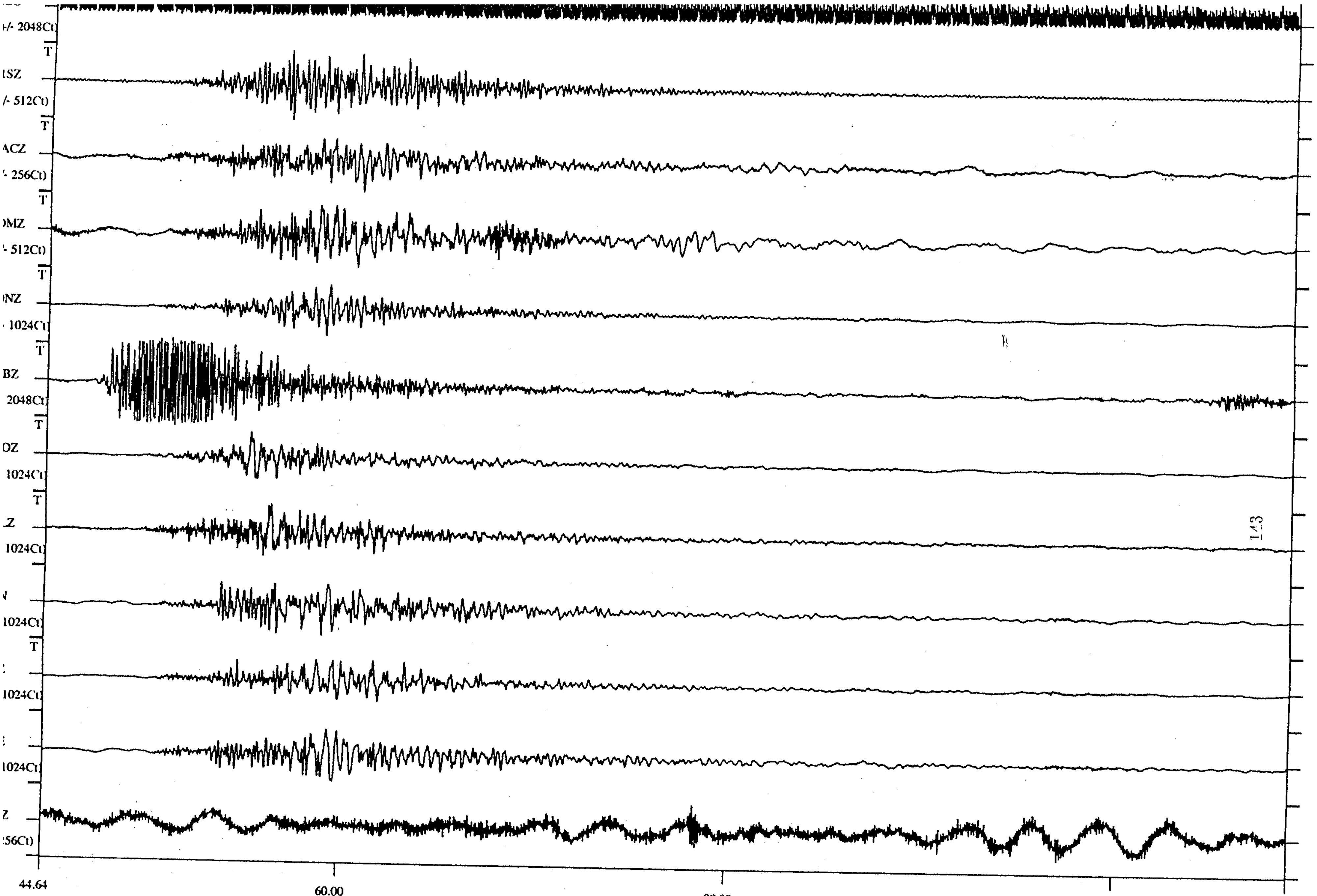
Trace start: 96, 4/14, 18:12:7.78. Input file: 9604142t.wvm.filter.ah



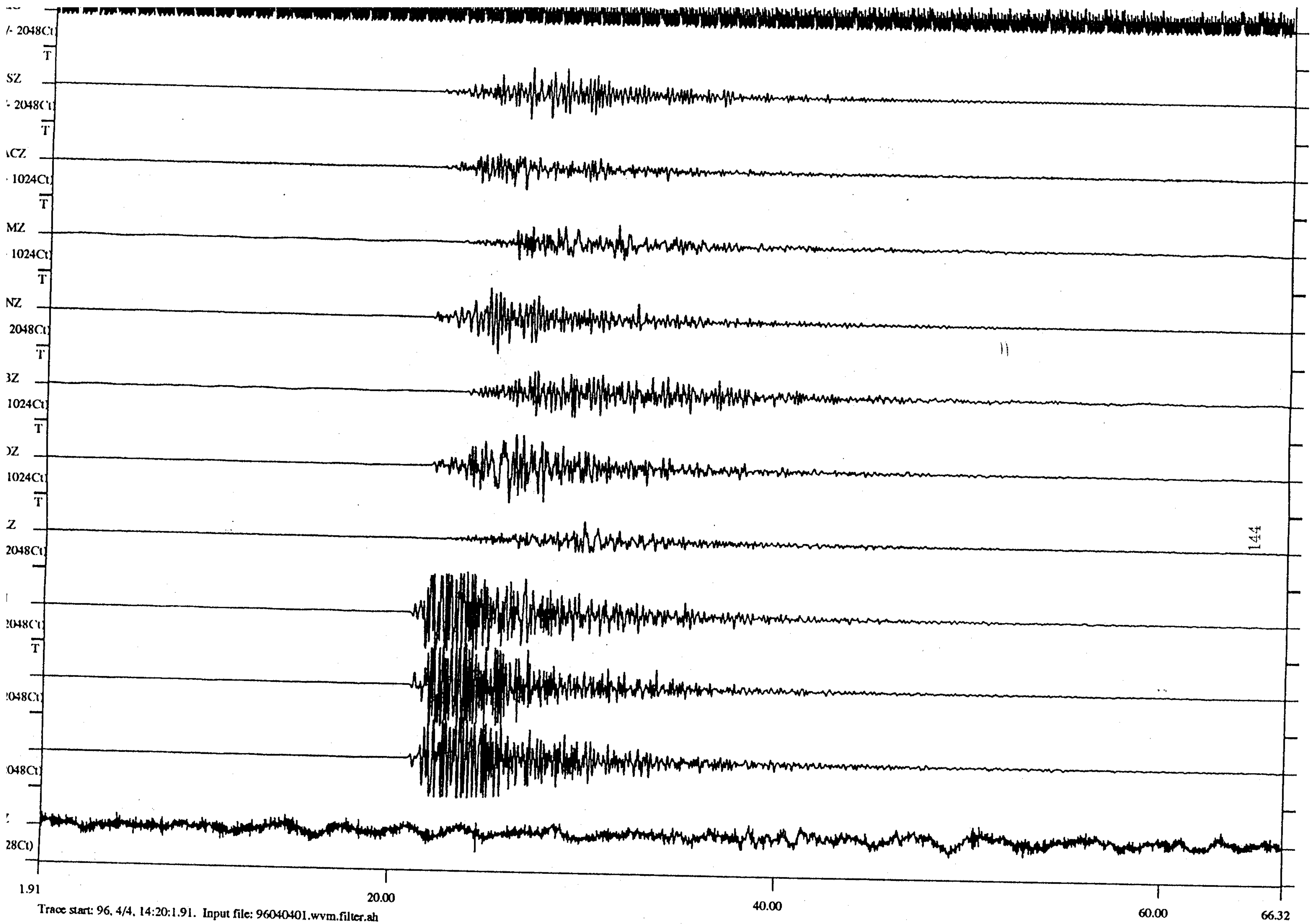
Trace start: 96, 4/14, 18:13:50.67. Input file: 9604142u.wvm.filter.ah



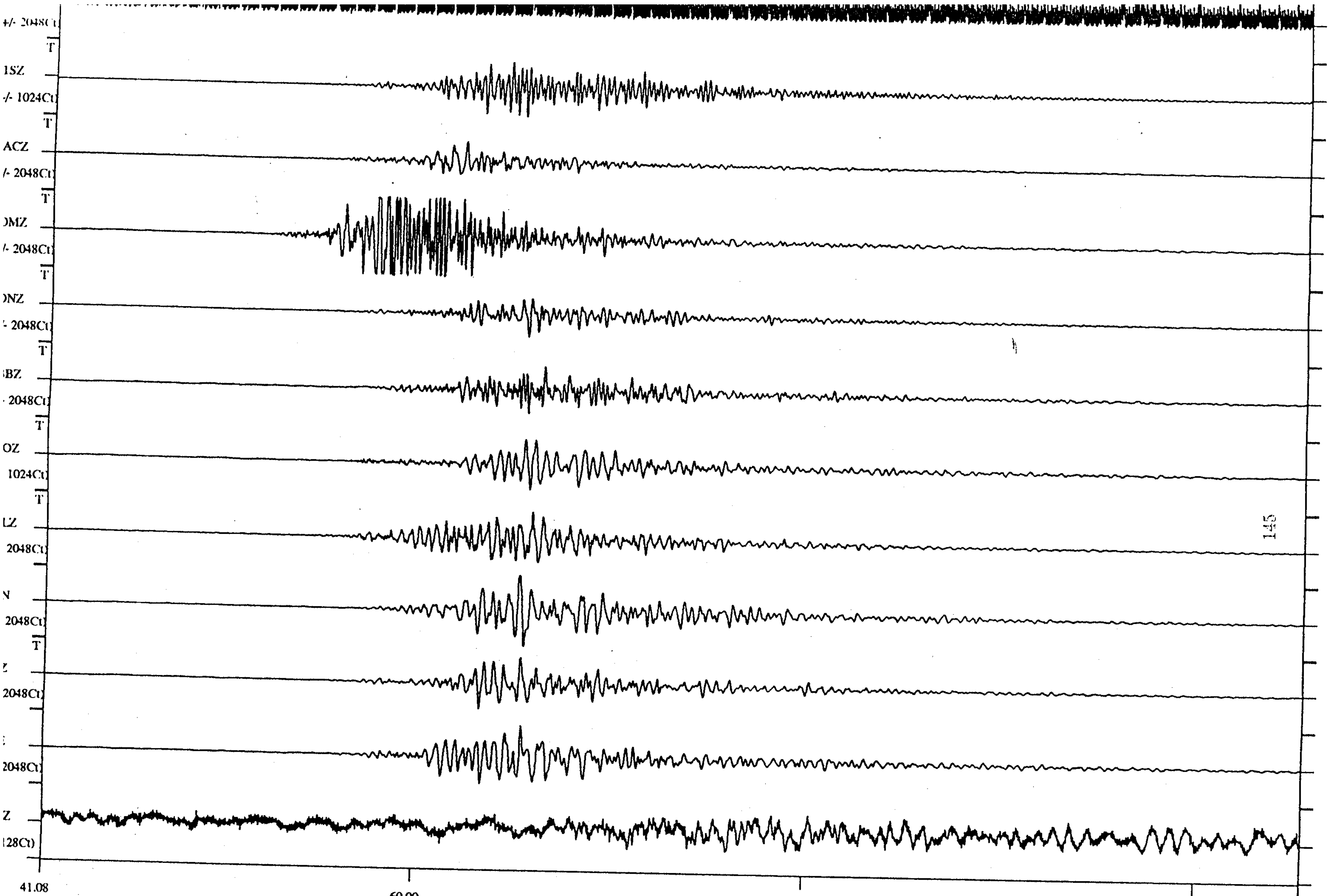
Trace start: 96, 3/26, 4:9:52.07. Input file: 96032601.wvm.filter.ah



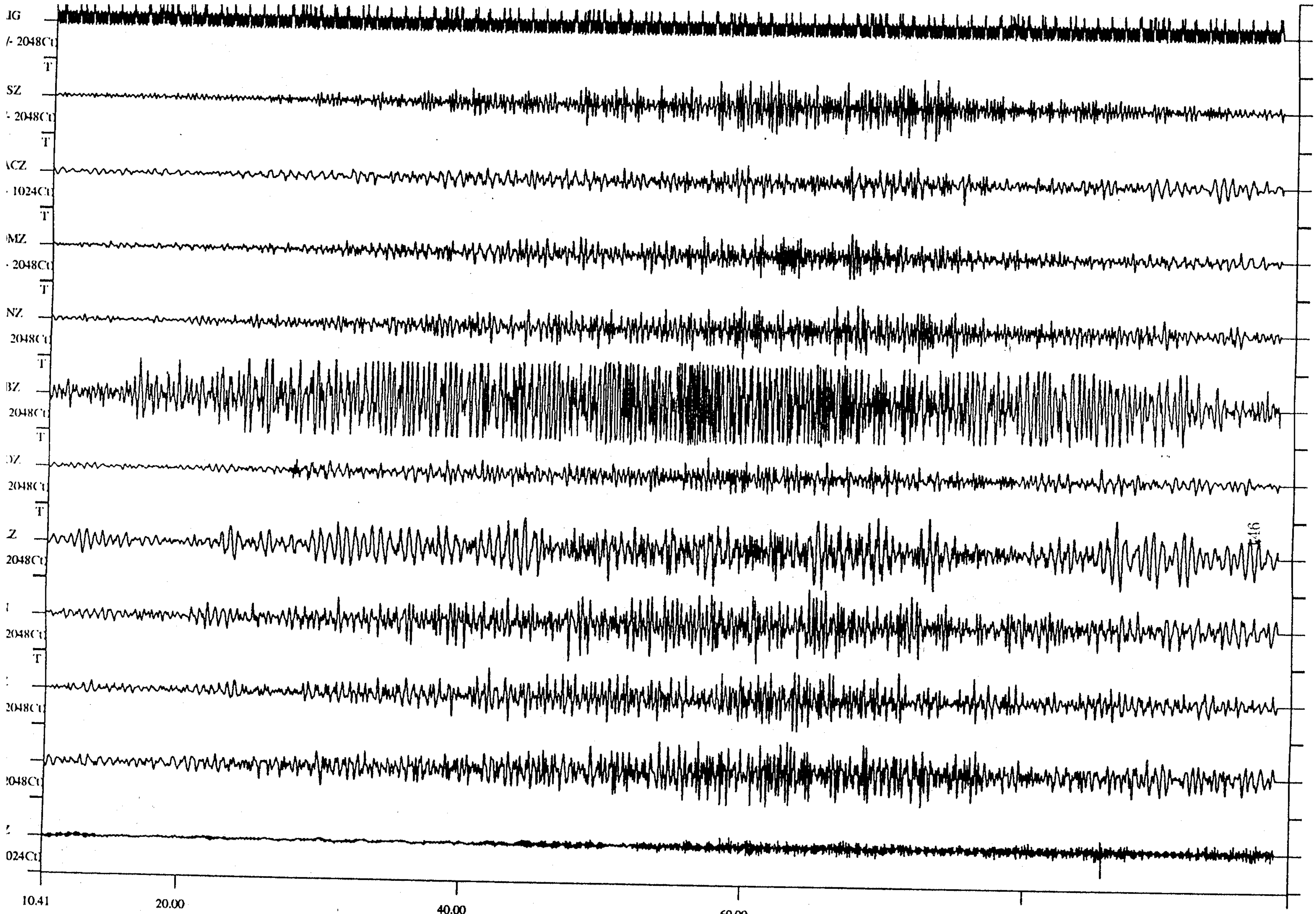

Trace start: 96. 3/20. 8:37:44.64. Input file: 96032005.wvm.filter.ah




Trace start: 96. 4/4. 14:20:1.91. Input file: 96040401.wvm.filter.ah



Trace start: 96. 3/23. 3:33:41.08. Input file: 96032301.wvm.filter.ah




Trace start: 96, 3/22, 13:37:10.41. Input file: 96032203.wvm.filter.ah

# Appendix IV

The following pages contain location data, by event type:
148: VT events
149-152: LP events
153-154: E-type events

And these pages contain error ellipse data, by event type:
155-156: VT event error ellipses
157-163: LP event error ellipses
164-167: E-type event error ellipses

```
941129 433   9.76 77S3309 167E 473   3.01  2.2
941129 434  12.27 77S3336 167E 411   3.09  0.0
941205 450  12.01 77S2950 167E1091   0.15  2.1
941205 0 3   9.55 77S3290 167E 483   2.81  1.9
94120822 6  54.61 77S3031 167E 963  -0.77  1.8
9412102144  12.68 77S3041 167E1640  -2.38  1.8
94121121 6   5.61 77S3182 166E5884   1.05  0.0
941215 727  57.13 77S3167 166E5811   3.01  0.0
941228 9 1  25.30 77S3334 167E 606   2.39  1.7
950104 724   8.66 77S3172 167E1079  -2.84  1.7
950106 942  22.50 77S3333 167E 933   0.18  0.0
950110 424  43.30 77S2942 167E1642  -0.57  1.6
9501171859  15.00 77S3223 167E  43   0.72  0.0
9501181430  55.71 77S3001 166E3759  18.41  0.0
9501181958  34.99 77S3097 167E 646   0.09  0.0
9501202112  44.25 77S3372 167E1528   0.82  0.0
9501201127  33.64 77S3273 167E 762  -3.68  0.0
950202 720  17.44 77S2963 167E 476   0.90  1.8
950203 422   8.09 77S3035 167E2107  -1.42  0.0
950206 535  25.66 77S2895 167E 352   1.63  1.8
50222 244    8.14 77S3306 167E1394   0.70  0.0
503032042   19.72 77S2957 167E1898  -1.84  1.6
51004 247   50.54 77S3334 167E 161   0.55  0.0
510052111   53.01 77S2978 167E 243   1.14  0.0
510141748   15.95 77S2976 166E5979  -1.70  0.0
510241432   57.89 77S3016 166E5484   4.16  1.9
510251451   22.98 77S2955 167E 455  -3.63  0.0
51026 718   20.00 77S3203 167E 172  -0.03  0.0
511281340   45.26 77S3250 167E1858  -2.46  0.0
51105 151   53.03 77S3172 166E5841   1.47  1.8
511142328    7.19 77S3341 167E 111   3.11  1.8
511162341   12.02 77S3002 167E  65   2.94  0.0
511161014   24.97 77S3118 166E5953   0.62  0.0
511172254   38.88 77S3082 166E5554   2.23  0.0
511181153   47.32 77S3262 167E 417  -2.53  0.0
51119 655   34.41 77S3234 167E 181   3.94  0.0
51129 8 5   17.26 77S2949 167E 336   0.39  1.7
512042342    8.03 77S3313 167E 483   3.05  1.8
5120513 2   34.52 77S3192 167E1152  -3.71  1.7
51210 723   23.85 77S3080 167E1359  -0.14  2.0
5122518 1   29.21 77S5740 168E5103  -3.71  0.0
51226 834   57.31 77S3216 167E1349  -2.28  2.0
51230 036    7.11 77S2895 167E   8   2.98  0.0
512312320   51.23 77S3164 167E 708  -2.26  1.6
6010417 8    5.97 77S3202 167E 109   3.31  2.0
60106 518   26.47 77S3218 167E1337  -2.43  1.9
60106 618   22.17 77S2970 166E5958   1.47  1.9
601142249   54.27 77S3124 166E5928   2.71  2.0
601171152   23.55 77S3247 166E5932   2.62  1.9
6011721 1   47.50 77S3075 167E 538  -0.65  1.9
601181120   15.33 77S3658 166E1650  24.39  0.0
601191611   45.17 77S3228 166E5924   3.02  2.0
6020615 8    4.35 77S3152 167E 980  -3.02  2.0
602061635   55.31 77S3185 167E1902  -1.77  2.1
60209 115    9.58 77S3533 167E 530  -0.71  0.0
60209 116    9.26 77S3502 167E 351  -0.10  0.0
602101721   49.66 77S3077 167E1005  -1.27  1.7
6021123 3   53.11 77S3160 166E5912  -2.91  1.9
6021123 8   22.16 77S3333 167E 457  -2.56  2.1
6021318 1   36.07 77S3221 167E1033   0.88  0.0
60214 017    8.81 77S3225 166E5254   2.04  0.0
602141257   41.55 77S3480 167E1787   2.03  2.0
```

```
9602201611 37.95 77S3262 167E 680   1.80  2.0
9602251230  0.77 77S3141 167E 256  -1.65  1.8
9603051047 29.31 77S3185 167E1064  -2.28  1.7
96030517 1  1.65 77S2392 166E1886   3.49  2.1
9603052035 54.65 77S3256 167E  26   2.94  1.9
9603081857  1.31 77S3091 167E5146   4.90  2.1
960321 011 28.28 77S3077 167E2456  -1.01  2.0
960328 3 9 58.72 77S3537 167E2367   0.09  2.1
960328 4 8 23.96 77S3307 167E1219  -1.48  1.9
960328 646 38.10 77S3437 167E1270   1.93  2.0
960421 613 47.73 77S2878 166E5147   1.52  2.1
9604232319 32.60 77S3153 166E5622   4.44  1.7
9604241550 21.68 77S3284 167E 864  -1.19  1.5
960505 3 0  8.81 77S3074 166E5982  -0.02  1.8
960505 627 37.63 77S3186 167E 329  -1.93  1.7
9605131129 11.05 77S3337 167E 651  -2.22  2.0
960514 633  7.37 77S3231 167E1244  -2.36  1.8
960514 649 35.36 77S3298 167E1149   1.89  0.0
96051421 8 22.88 77S3193 167E1973  -1.48  0.0
960515 812 12.84 77S3187 167E1375  -2.39  1.8
960515 921 20.12 77S3252 167E1194  -2.41  1.8
9605241921  4.19 77S3266 167E1109   0.41  0.0
9605261021 11.80 77S3297 167E1357  -3.71  0.0
9605312311 50.36 77S3157 167E 850  -1.60  0.0
960603 320  0.65 77S3397 167E1006  -1.22  0.0
960718 541 13.59 77S3073 167E1610  -0.79  1.4
```

```
941112 244 58.43 77S4136 167E 588 -1.90  0.0
941112 257 38.18 77S4121 166E5175 -3.71  0.0
941113 141 57.33 77S2842 167E4897 -1.24  0.0
941113 242 14.26 77S3666 167E1740 -3.69  0.0
941113 724 55.43 77S4081 166E2669 -2.23  0.0
941113 917  6.08 77S2580 168E 656 -3.31  0.0
9411131338 56.00 77S3411 167E 845  0.11  2.0
9411151220 14.51 77S3202 167E 949 -1.40  0.0
9411151942 45.28 77S3598 167E1067  0.47  2.0
94111521 7 46.88 77S3325 167E 557 -0.16  2.0
9411162240 50.61 77S3550 167E1334 -3.70  0.0
941117 121 44.19 77S3009 167E1560 -1.86  1.9
94111817 3 52.59 77S2929 168E 832 -3.63  0.0
941121 0 0 48.70 77S3553 167E1458 -3.02  0.0
9411221925  1.23 77S3507 167E1161 -0.79  0.0
941123 027 31.44 77S3481 167E1811 -3.70  0.0
941128 217 47.71 77S3518 167E1777 -3.71  1.7
9411281339 59.11 77S3383 167E 442 -0.70  0.0
9411281423 18.23 77S3491 167E1084  0.60  0.0
941129 228 37.78 77S3336 167E 904 -2.69  0.0
94120223 4 26.74 77S3196 167E1585 -3.28  1.8
941203 621 28.13 77S3329 167E 678 -0.51  1.9
941207 434 47.87 77S3522 167E2052 -3.71  1.9
941207 5 6 22.18 77S3441 167E 648  2.47  2.0
941207 939 25.91 77S2939 167E1401 -1.54  1.8
9412071524 16.63 77S3358 167E1804 -3.71  1.8
9412072250 25.00 77S3241 167E2185  1.22  0.0
94120822 6 54.61 77S3031 167E 963 -0.77  1.8
9412092151 14.14 77S3203 167E1397 -2.62  1.9
9412112149 56.45 77S3138 167E1040 -3.04  0.0
941212 424 10.15 77S2941 167E1221 -0.20  0.0
9412121517 39.53 77S3339 167E  57 -3.45  1.9
941213 543 10.32 77S3573 167E 627  1.85  0.0
412131810  5.77 77S3330 167E1517 -3.71  0.0
41215 1 4  5.68 77S3316 167E1412 -2.38  0.0
41215 727 57.13 77S3167 166E5811  3.01  0.0
41217 249 38.73 77S3231 167E1310 -3.21  0.0
41217 929 26.26 77S2829 167E1357 -3.71  0.0
41217 930 21.57 77S2899 167E1521 -3.48  0.0
412171042  7.11 77S3321 167E 863 -0.88  0.0
412192150 55.87 77S3293 167E 781 -0.27  0.0
41220 725 10.05 77S3343 167E1471 -3.70  0.0
412211122 10.78 77S3318 167E 429 -3.37  0.0
412211926 42.39 77S3472 167E1308 -2.38  0.0
41224 617  0.07 77S3337 167E1799 -3.70  0.0
412251340 49.32 77S3447 167E2391 -0.36  0.0
4122523 6 37.18 77S3168 167E 987 -2.58  0.0
412252357 18.09 77S3405 166E5972 -1.44  0.0
41226 110 31.92 77S3202 167E1210 -2.10  0.0
41226 246  8.90 77S3320 167E 623 -1.44  0.0
41226 354  8.35 77S3215 167E1970 -3.71  0.0
412271539 43.62 77S3263 167E 407 -3.17  0.0
412271930 28.15 77S3500 167E 972 -3.69  0.0
412271946 12.21 77S2215 166E1494  7.68  0.0
41228 351 39.22 77S2938 167E1804 -1.66  0.0
41228 532 28.13 77S3323 167E1242 -1.34  0.0
41229 338 39.83 77S3135 167E1101 -3.70  0.0
412291454 52.45 77S3096 167E 999 -1.35  0.0
4122916 2 49.69 77S3209 167E1068 -2.18  0.0
501031737 29.16 77S3386 166E5906 -1.72  0.0
501041712 36.46 77S3272 167E1188 -2.30  1.9
50106 715 15.38 77S3341 167E 128 -3.71  1.9
501071341 19.99 77S3291 167E1328 -1.96  1.8
```

```
950113 038 42.23 77S3727 167E 761 -3.71  0.0
950113 544  8.98 79S1036 165E2735 -3.71  0.0
950113 812 24.32 77S3209 167E1374 -2.42  0.0
9501131447 18.13 77S2550 167E1155 -3.70  0.0
950116 441 26.76 77S3154 167E1021 -3.71  0.0
950118 143 24.63 77S2562 167E1111 -3.69  1.9
950118 621 43.63 77S3307 167E1728 -3.71  0.0
9501181230 12.17 77S3221 167E1298 -3.64  0.0
9501181354 44.18 77S3366 167E1279 -1.96  0.0
9501182310 42.73 77S3357 167E 316 -3.69  0.0
950123 856 16.72 77S3200 167E1518 -3.36  0.0
950127 552  6.42 77S3361 167E1734 -3.70  0.0
9501281556 38.83 77S3178 167E1710 -3.36  1.6
9504042334 30.21 77S3482 166E5404 -2.59  0.0
950424 416 49.95 77S3784 166E4671 -1.81  0.0
951006 3 1 53.57 77S3308 167E 593 -3.70  0.0
951011 518 38.45 77S3343 167E1520 -3.70  0.0
951012 611  2.08 77S2862 167E1345 -3.68  0.0
9510132358 48.04 77S3324 167E 802 -3.58  0.0
951016 719 59.03 77S3323 167E1537 -3.66  0.0
951017 250 36.28 77S3334 167E 653 -0.89  0.0
951017 734  0.80 77S3416 167E 850  1.19  0.0
951019 456 47.54 77S3825 166E 648  6.68  0.0
951023 453 29.07 77S3609 167E2211 -0.32  0.0
9510251333 43.54 77S3370 167E2709  7.74  0.0
951027 241 35.34 77S3256 167E1662 -3.54  0.0
95102713 5 59.98 77S3106 167E1230 -3.42  0.0
95103021 7  4.32 77S3361 167E1450 -3.70  0.0
951031 0 6  0.07 77S3973 166E5287 -3.71  0.0
9510311312 52.59 77S3165 167E1661 -1.17  0.0
9510311830 51.66 77S3364 167E1155 -2.17  0.0
951101 859 47.53 77S2858 167E1316 -3.70  0.0
9511042043 22.41 77S3391 167E  62 -1.57  0.0
951106 932 12.20 77S3528 167E2173 -1.51  0.0
9511081240 23.62 77S3239 167E1051 -2.25  0.0
9511141656 15.59 77S3222 167E 806 -1.50  0.0
951115 857 54.05 77S4163 167E3209 -3.54  0.0
9511151212 11.29 77S3253 167E 442 -3.30  0.0
9511171013 11.90 77S2887 167E  68  0.04  0.0
9511171655 49.28 77S3315 167E1584 -3.01  1.9
9511171853 58.91 77S3231 167E2305 -1.28  0.0
951118 834 12.03 77S3237 167E1398 -3.70  0.0
9511182215 24.20 77S3199 167E2091  0.09  0.0
951119 858  7.53 77S3558 167E 252 -2.49  0.0
951119 922 36.87 77S3158 167E1079 -3.71  0.0
951126 250  3.03 77S3372 167E1302 -0.34  2.0
951129 411 22.67 77S3605 166E3972 -3.71  0.0
951202 140 34.17 77S3241 167E1430 -3.71  1.6
95120221 9 38.97 77S3966 167E2563 -3.71  0.0
9512031049 37.07 77S3509 166E5691 -0.51  0.0
95120313 2 33.76 77S3804 166E4783 -1.07  0.0
951204 1 3 27.69 77S3791 167E2470 -0.33  2.0
951204 9 1 20.32 77S3153 167E1014 -2.27  2.1
9512061118 15.70 77S3307 167E 263 -3.70  1.9
9512061255 17.00 77S3308 167E1327 -3.26  1.9
951207 216 58.42 77S3295 167E1799 -3.71  1.8
951208 937  9.71 77S3499 166E5949 -3.71  1.9
9512081428 15.39 77S3254 167E1334 -3.40  1.9
9512081610 22.03 77S3147 167E1142 -3.69  2.0
951210 851 15.19 77S3161 167E1044 -2.29  2.1
951212 335  0.19 77S3216 167E 344 -2.45  2.1
951213 236  1.91 77S3400 167E 483  0.19  0.0
9512131740 24.07 77S3243 167E1180 -2.41  0.0
```

```
5121511 8   5.43 77S3372 167E1461 -1.61  2.0
5121511 9  58.49 77S3249 167E1114 -2.65  2.1
512151620 57.60 77S3234 167E1301 -3.71  2.0
512151845 13.15 77S2296 166E1492 10.25  2.3
51216 332   6.38 77S3363 167E 190 -3.71  0.0
512171826 27.37 77S3136 167E1075 -3.07  2.1
512181649   7.50 77S3131 167E1211 -3.71  2.1
512191821 57.78 77S3473 167E 598  1.60  2.1
512191839 13.90 77S2627 167E5792 -3.21  0.0
51220 038 51.96 77S3203 167E3486 -3.71  2.2
51220 753 28.13 77S3327 167E3325 -3.71  2.1
512202039 50.80 77S3144 167E1008 -2.54  2.1
51224 926 42.65 77S3318 167E1304 -2.04  2.2
512241633 48.51 77S3238 167E1042 -3.71  2.1
512242244 26.61 77S3582 167E 649  0.43  2.2
51225 753   4.66 77S3309 167E1331 -1.27  2.2
51226 435 35.31 77S2592 167E 964 -2.97  2.2
5122716 3 47.73 77S3439 167E1462 -3.70  0.0
512281848 11.25 77S3279 167E1506 -2.98  0.0
51229 713 36.50 77S3300 167E 992 -1.80  0.0
51231 159 20.33 77S3200 167E2743 -2.65  0.0
51231 617   3.77 77S2597 166E4676 -0.89  0.0
60101 554 47.40 77S3298 167E1487 -2.03  2.0
60101 811 19.77 77S3192 167E1044 -3.70  2.0
60102 613 53.50 77S3252 167E1541 -3.50  2.0
60102 646 20.60 77S3127 167E1026 -3.70  2.1
60102 858 20.58 77S3313 167E1320 -1.24  0.0
60103 156   0.53 77S3304 167E1369 -2.02  2.1
60103 258 57.52 77S3272 167E1604 -3.67  1.8
60103 752 16.44 77S3163 167E1008 -3.70  2.0
01032244   8.69 77S3265 167E1217 -2.35  2.1
01051811 36.73 77S3302 167E 264 -1.02  2.0
0106 330 24.77 77S3307 167E1441 -3.71  1.8
0106 7 9 43.60 77S3164 167E1089 -3.70  2.0
01071243   9.16 77S3286 167E1580 -1.85  2.0
0108 041 41.47 77S3324 167E1246 -1.90  0.0
0108 956 46.24 77S3306 167E1421 -1.66  2.0
01101413   3.39 77S2479 167E1171 -1.79  2.0
0111 5 0 44.53 77S3176 167E 972 -3.71  2.0
0111 521 42.37 77S3176 167E 917 -3.05  2.1
01121334 16.06 77S3543 167E1274 -3.71  2.0
011214 7 28.22 77S3299 167E 968 -2.43  2.0
01122125   5.65 77S2551 166E4089 -0.88  2.2
011312 7 25.75 77S3336 167E 888 -3.71  2.0
01131656 12.06 77S3220 167E2642  1.11  2.2
0114 628   2.73 77S3119 167E1152 -3.71  2.0
0114 8 0   8.44 77S3291 167E1124 -2.35  2.1
01141517 18.67 77S3399 167E 989  0.11  2.1
0115 0 1 55.72 77S3179 167E1005 -3.45  2.0
0115 928 44.28 77S3430 166E5808 -1.73  0.0
01151114 31.51 77S3945 167E2454 -3.71  2.0
01151413 10.16 77S3218 167E1498 -3.35  2.0
01151415   5.72 77S3218 167E1497 -3.15  1.9
01151617 44.16 77S3631 166E4540 -3.69  2.2
0117 2 3 58.86 77S3418 167E1354 -2.35  2.1
0117 950 48.73 77S3172 167E1191 -3.71  2.1
01172111 25.12 77S3481 167E 466  1.19  2.1
0119 123   3.54 77S3387 167E1614 -3.69  2.1
01191249 47.88 77S3299 167E1239 -0.23  2.1
0120 413 39.80 77S3266 167E1327 -2.62  2.2
0121 528   9.84 77S3343 167E1357 -3.71  2.1
1211959 13.21 77S3498 167E1757 -2.86  1.9
```

```
9601241939 26.90 77S3067 167E2828 -2.09  2.2
9601281721 48.01 77S3138 167E1036 -3.70  2.1
96012821 0 19.12 77S3125 167E 968 -2.51  0.0
9602011638 41.31 77S3218 167E1430 -1.59  2.1
960202 016 59.25 77S3206 167E1371 -2.54  2.1
9602022336 15.90 77S3241 167E1059 -3.71  0.0
9602032028 55.21 77S3370 167E2602 -2.15  0.0
960204 658 39.75 77S3199 167E 756 -1.43  2.0
9602041022 14.60 77S3282 167E 971 -3.71  2.0
9602041456 55.01 77S2527 167E 830 -3.71  2.1
9602051217 44.57 77S3222 167E1177 -3.70  2.0
960208 442 28.71 77S3334 167E1457 -0.56  2.1
960208 9 5 58.25 77S3261 167E 699  2.54  2.1
9602081325   6.11 77S3180 167E1945 -1.80  2.0
960210 524 16.57 77S3149 167E2465 -2.58  2.2
9602101855   2.05 77S3488 167E1121 -2.62  0.0
9602111846 55.10 77S3253 167E1470 -3.40  2.0
960212 0 2 23.34 77S3187 166E5597 -2.12  0.0
960212 141 41.08 77S3349 167E1151 -1.54  2.1
960212 5 2   5.06 77S3345 167E1312 -1.43  0.0
9602121521   7.52 77S3227 167E1932  2.02  1.9
9602122210 22.18 77S3146 166E5879 -3.68  0.0
9602122227 10.37 77S3182 167E 324 -2.55  0.0
96021223 6 54.75 77S3165 166E4984 -1.76  0.0
9602122341 54.17 77S3179 167E 305 -3.57  0.0
960213 129 26.08 77S3231 167E 209 -3.34  0.0
960213 133   0.66 77S3250 167E 303 -3.47  0.0
960213 213 38.64 77S3228 167E 143 -3.69  0.0
960213 723 52.35 77S3115 166E5148 -2.18  0.0
9602131644 54.44 77S3218 167E1745 -3.39  0.0
960214 113   7.58 77S3143 167E 180 -3.70  1.9
960214 736 32.55 77S3228 167E1405 -3.71  2.0
960215 218   1.13 77S3148 167E 179 -3.56  2.0
9602151954 18.45 77S3355 167E2489 -2.52  0.0
9602162248 40.17 77S3177 167E 303 -3.56  1.9
9602171450   3.85 77S3238 167E2091 -1.36  2.1
9602171530 29.47 77S3240 167E1308 -3.70  1.9
9602171940 20.96 77S3341 167E 417 -0.40  2.1
9602172236   1.58 77S3200 167E 475 -3.70  0.0
9602172253 54.35 77S3166 167E 812 -2.33  1.9
960218 6 5 28.02 77S3330 167E 947 -2.53  0.0
96021813 4 46.37 77S3241 167E 194 -3.69  0.0
9602182013 21.55 77S3209 167E1484 -1.66  0.0
9602182113   9.60 77S3213 167E 503 -3.54  2.1
9602182314 16.53 77S3146 166E5759 -2.94  0.0
9602182334 15.65 77S3178 167E 446 -3.59  0.0
960219 025 49.43 77S3149 166E5858 -3.00  2.0
960219 1 3 40.00 77S3211 167E 112 -3.59  0.0
960219 138 12.88 77S3160 167E2627 -0.66  0.0
960219 416 28.26 77S3268 167E 628 -1.64  0.0
9602191740 45.32 77S3208 167E 629 -2.96  2.2
9602201221 55.90 77S3072 167E1935 -3.59  0.0
96022013 8 52.42 77S3106 167E2243 -3.24  0.0
96022016 3 22.33 77S3182 167E  50 -3.05  0.0
9602201732 54.72 77S3161 167E 224 -3.32  0.0
9602201746 17.90 77S3221 167E1467 -2.44  0.0
9602202041 13.90 77S3238 166E5718 -2.70  0.0
9602202112 23.17 77S3570 167E2036  2.10  0.0
9602202113 45.72 77S3252 167E 455 -3.51  0.0
9602202359 32.59 77S3231 167E  79 -3.59  2.0
960221 048 13.73 77S3175 167E  62 -1.30  0.0
960221 113 42.00 77S3216 167E 331 -3.49  0.0
```

```
960221 320 47.89 77S3205 167E 491 -3.44  1.9
960221 4 5 10.87 77S3128 166E5348 -2.90  1.6
960221 5 2 14.31 77S3216 167E 368 -3.33  0.0
960221 531 54.87 77S3116 167E  41 -3.68  1.9
960221 554 15.15 77S3293 167E1318 -3.13  2.1
960221 6 3 56.17 77S3178 167E 203 -3.33  1.8
960221 648  5.49 77S3213 167E 494 -3.45  1.9
960221 729 25.89 77S3196 167E 180 -3.69  1.8
96022121 8 28.37 77S3286 167E1366 -2.82  1.9
9602212130 33.99 77S3095 166E5462 -2.42  2.1
9602212140 54.41 77S3093 166E5058 -3.21  1.8
9602212311 47.91 77S3200 167E 123 -3.46  1.9
960222 633 23.79 77S3391 166E5417 -2.00  2.1
960222 747 26.27 77S3288 166E5805 -3.71  0.0
960222 850  1.24 77S3215 166E5501 -3.50  1.9
9602221338 33.02 77S3322 167E 459 -1.65  2.0
9602222120 15.21 77S3211 167E 482 -3.49  1.9
960223 035 16.53 77S3275 167E 664 -3.59  2.0
960225 1 4 19.01 77S3338 167E1336 -0.56  2.1
9602251755 45.61 77S3111 166E5615 -1.70  2.0
9602252027 11.62 77S3104 166E5405 -2.42  1.8
9602252158 59.25 77S3239 166E5982 -3.08  1.7
96022522 8 32.01 77S3154 166E5803 -3.71  1.9
9602252218  4.07 77S3221 167E 187 -2.26  1.7
960226 240 50.31 77S3162 166E5885 -3.10  1.8
9602271242 50.46 77S2913 167E1890 -3.69  1.9
602272049 36.22 77S3311 166E5692 -3.70  1.8
602272121 35.14 77S3218 166E5976 -1.75  1.8
602272159 32.52 77S3110 166E5829 -3.38  1.8
602272219 44.20 77S3138 167E  98 -3.70  0.0
602272245 42.78 77S3099 167E   3 -2.39  1.7
602272247  3.84 77S3216 166E5797 -3.21  1.9
60228 044 33.24 77S3199 167E 484 -3.54  2.1
60228 1 2 53.98 77S3202 166E5658  2.77  1.9
60228 116  2.02 77S3208 166E5875 -2.18  2.1
60228 122  8.86 77S3222 167E 316 -3.53  0.0
960228 217 36.93 77S3228 167E 260 -3.47  1.7
960228 235 24.71 77S3225 167E 614 -2.71  0.0
60228 3 9  8.22 77S3209 167E 464 -3.49  2.0
60228 524 24.84 77S3193 167E 373 -3.56  1.8
60228 749 43.11 77S3375 166E5841 -3.44  1.9
602281118 37.04 77S3136 166E5762 -3.36  1.7
602281253 19.13 77S3216 166E5496 -3.25  1.7
602281316 35.23 77S3280 166E5714 -3.37  1.8
602281512 27.72 77S3209 167E 514 -3.49  1.8
602281831 49.05 77S3200 167E 327 -3.71  1.6
602281930 58.82 77S3388 167E1028 -3.66  1.9
60229 328 32.13 77S3127 166E5978 -2.80  1.8
603042136 49.39 77S3225 167E1356 -2.09  2.0
603062316  5.62 77S3439 167E 985 -0.77  2.1
60308 122 12.58 77S3477 167E  64 -2.78  2.1
6030923 9 45.92 77S2499 166E4411  1.81  0.0
603101421 10.53 77S3343 167E1417 -3.71  0.0
603121138 27.94 77S3155 166E5904 -2.86  1.6
603121236 37.85 77S3181 167E  34 -3.36  1.9
60313 2 8 14.16 77S3183 166E5813 -3.09  1.9
60320 536 52.61 77S3197 167E2970  1.28  0.0
60320 915 32.65 77S3416 167E2414  1.17  2.2
6032014 5 24.10 77S3458 167E1238 -2.33  1.9
60321 714 34.42 77S3115 166E5821 -3.58  2.0
60322 023 58.06 77S3373 167E1500 -3.70  2.1
60322 929  1.90 77S3203 167E 262 -3.53  1.9
603221658 29.15 77S3268 167E1179 -1.79  2.1
```

```
960323 418 55.99 77S3214 167E 433 -3.49  1.9
96032314 6 35.91 77S3329 166E5864 -1.44  2.1
9603232144  7.37 77S3550 167E2098  0.04  0.0
9603241216  5.86 77S3578 167E1152  0.82  0.0
96032510 5 17.04 77S3198 167E 913 -2.17  2.1
9603251030 38.58 77S3156 167E1036 -2.13  2.0
96032516 6 30.97 77S3225 167E 705 -0.60  2.1
9603251642 19.10 77S3153 167E1028 -2.35  2.0
960326 538 19.32 77S3487 167E1136 -3.69  0.0
96032614 0  1.47 77S3161 167E  44 -2.90  1.8
9603261824 58.77 77S3243 167E2119 -1.59  2.0
96032622 7 53.01 77S3263 166E5565 -2.05  0.0
960328 4 4 55.82 77S3205 167E 492 -3.50  2.0
96032810 8  8.97 77S3209 167E 473 -3.43  2.0
9603281552 19.10 77S3166 167E1031 -3.70  2.0
96032819 2 27.40 77S3211 167E 366 -3.39  0.0
9603282330 43.86 77S3216 167E 488 -3.58  1.7
9605121639 43.18 77S3254 167E 966 -2.09  2.0
9605152147 53.93 77S3289 167E1375 -0.42  0.0
960516 326 53.69 77S3681 166E5765  0.14  0.0
960516 625 29.37 77S3327 167E1292 -2.98  0.0
9605182037 22.19 77S3256 167E2274 -2.05  0.0
9605202344 26.92 77S3316 166E4778  0.58  0.0
960525 436 16.17 77S3209 167E 870 -3.67  0.0
960525 816 23.02 77S3298 167E1136 -2.50  0.0
960529 312 36.62 77S3161 167E 887 -3.69  0.0
960530 654  3.26 77S3221 167E1236 -2.67  0.0
960530 930 43.77 77S3171 167E 677 -2.77  0.0
960531 015 58.39 77S3309 167E1376 -1.27  0.0
960531 022 10.11 77S3308 167E 938 -0.20  0.0
960531 450 58.32 77S3340 167E1398 -0.06  0.0
960531 915 26.14 77S3316 167E1052 -1.58  0.0
9605311424 39.31 77S3450 167E1175 -2.49  0.0
9605311513 30.05 77S3277 167E1512 -2.18  0.0
960602 143 29.09 77S3486 167E1537 -2.55  0.0
9606031523 38.27 77S3466 167E1582 -3.69  0.0
96060520 4  6.95 77S3284 167E1143 -2.02  0.0
96060922 4  3.83 77S3341 167E1197  0.31  0.0
960610 642 24.93 77S3227 166E5571  1.77  0.0
9606101039 16.73 77S3922 166E2688 -3.71  0.0
9606101431  7.61 77S3142 167E 243 -1.03  0.0
9606101434 16.21 77S3484 167E1733  0.24  0.0
96061017 4 52.94 77S3257 167E 476  0.21  0.0
9606101825 59.50 77S3204 166E5984 -1.48  0.0
9606101948 40.74 77S3303 167E 380 -2.39  0.0
960611 049 56.80 77S3190 166E5651 -3.71  1.9
960611 152 18.87 77S2787 166E4148  9.98  2.0
960611 2 9 47.71 77S3425 166E5059 -0.90  0.0
960611 839 38.73 77S3274 166E5505 -2.37  0.0
96061215 6 28.51 77S3023 167E 221 -0.93  0.0
960613 156 35.53 77S3409 167E2111  2.82  0.0
960713 837 18.93 77S3047 167E1387 -3.30  0.0
9607141624 49.18 77S3237 167E 864 -1.77  0.0
9607141854 58.52 77S3194 167E 988 -2.93  0.0
9607142317  3.02 77S3209 167E1409 -1.49  0.0
9607151221  5.46 77S3909 167E3337 -3.64  1.6
96071518 7  0.79 77S3218 167E3559  1.24  2.1
9607161415 32.15 77S3194 167E 400 -3.54  0.0
9607161624  7.50 77S3138 167E 995 -3.71  0.0
96071619 7 29.20 77S3193 167E 997 -2.30  0.0
9607161938 51.59 77S3215 167E 389 -3.37  0.0
960717 637 33.48 77S2779 167E 288 12.39  0.0
9607172242 17.59 77S3439 167E2090  0.59  1.9
```

```
607181011 45.37 77S3140 167E1479 -1.50  2.1
607191510 36.54 77S3637 167E2261  0.94  0.0
6071919 5  7.17 77S3027 167E1120 -3.71  1.8
607192155 30.34 77S3163 167E1706 -3.19  0.0
6071922 0 54.93 77S3261 167E 396 -2.31  0.0
60722 0 1 51.90 77S2908 166E5334  8.79  0.0
60722 218 32.83 77S3157 167E 842 -2.79  0.0
60722 545 58.26 77S3241 167E1057 -2.47  0.0
607222338 45.38 77S3125 167E1896  3.28  0.0
607231116 37.03 77S3178 166E5834 -2.91  1.9
607231440  5.96 77S3209 167E1024 -3.71  0.0
60724 4 4  6.12 77S3337 167E1341 -1.23  0.0
607241519 42.01 77S3132 167E 989 -3.65  0.0
607251450 51.77 77S3193 167E1524 -3.35  0.0
607251743 14.89 77S3215 167E 390 -2.11  0.0
60727 122 20.57 77S3017 167E 636 -0.98  0.0
60727 732 41.21 77S3536 167E 790  1.12  2.1
60727 941 35.58 77S3532 167E1282 -1.03  0.0
607272158 38.97 77S3139 167E 789 -3.70  2.1
60728 717 44.91 77S3259 167E 324 -1.59  2.0
6072817 0  2.69 77S3109 167E1033 -3.71  2.1
```

```
941207 8 0 41.88 77S3668 167E1418 -2.29  0.0
9412081511  7.41 77S3169 167E1119 -3.71  0.0
941209 921  7.90 77S3119 167E1305 -3.71  0.0
9412091844 39.40 77S3144 167E1089 -3.70  0.0
9412092236  0.22 77S3151 167E1281 -3.71  0.0
9412092353 16.13 77S3172 167E1102 -3.70  0.0
941210 8 6 12.27 77S3156 167E1044 -3.68  0.0
941210 849  6.22 77S3134 167E1059 -2.39  0.0
9412102111 51.93 77S3164 167E 963 -3.68  0.0
941211 333 48.33 77S3142 167E1046 -3.70  0.0
9412112149 56.45 77S3138 167E1040 -3.04  0.0
9412121617  7.92 77S3151 167E 970 -3.57  0.0
9412161138 41.03 77S3150 167E1020 -2.81  0.0
9412162159 24.23 77S3128 167E1132 -3.71  0.0
941217 255 15.52 77S3120 167E1108 -3.71  0.0
941217 615 34.42 77S3124 167E1070 -2.18  0.0
941217 929 26.26 77S2829 167E1357 -3.71  0.0
9412171047 30.94 77S3136 167E1055 -3.07  0.0
94121715 3  3.89 77S3149 167E 976 -3.55  0.0
9412181357 35.62 77S3129 167E1073 -3.71  1.9
941219 549 53.31 77S3153 167E 999 -3.64  0.0
941219 632 46.34 77S3159 167E 995 -2.67  0.0
941219 8 4 26.54 77S3141 167E1008 -3.70  1.9
9412191942 19.55 77S3154 167E 982 -2.42  0.0
941220 329 50.84 77S3151 167E1003 -2.79  0.0
9412201531 27.11 77S3139 167E1009 -3.33  0.0
94122111 9 55.73 77S3145 167E1030 -2.84  0.0
9412211657 33.63 77S3142 167E1172 -3.70  0.0
9412251611 24.41 77S3126 167E1025 -1.30  0.0
94122523 6 37.18 77S3168 167E 987 -2.58  0.0
941226 221 29.10 77S3141 167E1306 -3.71  0.0
412271424 58.72 77S3128 167E1002 -2.64  0.0
412291454 52.45 77S3096 167E 999 -1.35  0.0
501031912 44.88 77S3138 167E1003 -3.39  0.0
50104 644 20.54 77S3141 167E1018 -2.80  0.0
501041212 28.54 77S3142 167E1108 -3.25  0.0
501052041 41.06 77S3148 167E1022 -3.70  1.9
501061214 46.01 77S3146 167E1034 -3.71  0.0
501061754 35.02 77S3146 167E1130 -2.99  0.0
501061811  4.28 77S3120 167E1446 -3.71  1.9
501072032 51.17 77S3178 167E1014 -3.71  0.0
501142142 43.02 77S3145 167E1002 -3.70  0.0
50115 459 23.24 77S3154 167E1213 -3.71  0.0
501232358 49.71 77S3175 167E1132 -1.47  0.0
50208 054  2.98 77S3247 167E 779 -2.55  0.0
502172219 54.92 77S3117 167E1150 -3.70  0.0
50219 5 0 45.42 77S3144 167E1072 -3.70  0.0
50222 326 50.39 77S3181 167E1168 -3.71  0.0
502221347 33.00 77S3139 167E 999 -3.22  0.0
502221557  4.00 77S3186 167E1384 -3.71  0.0
50223 6 2 22.27 77S3160 167E1055 -3.70  1.9
502231040 29.79 77S3160 167E1049 -2.68  0.0
50225 058  2.20 77S3169 167E 966 -1.53  0.0
50225 457 49.85 77S3139 167E1036 -3.69  0.0
502251424 24.00 77S3176 167E1080 -3.71  0.0
50226 244 17.82 77S3128 167E1081 -2.76  1.9
50226 324 54.75 77S3147 167E 982 -2.48  1.9
50226 519 23.85 77S3130 167E1195 -3.70  1.9
50226 825 46.06 77S3151 167E1098 -3.71  0.0
50227 820  1.89 77S3153 167E1124 -2.26  1.9
50228 239 37.47 77S3126 167E1209 -3.70  0.0
50228 747 46.93 77S3134 167E1142 -3.17  0.0
50301 154 54.71 77S3148 167E 935 -3.20  0.0
```

```
950303 5 1 59.01 77S3140 167E1153 -3.15  1.9
950304 232 45.77 77S3157 167E1076 -3.28  0.0
9503041345 59.14 77S3093 167E1057 -3.71  0.0
950305 441 12.23 77S3190 167E1028 -3.71  0.0
9503061348 30.95 77S3129 167E1022 -3.70  0.0
950308 421 51.76 77S3130 167E1166 -3.53  0.0
950309 310 10.14 77S3127 167E1162 -1.90  0.0
950310 656  3.91 77S3132 167E1035 -2.99  0.0
9503102021 41.25 77S3150 167E1006 -2.52  1.5
9503131539 14.82 77S3117 167E1159 -3.70  0.0
9503141716  1.74 77S3109 167E1103 -3.68  0.0
950315 2 7 54.27 77S3150 167E 967 -3.70  0.0
950315 818 40.07 77S3152 167E 960 -2.76  0.0
950315 849  1.83 77S3213 167E1074 -3.49  1.9
950315 924 34.04 77S3196 167E1304 -3.71  0.0
950317 620  9.02 77S3087 167E1048 -3.71  0.0
9503171318 28.13 77S3214 167E1629 -3.15  0.0
9503171447 22.87 77S3119 167E1062 -3.70  0.0
9503171557  7.06 77S3181 167E 968 -3.71  0.0
950318 2 1 22.95 77S3128 167E1140 -2.57  0.0
950319 1 6 24.43 77S3124 167E1072 -3.66  0.0
9503192219 42.16 77S3166 167E1022 -3.71  0.0
9503201244 59.48 77S3166 167E 996 -3.71  0.0
950322 244 53.12 77S3145 167E 917 -3.70  0.0
95032213 3 15.41 77S3170 167E 933 -3.71  0.0
9503222331 60.00 77S3165 167E 792 -3.71  1.8
950323 230  0.91 77S3151 167E1018 -3.71  0.0
9503232329 46.52 77S3130 167E 946 -3.69  0.0
950324 817 45.48 77S3138 167E1071 -2.33  0.0
95032414 9 44.24 77S3095 167E 914 -3.69  0.0
9503242231 27.95 77S3144 167E1093 -3.28  1.9
950325 731 26.68 77S3139 167E1061 -3.70  0.0
9503251643 11.43 77S3100 167E 989 -3.71  0.0
950326 221 39.06 77S3069 167E1156 -3.32  2.0
950329 111 21.07 77S3089 167E1045 -0.55  0.0
950329 446 20.06 77S3163 167E1010 -0.39  2.0
950925 132 21.20 77S3152 167E1037 -3.69  0.0
950926 420 54.85 77S3137 167E 943 -3.71  0.0
951004 132 58.59 77S3142 167E 980 -3.71  0.0
951008 656 20.47 77S3159 167E 989 -3.70  0.0
9510172126 57.84 77S3118 167E1033 -3.71  0.0
951024 249 46.69 77S3129 167E 958 -3.69  0.0
95102920 0 29.68 77S3146 167E 968 -3.70  0.0
9510301936 47.68 77S3083 167E1115 -3.71  0.0
9510311622 35.52 77S3182 167E 972 -3.71  0.0
951101 722  2.83 77S3106 167E1110 -3.70  0.0
951114 948 41.37 77S3147 167E1036 -3.71  0.0
9511141322 12.39 77S3119 167E1061 -3.71  0.0
9511141345 30.97 77S3131 167E1036 -3.70  0.0
951115 154 29.29 77S3141 167E1051 -2.77  0.0
951115 526 16.66 77S3104 167E1102 -3.70  0.0
951118 730 40.55 77S3139 167E1014 -3.18  0.0
95120121 0 14.11 77S3110 167E1188 -3.16  0.0
951202 223  2.16 77S3150 167E1005 -3.57  0.0
951203 141 12.71 77S3147 167E 983 -3.48  0.0
9512031326 14.74 77S3148 167E1083 -3.67  2.1
9512061213 48.15 77S3128 167E1083 -2.14  2.1
9512072136 56.37 77S3133 167E1092 -3.70  2.1
951208 237 36.51 77S3142 167E1074 -3.67  1.9
951215 449 29.94 77S3163 167E 918 -1.67  2.1
9512151517 36.76 77S3152 167E1035 -2.77  2.1
951216 912 14.41 77S3172 167E1053 -3.70  2.1
[illegible]
```

```
'512191853 22.94 77S3159 167E 951 -2.68  0.0
'5122013 6  8.84 77S3115 167E1014 -3.70  2.1
5122117 3 59.43 77S3137 167E 849 -3.71  2.2
51222 252 26.38 77S3076 167E1081 -3.71  2.0
51222 434  7.36 77S3101 167E1051 -3.71  2.1
51223 133 41.05 77S3173 167E1033 -3.68  2.0
51223 951 22.13 77S3156 167E 917 -3.70  0.0
512231536 15.32 77S3152 167E1007 -3.18  2.1
512232343 44.77 77S3119 167E1107 -2.76  2.1
512241454 52.91 77S3130 167E1102 -2.47  2.1
512251133 46.05 77S3140 167E1021 -3.70  2.1
512251827 54.65 77S3136 167E1017 -3.34  2.1
51226 613 13.42 77S3141 167E 981 -2.86  2.1
512262255 36.91 77S3133 167E1103 -2.88  2.1
51227 444 43.76 77S3130 167E1014 -2.70  2.1
51227 955  4.48 77S3156 167E1030 -3.14  2.1
51228 518 33.97 77S3124 167E1154 -2.08  2.1
512281330  5.83 77S3142 167E1036 -2.97  2.1
512291036 34.68 77S3119 167E1132 -3.68  2.1
512291823 31.19 77S3143 167E 989 -2.71  2.1
512301414 35.95 77S3134 167E1175 -3.71  2.1
5123017 5  1.28 77S3141 167E1010 -2.50  2.1
60103 941 57.36 77S3130 167E1024 -3.17  2.1
6010316 4  1.04 77S3143 167E 999 -3.18  2.1
601042112 29.79 77S3128 167E1094 -3.71  2.1
601042121 16.61 77S3148 167E1021 -2.72  2.1
601052334  9.87 77S3146 167E 939 -3.71  2.1
601061553 16.11 77S3135 167E 985 -2.86  2.1
60108 149  5.92 77S3155 167E1055 -3.70  2.1
60109 556 53.78 77S3139 167E1100 -3.70  2.0
6011315 8 35.86 77S3144 167E 974 -3.24  2.1
601171313 57.97 77S3156 167E1049 -3.70  0.0
60118 1 3 49.31 77S3176 167E 997 -3.70  0.0
60118 838 55.97 77S3144 167E 967 -3.70  0.0
60119 440 29.92 77S3157 167E1120 -3.71  2.1
601191424 36.37 77S3148 167E 908 -3.70  2.1
601191933 56.45 77S3137 167E1014 -3.05  0.0
60121 947 48.82 77S3150 167E1145 -3.71  2.1
601212351 38.61 77S3169 167E1091 -3.70  2.0
601281022 28.37 77S3172 167E1105 -3.70  2.2
60131 310 48.09 77S3144 167E1006 -3.70  1.9
60131 536 26.81 77S3150 167E1090 -3.71  2.1
60206 146 54.60 77S3157 167E1008 -3.69  0.0
60209 942 34.20 77S3128 167E1060 -3.17  0.0
60212 251 40.92 77S3179 167E1285 -3.70  2.1
60212 337 36.22 77S3181 167E1097 -3.71  0.0
60213 543 38.67 77S3157 167E1161 -3.05  0.0
602131827 42.47 77S3149 167E 955 -2.91  0.0
602131954  3.74 77S3160 167E1037 -3.70  2.1
60214 6 0  2.77 77S3160 167E 935 -2.80  2.1
602141333 19.84 77S3139 167E 980 -3.70  2.1
60215 037 15.12 77S3163 167E1009 -3.71  0.0
602151249 47.97 77S3135 167E 981 -3.70  2.0
0216 122 24.77 77S3137 167E1253 -3.71  2.1
0217 022 28.72 77S3151 167E 955 -3.70  2.1
0217 846 34.44 77S3138 167E1012 -3.70  0.0
021723 9 55.85 77S3124 167E1215 -2.78  2.1
022313 7 39.07 77S3173 167E 953 -3.71  2.1
022423 5 32.79 77S3141 167E 988 -3.21  2.0
0225 324 38.67 77S3157 167E 892 -3.71  0.0
0225 534 11.74 77S3190 167E1106 -3.71  0.0
022718 6 57.80 77S3176 167E1131 -3.70  2.0
```

```
96030510 0 57.82 77S3153 167E 978 -3.71  0.0
960306 913 40.25 77S3158 167E 964 -2.95  0.0
9603111912 28.68 77S3109 167E1130 -3.70  2.1
9603221529 41.97 77S3185 167E 866 -3.71  2.0
9603221742 11.72 77S3188 167E 847 -3.71  0.0
9603281254 10.02 77S3130 167E1000 -3.70  0.0
9603281459 56.56 77S3162 167E1199 -3.70  0.0
9603281537 15.65 77S3173 167E1022 -3.71  1.9
960514 135 46.13 77S3139 167E 999 -3.70  0.0
9605142117  4.52 77S3124 167E 893 -3.70  0.0
96051617 3 27.53 77S3160 167E 893 -3.70  0.0
9605202336 38.82 77S3159 167E 978 -3.04  0.0
960602 340 14.32 77S3154 167E 943 -3.40  0.0
960603 611 51.15 77S3170 167E 889 -3.68  0.0
960607 430 30.44 77S3153 167E 868 -1.48  0.0
960608 311 26.42 77S3196 167E 945 -3.29  0.0
960608 7 0  5.82 77S3129 167E1034 -3.71  0.0
960608 711 37.38 77S3180 167E 851 -3.70  0.0
9607141954  3.16 77S3114 167E 972 -3.69  0.0
960717 716 57.84 77S3093 167E 906 -3.68  0.0
9607251037  0.56 77S3119 167E1020 -3.24  0.0
```

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1129 | -77.551498 | 167.078995 | 3.01 | 0.15065 | -0.02703 | -0.03573 | 0.27222 | -0.02431 | 0.13713 |
| 1129 | -77.556000 | 167.068497 | 3.09 | 0.16067 | -0.00251 | -0.04218 | 0.24840 | -0.01369 | 0.13092 |
| 1205 | -77.491669 | 167.181839 | 0.15 | 0.07598 | 0.01564 | 0.00433 | 0.12136 | -0.02950 | 0.23266 |
| 1205 | -77.548332 | 167.080505 | 2.81 | 0.12679 | -0.01440 | -0.02344 | 0.18384 | -0.05126 | .10936 |
| 1208 | -77.505165 | 167.160507 | -0.77 | 0.07855 | 0.01203 | 0.00636 | 0.10525 | -0.03417 | .17620 |
| 1210 | -77.506836 | 167.273331 | -2.38 | 0.08591 | 0.01268 | -0.07824 | 0.13958 | -0.11098 | 0.49451 |
| 1211 | -77.530334 | 166.980667 | 1.05 | 0.14336 | -0.01602 | -0.07299 | 0.14677 | 0.02105 | 0.18987 |
| 1215 | -77.527832 | 166.968506 | 3.01 | 0.18872 | 0.02928 | -0.03355 | 0.08212 | -0.03248 | .19917 |
| 1228 | -77.555664 | 167.100998 | 2.39 | 0.09825 | -0.04124 | 0.00495 | 0.18711 | -0.03848 | .13463 |
| 104 | -77.528664 | 167.179840 | -2.84 | 0.06093 | -0.00128 | -0.00928 | 0.09220 | -0.01464 | .17687 |
| 106 | -77.555496 | 167.155502 | 0.18 | 0.14269 | -0.04259 | 0.02157 | 0.36785 | 0.05936 | .34945 |
| 110 | -77.490334 | 167.273666 | -0.57 | 0.11075 | -0.04306 | 0.01921 | 0.29561 | -0.17070 | .51363 |
| 117 | -77.537170 | 167.007172 | 0.72 | 0.11476 | 0.06951 | -0.06057 | 0.31208 | -0.14991 | .25315 |
| 118 | -77.500168 | 166.626495 | 18.41 | 0.88713 | 0.10693 | 0.17302 | 0.62042 | 0.16951 | .49239 |
| 118 | -77.516167 | 167.107666 | 0.09 | 0.11273 | -0.00205 | 0.05171 | 0.09519 | -0.03079 | .21208 |
| 120 | -77.561996 | 167.254669 | 0.82 | 0.13986 | -0.09095 | -0.01451 | 0.38729 | 0.04960 | .22285 |
| 120 | -77.545502 | 167.126999 | -3.68 | 0.07179 | 0.00178 | 0.02562 | 0.14982 | 0.05533 | .44839 |
| 202 | -77.493835 | 167.079330 | 0.90 | 0.11372 | 0.00844 | 0.01488 | 0.13736 | -0.00129 | .31892 |
| 203 | -77.505836 | 167.351166 | -1.42 | 0.08257 | 0.02164 | -0.00192 | 0.32659 | -0.19609 | .57071 |
| 206 | -77.482498 | 167.058670 | 1.63 | 0.18941 | 0.07565 | -0.08956 | 0.20656 | -0.00197 | .49396 |
| 222 | -77.551003 | 167.232330 | 0.70 | 0.12842 | -0.06892 | -0.03560 | 0.28729 | 0.04863 | .21426 |
| 303 | -77.492836 | 167.316330 | -1.84 | 0.09116 | 0.01323 | -0.02980 | 0.27842 | -0.28333 | .91032 |
| 004 | -77.555832 | 167.026840 | 0.55 | 0.13297 | -0.00477 | -0.09589 | 0.16527 | -0.08227 | .52171 |
| 005 | -77.496330 | 167.040497 | 1.14 | 0.23475 | 0.07065 | -0.13820 | 0.17766 | -0.09322 | .10760 |
| 014 | -77.496002 | 166.996506 | -1.70 | 0.12405 | 0.01720 | 0.07947 | 0.06020 | -0.03671 | .62574 |
| 024 | -77.502670 | 166.914001 | 4.16 | 0.31734 | 0.07947 | -0.05319 | 0.15222 | -0.00979 | .64030 |
| 025 | -77.492500 | 167.075836 | -3.63 | 0.09123 | 0.00334 | 0.07790 | 0.06754 | -0.02736 | .43121 |
| 026 | -77.533836 | 167.028671 | -0.03 | 0.10304 | -0.00487 | -0.00627 | 0.10779 | 0.01003 | .27917 |
| 128 | -77.541664 | 167.309662 | -2.46 | 0.72307 | -1.34212 | -0.98259 | 3.03226 | 2.03157 | .82467 |
| 105 | -77.528664 | 166.973495 | 1.47 | 0.14664 | 0.02196 | -0.03013 | 0.11200 | -0.07628 | .27135 |
| 114 | -77.556999 | 167.018494 | 3.11 | 0.18497 | 0.01440 | -0.04912 | 0.32779 | -0.00618 | .15724 |
| 116 | -77.500336 | 167.010834 | 2.94 | 0.22327 | -0.09534 | -0.02179 | 0.30504 | -0.03788 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 951116 | -77.519669 | 166.992172 | 0.62 | 0.16410 | 0.00873 | 0.02252 | 0.16772 | -0.09274 | 0.41817 |
| 951117 | -77.513664 | 166.925659 | 2.23 | 0.15843 | 0.00169 | -0.01386 | 0.12594 | -0.01607 | 0.16562 |
| 951118 | -77.543663 | 167.069504 | -2.53 | 0.20991 | -0.13275 | -0.08257 | 0.45407 | 0.32220 | 0.54602 |
| 951119 | -77.539169 | 167.030167 | 3.94 | 0.24726 | 0.00267 | 0.07156 | 0.41591 | 0.02830 | 0.52674 |
| 951129 | -77.491501 | 167.056000 | 0.39 | 0.15425 | 0.01823 | 0.04122 | 0.15250 | -0.01262 | 0.41321 |
| 951204 | -77.552170 | 167.080505 | 3.05 | 0.13041 | 0.00293 | -0.02521 | 0.18128 | -0.03569 | 0.11831 |
| 951205 | -77.531998 | 167.192001 | -3.71 | 0.10191 | -0.03620 | -0.01283 | 0.21304 | 0.11894 | 0.59505 |
| 951210 | -77.513336 | 167.226501 | -0.14 | 0.09646 | 0.01038 | -0.03364 | 0.18114 | -0.09015 | 0.28238 |
| 951225 | -77.956665 | 168.850494 | -3.71 | 4.36492 | -2.38837 | 0.00000 | 1.82508 | 0.00000 | 99.00000 |
| 951226 | -77.536003 | 167.224838 | -2.28 | 0.08549 | -0.03126 | 0.00571 | 0.14302 | 0.01282 | 0.13148 |
| 951230 | -77.482498 | 167.001328 | 2.98 | 0.13596 | 0.02927 | -0.01256 | 0.12086 | 0.02857 | 0.10317 |
| 951231 | -77.527336 | 167.117996 | -2.26 | 0.09508 | -0.03696 | 0.01292 | 0.17114 | -0.03767 | 0.14376 |
| 960104 | -77.533669 | 167.018173 | 3.31 | 0.17997 | -0.00094 | -0.00259 | 0.15312 | -0.07427 | 0.28691 |
| 960106 | -77.536499 | 167.222839 | -2.43 | 0.07079 | -0.02873 | -0.00281 | 0.13816 | 0.01815 | 0.13106 |
| 960106 | -77.495003 | 166.992996 | 1.47 | 0.12945 | 0.02282 | -0.03607 | 0.07876 | -0.01385 | 0.31179 |
| 960114 | -77.520668 | 166.988007 | 2.71 | 0.14937 | 0.01323 | -0.01657 | 0.09251 | -0.03215 | 0.16812 |
| 960117 | -77.541168 | 166.988663 | 2.62 | 0.15770 | -0.00377 | -0.05302 | 0.11971 | -0.02198 | 0.15260 |
| 960117 | -77.512497 | 167.089661 | -0.65 | 0.08046 | -0.00752 | 0.03171 | 0.06837 | -0.02874 | 0.16117 |
| 960118 | -77.609665 | 166.274994 | 24.39 | 0.76997 | -0.18119 | 0.25253 | 0.19096 | -0.00710 | 0.65907 |
| 960119 | -77.538002 | 166.987335 | 3.02 | 0.14935 | -0.00041 | -0.00970 | 0.16442 | -0.05071 | 0.12622 |
| 960206 | -77.525330 | 167.163330 | -3.02 | 0.06751 | 0.00762 | 0.01546 | 0.07558 | -0.01458 | 0.20688 |
| 960206 | -77.530830 | 167.317001 | -1.77 | 0.16070 | -0.16483 | -0.06720 | 0.40565 | 0.03216 | 0.34361 |
| 960209 | -77.588837 | 167.088333 | -0.71 | 0.16924 | 0.05780 | -0.03093 | 0.54155 | 0.24032 | 0.70920 |
| 960209 | -77.583664 | 167.058502 | -0.10 | 0.14393 | 0.05568 | -0.00665 | 0.42241 | 0.06121 | 0.24366 |
| 960210 | -77.512833 | 167.167496 | -1.27 | 0.09531 | -0.02651 | -0.02896 | 0.15436 | 0.03752 | 0.14033 |
| 960211 | -77.526665 | 166.985336 | -2.91 | 0.23772 | 0.00074 | 0.38931 | 0.13992 | 0.01115 | 1.04224 |
| 960211 | -77.555496 | 167.076172 | -2.56 | 0.31490 | -0.07635 | 0.27190 | 0.28189 | 0.18774 | 1.05309 |
| 960213 | -77.536835 | 167.172165 | 0.88 | 0.13657 | -0.05569 | 0.02948 | 0.18931 | -0.01197 | 0.36411 |
| 960214 | -77.537498 | 166.875671 | 2.04 | 0.70232 | 0.18940 | 0.00912 | 0.23134 | -0.08262 | 0.40624 |
| 960214 | -77.580002 | 167.298004 | 2.03 | 0.22643 | -0.19696 | 0.03899 | 0.74741 | -0.07844 | 0.55610 |
| 960214 | -77.502502 | 167.037674 | -1.00 | 0.12181 | -0.02240 | 0.07039 | 0.13564 | -0.03080 | 0.46253 |
| 960218 | -77.551666 | 167.201172 | -1.34 | 0.13241 | -0.09000 | -0.02079 | 0.31875 | 0.13079 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 50220 | -77.543663 | 167.113327 | 1.80 | 0.14861 | -0.03453 | -0.02511 | 0.21017 | -0.06291 | 0.32122 |
| 50225 | -77.523499 | 167.042664 | -1.65 | 0.07620 | -0.01095 | 0.02822 | 0.10050 | -0.02086 | 0.27329 |
| 50305 | -77.530830 | 167.177338 | -2.28 | 0.09393 | 0.01270 | -0.01673 | 0.14755 | -0.03229 | 0.18850 |
| 50305 | -77.398666 | 166.314331 | 3.49 | 0.94987 | 0.06374 | 0.75169 | 0.66355 | 0.15978 | 4.97659 |
| 50305 | -77.542664 | 167.004333 | 2.94 | 0.11944 | 0.01106 | -0.01633 | 0.21172 | -0.06531 | 0.12884 |
| 0308 | -77.515167 | 167.857666 | 4.90 | 48.95621 | -0.04782 | -1.25402 | 3.98155 | -0.96616 | 3.13207 |
| 0321 | -77.512833 | 167.409332 | -1.01 | 0.26472 | -0.21522 | 0.20583 | 0.43752 | -0.09795 | 0.49772 |
| 0328 | -77.589500 | 167.394501 | 0.09 | 0.25171 | -0.14133 | -0.05219 | 0.58822 | 0.16195 | 0.41000 |
| 0328 | -77.551170 | 167.203171 | -1.48 | 0.11508 | -0.02523 | -0.01546 | 0.24909 | 0.04615 | 0.22583 |
| 0328 | -77.572830 | 167.211670 | 1.93 | 0.39064 | -0.21830 | -0.04576 | 0.66668 | 0.06102 | 0.56266 |
| 0421 | -77.479668 | 166.857834 | 1.52 | 0.25382 | 0.00852 | -0.05236 | 0.07763 | 0.00751 | 0.09854 |
| 0423 | -77.525497 | 166.936996 | 4.44 | 0.27298 | 0.02451 | -0.07736 | 0.19102 | -0.10366 | 0.50592 |
| 0424 | -77.547501 | 167.143997 | -1.19 | 0.16363 | 0.02649 | 0.02580 | 0.31339 | 0.01039 | 0.21298 |
| 0505 | -77.512337 | 166.996994 | -0.02 | 0.10182 | -0.02212 | 0.00908 | 0.10509 | -0.03105 | 0.26309 |
| 0505 | -77.530998 | 167.054840 | -1.93 | 0.15429 | -0.06325 | 0.10423 | 0.23163 | -0.13221 | 0.36408 |
| 0513 | -77.556168 | 167.108505 | -2.22 | 0.11611 | -0.05699 | 0.01636 | 0.26922 | 0.18252 | 0.52467 |
| 0514 | -77.538498 | 167.207336 | -2.36 | 0.10667 | -0.02582 | 0.05297 | 0.13550 | 0.02080 | 0.21782 |
| 0514 | -77.549667 | 167.191498 | 1.89 | 0.24832 | -0.10885 | 0.02668 | 0.53088 | -0.05641 | 0.26080 |
| 0514 | -77.532166 | 167.328827 | -1.48 | 0.12161 | -0.08944 | -0.04732 | 0.25720 | 0.02041 | 0.23119 |
| 0515 | -77.531166 | 167.229172 | -2.39 | 0.10256 | -0.00206 | -0.01380 | 0.18154 | -0.05149 | 0.11590 |
| 0515 | -77.542000 | 167.199005 | -2.41 | 0.11537 | -0.05616 | 0.00225 | 0.26690 | 0.09707 | 0.28768 |
| 0524 | -77.544502 | 167.184830 | 0.41 | 0.09569 | -0.03248 | -0.01039 | 0.31502 | -0.00683 | 0.21929 |
| 0526 | -77.549500 | 167.226166 | -3.71 | 0.10712 | -0.02700 | -0.02287 | 0.21412 | 0.01080 | 0.66876 |
| 0531 | -77.526169 | 167.141663 | -1.60 | 0.07287 | -0.00492 | 0.01298 | 0.12855 | -0.04458 | 0.13858 |
| 0603 | -77.566170 | 167.167664 | -1.22 | 0.18254 | -0.05658 | -0.11774 | 0.44317 | 0.11269 | 0.47428 |
| 0718 | -77.512169 | 167.268326 | -0.79 | 0.09841 | -0.04216 | 0.05144 | 0.30716 | -0.24000 | 0.45440 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41112 | -77.689331 | 167.098007 | -1.90 | 0.54608 | -0.14469 | -0.09412 | 0.12553 | 0.07785 | 0.29837 |
| 41112 | -77.686836 | 166.862503 | -3.71 | 1.05179 | -0.19282 | 0.22629 | 0.31708 | 0.05587 | 1.54113 |
| 41113 | -77.473663 | 167.816162 | -1.24 | 1.68008 | -2.43295 | 1.15863 | 5.42726 | -2.46487 | 1.36264 |
| 41113 | -77.611168 | 167.289993 | -3.69 | 0.54853 | -0.10897 | -0.20630 | 0.42458 | -0.24292 | 1.91667 |
| 41113 | -77.680168 | 166.444839 | -2.23 | 8.97757 | 10.51801 | 0.00000 | 14.22243 | 0.00000 | 99.00000 |
| 41113 | -77.430000 | 168.109329 | -3.31 | 46.70610 | 13.66306 | ******** | 5.36261 | ******** | 31.35125 |
| 41113 | -77.568497 | 167.140839 | 0.11 | 0.08416 | 0.00984 | 0.01281 | 0.16736 | 0.00628 | 0.12848 |
| 41115 | -77.533669 | 167.158173 | -1.40 | 0.11610 | 0.03803 | -0.01160 | 0.56421 | -0.30894 | 0.38968 |
| 41115 | -77.599670 | 167.177826 | 0.47 | 0.52160 | -0.07274 | 0.14004 | 0.39511 | 0.04599 | 0.21329 |
| 41115 | -77.554169 | 167.092834 | -0.16 | 0.11385 | 0.00789 | 0.03273 | 0.28816 | -0.06792 | 0.21797 |
| 41116 | -77.591667 | 167.222336 | -3.70 | 0.15296 | -0.00022 | -0.03354 | 0.32705 | -0.04001 | 0.53999 |
| 41117 | -77.501503 | 167.259995 | -1.86 | 0.07133 | 0.00984 | -0.01001 | 0.17739 | -0.20243 | 0.62128 |
| 1118 | -77.488167 | 168.138672 | -3.63 | 58.52635 | 2.18191 | ******** | 4.66649 | -3.22991 | 1.60711 |
| 1121 | -77.592163 | 167.242996 | -3.02 | 0.14155 | -0.03369 | -0.00169 | 0.22912 | -0.01218 | 0.44933 |
| 1122 | -77.584503 | 167.193497 | -0.79 | 0.11197 | -0.01553 | 0.01405 | 0.32293 | 0.01866 | 0.39510 |
| 1123 | -77.580170 | 167.301834 | -3.70 | 0.26566 | -0.08703 | -0.04329 | 0.29012 | 0.04980 | 1.11423 |
| 1128 | -77.586334 | 167.296173 | -3.71 | 0.27102 | 0.01472 | -0.13206 | 0.22884 | -0.07157 | 0.80010 |
| 1128 | -77.563835 | 167.073837 | -0.70 | 0.17179 | -0.06628 | -0.02639 | 0.46350 | -0.10376 | 0.48471 |
| 1128 | -77.582001 | 167.180664 | 0.60 | 0.13383 | -0.06992 | -0.02133 | 0.31516 | 0.06105 | 0.16100 |
| 1129 | -77.556000 | 167.150665 | -2.69 | 0.07306 | -0.03970 | -0.01908 | 0.18143 | 0.04743 | 0.23551 |
| 1202 | -77.532669 | 167.264160 | -3.28 | 0.08244 | -0.05589 | -0.05824 | 0.21855 | 0.08018 | 0.42901 |
| 1203 | -77.554832 | 167.113007 | -0.51 | 0.16478 | -0.04487 | 0.00895 | 0.14118 | 0.01903 | 0.16403 |
| 1207 | -77.586998 | 167.341995 | -3.71 | 0.40457 | -0.35496 | -0.23808 | 1.06732 | 0.50567 | 1.29789 |
| 1207 | -77.573502 | 167.108002 | 2.47 | 0.42116 | -0.29472 | -0.12548 | 1.05798 | 0.03135 | 0.31086 |
| 1207 | -77.489830 | 167.233505 | -1.54 | 0.11824 | 0.05120 | -0.07276 | 0.18601 | -0.24839 | 0.82554 |
| 1207 | -77.559669 | 167.300827 | -3.71 | 0.16761 | -0.04716 | -0.09728 | 0.22856 | 0.00241 | 0.74381 |
| 1207 | -77.540169 | 167.364166 | 1.22 | 0.26946 | -0.25302 | 0.00135 | 0.47756 | 0.08108 | 0.31294 |
| 1208 | -77.505165 | 167.160507 | -0.77 | 0.07855 | 0.01203 | 0.00636 | 0.10525 | -0.03417 | 0.17620 |
| 1209 | -77.533836 | 167.232834 | -2.62 | 0.07274 | -0.04451 | 0.01404 | 0.16141 | 0.00261 | 0.09583 |
| 1211 | -77.523003 | 167.173340 | -3.04 | 0.06931 | 0.01287 | 0.00646 | 0.08592 | -0.02720 | 0.22476 |
| 1212 | -77.490166 | 167.203506 | -0.20 | 0.08212 | 0.03173 | -0.02112 | 0.15681 | -0.07202 | 0.18106 |
| 1212 | -77.556503 | 167.009506 | -3.45 | 0.23820 | 0.07764 | 0.28570 | 0.15050 | 0.13289 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 941213 | -77.595497 | 167.104507 | 1.85 | 0.37145 | -0.29840 | -0.17424 | 1.52417 | 0.23825 | 0.64437 |
| 941213 | -77.555000 | 167.252838 | -3.71 | 0.16684 | -0.06392 | 0.00930 | 0.32622 | 0.11671 | 0.70685 |
| 941215 | -77.552666 | 167.235336 | -2.38 | 0.14950 | -0.09712 | -0.06590 | 0.29041 | 0.12900 | 0.35001 |
| 941215 | -77.527832 | 166.968506 | 3.01 | 0.18872 | 0.02928 | -0.03355 | 0.08212 | -0.03248 | 0.19917 |
| 941217 | -77.538498 | 167.218338 | -3.21 | 0.13103 | -0.04479 | -0.03964 | 0.20596 | 0.06913 | 0.58300 |
| 941217 | -77.471497 | 167.226166 | -3.71 | 0.20241 | 0.04996 | -0.06387 | 0.31292 | -0.27596 | 1.18460 |
| 941217 | -77.483170 | 167.253494 | -3.48 | 0.28794 | 0.07584 | -0.52548 | 0.76005 | -1.05444 | 4.37187 |
| 941217 | -77.553497 | 167.143829 | -0.88 | 0.09354 | -0.04003 | -0.00035 | 0.20528 | 0.03031 | 0.20115 |
| 941219 | -77.549004 | 167.130173 | -0.27 | 0.17429 | -0.03801 | 0.04362 | 0.25957 | -0.04843 | 0.23614 |
| 941220 | -77.557167 | 167.245163 | -3.70 | 0.14394 | -0.04819 | 0.00585 | 0.11631 | -0.00441 | 0.38974 |
| 941221 | -77.553001 | 167.071503 | -3.37 | 0.15717 | -0.02944 | 0.10808 | 0.23067 | 0.24918 | 0.95213 |
| 941221 | -77.578667 | 167.218002 | -2.38 | 0.27761 | -0.19379 | -0.16707 | 0.87252 | 0.53184 | 1.24955 |
| 941224 | -77.556168 | 167.299835 | -3.70 | 0.28580 | -0.12376 | -0.16670 | 0.45276 | 0.31352 | 1.57144 |
| 941225 | -77.574501 | 167.398499 | -0.36 | 0.57155 | -0.46094 | -0.16044 | 0.94224 | 0.23238 | 0.41619 |
| 941225 | -77.528000 | 167.164505 | -2.58 | 0.07162 | -0.00797 | 0.00013 | 0.10961 | -0.00696 | 0.14877 |
| 941225 | -77.567497 | 166.995331 | -1.44 | 0.14111 | 0.11607 | 0.00484 | 0.54893 | -0.01278 | 0.25990 |
| 941226 | -77.533669 | 167.201660 | -2.10 | 0.15954 | -0.04495 | 0.03681 | 0.25511 | 0.02630 | 0.29534 |
| 941226 | -77.553337 | 167.103836 | -1.44 | 0.16619 | -0.08422 | 0.04003 | 0.20243 | 0.02395 | 0.35137 |
| 941226 | -77.535835 | 167.328339 | -3.71 | 0.17171 | -0.13651 | -0.20479 | 0.46273 | 0.12136 | 1.38551 |
| 941227 | -77.543831 | 167.067841 | -3.17 | 0.18511 | -0.01351 | 0.16225 | 0.24834 | 0.21703 | 0.90655 |
| 941227 | -77.583504 | 167.162170 | -3.69 | 0.40333 | -0.28068 | 0.02917 | 1.58401 | 1.31930 | 2.91262 |
| 941227 | -77.369164 | 166.248993 | 7.68 | 25.23508 | ******** | -8.90427 | 21.54959 | 9.68334 | 11.32526 |
| 941228 | -77.489670 | 167.300659 | -1.66 | 0.17680 | 0.05764 | -0.14659 | 0.40817 | -0.29447 | 0.95501 |
| 941228 | -77.553833 | 167.207001 | -1.34 | 0.30214 | -0.13222 | 0.06399 | 0.46562 | 0.08612 | 0.54224 |
| 941229 | -77.522499 | 167.183502 | -3.70 | 0.18763 | 0.02026 | -0.09751 | 0.19399 | -0.08628 | 1.65838 |
| 941229 | -77.515999 | 167.166504 | -1.35 | 0.11408 | 0.00670 | 0.00625 | 0.12138 | 0.01434 | 0.16454 |
| 941229 | -77.535004 | 167.177994 | -2.18 | 0.15709 | -0.04749 | 0.02313 | 0.25217 | 0.04111 | 0.32073 |
| 950103 | -77.564331 | 166.984329 | -1.72 | 0.12153 | 0.09918 | -0.01333 | 0.56211 | -0.09202 | 0.28635 |
| 950104 | -77.545334 | 167.197998 | -2.30 | 0.11673 | -0.04125 | 0.01604 | 0.18553 | 0.05470 | 0.29774 |
| 950106 | -77.556999 | 167.021332 | -3.71 | 0.27542 | 0.13870 | 0.44022 | 0.49693 | 0.69173 | 1.77766 |
| 950107 | -77.548500 | 167.221329 | -1.96 | 0.17001 | -0.07171 | -0.01361 | 0.21246 | 0.07359 | 0.30743 |
| 950110 | -77.483170 | 167.091171 | -1.00 | 0.23165 | 0.07550 | 0.13398 | 0.17277 | -0.00317 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0113 | -77.621170 | 167.126831 | -3.71 | 0.33730 | 0.00594 | 0.32287 | 0.53070 | -0.22222 | 1.29198 |
| 0113 | -79.172668 | 165.455826 | -3.71 | 8.01091 | 19.34033 | 0.00000 | 94.88909 | 0.00000 | 0.00002 |
| 0113 | -77.534836 | 167.229004 | -2.42 | 0.09224 | -0.03060 | -0.02877 | 0.18875 | 0.01470 | .24900 |
| 0113 | -77.425003 | 167.192505 | -3.70 | 0.22127 | 0.34154 | -0.49628 | 1.31892 | -2.29996 | 5.07981 |
| 0116 | -77.525665 | 167.170166 | -3.71 | 0.10098 | 0.01067 | -0.09633 | 0.10957 | -0.04589 | .17942 |
| 0118 | -77.427002 | 167.185165 | -3.69 | 0.15466 | 0.09161 | 0.01262 | 0.40671 | -0.18442 | .18862 |
| 0118 | -77.551170 | 167.287994 | -3.71 | 0.12023 | -0.04437 | -0.08390 | 0.29319 | 0.05280 | 1.62651 |
| 0118 | -77.536835 | 167.216339 | -3.64 | 0.14933 | -0.08027 | -0.22655 | 0.35690 | 0.18971 | .39374 |
| 0118 | -77.560997 | 167.213165 | -1.96 | 0.14593 | -0.09581 | -0.09278 | 0.69045 | 0.27440 | 1.47362 |
| 118 | -77.559502 | 167.052673 | -3.69 | 0.17108 | 0.06477 | 0.27700 | 0.34187 | 0.51022 | .37705 |
| 123 | -77.533501 | 167.253006 | -3.36 | 0.47543 | -0.07633 | -0.28252 | 0.60694 | -0.06723 | .00738 |
| 127 | -77.560165 | 167.289001 | -3.70 | 0.11351 | -0.00065 | -0.14769 | 0.25109 | -0.03241 | .02525 |
| 128 | -77.529663 | 167.285004 | -3.36 | 0.13006 | -0.06057 | -0.22614 | 0.25493 | 0.02483 | .25500 |
| 404 | -77.580330 | 166.900665 | -2.59 | 0.63757 | 0.75548 | 0.27492 | 1.72349 | 0.32554 | .77890 |
| 424 | -77.630836 | 166.778503 | -1.81 | 12.41432 | 16.90374 | 12.19199 | 28.65677 | 19.78461 | .56883 |
| 006 | -77.551331 | 167.098831 | -3.70 | 0.15946 | -0.07048 | -0.01496 | 0.27862 | 0.16527 | .71190 |
| 011 | -77.557335 | 167.253326 | -3.70 | 0.20374 | -0.12511 | -0.13403 | 0.38554 | 0.26305 | .06072 |
| 012 | -77.476997 | 167.224167 | -3.68 | 0.20088 | 0.04244 | -0.04711 | 0.28387 | -0.22092 | .17525 |
| 013 | -77.554001 | 167.133667 | -3.58 | 0.24170 | -0.06195 | 0.07126 | 0.49392 | 0.60757 | .09438 |
| 016 | -77.553833 | 167.256165 | -3.66 | 0.49129 | -0.39183 | -0.57992 | 0.90893 | 0.62709 | .15947 |
| 017 | -77.555832 | 167.108841 | -0.89 | 0.21497 | -0.07273 | 0.06226 | 0.38031 | -0.03439 | .47470 |
| 017 | -77.569336 | 167.141663 | 1.19 | 0.12478 | -0.03957 | -0.03911 | 0.33817 | 0.00970 | .28703 |
| 019 | -77.637665 | 166.108002 | 6.68 | 38.42579 | 22.71757 | -5.87179 | 18.03571 | -4.17242 | .58804 |
| 023 | -77.601669 | 167.368500 | -0.32 | 0.49367 | -0.16344 | -0.08034 | 0.67965 | 0.16842 | .50666 |
| 025 | -77.561668 | 167.451508 | 7.74 | 3.39392 | -2.95707 | 1.95328 | 5.41778 | -0.87969 | .61829 |
| 027 | -77.542664 | 167.276993 | -3.54 | 0.22584 | -0.06806 | -0.32175 | 0.44641 | 0.16773 | 85765 |
| 027 | -77.517670 | 167.205002 | -3.42 | 0.18091 | -0.00035 | -0.01038 | 0.26519 | -0.31375 | 48389 |
| 30 | -77.560165 | 167.241669 | -3.70 | 0.27092 | -0.22370 | -0.38205 | 0.73947 | 0.85879 | 50960 |
| 31 | -77.662170 | 166.881165 | -3.71 | 1.48251 | 1.98230 | 1.96695 | 6.51457 | 5.03900 | 90292 |
| 31 | -77.527496 | 167.276840 | -1.17 | 0.25868 | -0.27293 | 0.02736 | 0.88606 | -0.16896 | 35525 |
| 31 | -77.560669 | 167.192505 | -2.17 | 0.20215 | -0.05272 | 0.08595 | 0.40811 | 0.08553 | 53972 |
| 01 | -77.476334 | 167.219330 | -3.70 | 0.11523 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 951104 | -77.565170 | 167.010330 | -1.57 | 0.19465 | -0.04379 | 0.03222 | 0.67048 | -0.10345 | 0.96475 |
| 951106 | -77.587997 | 167.362167 | -1.51 | 0.63738 | -0.70965 | -0.57884 | 1.65173 | 1.03253 | 1.85088 |
| 951108 | -77.539833 | 167.175171 | -2.25 | 0.20037 | -0.09808 | -0.03631 | 0.66670 | 0.12125 | 0.44292 |
| 951114 | -77.537003 | 167.134338 | -1.50 | 0.15613 | -0.10440 | -0.02000 | 0.36078 | 0.09556 | 0.29310 |
| 951115 | -77.693832 | 167.535004 | -3.54 | 2.43846 | -4.14520 | -3.92821 | 10.04086 | 8.68246 | 10.53067 |
| 951115 | -77.542168 | 167.073669 | -3.30 | 0.18319 | -0.09850 | -0.01309 | 0.30792 | 0.14287 | 0.55888 |
| 951117 | -77.481163 | 167.011337 | 0.04 | 1.02698 | -1.13509 | 0.35249 | 1.87746 | -0.41787 | 0.61556 |
| 951117 | -77.552498 | 167.264008 | -3.01 | 0.13765 | -0.06922 | -0.09066 | 0.22724 | 0.16255 | 0.53507 |
| 951117 | -77.538498 | 167.384171 | -1.28 | 1.23038 | -1.26074 | -0.29134 | 2.24912 | 0.43192 | 2.02050 |
| 951118 | -77.539497 | 167.233002 | -3.70 | 0.18503 | -0.06602 | -0.13049 | 0.23799 | 0.00774 | 0.68696 |
| 951118 | -77.533165 | 167.348495 | 0.09 | 0.28924 | -0.15583 | 0.10139 | 0.45509 | -0.10168 | 0.45566 |
| 951119 | -77.593002 | 167.042007 | -2.49 | 0.83620 | 0.30605 | 0.81668 | 5.69799 | 1.16936 | 3.42549 |
| 951119 | -77.526337 | 167.179840 | -3.71 | 0.14514 | 0.00460 | -0.14492 | 0.46351 | -0.16544 | 1.56134 |
| 951126 | -77.561996 | 167.216995 | -0.34 | 0.15341 | -0.10682 | -0.00990 | 0.65347 | -0.06209 | 0.45312 |
| 951129 | -77.600830 | 166.662003 | -3.71 | 0.71632 | -0.03395 | -0.54265 | 1.30280 | -0.58273 | 2.51087 |
| 951202 | -77.540337 | 167.238327 | -3.71 | 0.43925 | -0.38823 | -0.23347 | 0.62989 | 0.37491 | 0.84085 |
| 951202 | -77.661163 | 167.427170 | -3.71 | 0.56314 | 0.20594 | 0.10088 | 0.82717 | 0.20178 | 0.67968 |
| 951203 | -77.584999 | 166.948502 | -0.51 | 0.47585 | 0.18036 | 0.21749 | 0.56840 | 0.34017 | 0.70575 |
| 951203 | -77.634003 | 166.797165 | -1.07 | 1.19533 | -0.24406 | 0.63154 | 0.32206 | -0.00900 | 0.94259 |
| 951204 | -77.631836 | 167.411667 | -0.33 | 0.60054 | 0.00207 | -0.01850 | 0.40513 | 0.23573 | 0.77433 |
| 951204 | -77.525497 | 167.169006 | -2.27 | 0.29896 | -0.03631 | 0.13926 | 0.35425 | 0.11728 | 0.85679 |
| 951206 | -77.551170 | 167.043839 | -3.70 | 0.44179 | -0.00622 | 0.42291 | 0.51328 | 0.52445 | 1.85491 |
| 951206 | -77.551331 | 167.221161 | -3.26 | 0.33835 | -0.43676 | -0.21837 | 1.24188 | 1.03912 | 1.79928 |
| 951207 | -77.549164 | 167.299835 | -3.71 | 0.31439 | -0.16350 | 0.00722 | 0.46179 | 0.37253 | 1.28382 |
| 951208 | -77.583168 | 166.991501 | -3.71 | 0.51756 | 0.06117 | 0.22857 | 0.76178 | -0.23954 | 0.51060 |
| 951208 | -77.542336 | 167.222336 | -3.40 | 0.36874 | -0.33907 | -0.02814 | 0.85311 | 0.63904 | 1.83782 |
| 951208 | -77.524498 | 167.190338 | -3.69 | 0.21394 | 0.02805 | 0.00938 | 0.40959 | 0.06676 | 1.69647 |
| 951210 | -77.526833 | 167.173996 | -2.29 | 0.21356 | 0.01539 | 0.06243 | 0.29598 | -0.08335 | 0.79046 |
| 951212 | -77.536003 | 167.057327 | -2.45 | 0.15006 | -0.02018 | 0.05875 | 0.13034 | 0.00289 | 0.29959 |
| 951213 | -77.566833 | 167.080505 | 0.19 | 0.20790 | -0.03184 | -0.02776 | 0.55284 | -0.10665 | 0.50923 |
| 951213 | -77.540497 | 167.196671 | -2.41 | 0.14733 | -0.07509 | 0.01836 | 0.26024 | 0.08115 | 0.40236 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 51215 | -77.561996 | 167.243500 | -1.61 | 0.26514 | -0.15651 | -0.10896 | 0.57689 | 0.24556 | 0.69797 |
| 51215 | -77.541496 | 167.185669 | -2.65 | 0.23176 | -0.02015 | -0.00392 | 0.46029 | 0.04483 | 0.61794 |
| 51215 | -77.539001 | 167.216827 | -3.71 | 0.23821 | -0.11618 | -0.21446 | 0.51755 | 0.38778 | 1.49424 |
| 51215 | -77.382668 | 166.248672 | 10.25 | 1.99795 | 0.45337 | 1.17170 | 0.73907 | -0.18555 | 3.70279 |
| 51216 | -77.560501 | 167.031662 | -3.71 | 0.23565 | 0.02342 | 0.18879 | 0.42903 | 0.28309 | 0.52516 |
| 51217 | -77.522667 | 167.179169 | -3.07 | 0.19798 | 0.02897 | -0.05272 | 0.20000 | -0.05459 | 0.94202 |
| 51218 | -77.521835 | 167.201828 | -3.71 | 0.23886 | 0.08091 | -0.27335 | 0.36932 | -0.24662 | 2.65167 |
| 51219 | -77.578835 | 167.099670 | 1.60 | 0.21109 | -0.07524 | -0.06844 | 0.97057 | 0.03217 | 0.25828 |
| 51219 | -77.437836 | 167.965332 | -3.21 | 0.59186 | -0.36515 | 0.06063 | 0.90101 | -0.31148 | 0.63713 |
| 1220 | -77.533836 | 167.580994 | -3.71 | 3.73730 | -0.74072 | -1.97750 | 0.56940 | 0.24293 | 2.29330 |
| 1220 | -77.554497 | 167.554337 | -3.71 | 0.42528 | -0.16112 | 0.18731 | 0.28776 | -0.09925 | 0.61695 |
| 1220 | -77.524002 | 167.167999 | -2.54 | 0.17971 | 0.02137 | 0.01415 | 0.21022 | -0.07013 | 0.44007 |
| 1224 | -77.553169 | 167.217331 | -2.04 | 0.31924 | -0.15014 | 0.00286 | 0.48590 | 0.17980 | 0.69479 |
| 1224 | -77.539665 | 167.173660 | -3.71 | 0.13659 | -0.03030 | -0.01333 | 0.27449 | 0.13166 | 1.08891 |
| 1224 | -77.597000 | 167.108170 | 0.43 | 0.24215 | 0.08284 | 0.01222 | 0.95146 | 0.22912 | 0.37634 |
| 1225 | -77.551666 | 167.221832 | -1.27 | 0.20792 | -0.10104 | -0.02631 | 0.44556 | 0.10942 | 0.42649 |
| 1226 | -77.431999 | 167.160660 | -2.97 | 0.12698 | 0.01056 | 0.05383 | 0.30459 | 0.03398 | 0.54843 |
| 1227 | -77.573166 | 167.243668 | -3.70 | 0.39699 | -0.23411 | -0.32173 | 1.33305 | 1.14876 | 3.10996 |
| 1228 | -77.546501 | 167.251007 | -2.98 | 0.11925 | -0.03145 | -0.02502 | 0.16215 | 0.10563 | 0.51854 |
| 1229 | -77.550163 | 167.165329 | -1.80 | 0.17888 | -0.07774 | -0.01700 | 0.37785 | 0.11577 | 0.42326 |
| 1231 | -77.533333 | 167.457169 | -2.65 | 0.57326 | -0.30213 | -0.05901 | 0.47865 | -0.05630 | 0.85803 |
| 1231 | -77.432831 | 166.779327 | -0.89 | 2.43624 | -2.20699 | 0.70389 | 3.07635 | -0.73650 | 1.15739 |
| 0101 | -77.549667 | 167.247833 | -2.03 | 0.17386 | -0.10375 | -0.11019 | 0.44018 | 0.18056 | 0.50596 |
| 0101 | -77.531998 | 167.173996 | -3.70 | 0.16418 | 0.01918 | -0.10876 | 0.18684 | -0.06380 | 1.61896 |
| 0102 | -77.542000 | 167.256836 | -3.50 | 0.53792 | -0.26318 | -0.52458 | 0.53273 | 0.33222 | 2.39925 |
| 0102 | -77.521164 | 167.171005 | -3.70 | 0.23368 | 0.03854 | -0.06591 | 0.19571 | -0.10039 | 1.77060 |
| 0102 | -77.552170 | 167.220001 | -1.24 | 0.20858 | -0.10295 | -0.02789 | 0.45112 | 0.11400 | 0.43028 |
| 0103 | -77.550667 | 167.228165 | -2.02 | 0.13899 | -0.02279 | 0.03816 | 0.21245 | 0.05038 | 0.33855 |
| 0103 | -77.545334 | 167.267334 | -3.67 | 0.15269 | -0.03852 | 0.01078 | 0.17019 | 0.03138 | 0.52711 |
| 0103 | -77.527168 | 167.167999 | -3.70 | 0.16720 | 0.00427 | -0.10544 | 0.22445 | -0.08169 | 1.70832 |
| 0103 | -77.544167 | 167.202835 | -2.35 | 0.12265 | -0.05057 | -0.00214 | 0.32403 | 0.06111 | 0.34332 |
| 0105 | -77.550331 | 167.044006 | -1.02 | 0.17134 | -0.05639 | 0.04496 | 0.16310 | -0.01458 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960106 | -77.551170 | 167.240173 | -3.71 | 0.17137 | -0.00410 | -0.19575 | 0.22971 | -0.01369 | 1.37892 |
| 960106 | -77.527336 | 167.181503 | -3.70 | 0.15752 | 0.00736 | -0.09761 | 0.21959 | -0.01428 | 1.52289 |
| 960107 | -77.547668 | 167.263336 | -1.85 | 0.18494 | -0.14072 | -0.04824 | 0.39768 | 0.17120 | 0.41734 |
| 960108 | -77.554001 | 167.207672 | -1.90 | 0.28588 | -0.14476 | 0.02472 | 0.48534 | 0.14067 | 0.60877 |
| 960108 | -77.551003 | 167.236832 | -1.66 | 0.10806 | -0.02862 | 0.00508 | 0.15756 | 0.04206 | 0.20437 |
| 960110 | -77.413170 | 167.195160 | -1.79 | 0.31732 | 0.33124 | -0.13628 | 1.00508 | -0.54222 | 2.05750 |
| 960111 | -77.529335 | 167.162170 | -3.71 | 0.08187 | 0.00300 | -0.03356 | 0.13055 | -0.01900 | 0.70757 |
| 960111 | -77.529335 | 167.152832 | -3.05 | 0.11878 | -0.00729 | -0.01450 | 0.15410 | -0.04074 | 0.20711 |
| 960112 | -77.590500 | 167.212326 | -3.71 | 0.09853 | -0.02473 | 0.02270 | 0.19402 | 0.00775 | 0.31745 |
| 960112 | -77.549835 | 167.161499 | -2.43 | 0.12670 | -0.06469 | -0.01348 | 0.22336 | 0.09128 | 0.32991 |
| 960112 | -77.425163 | 166.681503 | -0.88 | 0.79520 | -0.00374 | 0.17086 | 0.38691 | 0.09138 | 0.74790 |
| 960113 | -77.556000 | 167.147995 | -3.71 | 0.14522 | -0.04718 | 0.04828 | 0.37000 | 0.30876 | 0.88478 |
| 960113 | -77.536667 | 167.440338 | 1.11 | 0.34023 | -0.22864 | 0.05065 | 0.50751 | 0.07244 | 0.31224 |
| 960114 | -77.519836 | 167.192001 | -3.71 | 0.13510 | 0.01245 | -0.03975 | 0.16185 | -0.06709 | 1.03304 |
| 960114 | -77.548668 | 167.187332 | -2.35 | 0.17585 | -0.07722 | -0.03088 | 0.39174 | 0.15209 | 0.50235 |
| 960114 | -77.566498 | 167.164993 | 0.11 | 0.13349 | -0.08958 | 0.01195 | 0.46726 | 0.00950 | 0.30925 |
| 960115 | -77.529831 | 167.167496 | -3.45 | 0.20065 | 0.03512 | -0.09852 | 0.28021 | -0.06519 | 0.90914 |
| 960115 | -77.571663 | 166.968002 | -1.73 | 0.36858 | 0.02628 | 0.17958 | 0.27806 | 0.02990 | 0.90336 |
| 960115 | -77.657501 | 167.408997 | -3.71 | 0.66639 | -0.18248 | -0.21468 | 0.79616 | 0.75907 | 2.18739 |
| 960115 | -77.536499 | 167.249664 | -3.35 | 0.16248 | -0.07724 | -0.09944 | 0.23560 | 0.22310 | 0.79189 |
| 960115 | -77.536499 | 167.249496 | -3.15 | 0.16452 | -0.08783 | -0.06310 | 0.31996 | 0.19698 | 0.40546 |
| 960115 | -77.605164 | 166.756668 | -3.69 | 0.40851 | 0.18476 | -0.10569 | 0.76550 | -0.22091 | 1.31592 |
| 960117 | -77.569832 | 167.225662 | -2.35 | 0.11283 | -0.06232 | -0.05273 | 0.41610 | 0.20570 | 0.50103 |
| 960117 | -77.528664 | 167.198502 | -3.71 | 0.16457 | 0.01385 | -0.18340 | 0.22913 | -0.02227 | 1.58603 |
| 960117 | -77.580170 | 167.077667 | 1.19 | 0.21922 | -0.12716 | 0.00255 | 0.74064 | 0.00059 | 0.14014 |
| 960119 | -77.564499 | 167.268997 | -3.69 | 0.25271 | -0.13724 | -0.14075 | 0.66972 | 0.34782 | 1.24748 |
| 960119 | -77.549835 | 167.206497 | -0.23 | 0.17990 | -0.07926 | -0.00642 | 0.29976 | 0.03258 | 0.31034 |
| 960120 | -77.544502 | 167.221161 | -2.62 | 0.16149 | -0.10211 | -0.04000 | 0.33242 | 0.15603 | 0.43608 |
| 960121 | -77.557335 | 167.226166 | -3.71 | 0.19561 | -0.09424 | -0.07042 | 0.34768 | 0.19331 | 0.99660 |
| 960121 | -77.583000 | 167.292831 | -2.86 | 0.19813 | -0.10588 | 0.03754 | 0.43620 | 0.08001 | 0.67567 |
| 960123 | -77.522835 | 167.423340 | -3.66 | 0.39836 | -0.21523 | -0.28628 | 0.42922 | -0.04995 | 0.83233 |
| 960124 | -77.375336 | 166.492172 | -0.78 | 0.65189 | 0.12712 | 0.18337 | 0.52905 | 0.02382 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0124 | -77.511169 | 167.471329 | -2.09 | 1.55554 | -0.21183 | 0.36667 | 0.39279 | -0.16239 | 1.06167 |
| 0128 | -77.523003 | 167.172668 | -3.70 | 0.18562 | 0.02765 | -0.06388 | 0.32607 | -0.21446 | 1.87830 |
| 0128 | -77.520836 | 167.161331 | -2.51 | 0.21017 | 0.00825 | 0.06709 | 0.17527 | -0.03385 | 0.39456 |
| 0201 | -77.536331 | 167.238327 | -1.59 | 0.28090 | -0.07263 | 0.08392 | 0.34863 | -0.04381 | 0.41043 |
| 0202 | -77.534332 | 167.228500 | -2.54 | 0.08332 | -0.01021 | 0.00811 | 0.13738 | -0.00244 | 0.11930 |
| 0202 | -77.540337 | 167.176498 | -3.71 | 0.09831 | -0.02458 | -0.00833 | 0.17196 | 0.09229 | 0.57965 |
| 0203 | -77.561668 | 167.433670 | -2.15 | 0.24883 | -0.16398 | -0.13330 | 0.46588 | 0.20442 | 0.90529 |
| 0204 | -77.533165 | 167.126007 | -1.43 | 0.11611 | -0.04086 | 0.01367 | 0.27351 | 0.05262 | 0.22036 |
| 0204 | -77.546997 | 167.161835 | -3.71 | 0.24755 | -0.13500 | -0.06899 | 0.69745 | 0.84941 | 1.77489 |
| 0204 | -77.421165 | 167.138336 | -3.71 | 0.27227 | 0.03416 | 0.08895 | 0.49972 | 0.14420 | 0.97799 |
| 0205 | -77.537003 | 167.196167 | -3.70 | 0.09536 | -0.03037 | -0.03733 | 0.26225 | 0.21173 | 1.01239 |
| 0208 | -77.555832 | 167.242828 | -0.56 | 0.22624 | -0.12186 | -0.02522 | 0.50442 | 0.09055 | 0.36934 |
| 0208 | -77.543503 | 167.116501 | 2.54 | 0.21726 | -0.11804 | -0.06767 | 0.42709 | -0.02806 | 0.52559 |
| 0208 | -77.529999 | 167.324173 | -1.80 | 0.17488 | -0.19202 | -0.05790 | 0.43389 | 0.05288 | 0.33124 |
| 0210 | -77.524834 | 167.410828 | -2.58 | 0.42947 | -0.40661 | -0.12204 | 0.63818 | 0.08192 | 0.66235 |
| 0210 | -77.581337 | 167.186829 | -2.62 | 0.21534 | -0.13753 | -0.05989 | 1.58954 | 0.91520 | 1.34510 |
| 0211 | -77.542168 | 167.244995 | -3.40 | 0.16580 | -0.06271 | -0.02383 | 0.19947 | 0.13128 | 0.69470 |
| 0212 | -77.531166 | 166.932831 | -2.12 | 0.23442 | 0.03188 | -0.03441 | 0.10041 | -0.00003 | 0.11516 |
| 0212 | -77.558167 | 167.191833 | -1.54 | 0.23415 | -0.12855 | -0.06321 | 0.49070 | 0.19468 | 0.58497 |
| 0212 | -77.557503 | 167.218674 | -1.43 | 0.18424 | -0.13022 | -0.04505 | 0.45272 | 0.16543 | 0.49304 |
| 0212 | -77.537834 | 167.322006 | 2.02 | 0.31351 | -0.27134 | 0.02221 | 0.79815 | 0.02184 | 0.60834 |
| 0212 | -77.524330 | 166.979828 | -3.68 | 0.17079 | 0.02334 | 0.18086 | 0.16534 | 0.08837 | 0.51385 |
| 0212 | -77.530334 | 167.054001 | -2.55 | 0.18325 | -0.04797 | 0.13131 | 0.29227 | -0.10830 | 0.45443 |
| 0212 | -77.527496 | 166.830673 | -1.76 | 0.58988 | 0.15729 | 0.57588 | 0.67474 | -0.08157 | 3.14538 |
| 0212 | -77.529831 | 167.050827 | -3.57 | 0.66093 | 0.31150 | 1.97855 | 0.68588 | 0.81547 | 8.25318 |
| 0213 | -77.538498 | 167.035004 | -3.34 | 0.30318 | -0.10362 | 0.28536 | 0.22429 | 0.00600 | 0.96253 |
| 0213 | -77.541664 | 167.050507 | -3.47 | 0.34532 | -0.11108 | 0.31360 | 0.43508 | 0.21152 | 1.96960 |
| 0213 | -77.538002 | 167.023834 | -3.69 | 0.22035 | 0.06786 | 0.33713 | 0.23301 | 0.33048 | .32663 |
| 0213 | -77.519165 | 166.858002 | -2.18 | 1.29893 | 0.13758 | 1.69183 | 0.33934 | 0.23777 | .69173 |
| 0213 | -77.536331 | 167.290833 | -3.39 | 0.36531 | -0.40751 | -0.42998 | 1.21071 | 0.98782 | .15388 |
| 0214 | -77.523834 | 167.029999 | -3.70 | 0.15331 | 0.03826 | 0.22271 | 0.10885 | 0.11222 | .75778 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960215 | -77.524666 | 167.029831 | -3.56 | 0.18073 | 0.02612 | 0.25755 | 0.15558 | 0.06182 | 0.82369 |
| 960215 | -77.559166 | 167.414841 | -2.52 | 0.78627 | -0.80495 | -0.82332 | 1.45013 | 0.76398 | 2.67352 |
| 960216 | -77.529503 | 167.050507 | -3.56 | 0.27989 | 0.06084 | 0.57817 | 0.31671 | 0.18817 | 2.37322 |
| 960217 | -77.539665 | 167.348495 | -1.36 | 0.35659 | -0.25411 | -0.17797 | 0.56325 | 0.19968 | 0.54015 |
| 960217 | -77.540001 | 167.218002 | -3.70 | 0.20903 | -0.05727 | -0.33408 | 0.32743 | 0.26001 | 2.07334 |
| 960217 | -77.556999 | 167.069672 | -0.40 | 0.19699 | -0.18587 | -0.02154 | 0.47246 | -0.04386 | 0.55054 |
| 960217 | -77.533333 | 167.079163 | -3.70 | 0.14024 | -0.03504 | -0.02949 | 0.21319 | 0.13047 | 0.35655 |
| 960217 | -77.527664 | 167.135330 | -2.33 | 0.17295 | -0.02398 | 0.02812 | 0.20465 | -0.04807 | 0.26240 |
| 960218 | -77.555000 | 167.157837 | -2.53 | 0.18228 | -0.07870 | 0.00721 | 0.48950 | 0.31445 | 0.89819 |
| 960218 | -77.540169 | 167.032333 | -3.69 | 0.13915 | -0.00664 | 0.11626 | 0.19069 | 0.17263 | 0.72001 |
| 960218 | -77.534836 | 167.247330 | -1.66 | 0.28266 | 0.00135 | 0.08317 | 0.19997 | 0.00131 | 0.24736 |
| 960218 | -77.535500 | 167.083832 | -3.54 | 0.28689 | 0.00034 | 0.14415 | 0.36898 | 0.10741 | 0.35410 |
| 960218 | -77.524330 | 166.959839 | -2.94 | 0.44280 | 0.00117 | 0.45411 | 0.34300 | 0.18084 | 1.06417 |
| 960218 | -77.529663 | 167.074493 | -3.59 | 0.37121 | 0.07173 | 0.34084 | 0.25440 | 0.18417 | 2.31436 |
| 960219 | -77.524834 | 166.976334 | -3.00 | 0.68882 | 0.08877 | 1.37770 | 0.16289 | 0.25345 | 3.70828 |
| 960219 | -77.535164 | 167.018661 | -3.59 | 0.20813 | 0.01881 | 0.31741 | 0.33907 | 0.15918 | 1.45269 |
| 960219 | -77.526665 | 167.437836 | -0.66 | 0.64843 | -0.46071 | 0.53767 | 0.75728 | -0.12607 | 1.64425 |
| 960219 | -77.544670 | 167.104660 | -1.64 | 0.16627 | -0.06020 | 0.02261 | 0.27365 | 0.06833 | 0.40007 |
| 960219 | -77.534668 | 167.104828 | -2.96 | 0.26074 | -0.17358 | -0.06642 | 0.60829 | 0.27706 | 0.38094 |
| 960220 | -77.512001 | 167.322495 | -3.59 | 0.24353 | 0.03446 | -0.45822 | 0.46389 | -0.40027 | 2.57251 |
| 960220 | -77.517670 | 167.373840 | -3.24 | 0.20939 | -0.05030 | -0.26532 | 0.36893 | -0.20725 | 0.98167 |
| 960220 | -77.530334 | 167.008331 | -3.05 | 0.47842 | 0.03024 | 0.88011 | 0.43245 | 0.07000 | 2.42908 |
| 960220 | -77.526833 | 167.037338 | -3.32 | 0.19178 | -0.00324 | 0.31281 | 0.21082 | -0.03701 | 1.05725 |
| 960220 | -77.536835 | 167.244507 | -2.44 | 0.17576 | -0.06124 | 0.00826 | 0.28894 | 0.02968 | 0.18528 |
| 960220 | -77.539665 | 166.953003 | -2.70 | 0.39227 | 0.09829 | 0.34737 | 0.12240 | 0.10342 | 0.68525 |
| 960220 | -77.595001 | 167.339340 | 2.10 | 0.72986 | -0.83098 | -0.13233 | 2.09682 | 0.39558 | 0.44330 |
| 960220 | -77.542000 | 167.075836 | -3.51 | 0.37059 | 0.00928 | 0.64988 | 0.24384 | 0.29036 | 2.50542 |
| 960220 | -77.538498 | 167.013168 | -3.59 | 0.38330 | 0.07474 | 0.78618 | 0.20437 | 0.32341 | 2.84230 |
| 960221 | -77.529167 | 167.010330 | -1.30 | 0.17229 | -0.02550 | 0.11040 | 0.46085 | -0.18137 | 0.54682 |
| 960221 | -77.536003 | 167.055161 | -3.49 | 0.19653 | -0.00377 | 0.35743 | 0.18812 | 0.06785 | 1.35515 |
| 960221 | -77.527496 | 167.005829 | -3.14 | 0.21674 | 0.00481 | 0.26806 | 0.14556 | 0.03750 | 1.15770 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0221 | -77.534164 | 167.081833 | -3.44 | 0.29686 | -0.09926 | 0.03761 | 0.35421 | 0.04800 | 0.19893 |
| 0221 | -77.521332 | 166.891327 | -2.90 | 0.62427 | -0.02293 | -0.02907 | 0.51734 | 0.27235 | 0.75839 |
| 0221 | -77.536163 | 167.061340 | -3.33 | 0.22432 | 0.01499 | 0.31424 | 0.22384 | 0.22281 | 1.09171 |
| 0221 | -77.519333 | 167.006836 | -3.68 | 0.47304 | 0.06514 | 0.47381 | 0.18431 | 0.11429 | 1.36253 |
| 0221 | -77.548836 | 167.219666 | -3.13 | 0.18402 | -0.09798 | -0.04256 | 0.44108 | 0.19193 | 0.73483 |
| 0221 | -77.529663 | 167.033829 | -3.33 | 0.45639 | -0.04199 | 0.68448 | 0.31021 | -0.03614 | 2.41340 |
| 0221 | -77.535500 | 167.082336 | -3.45 | 0.24647 | -0.06836 | 0.31523 | 0.36957 | 0.14035 | 1.51397 |
| 0221 | -77.532669 | 167.029999 | -3.69 | 0.33107 | 0.08913 | 0.54752 | 0.47424 | 0.41294 | 2.33463 |
| 0221 | -77.547668 | 167.227661 | -2.82 | 0.25970 | -0.20722 | -0.06017 | 0.61962 | 0.45515 | 0.97055 |
| 0221 | -77.515831 | 166.910339 | -2.42 | 0.30503 | 0.06564 | 0.34859 | 0.09929 | 0.09226 | 1.24564 |
| 0221 | -77.515503 | 166.843002 | -3.21 | 0.51288 | 0.15200 | 0.44488 | 0.17052 | 0.21977 | 1.44642 |
| 0221 | -77.533501 | 167.020493 | -3.46 | 0.45353 | 0.02930 | 0.71269 | 0.37836 | 0.33767 | 2.47802 |
| 0222 | -77.565331 | 166.902832 | -2.00 | 1.61089 | 1.58535 | 1.13727 | 2.14664 | 1.20375 | 1.87244 |
| 0222 | -77.547997 | 166.967499 | -3.71 | 0.45579 | 0.08985 | 0.29430 | 0.38131 | 0.37695 | 0.81259 |
| 0222 | -77.535835 | 166.916840 | -3.50 | 1.18884 | 0.05266 | 0.81902 | 0.51141 | 0.02788 | 1.01974 |
| 0222 | -77.553665 | 167.076508 | -1.65 | 0.31950 | -0.22903 | 0.02103 | 0.46164 | 0.16151 | 0.76871 |
| 0222 | -77.535164 | 167.080338 | -3.49 | 0.25944 | -0.15099 | 0.07632 | 0.40839 | 0.08578 | 0.93212 |
| 0223 | -77.545830 | 167.110672 | -3.59 | 0.21027 | 0.11487 | 0.40144 | 0.62909 | 0.97418 | 3.38042 |
| 0225 | -77.556335 | 167.222672 | -0.56 | 0.29327 | -0.21979 | 0.09195 | 0.58080 | -0.00218 | 0.60589 |
| 0225 | -77.518501 | 166.935837 | -1.70 | 0.26451 | 0.00312 | 0.15391 | 0.16384 | -0.09289 | 1.04163 |
| 0225 | -77.517334 | 166.900833 | -2.42 | 0.46296 | 0.08545 | 0.65328 | 0.16283 | 0.15756 | 2.47414 |
| 0225 | -77.539833 | 166.996994 | -3.08 | 0.49671 | 0.09452 | 0.65651 | 0.30867 | 0.45457 | 1.96455 |
| 0225 | -77.525665 | 166.967163 | -3.71 | 0.44464 | -0.00438 | 0.50497 | 0.24064 | 0.04325 | 1.24472 |
| 0225 | -77.536835 | 167.031174 | -2.26 | 0.32306 | 0.06728 | 0.31811 | 0.27404 | 0.19379 | 1.03290 |
| 0226 | -77.527000 | 166.980835 | -3.10 | 0.35859 | -0.03162 | 0.64508 | 0.29151 | 0.09960 | 1.96981 |
| 0227 | -77.485497 | 167.315002 | -3.69 | 0.22533 | 0.04473 | -0.25070 | 0.61981 | -0.37085 | 1.60479 |
| 0227 | -77.551834 | 166.948669 | -3.70 | 0.42849 | 0.20984 | 0.22702 | 0.34745 | 0.31569 | 0.59405 |
| 0227 | -77.536331 | 166.996002 | -1.75 | 0.18736 | -0.05871 | 0.01222 | 0.20516 | 0.07116 | 0.59748 |
| 0227 | -77.518333 | 166.971497 | -3.38 | 0.33364 | 0.00128 | 0.43460 | 0.21298 | 0.15521 | 1.43331 |
| 0227 | -77.523003 | 167.016327 | -3.70 | 0.28703 | 0.08899 | 0.40788 | 0.31496 | 0.19526 | 1.55801 |
| 0227 | -77.516502 | 167.000504 | -2.39 | 0.29595 | -0.06292 | 0.27255 | 0.38033 | 0.06000 | 1.38368 |
| 0227 | -77.536003 | 166.966171 | -3.21 | 0.40256 | 0.04270 | 0.52044 | 0.16695 | 0.09259 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960228 | -77.533165 | 167.080673 | -3.54 | 0.17234 | 0.04904 | 0.19152 | 0.25839 | 0.23646 | 1.33921 |
| 960228 | -77.533669 | 166.942993 | 2.77 | 0.49858 | 0.06714 | -0.12853 | 0.26739 | -0.07580 | 0.38402 |
| 960228 | -77.534668 | 166.979172 | -2.18 | 0.19981 | 0.01894 | 0.10005 | 0.15883 | 0.01275 | 0.73131 |
| 960228 | -77.537003 | 167.052673 | -3.53 | 0.24576 | 0.01792 | 0.52555 | 0.24413 | 0.28886 | 2.51007 |
| 960228 | -77.538002 | 167.043335 | -3.47 | 0.18903 | -0.00321 | 0.31974 | 0.21206 | 0.17496 | 1.55888 |
| 960228 | -77.537498 | 167.102341 | -2.71 | 0.20728 | -0.10181 | -0.00701 | 0.38725 | 0.16768 | 0.40545 |
| 960228 | -77.534836 | 167.077332 | -3.49 | 0.15942 | -0.00867 | 0.17775 | 0.50992 | 0.17485 | 1.34060 |
| 960228 | -77.532166 | 167.062164 | -3.56 | 0.20972 | 0.03154 | 0.43499 | 0.21780 | 0.19807 | 2.25247 |
| 960228 | -77.562668 | 166.973495 | -3.44 | 1.32224 | 1.52483 | 1.85442 | 3.07497 | 3.21899 | 3.95280 |
| 960228 | -77.522667 | 166.960327 | -3.36 | 0.74599 | 0.18874 | 1.01070 | 0.31250 | 0.49338 | 2.85145 |
| 960228 | -77.536163 | 166.916000 | -3.25 | 0.75225 | -0.00957 | 0.34240 | 0.24148 | 0.00928 | 0.65626 |
| 960228 | -77.546669 | 166.952332 | -3.37 | 0.47558 | 0.18568 | 0.35112 | 0.24460 | 0.28352 | 0.82982 |
| 960228 | -77.534836 | 167.085663 | -3.49 | 0.32528 | -0.18796 | 0.07648 | 0.45049 | -0.04827 | 0.31422 |
| 960228 | -77.533501 | 167.054504 | -3.71 | 0.17858 | 0.01853 | 0.32262 | 0.30431 | 0.25905 | 2.90699 |
| 960228 | -77.564667 | 167.171341 | -3.66 | 0.48433 | -0.16862 | -0.06830 | 1.46294 | 1.03205 | 3.19240 |
| 960229 | -77.521164 | 166.996338 | -2.80 | 0.39596 | -0.01571 | 0.55809 | 0.30768 | -0.00224 | 2.01636 |
| 960304 | -77.537498 | 167.225998 | -2.09 | 0.19009 | 0.00314 | 0.00177 | 0.44522 | -0.05516 | 0.25464 |
| 960306 | -77.573166 | 167.164169 | -0.77 | 0.10645 | -0.10060 | -0.07425 | 0.50449 | 0.17777 | 0.54901 |
| 960308 | -77.579498 | 167.010666 | -2.78 | 0.75998 | 0.42732 | 0.47665 | 1.50474 | -0.26367 | 1.46525 |
| 960309 | -77.416496 | 166.735168 | 1.81 | 1.00343 | -0.09038 | 0.21485 | 1.28551 | -0.15781 | 0.36104 |
| 960310 | -77.557167 | 167.236160 | -3.71 | 0.18625 | -0.13398 | -0.07580 | 0.61158 | 0.48876 | 1.13216 |
| 960312 | -77.525833 | 166.983994 | -2.86 | 0.16272 | -0.03127 | 0.20639 | 0.21617 | -0.01097 | 0.63110 |
| 960312 | -77.530167 | 167.005661 | -3.36 | 0.28744 | 0.00960 | 0.41938 | 0.15838 | 0.05990 | 1.20407 |
| 960313 | -77.530502 | 166.968826 | -3.09 | 0.29051 | 0.01719 | 0.37926 | 0.21259 | 0.04857 | 1.02689 |
| 960320 | -77.532837 | 167.494995 | 1.28 | 1.57012 | -1.07885 | 0.10273 | 1.19407 | -0.00173 | 0.19580 |
| 960320 | -77.569504 | 167.402328 | 1.17 | 0.36783 | -0.38311 | -0.03380 | 0.87661 | 0.11017 | 0.38556 |
| 960320 | -77.576332 | 167.206329 | -2.33 | 0.24389 | -0.13007 | -0.02382 | 0.62745 | 0.21664 | 0.71860 |
| 960321 | -77.519165 | 166.970169 | -3.58 | 0.32243 | 0.04762 | 0.28158 | 0.15720 | 0.14501 | 0.75037 |
| 960322 | -77.562164 | 167.250000 | -3.70 | 0.33236 | -0.15244 | -0.05857 | 0.46262 | 0.26534 | 1.21499 |
| 960322 | -77.533836 | 167.043671 | -3.53 | 0.24675 | 0.02696 | 0.51750 | 0.17939 | 0.16761 | 2.29346 |
| 960322 | -77.544830 | 167.196503 | -1.79 | 0.17552 | -0.04904 | -0.00250 | 0.31781 | 0.03053 | 0.32665 |
| 960323 | -77.553497 | 166.899170 | -3.51 | 0.79858 | 0.23403 | 0.24957 | 0.56165 | 0.36509 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0323 | -77.535667 | 167.072174 | -3.49 | 0.18907 | -0.03431 | 0.27086 | 0.49291 | 0.12724 | 1.60800 |
| 0323 | -77.554832 | 166.977341 | -1.44 | 0.34313 | 0.01911 | 0.05196 | 0.11400 | -0.08407 | 0.73287 |
| 0323 | -77.591667 | 167.349670 | 0.04 | 0.93491 | -0.77990 | -0.28645 | 1.78794 | 0.43917 | 0.56711 |
| 0324 | -77.596336 | 167.192001 | 0.82 | 0.29732 | -0.16142 | -0.05702 | 1.46754 | 0.25690 | 0.41514 |
| 0325 | -77.532997 | 167.152161 | -2.17 | 0.15230 | 0.00568 | -0.01552 | 0.21323 | -0.03896 | 0.25448 |
| 0325 | -77.526001 | 167.172668 | -2.13 | 0.15919 | 0.03194 | 0.00746 | 0.24488 | -0.08489 | 0.32592 |
| 0325 | -77.537666 | 167.117493 | -0.60 | 0.16024 | -0.00463 | 0.00541 | 0.30656 | -0.04097 | 0.34319 |
| 0325 | -77.525497 | 167.171341 | -2.35 | 0.12264 | 0.02820 | -0.00905 | 0.21740 | -0.10809 | 0.28995 |
| 0326 | -77.581169 | 167.189331 | -3.69 | 0.34115 | -0.09618 | -0.14854 | 1.43752 | 1.10487 | 2.42133 |
| 0326 | -77.526833 | 167.007339 | -2.90 | 0.17088 | 0.03710 | 0.23468 | 0.16445 | 0.10393 | 0.88457 |
| 0326 | -77.540665 | 167.353165 | -1.59 | 0.27145 | -0.27696 | -0.15575 | 0.64523 | 0.18293 | 0.83327 |
| 0326 | -77.543831 | 166.927505 | -2.05 | 0.52627 | 0.13623 | 0.38105 | 0.13934 | 0.19642 | 1.30437 |
| 0328 | -77.534164 | 167.082169 | -3.50 | 0.18611 | -0.07374 | 0.02124 | 0.22156 | 0.02146 | 0.23232 |
| 0328 | -77.535004 | 167.078827 | -3.43 | 0.18020 | -0.01676 | 0.26259 | 0.23599 | 0.03724 | 1.02379 |
| 0328 | -77.527664 | 167.171829 | -3.70 | 0.19790 | 0.02056 | -0.17422 | 0.23853 | -0.07067 | 2.35354 |
| 0328 | -77.535164 | 167.061005 | -3.39 | 0.23735 | 0.06825 | 0.46378 | 0.33704 | 0.25033 | 1.55562 |
| 0328 | -77.536163 | 167.081329 | -3.58 | 0.30123 | -0.27367 | 0.10734 | 0.80859 | -0.34883 | 1.30997 |
| 0512 | -77.542336 | 167.160995 | -2.09 | 0.18929 | -0.02430 | 0.03811 | 0.48749 | -0.00473 | 0.37321 |
| 0515 | -77.548164 | 167.229172 | -0.42 | 0.16729 | -0.10249 | -0.05828 | 0.45502 | 0.08027 | 0.36766 |
| 0516 | -77.613503 | 166.960831 | 0.14 | 0.46279 | 0.64592 | 0.26737 | 2.92703 | 0.96262 | 0.53018 |
| 0516 | -77.554497 | 167.215332 | -2.98 | 0.09349 | -0.05128 | -0.01782 | 0.22486 | 0.16800 | 0.47163 |
| 0518 | -77.542664 | 167.378998 | -2.05 | 0.30414 | -0.23490 | -0.07103 | 0.58401 | 0.08382 | 0.82184 |
| 0520 | -77.552834 | 166.796326 | 0.58 | 1.63493 | 1.14278 | 0.33187 | 1.24691 | 0.22203 | 0.41816 |
| 0525 | -77.535004 | 167.145004 | -3.67 | 0.12985 | 0.03678 | 0.01749 | 0.25725 | 0.06527 | 0.90290 |
| 0525 | -77.549667 | 167.189331 | -2.50 | 0.17119 | -0.04259 | -0.04433 | 0.42597 | 0.07921 | 0.41284 |
| 0529 | -77.526833 | 167.147827 | -3.69 | 0.17268 | -0.01260 | 0.02204 | 0.18388 | -0.13206 | 1.25336 |
| 0530 | -77.536835 | 167.205994 | -2.67 | 0.22014 | -0.00716 | 0.00808 | 0.58460 | -0.20737 | 0.80518 |
| 0530 | -77.528503 | 167.112839 | -2.77 | 0.17954 | -0.11449 | 0.13475 | 0.24481 | -0.20956 | 0.45550 |
| 0531 | -77.551666 | 167.229340 | -1.27 | 0.18600 | -0.08982 | -0.06607 | 0.90247 | 0.15005 | 0.27147 |
| 0531 | -77.551331 | 167.156326 | -0.20 | 0.21670 | -0.00180 | 0.04381 | 0.67453 | -0.05369 | 0.49872 |
| 0531 | -77.556664 | 167.233002 | -0.06 | 0.22435 | -0.09972 | -0.00048 | 0.91318 | -0.03875 | 0.38247 |
| 0531 | -77.552666 | 167.175339 | -1.58 | 0.14332 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960531 | -77.574997 | 167.195831 | -2.49 | 0.27539 | -0.13138 | -0.11153 | 1.42591 | 0.81264 | 1.43836 |
| 960531 | -77.546165 | 167.251999 | -2.18 | 0.16845 | -0.11006 | -0.09942 | 0.76696 | 0.24087 | 0.32459 |
| 960602 | -77.581001 | 167.256165 | -2.55 | 0.27338 | -0.19524 | -0.10518 | 1.15352 | 0.34586 | 0.84306 |
| 960603 | -77.577835 | 167.263672 | -3.69 | 0.28930 | -0.19085 | -0.12407 | 0.98337 | 0.53932 | 1.30731 |
| 960605 | -77.547501 | 167.190506 | -2.02 | 0.12916 | -0.06248 | 0.00149 | 0.56078 | 0.04953 | 0.35003 |
| 960609 | -77.556999 | 167.199493 | 0.31 | 0.13092 | -0.07323 | -0.00727 | 0.63954 | -0.00827 | 0.23954 |
| 960610 | -77.537834 | 166.928497 | 1.77 | 0.98786 | 1.10644 | -0.99119 | 2.04010 | -1.78389 | 1.87204 |
| 960610 | -77.653664 | 166.447998 | -3.71 | 6.01713 | 5.20639 | 6.74882 | 6.14037 | 6.64815 | 8.62251 |
| 960610 | -77.523666 | 167.040497 | -1.03 | 0.27311 | -0.17306 | 0.38720 | 0.47905 | -0.63360 | 1.63781 |
| 960610 | -77.580666 | 167.288834 | 0.24 | 0.59303 | -1.16322 | -0.24436 | 4.62074 | 0.94521 | 0.54622 |
| 960610 | -77.542831 | 167.079330 | 0.21 | 0.17015 | -0.00870 | 0.00333 | 0.66846 | -0.19065 | 0.41139 |
| 960610 | -77.533997 | 166.997330 | -1.48 | 0.14197 | -0.02912 | 0.04191 | 0.63458 | -0.55537 | 1.08341 |
| 960610 | -77.550499 | 167.063339 | -2.39 | 0.32373 | 0.00463 | 0.12941 | 0.97664 | 0.16198 | 0.50956 |
| 960611 | -77.531670 | 166.941833 | -3.71 | 1.89614 | 1.33644 | 2.21196 | 1.13179 | 1.65400 | 2.89204 |
| 960611 | -77.464500 | 166.691330 | 9.98 | 6.71864 | -1.62561 | -6.56510 | 1.43974 | 2.74698 | 9.83973 |
| 960611 | -77.570831 | 166.843170 | -0.90 | 3.20145 | 3.32545 | 1.64729 | 4.19347 | 1.77980 | 1.67508 |
| 960611 | -77.545670 | 166.917496 | -2.37 | 1.10751 | 0.92761 | 0.45083 | 1.53775 | -0.18143 | 1.78451 |
| 960612 | -77.503830 | 167.036835 | -0.93 | 0.35132 | -0.12227 | 0.56256 | 0.33788 | -0.27999 | 2.03074 |
| 960613 | -77.568169 | 167.351837 | 2.82 | 8.03162 | ******** | -0.90070 | 29.57651 | 3.28835 | 2.61181 |
| 960713 | -77.507835 | 167.231171 | -3.30 | 0.13545 | 0.05040 | -0.24693 | 0.31067 | -0.76918 | 3.28383 |
| 960714 | -77.539497 | 167.144165 | -1.77 | 0.12022 | 0.00854 | 0.00245 | 0.61996 | -0.09793 | 0.32979 |
| 960714 | -77.532333 | 167.164673 | -2.93 | 0.13146 | -0.02130 | 0.00112 | 0.46210 | -0.10009 | 0.45644 |
| 960714 | -77.534836 | 167.234833 | -1.49 | 0.36476 | -0.28584 | 0.13884 | 1.60230 | -0.35513 | 0.54291 |
| 960715 | -77.651497 | 167.556168 | -3.64 | 6.91519 | ******** | -8.68094 | 19.10042 | 16.31022 | 17.04431 |
| 960715 | -77.536331 | 167.593170 | 1.24 | 1.40558 | -0.28193 | -0.26695 | 0.79973 | 0.12778 | 0.40469 |
| 960716 | -77.532333 | 167.066666 | -3.54 | 0.15954 | 0.05399 | 0.20676 | 0.20497 | 0.01073 | 1.37545 |
| 960716 | -77.523003 | 167.165833 | -3.71 | 0.19352 | -0.02912 | -0.17022 | 0.49627 | -0.75954 | 3.15020 |
| 960716 | -77.532166 | 167.166336 | -2.30 | 0.08218 | -0.04029 | -0.02188 | 0.48277 | -0.11518 | 0.23503 |
| 960716 | -77.535835 | 167.064835 | -3.37 | 0.32409 | 0.02876 | 0.13354 | 1.19983 | 0.05462 | 0.81596 |
| 960717 | -77.463165 | 167.048004 | 12.39 | 1.78592 | 0.30707 | -3.80184 | 1.39677 | 0.66910 | 17.47730 |
| 960717 | -77.573166 | 167.348328 | 0.59 | 1.24277 | -2.64512 | -0.40885 | 7.09889 | 1.14995 | 0.60832 |
| 960718 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 60718 | -77.523331 | 167.246506 | -1.50 | 0.17055 | -0.07121 | 0.04019 | 0.68371 | -0.40777 | 0.74573 |
| 50719 | -77.606163 | 167.376831 | 0.94 | 0.58703 | -0.06164 | -0.06977 | 0.43751 | 0.21853 | 0.55545 |
| 50719 | -77.504501 | 167.186661 | -3.71 | 0.19569 | 0.07907 | -0.34753 | 0.41336 | -1.06958 | 5.49095 |
| 50719 | -77.527168 | 167.284332 | -3.19 | 0.16174 | -0.04842 | -0.21190 | 0.69593 | -0.95843 | 2.83227 |
| 50719 | -77.543503 | 167.065994 | -2.31 | 0.16945 | 0.03904 | 0.05266 | 0.39094 | -0.02859 | 0.22961 |
| 50722 | -77.484665 | 166.889008 | 8.79 | 1.89525 | 0.27892 | -2.54492 | 0.51912 | 0.13082 | 5.85563 |
| 60722 | -77.526169 | 167.140335 | -2.79 | 0.10560 | 0.00403 | 0.02380 | 0.27334 | -0.10665 | 0.29106 |
| 50722 | -77.540337 | 167.176163 | -2.47 | 0.16023 | -0.00021 | 0.00662 | 0.67990 | 0.00577 | 0.34987 |
| 50722 | -77.520836 | 167.316162 | 3.28 | 0.54375 | -0.66667 | 0.33145 | 1.98280 | -0.67089 | 0.58344 |
| 50723 | -77.529663 | 166.972336 | -2.91 | 0.33717 | 0.01077 | 0.47204 | 0.23894 | 0.10510 | 1.33363 |
| 50723 | -77.534836 | 167.170670 | -3.71 | 0.10622 | 0.06843 | -0.05919 | 0.47835 | -0.00438 | 0.90523 |
| 50724 | -77.556168 | 167.223495 | -1.23 | 0.23233 | -0.33145 | -0.09957 | 1.69649 | 0.51804 | 0.51116 |
| 50724 | -77.522003 | 167.164841 | -3.65 | 0.11159 | -0.02742 | -0.04910 | 0.27495 | -0.35174 | 1.34343 |
| 50725 | -77.532166 | 167.253998 | -3.35 | 0.22080 | -0.24666 | -0.36338 | 0.73788 | 0.02510 | 2.17132 |
| 50725 | -77.535835 | 167.065002 | -2.11 | 0.24587 | -0.10799 | 0.14756 | 1.51867 | -0.23380 | 0.41546 |
| 50727 | -77.502831 | 167.106003 | -0.98 | 0.10382 | 0.04228 | -0.04486 | 0.16852 | -0.14781 | 0.50759 |
| 50727 | -77.589333 | 167.131668 | 1.12 | 0.30078 | -0.00001 | -0.00273 | 8.48583 | 1.44162 | 0.56339 |
| 50727 | -77.588669 | 167.213669 | -1.03 | 0.35587 | -0.36964 | -0.31499 | 3.85307 | 1.24292 | 1.43087 |
| 0727 | -77.523163 | 167.131500 | -3.70 | 0.28025 | -0.12134 | 0.25896 | 0.73669 | -1.03864 | 4.19306 |
| 50728 | -77.543167 | 167.054001 | -1.59 | 0.17860 | 0.04123 | 0.02970 | 1.00708 | 0.02377 | 0.29430 |
| 50728 | -77.518166 | 167.172165 | -3.71 | 0.14841 | 0.02916 | -0.04815 | 0.26495 | -0.36717 | 2.06640 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1207 | -77.611336 | 167.236328 | -2.29 | 0.38078 | -0.32227 | -0.26295 | 1.82809 | 1.00727 | 1.96060 |
| 1208 | -77.528168 | 167.186493 | -3.71 | 0.14706 | -0.01081 | -0.03491 | 0.17708 | -0.02640 | 0.60573 |
| 1209 | -77.519836 | 167.217499 | -3.71 | 0.13853 | 0.01489 | -0.06163 | 0.15977 | -0.06300 | 1.09169 |
| 1209 | -77.524002 | 167.181503 | -3.70 | 0.15214 | 0.00756 | -0.12116 | 0.18694 | -0.09044 | 1.35084 |
| 1209 | -77.525169 | 167.213501 | -3.71 | 0.16779 | 0.03944 | -0.15234 | 0.18421 | -0.08727 | 1.13799 |
| 1209 | -77.528664 | 167.183670 | -3.70 | 0.13160 | 0.00688 | -0.03201 | 0.22952 | 0.00224 | 1.04888 |
| 1210 | -77.526001 | 167.173996 | -3.68 | 0.18630 | -0.02303 | -0.00844 | 0.20576 | -0.04077 | 1.03794 |
| 1210 | -77.522331 | 167.176498 | -2.39 | 0.14371 | 0.01422 | 0.02812 | 0.18113 | -0.04491 | 0.33504 |
| 1210 | -77.527336 | 167.160507 | -3.68 | 0.10136 | 0.00907 | 0.00646 | 0.17228 | -0.05008 | 0.86636 |
| 1211 | -77.523666 | 167.174332 | -3.70 | 0.10722 | 0.02924 | 0.01122 | 0.14888 | -0.06894 | 0.93389 |
| 1211 | -77.523003 | 167.173340 | -3.04 | 0.06931 | 0.01287 | 0.00646 | 0.08592 | -0.02720 | 0.22476 |
| 1212 | -77.525169 | 167.161667 | -3.57 | 0.11796 | 0.02569 | -0.01654 | 0.11397 | -0.03081 | 0.76807 |
| 1216 | -77.525002 | 167.169998 | -2.81 | 0.10871 | 0.01982 | 0.01361 | 0.18038 | -0.06291 | 0.37091 |
| 1216 | -77.521332 | 167.188660 | -3.71 | 0.07221 | 0.00488 | -0.02084 | 0.08135 | -0.03398 | 0.52644 |
| 1217 | -77.519997 | 167.184662 | -3.71 | 0.10341 | 0.00991 | -0.03229 | 0.12877 | -0.09378 | 0.92782 |
| 1217 | -77.520668 | 167.178329 | -2.18 | 0.13161 | -0.00142 | -0.01080 | 0.17907 | -0.04714 | 0.26931 |
| 1217 | -77.471497 | 167.226166 | -3.71 | 0.20241 | 0.04996 | -0.06387 | 0.31292 | -0.27596 | 1.18460 |
| 1217 | -77.522667 | 167.175827 | -3.07 | 0.10148 | 0.02348 | -0.00648 | 0.14913 | -0.06788 | 0.35936 |
| 1217 | -77.524834 | 167.162674 | -3.55 | 0.09322 | -0.00259 | -0.01330 | 0.10306 | -0.03972 | 0.37370 |
| 1218 | -77.521500 | 167.178833 | -3.71 | 0.11183 | -0.00041 | -0.03520 | 0.15631 | -0.07157 | 0.92185 |
| 1219 | -77.525497 | 167.166504 | -3.64 | 0.07096 | 0.00451 | -0.00223 | 0.09342 | -0.04108 | 0.47562 |
| 1219 | -77.526497 | 167.165833 | -2.67 | 0.13172 | -0.00343 | -0.04482 | 0.13956 | 0.00061 | 0.29870 |
| 1219 | -77.523499 | 167.167999 | -3.70 | 0.13125 | 0.00249 | -0.02572 | 0.14434 | -0.10012 | 0.81432 |
| 1219 | -77.525665 | 167.163666 | -2.42 | 0.07109 | -0.00227 | 0.01163 | 0.11212 | -0.01357 | 0.19679 |
| 1220 | -77.525169 | 167.167160 | -2.79 | 0.14079 | -0.00746 | -0.00205 | 0.21843 | -0.03977 | 0.38071 |
| 1220 | -77.523163 | 167.168167 | -3.33 | 0.13767 | 0.01564 | 0.00270 | 0.17652 | -0.07841 | 0.59570 |
| .221 | -77.524170 | 167.171661 | -2.84 | 0.15084 | 0.02113 | -0.01217 | 0.18614 | -0.10513 | .38291 |
| 221 | -77.523666 | 167.195328 | -3.70 | 0.12427 | 0.01290 | -0.04039 | 0.17064 | -0.04824 | .96508 |
| .225 | -77.521004 | 167.170837 | -1.30 | 0.14872 | 0.02920 | 0.04364 | 0.19171 | -0.05862 | .29957 |
| .225 | -77.528000 | 167.164505 | -2.58 | 0.07162 | -0.00797 | 0.00013 | 0.10961 | -0.00696 | .14877 |
| .226 | -77.523499 | 167.217667 | -3.71 | 0.13095 | 0.01470 | -0.07688 | 0.15606 | -0.02299 | .05297 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 941229 | -77.515999 | 167.166504 | -1.35 | 0.11408 | 0.00670 | 0.00625 | 0.12138 | 0.01434 | 0.16454 |
| 950103 | -77.523003 | 167.167160 | -3.39 | 0.08215 | -0.00113 | -0.02077 | 0.13821 | -0.07340 | 0.39957 |
| 950104 | -77.523499 | 167.169662 | -2.80 | 0.13159 | -0.00097 | 0.01838 | 0.17591 | -0.03321 | 0.35250 |
| 950104 | -77.523666 | 167.184662 | -3.25 | 0.09895 | 0.02259 | -0.02384 | 0.10692 | -0.02841 | 0.35413 |
| 950105 | -77.524666 | 167.170334 | -3.70 | 0.08076 | -0.00070 | -0.01971 | 0.14806 | -0.06597 | 0.67106 |
| 950106 | -77.524330 | 167.172333 | -3.71 | 0.12082 | -0.00061 | -0.01880 | 0.14958 | -0.07885 | 0.76947 |
| 950106 | -77.524330 | 167.188339 | -2.99 | 0.11806 | 0.03594 | -0.00533 | 0.11668 | -0.03310 | 0.36524 |
| 950106 | -77.519997 | 167.240997 | -3.71 | 0.16000 | 0.00195 | -0.16398 | 0.17104 | -0.04364 | 1.50895 |
| 950107 | -77.529663 | 167.169006 | -3.71 | 0.14105 | 0.00000 | -0.03000 | 0.25000 | 0.00000 | 0.99895 |
| 950114 | -77.524170 | 167.167007 | -3.70 | 0.09025 | 0.00247 | -0.01145 | 0.14810 | -0.06631 | 0.68165 |
| 950115 | -77.525665 | 167.202164 | -3.71 | 0.19042 | 0.03792 | -0.17537 | 0.20937 | -0.02221 | 1.76014 |
| 950123 | -77.529167 | 167.188660 | -1.47 | 0.24487 | 0.05850 | -0.08602 | 0.41321 | -0.14183 | 0.42188 |
| 950208 | -77.541168 | 167.129837 | -2.55 | 0.16398 | -0.04451 | 0.00122 | 0.22956 | 0.07063 | 0.25646 |
| 950217 | -77.519501 | 167.191666 | -3.70 | 0.13165 | 0.02835 | -0.03619 | 0.14967 | -0.09566 | 1.07866 |
| 950219 | -77.524002 | 167.178665 | -3.70 | 0.13731 | 0.01659 | -0.01597 | 0.16894 | -0.06821 | 0.95375 |
| 950222 | -77.530167 | 167.194672 | -3.71 | 0.12059 | -0.00175 | -0.08576 | 0.22082 | -0.02537 | 0.81858 |
| 950222 | -77.523163 | 167.166504 | -3.22 | 0.16925 | 0.02948 | 0.00573 | 0.19352 | -0.10082 | 0.61719 |
| 950222 | -77.530998 | 167.230667 | -3.71 | 0.15877 | -0.01383 | -0.14125 | 0.24122 | 0.12065 | 0.85000 |
| 950223 | -77.526665 | 167.175827 | -3.70 | 0.08818 | 0.00506 | -0.09010 | 0.12074 | -0.02921 | 1.09107 |
| 950223 | -77.526665 | 167.174835 | -2.68 | 0.12402 | -0.01495 | -0.00914 | 0.21019 | -0.02913 | 0.25578 |
| 950225 | -77.528168 | 167.160995 | -1.53 | 0.21823 | 0.01901 | -0.04295 | 0.22050 | -0.03707 | 0.39128 |
| 950225 | -77.523163 | 167.172668 | -3.69 | 0.17927 | -0.00238 | -0.03191 | 0.17220 | -0.10438 | 1.19853 |
| 950225 | -77.529335 | 167.179993 | -3.71 | 0.20093 | 0.04468 | -0.23028 | 1.05623 | -0.34072 | 2.74284 |
| 950226 | -77.521332 | 167.180161 | -2.76 | 0.10308 | -0.00062 | -0.02574 | 0.16927 | -0.04324 | 0.34762 |
| 950226 | -77.524498 | 167.163666 | -2.48 | 0.12999 | 0.00874 | -0.02741 | 0.12755 | -0.02174 | 0.29245 |
| 950226 | -77.521667 | 167.199173 | -3.70 | 0.12950 | 0.00272 | -0.08281 | 0.16817 | -0.08298 | 0.91223 |
| 950226 | -77.525169 | 167.182999 | -3.71 | 0.18245 | 0.01536 | -0.12611 | 0.21961 | -0.05609 | 1.76792 |
| 950227 | -77.525497 | 167.187332 | -2.26 | 0.18402 | 0.01141 | -0.03881 | 0.25733 | -0.07683 | 0.57865 |
| 950228 | -77.521004 | 167.201508 | -3.70 | 0.14672 | 0.01134 | -0.07086 | 0.17299 | -0.06261 | 1.08010 |
| 950228 | -77.522331 | 167.190338 | -3.17 | 0.17974 | 0.03237 | -0.01216 | 0.19428 | -0.08329 | 0.69596 |
| 950301 | -77.524666 | 167.155838 | -3.20 | 0.19154 | -0.00227 | 0.02609 | 0.17871 | -0.08114 | 0.51973 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 50303 | -77.523331 | 167.192169 | -3.15 | 0.14271 | 0.00977 | -0.02289 | 0.17826 | -0.05663 | 0.50900 |
| 50304 | -77.526169 | 167.179337 | -3.28 | 0.11241 | -0.01261 | -0.00822 | 0.19023 | -0.02697 | 0.47735 |
| 50304 | -77.515503 | 167.176163 | -3.71 | 0.19355 | 0.01486 | 0.02791 | 0.36620 | -0.24564 | 1.54009 |
| 50305 | -77.531670 | 167.171341 | -3.71 | 0.15069 | -0.01047 | -0.01775 | 0.42146 | 0.03492 | 1.09785 |
| 50306 | -77.521500 | 167.170334 | -3.70 | 0.15976 | 0.03193 | 0.01937 | 0.22702 | -0.17666 | 1.37306 |
| 50308 | -77.521667 | 167.194336 | -3.53 | 0.12445 | 0.01345 | -0.02778 | 0.16230 | -0.05690 | 0.75325 |
| 50309 | -77.521164 | 167.193665 | -1.90 | 0.13771 | -0.01326 | -0.01014 | 0.15347 | 0.00736 | 0.28882 |
| 50310 | -77.522003 | 167.172501 | -2.99 | 0.15029 | 0.01295 | 0.00804 | 0.16974 | -0.05274 | 0.43997 |
| 50310 | -77.525002 | 167.167664 | -2.52 | 0.12792 | 0.01564 | 0.00263 | 0.16400 | -0.06948 | 0.23808 |
| 50313 | -77.519501 | 167.193161 | -3.70 | 0.18456 | 0.04260 | -0.04429 | 0.24021 | -0.16449 | 1.40501 |
| 50314 | -77.518166 | 167.183838 | -3.68 | 0.15165 | -0.04735 | 0.00640 | 0.38056 | -0.24701 | 1.15779 |
| 50315 | -77.525002 | 167.161163 | -3.70 | 0.15031 | 0.00175 | 0.00681 | 0.17352 | -0.05270 | 0.90617 |
| 50315 | -77.525330 | 167.160172 | -2.76 | 0.11027 | -0.00154 | -0.01081 | 0.10160 | -0.01172 | 0.23812 |
| 50315 | -77.535500 | 167.179001 | -3.49 | 0.07140 | -0.00965 | -0.01889 | 0.16182 | 0.06428 | 0.48676 |
| 50315 | -77.532669 | 167.217331 | -3.71 | 0.12671 | -0.10172 | -0.21238 | 0.37664 | 0.33350 | 1.26654 |
| 50317 | -77.514503 | 167.174667 | -3.71 | 0.13918 | 0.02194 | -0.01484 | 0.20600 | -0.20926 | 1.42470 |
| 50317 | -77.535667 | 167.271500 | -3.15 | 1.15952 | -0.28991 | -0.37940 | 1.08738 | 0.06721 | 1.59293 |
| 50317 | -77.519836 | 167.177002 | -3.70 | 0.14533 | 0.03261 | -0.04317 | 0.21245 | -0.22230 | 1.54212 |
| 50317 | -77.530167 | 167.161499 | -3.71 | 0.09844 | -0.06782 | -0.04123 | 0.41190 | -0.04687 | 0.64965 |
| 50318 | -77.521332 | 167.190002 | -2.57 | 0.08583 | 0.02270 | -0.00933 | 0.10467 | -0.02977 | 0.19948 |
| 50319 | -77.520668 | 167.178665 | -3.66 | 0.09221 | 0.02524 | -0.00998 | 0.13659 | -0.07880 | 0.85119 |
| 50319 | -77.527664 | 167.170502 | -3.71 | 0.14516 | -0.01870 | -0.03250 | 0.22613 | 0.00699 | 1.00870 |
| 50320 | -77.527664 | 167.166000 | -3.71 | 0.15687 | -0.09875 | -0.00977 | 0.42735 | -0.18324 | 1.14578 |
| 50322 | -77.524170 | 167.152832 | -3.70 | 0.27784 | -0.05753 | -0.10699 | 0.19460 | -0.02719 | 1.21740 |
| 50322 | -77.528336 | 167.155502 | -3.71 | 0.15924 | -0.14230 | -0.05785 | 0.60682 | -0.43467 | 1.50390 |
| 50322 | -77.527496 | 167.132004 | -3.71 | 0.23976 | -0.07488 | 0.09423 | 0.41729 | -0.05910 | 2.11244 |
| 50323 | -77.525169 | 167.169662 | -3.71 | 0.09402 | 0.00681 | 0.05161 | 0.11210 | 0.04725 | 0.90387 |
| 50323 | -77.521667 | 167.157669 | -3.69 | 0.13249 | -0.03149 | -0.02151 | 0.15937 | -0.02604 | 0.72813 |
| 50324 | -77.523003 | 167.178497 | -2.33 | 0.18222 | 0.01822 | 0.06586 | 0.18316 | -0.03982 | 0.37462 |
| 50324 | -77.515831 | 167.152496 | -3.69 | 0.14132 | -0.05400 | 0.08731 | 0.39125 | -0.36645 | 1.43738 |
| 50324 | -77.524002 | 167.182159 | -3.28 | 0.10275 | -0.00054 | -0.03033 | 0.16866 | -0.05493 | 0.48859 |
| 50325 | -77.523163 | 167.176834 | -3.70 | 0.08376 | 0.01592 | -0.00921 | 0.09136 | -0.04939 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 950325 | -77.516670 | 167.164993 | -3.71 | 0.08766 | -0.03238 | 0.03011 | 0.24687 | -0.28485 | 1.02546 |
| 950326 | -77.511497 | 167.192673 | -3.32 | 0.10966 | 0.04228 | -0.02938 | 0.14935 | -0.21362 | 1.06093 |
| 950329 | -77.514832 | 167.174164 | -0.55 | 0.19242 | 0.09049 | -0.07742 | 0.53562 | -0.48503 | 0.93186 |
| 950329 | -77.527168 | 167.168503 | -0.39 | 0.17747 | 0.01212 | 0.01629 | 0.35389 | -0.15202 | 0.39861 |
| 950925 | -77.525330 | 167.172836 | -3.69 | 0.15822 | -0.01053 | 0.01995 | 0.16347 | -0.02553 | 0.78830 |
| 950926 | -77.522835 | 167.157333 | -3.71 | 0.17214 | -0.00346 | 0.04562 | 0.15152 | -0.03595 | 1.08634 |
| 951004 | -77.523666 | 167.163330 | -3.71 | 0.13943 | 0.02876 | 0.04825 | 0.14350 | -0.02215 | 1.07707 |
| 951008 | -77.526497 | 167.164993 | -3.70 | 0.16173 | -0.00636 | -0.00578 | 0.19739 | -0.08214 | 0.93087 |
| 951017 | -77.519669 | 167.172165 | -3.71 | 0.13153 | 0.00892 | -0.03882 | 0.19716 | -0.19200 | 1.15126 |
| 951024 | -77.521500 | 167.159668 | -3.69 | 0.20557 | -0.02759 | 0.09660 | 0.14094 | -0.06056 | 0.98347 |
| 951029 | -77.524330 | 167.161331 | -3.70 | 0.12111 | -0.00622 | 0.01842 | 0.16247 | -0.04610 | 0.84642 |
| 951030 | -77.513832 | 167.185837 | -3.71 | 0.18210 | -0.02333 | -0.03661 | 0.30229 | -0.27201 | 1.62560 |
| 951031 | -77.530334 | 167.162170 | -3.71 | 0.18870 | 0.01534 | -0.11839 | 1.48915 | -0.33297 | 1.80204 |
| 951101 | -77.517670 | 167.184998 | -3.70 | 0.13112 | 0.00799 | -0.03016 | 0.20052 | -0.14981 | 1.25835 |
| 951114 | -77.524498 | 167.172668 | -3.71 | 0.12188 | 0.01315 | -0.00694 | 0.22588 | -0.17405 | 1.29224 |
| 951114 | -77.519836 | 167.176834 | -3.71 | 0.18826 | -0.02522 | -0.00680 | 0.30597 | -0.23922 | 1.55567 |
| 951114 | -77.521835 | 167.172668 | -3.70 | 0.13322 | 0.01605 | -0.02030 | 0.21576 | -0.18078 | 1.33100 |
| 951115 | -77.523499 | 167.175171 | -2.77 | 0.15510 | 0.03369 | 0.01702 | 0.20264 | -0.06173 | 0.40225 |
| 951115 | -77.517334 | 167.183670 | -3.70 | 0.13712 | 0.02078 | -0.02144 | 0.20601 | -0.20238 | 1.42667 |
| 951118 | -77.523163 | 167.169174 | -3.18 | 0.14593 | 0.01977 | 0.02310 | 0.17184 | -0.04573 | 0.48221 |
| 951201 | -77.518333 | 167.197998 | -3.16 | 0.16238 | 0.05827 | 0.02175 | 0.16213 | -0.04287 | 0.62548 |
| 951202 | -77.525002 | 167.167496 | -3.57 | 0.09190 | 0.01063 | -0.02529 | 0.16580 | -0.08601 | 0.60227 |
| 951203 | -77.524498 | 167.163834 | -3.48 | 0.14491 | 0.01284 | 0.00334 | 0.18551 | -0.07804 | 0.75954 |
| 951203 | -77.524666 | 167.180496 | -3.67 | 0.17957 | -0.01410 | -0.00548 | 0.17162 | -0.03007 | 0.94881 |
| 951206 | -77.521332 | 167.180496 | -2.14 | 0.16437 | 0.02960 | 0.01633 | 0.23587 | -0.03775 | 0.36970 |
| 951207 | -77.522163 | 167.182007 | -3.70 | 0.17769 | 0.02925 | 0.04650 | 0.18419 | -0.01294 | 1.39812 |
| 951208 | -77.523666 | 167.179001 | -3.67 | 0.20672 | 0.03421 | -0.01783 | 0.22378 | -0.02283 | 1.90949 |
| 951215 | -77.527168 | 167.153168 | -1.67 | 0.24791 | 0.04028 | 0.03072 | 0.29596 | -0.08178 | 0.40612 |
| 951215 | -77.525330 | 167.172501 | -2.77 | 0.13123 | 0.00486 | 0.00869 | 0.19515 | -0.05466 | 0.36362 |
| 951216 | -77.528664 | 167.175507 | -3.70 | 0.13030 | 0.00174 | -0.01518 | 0.22997 | 0.00026 | 0.99973 |
| 951217 | -77.525497 | 167.166504 | -3.70 | 0.20169 | 0.01521 | -0.11144 | 0.21267 | -0.10397 | 1.82563 |
| 951218 | -77.527336 | 167.151001 | -3.70 | 0.25035 | -0.01698 | -0.12643 | 0.19334 | -0.09042 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 51219 | -77.526497 | 167.158493 | -2.68 | 0.15215 | 0.01235 | -0.01247 | 0.21995 | -0.07452 | 0.36788 |
| 51220 | -77.519165 | 167.169006 | -3.70 | 0.17344 | 0.01147 | -0.10246 | 0.23527 | -0.30018 | 1.63125 |
| 51221 | -77.522835 | 167.141495 | -3.71 | 0.19203 | -0.03289 | 0.09777 | 0.31327 | -0.17619 | 1.16469 |
| 51222 | -77.512665 | 167.180161 | -3.71 | 0.26543 | 0.06190 | -0.12939 | 0.49826 | -0.51897 | 2.91631 |
| 51222 | -77.516830 | 167.175171 | -3.71 | 0.24490 | 0.05338 | -0.10424 | 0.28729 | -0.38947 | 2.20729 |
| 51223 | -77.528831 | 167.172165 | -3.68 | 0.17858 | 0.02257 | -0.10978 | 0.52783 | -0.09883 | 1.69353 |
| 51223 | -77.526001 | 167.152832 | -3.70 | 0.16541 | -0.02795 | 0.06312 | 0.15235 | -0.03632 | 0.86224 |
| 51223 | -77.525330 | 167.167831 | -3.18 | 0.11423 | 0.00211 | 0.02436 | 0.11940 | -0.01625 | 0.34637 |
| 51223 | -77.519836 | 167.184494 | -2.76 | 0.13298 | 0.00977 | -0.00375 | 0.16251 | -0.03419 | 0.37443 |
| 51224 | -77.521667 | 167.183670 | -2.47 | 0.14470 | 0.01539 | -0.00897 | 0.19377 | -0.05571 | 0.35152 |
| 51225 | -77.523331 | 167.170166 | -3.70 | 0.12027 | -0.00180 | 0.01369 | 0.16336 | -0.04846 | 0.85637 |
| 51225 | -77.522667 | 167.169495 | -3.34 | 0.12991 | 0.01520 | 0.01505 | 0.15807 | -0.05595 | 0.56198 |
| 51226 | -77.523499 | 167.163498 | -2.86 | 0.09097 | -0.00549 | 0.00953 | 0.13152 | -0.01699 | 0.27746 |
| 51226 | -77.522163 | 167.183838 | -2.88 | 0.13609 | 0.01938 | -0.01718 | 0.19208 | -0.06544 | 0.43183 |
| 51227 | -77.521667 | 167.169006 | -2.70 | 0.14754 | 0.01756 | 0.03129 | 0.17241 | -0.03673 | 0.36999 |
| 51227 | -77.526001 | 167.171661 | -3.14 | 0.12152 | -0.00330 | 0.01086 | 0.12907 | -0.00526 | 0.36940 |
| 51228 | -77.520668 | 167.192337 | -2.08 | 0.15736 | 0.01904 | -0.00945 | 0.20167 | -0.04729 | 0.31089 |
| 51228 | -77.523666 | 167.172668 | -2.97 | 0.15153 | 0.03238 | -0.00933 | 0.19397 | -0.08510 | 0.46450 |
| 51229 | -77.519836 | 167.188660 | -3.68 | 0.13346 | 0.01065 | -0.02200 | 0.16277 | -0.06771 | 0.97377 |
| 51229 | -77.523834 | 167.164993 | -2.71 | 0.14990 | -0.01476 | 0.01456 | 0.16254 | -0.01236 | 0.31756 |
| 51230 | -77.522331 | 167.195831 | -3.71 | 0.14928 | 0.01551 | -0.08997 | 0.12937 | -0.01856 | 1.12134 |
| 51230 | -77.523499 | 167.168335 | -2.50 | 0.15113 | 0.01398 | 0.02430 | 0.14296 | -0.00663 | 0.29591 |
| 50103 | -77.521667 | 167.170670 | -3.17 | 0.17299 | 0.03423 | 0.04767 | 0.17862 | -0.05514 | 0.58838 |
| 50103 | -77.523834 | 167.166504 | -3.18 | 0.11312 | 0.00695 | 0.01579 | 0.13907 | -0.01948 | 0.40781 |
| 50104 | -77.521332 | 167.182327 | -3.71 | 0.13213 | 0.00814 | -0.02835 | 0.16443 | -0.06788 | 0.98344 |
| 50104 | -77.524666 | 167.170166 | -2.72 | 0.11084 | 0.00279 | -0.00787 | 0.12964 | 0.00371 | 0.26952 |
| 0105 | -77.524330 | 167.156662 | -3.71 | 0.18524 | -0.02140 | -0.05614 | 0.17001 | -0.04654 | 1.16474 |
| 0106 | -77.522499 | 167.164337 | -2.86 | 0.09488 | 0.00968 | 0.00728 | 0.12242 | -0.03463 | 0.28270 |
| 0108 | -77.525833 | 167.175827 | -3.70 | 0.16386 | 0.00362 | -0.07229 | 0.21149 | -0.04464 | 1.52465 |
| 0109 | -77.523163 | 167.183334 | -3.70 | 0.19035 | 0.02190 | -0.12996 | 0.20203 | -0.05646 | 1.81760 |
| 0113 | -77.524002 | 167.162338 | -3.24 | 0.11801 | -0.01157 | 0.03271 | 0.12917 | -0.02770 | 0.38278 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960118 | -77.529335 | 167.166168 | -3.70 | 0.09024 | 0.00349 | 0.00056 | 0.13990 | 0.00801 | 0.59986 |
| 960118 | -77.524002 | 167.161163 | -3.70 | 0.10301 | 0.00762 | 0.02804 | 0.15243 | -0.05559 | 0.84455 |
| 960119 | -77.526169 | 167.186661 | -3.71 | 0.12506 | 0.01707 | -0.04579 | 0.19259 | -0.06705 | 1.04234 |
| 960119 | -77.524666 | 167.151337 | -3.70 | 0.18741 | -0.01831 | -0.05358 | 0.12615 | -0.01816 | 1.06644 |
| 960119 | -77.522835 | 167.169006 | -3.05 | 0.11125 | 0.00792 | -0.00827 | 0.15999 | -0.05222 | 0.39876 |
| 960121 | -77.525002 | 167.190826 | -3.71 | 0.19367 | 0.03449 | -0.13975 | 0.42317 | -0.09797 | 2.02312 |
| 960121 | -77.528168 | 167.181839 | -3.70 | 0.12106 | 0.00830 | -0.01773 | 0.20258 | -0.04733 | 0.89636 |
| 960128 | -77.528664 | 167.184174 | -3.70 | 0.09421 | 0.02164 | 0.01209 | 0.20134 | 0.06222 | 0.92445 |
| 960131 | -77.524002 | 167.167664 | -3.70 | 0.18552 | 0.02969 | -0.12026 | 0.19808 | -0.07994 | 1.73638 |
| 960131 | -77.525002 | 167.181671 | -3.71 | 0.17599 | 0.02436 | -0.08461 | 0.20215 | -0.06061 | 1.53186 |
| 960206 | -77.526169 | 167.167999 | -3.69 | 0.19803 | -0.02421 | 0.00524 | 0.21327 | -0.03272 | 1.06871 |
| 960209 | -77.521332 | 167.176666 | -3.17 | 0.13449 | 0.01716 | 0.01587 | 0.15232 | -0.04682 | 0.49316 |
| 960212 | -77.529831 | 167.214172 | -3.70 | 0.14466 | 0.01482 | -0.16078 | 0.23811 | 0.00189 | 1.25722 |
| 960212 | -77.530167 | 167.182831 | -3.71 | 0.12274 | -0.01409 | -0.01143 | 0.19250 | 0.05881 | 0.87476 |
| 960213 | -77.526169 | 167.193497 | -3.05 | 0.13747 | 0.02143 | -0.03685 | 0.14823 | -0.02165 | 0.47428 |
| 960213 | -77.524834 | 167.159164 | -2.91 | 0.19412 | 0.03355 | -0.04052 | 0.17564 | -0.03729 | 0.52024 |
| 960213 | -77.526665 | 167.172836 | -3.70 | 0.12098 | -0.00164 | -0.02163 | 0.14220 | -0.04570 | 0.93681 |
| 960214 | -77.526665 | 167.155838 | -2.80 | 0.20930 | -0.01550 | -0.01473 | 0.20247 | -0.05997 | 0.50821 |
| 960214 | -77.523163 | 167.163330 | -3.70 | 0.13535 | -0.00419 | -0.08189 | 0.13623 | -0.07373 | 1.16842 |
| 960215 | -77.527168 | 167.168167 | -3.71 | 0.12030 | -0.00430 | 0.00230 | 0.18143 | -0.03285 | 0.80827 |
| 960215 | -77.522499 | 167.163498 | -3.70 | 0.17376 | -0.02324 | -0.02697 | 0.15745 | -0.01488 | 0.93880 |
| 960216 | -77.522835 | 167.208832 | -3.71 | 0.15404 | 0.01487 | -0.11898 | 0.18075 | -0.05722 | 1.33517 |
| 960217 | -77.525169 | 167.159164 | -3.70 | 0.12545 | -0.01902 | 0.00936 | 0.18633 | -0.03266 | 0.83822 |
| 960217 | -77.523003 | 167.168671 | -3.70 | 0.10195 | -0.00865 | -0.01439 | 0.16384 | -0.05976 | 0.80421 |
| 960217 | -77.520668 | 167.202499 | -2.78 | 0.12875 | 0.03497 | -0.01400 | 0.10612 | -0.02566 | 0.31511 |
| 960223 | -77.528831 | 167.158829 | -3.71 | 0.14375 | -0.02873 | -0.01357 | 0.37670 | -0.01256 | 0.99955 |
| 960224 | -77.523499 | 167.164673 | -3.21 | 0.16101 | 0.00184 | 0.01732 | 0.20280 | -0.03311 | 0.55618 |
| 960225 | -77.526169 | 167.148666 | -3.71 | 0.17366 | -0.03700 | 0.06514 | 0.16284 | -0.02293 | 0.92349 |
| 960225 | -77.531670 | 167.184326 | -3.71 | 0.11539 | -0.00124 | -0.06162 | 0.25017 | 0.00984 | 0.81444 |
| 960227 | -77.529335 | 167.188507 | -3.70 | 0.15905 | 0.01278 | -0.10267 | 0.24820 | 0.01443 | 1.63275 |
| 960228 | -77.519836 | 167.156006 | -3.71 | 0.10228 | -0.00666 | -0.02312 | 0.18440 | -0.15826 | 1.11325 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 960305 | -77.525497 | 167.162994 | -3.71 | 0.12125 | -0.00741 | 0.01808 | 0.17222 | -0.04474 | 0.83652 |
| 960306 | -77.526337 | 167.160828 | -2.95 | 0.10648 | 0.02255 | -0.00311 | 0.19388 | -0.07027 | 0.32963 |
| 960311 | -77.518166 | 167.188339 | -3.70 | 0.13859 | 0.01546 | -0.02734 | 0.15877 | -0.07774 | 1.08265 |
| 60322 | -77.530830 | 167.144333 | -3.71 | 0.17500 | -0.01417 | -0.00600 | 0.21747 | -0.01479 | 0.30751 |
| 60322 | -77.531334 | 167.141159 | -3.71 | 0.28530 | -0.04986 | 0.05585 | 0.39339 | -0.06458 | 0.27130 |
| 60328 | -77.521667 | 167.166672 | -3.70 | 0.24057 | -0.02686 | 0.06975 | 0.17313 | -0.08323 | 1.07625 |
| 60328 | -77.527000 | 167.199829 | -3.70 | 0.14739 | 0.01850 | -0.04587 | 0.21560 | 0.02867 | 1.12701 |
| 60328 | -77.528831 | 167.170334 | -3.71 | 0.12203 | -0.00458 | -0.02886 | 0.20833 | -0.07156 | 0.75955 |
| 60514 | -77.523163 | 167.166504 | -3.70 | 0.13043 | -0.00279 | 0.01541 | 0.16325 | -0.04865 | 0.86632 |
| 60514 | -77.520668 | 167.148834 | -3.70 | 0.15020 | -0.01756 | 0.04718 | 0.14527 | -0.04101 | 0.87453 |
| 60516 | -77.526665 | 167.149002 | -3.70 | 0.14112 | -0.02583 | 0.03515 | 0.15205 | -0.02639 | 0.77683 |
| 60520 | -77.526497 | 167.162994 | -3.04 | 0.13030 | -0.00117 | -0.00646 | 0.21833 | -0.07391 | 0.38136 |
| 60602 | -77.525665 | 167.157166 | -3.40 | 0.13120 | -0.00461 | -0.00832 | 0.19225 | -0.09135 | 0.52654 |
| 60603 | -77.528336 | 167.148163 | -3.68 | 0.14705 | -0.02530 | 0.01101 | 0.17340 | -0.07700 | 0.74946 |
| 60607 | -77.525497 | 167.144669 | -1.48 | 0.16793 | 0.00111 | 0.03312 | 0.24580 | -0.02223 | 0.30625 |
| 60608 | -77.532669 | 167.157501 | -3.29 | 0.14714 | 0.01526 | -0.03900 | 0.39371 | -0.04609 | 0.35915 |
| 60608 | -77.521500 | 167.172333 | -3.71 | 0.16183 | 0.06720 | -0.23064 | 0.34681 | -0.70983 | 3.72136 |
| 60608 | -77.529999 | 167.141830 | -3.70 | 0.17342 | 0.01326 | 0.00222 | 0.31977 | -0.05080 | 0.20678 |
| 60714 | -77.518997 | 167.162003 | -3.69 | 0.12814 | 0.03229 | -0.00699 | 0.30530 | -0.33543 | 1.76634 |
| 60717 | -77.515503 | 167.151001 | -3.68 | 0.18756 | 0.02455 | 0.03073 | 0.29001 | -0.32261 | 1.77196 |
| 60725 | -77.519836 | 167.169998 | -3.24 | 0.15190 | 0.04054 | -0.03555 | 0.32914 | -0.37301 | 1.48895 |