RETRIEVAL AND DISPLAY OF DATA FROM THE HOCKLEY BROAD-BAND SEISMOMETER: INTERIM REPORT

Paul Nyffenegger and Fumiko Tajima
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Introduction

Most of the work cited in this report was completed by others. Thus this technical report is not intended as an original work of science, but as a descriptive guide and compilation of programs available at this time to retrieve, view, and aid in the analysis of data aquired by the Hockley broad-band seismometer.

During the week of July 17, 1995, a team from the Albuquerque Seismic Lab (ASL) operated jointly by the United States Geological Survey (USGS) and the Incorporated Research Institutions for Seismology (IRIS) assisted by several staff members from the University Of Texas Institute For Geophysics (UTIG) installed a state of the art broad-band seismometer at Hockley, Texas. The new station at Hockley is located about 100 miles east of Austin. The new Streckeisen sensors and Quanterra digital data aquisition system replaces an older analog Teledyne Geotech S-13 short period seismometer installed in 1973 at the same location.

The University of Texas Institute for Geophysics is responsible for operating and maintaining the seismic station, as well as providing data aquired from the system to the Global Seismic Network (GSN) operated by IRIS. The Hockley seismic station is the eighth University Network site selected by the IRIS GSN program. In addition, the Hockley station is a cooperating member of the United States National Seismic Network (USNSN) operated by the USGS. The new station became operational July 21, 1995, and has been given the station code HKT for use with GSN and USNSN databases.

Texas can be divided into four basic physiographic provinces (Figure 1). The 1931 magnitude 6.0 Valentine and the 1995 magnitude 5.7 Alpine earthquakes both occured within the Rio Grande Rift province. The Rio Grande Rift is a seismically active region containing numerous geologically recent faults. Portions of the Great Plains are also active, especially the Permian Basin where a magnitude 5.0 earthquake occured in 1992. The most recent activity outside the Rio Grande Rift has occured in the Coastal Plain province, near the town of Fashing in Atascosa County (1993,

magnitude 4.3). Earthquakes in the vicinity of Pleasanton-Fashing-Falls City have occured every 5-10 years since about 1973 (Davis et al., 1995). Previously, earthquakes in the Coastal Plain Province could not easily be studied and their mechanisms remained unknown. The installation of station HKT enables scientists to more closely monitor the local and regional seismic activity.

Station HKT is the first IRIS/GSN station in Texas; the nearest regional broad-band stations are located in Albuquerque, New Mexico, Tuscon, Arizona and in Mexico City. The Hockley station helps fill the large gap in station coverage throughout the mid-west and along the Gulf coast states (Figure 2) and provides crucial information to the national scientific comunity.

The addition of station HKT aids regional and global seismological studies. For example, the location of the Hockley station is ideal for studying the earth's crust and uppermantle structure beneath Texas, the Gulf of Mexico, and Northern Mexico (Figure 3). Such research projects have not been impossible without this modern broad-band seismic station. The addition of station HKT will contribute to studies of earthquake sources and structure of northwestern North America, the middle America Trench, and the South American Trench, as well as the structure of the deep earth.

Throughout this report, text representing computer dialogue, commands, and program names is in `courier font`. User input is in **`bold courier font`**. Multi line computer dialogue usually will be single spaced, and reduced to 10 point size where necessary to keep output on a single line. Annotations to computer dialogue are in *italicized times font.*

Brief Description Of The Hockley Seismometer

The data aquisition system for the Hockley seismometer is located in an excavated chamber within an active salt mine owned by United Salt Corporation (Figure 4). The chamber lies approximately 470 meters below the surface within a large salt dome. Locating the instrument within a salt

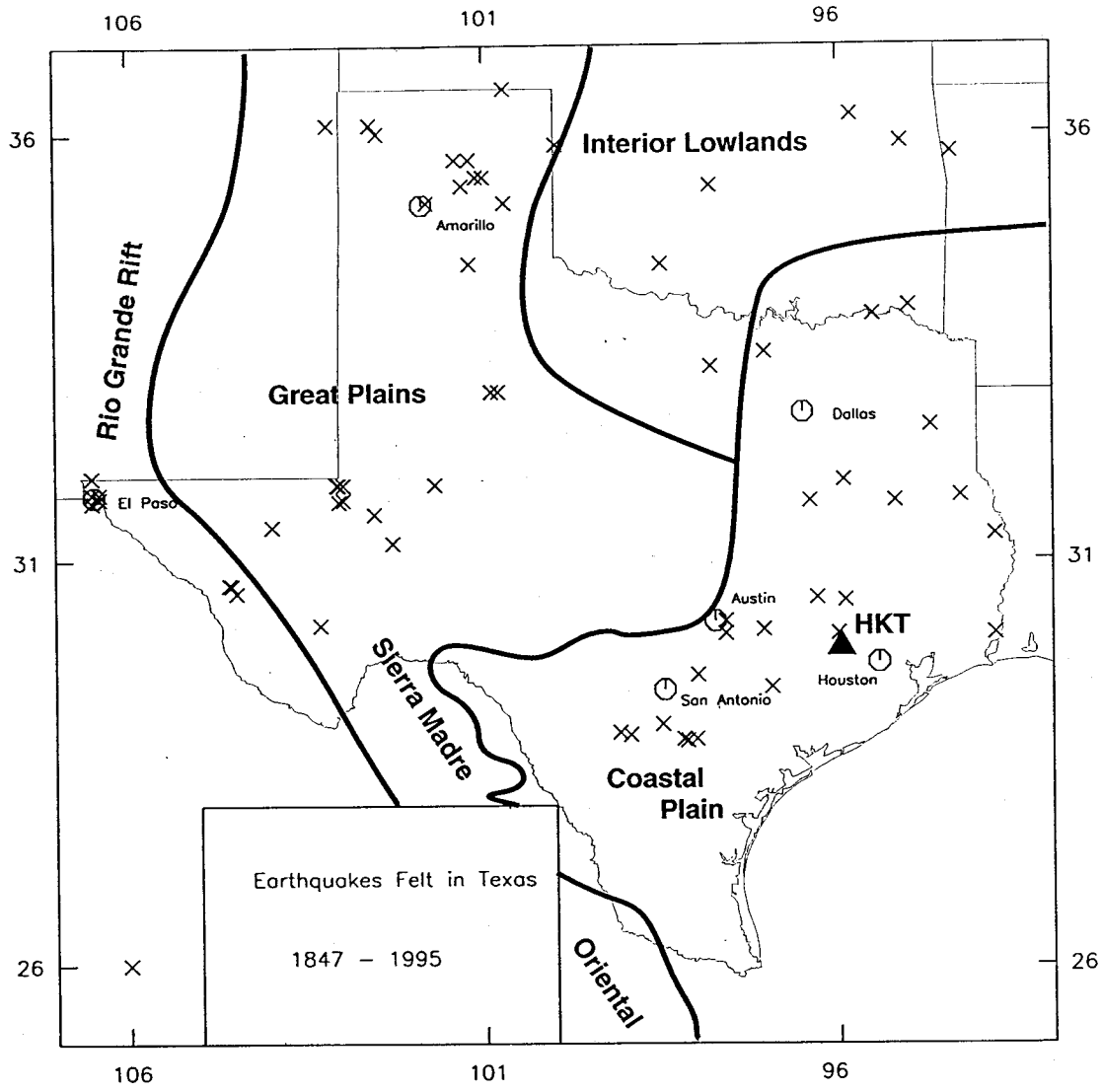

Figure 1. Location of the Hockley broad-band seismic station (triangle labeled HKT) with earthquake epicenters (x) from 1847 through 1995 (updated from Davis et al., 1989). Also shown are physiographic province boundaries (bold lines).

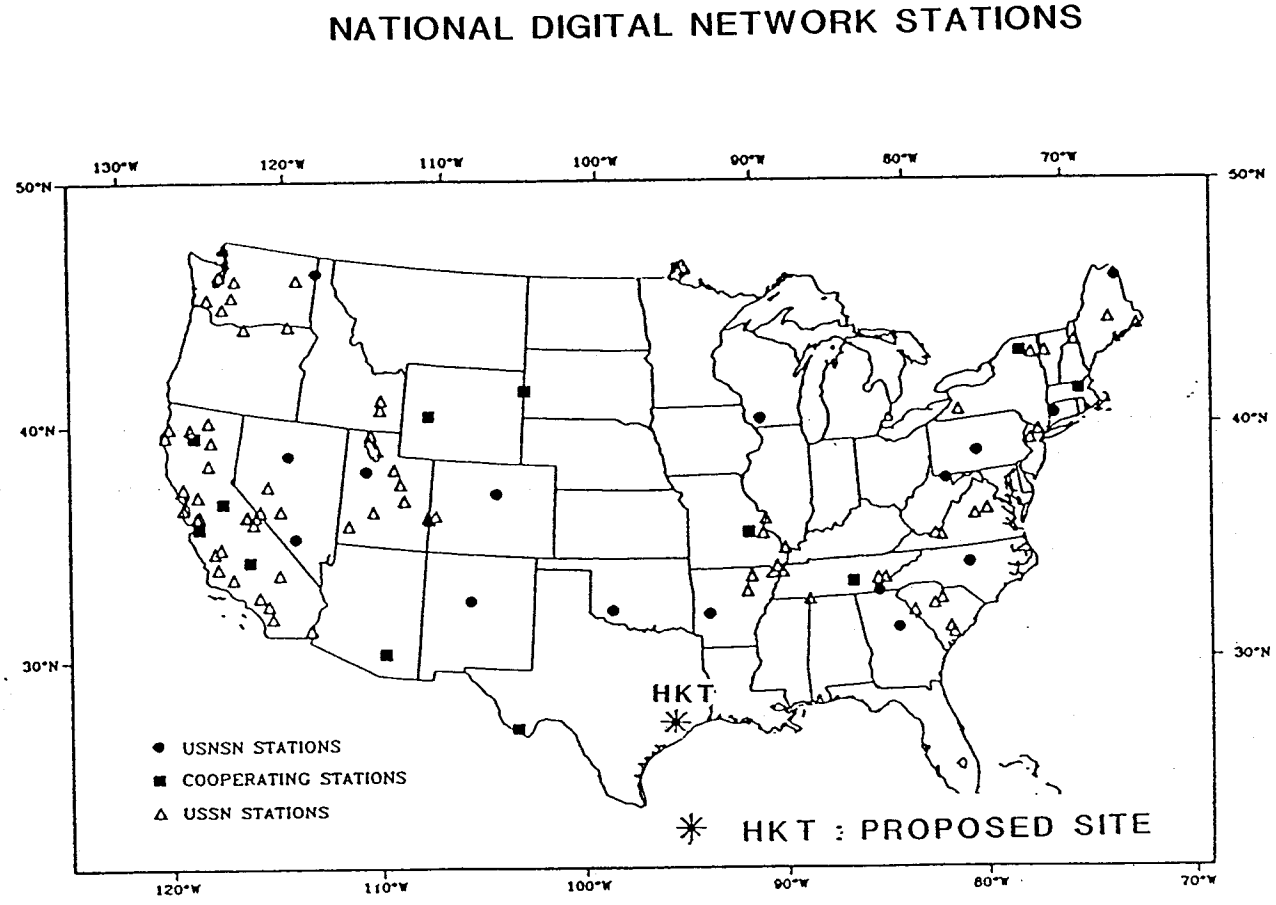

Fig. 2. USNSN (filled circles) and cooperating USNSN stations (filled squares) in relation to the so-called U. S. Seismograph Network (USSN) stations (open triangles) excluding Alaska and Hawaii (from Buland, 1993).

dome reduces the noise from human activity that generally affects instruments on the surface. The seismometer consists of three Streckeisen STS-1 sensors oriented vertically, north-south, and east-west, mounted on a concrete slab, and kept in evacuated containers. The seismic sensors feed a signal directly to the Q680 data aquisition (DA) unit made by Quanterra Corporation, which handles all aquisition procedures (Figure 5). The heart of the DA is a Motorola VME-147s computer running OS-9 system software.

A fiber optic cable running up a bore hole connects the DA to the VSAT communications hardware, a Global Positioning System (GPS) clock, and a dial-up modem on the surface. The DA regularly synchronizes its clock to Coordinated Universal Time (UTC) with GPS satellites. Using the VSAT link, the data stream travels to the National Earthquake Information Center (NEIC) in Golden, Colorado, where the USNSN monitors national earthquake activity. The NEIC then transmits the seismometer data via satellite to the data processing (DP) system located in the main computer room at UTIG in Austin. The Hockley station hardware arrangement is known as a separate or split system since the DA and DP are not at the same location.

The DP consists of a Motorola VME-147S computer running OS-9 system software. A 300 Mbyte disk serves as the data buffer area, holding about 1.5 weeks of broad-band high gain data. Hockley's seismic data is periodically written as Standard for the Exchange of Earthquake Data (SEED) Field Volumes to QIC-150 quarter inch tape drives using DC-6150 cartridges. The tapes are changed at about two week intervals, and then sent to the IRIS Data Collection Center at ASL for further processing and ultimately archival at the IRIS Data Management Center in Seattle, Washington. A Graphon GO-250 terminal provides direct control of the DP and display of data. A dot-matrix printer is also connected to the DP and provides a hard copy of the system logs. The DP is also accessible by dial-up modem and by internet connection (`telnet` or `ftp`) to hkt.ig.utexas.edu .

Quanterra Ultrashear software runs on both the DA and DP, providing all data aquisition, processing, recording, and retrieval utilities. SEED broadband, long period, very long period, and ultra long period high gain

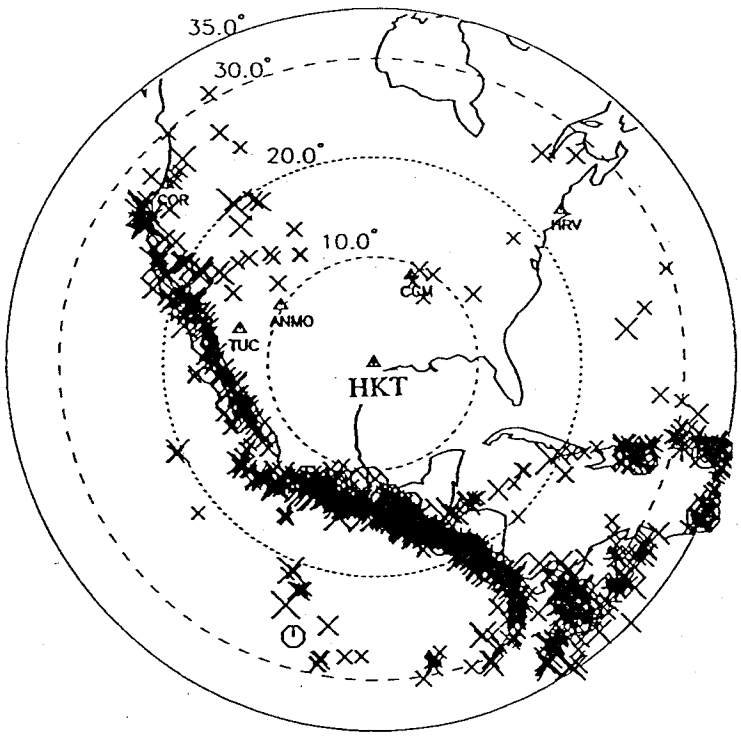

Figure 3. Regional seismicity (M ≥ 5.2) around station HKT (center) and other broad-band stations (Δ) on an equal area projection map. Symbols show depths ranges of the events, e.g. x: 0< H≤70; O: 70< H≤120; *: 120< H≤450 km. Equidistant lines are drawn at 10°, 20°, and 30° from HKT.

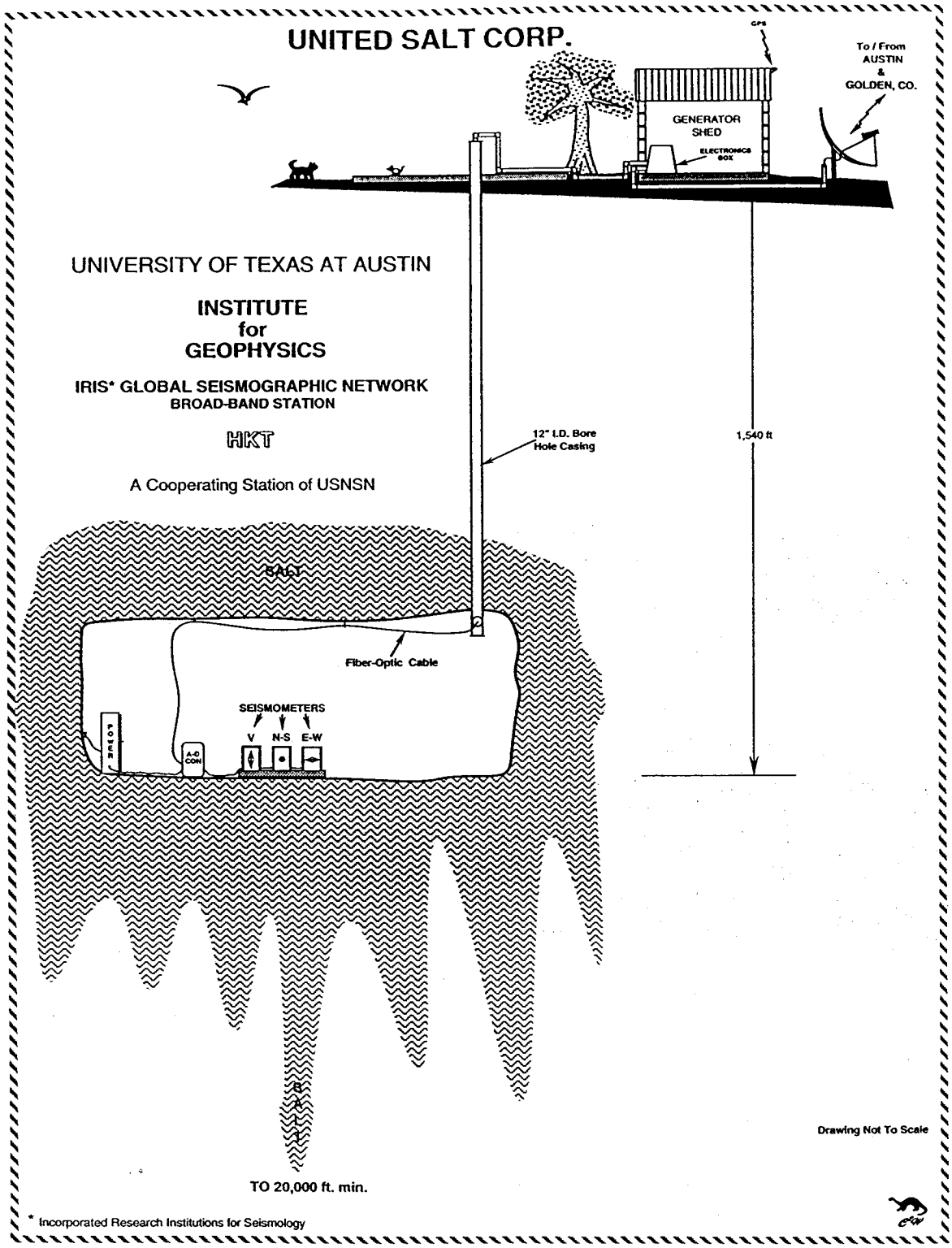

Figure 4. Schematic of the Hockley seismometer configuration at the United Salt Corporation mine at Hockley Texas. The seismometer is located in an excavated salt chamber about 470 meters below the surface, and is connected to communications hardware on the surface by a fiber optic cable running through a borehole.

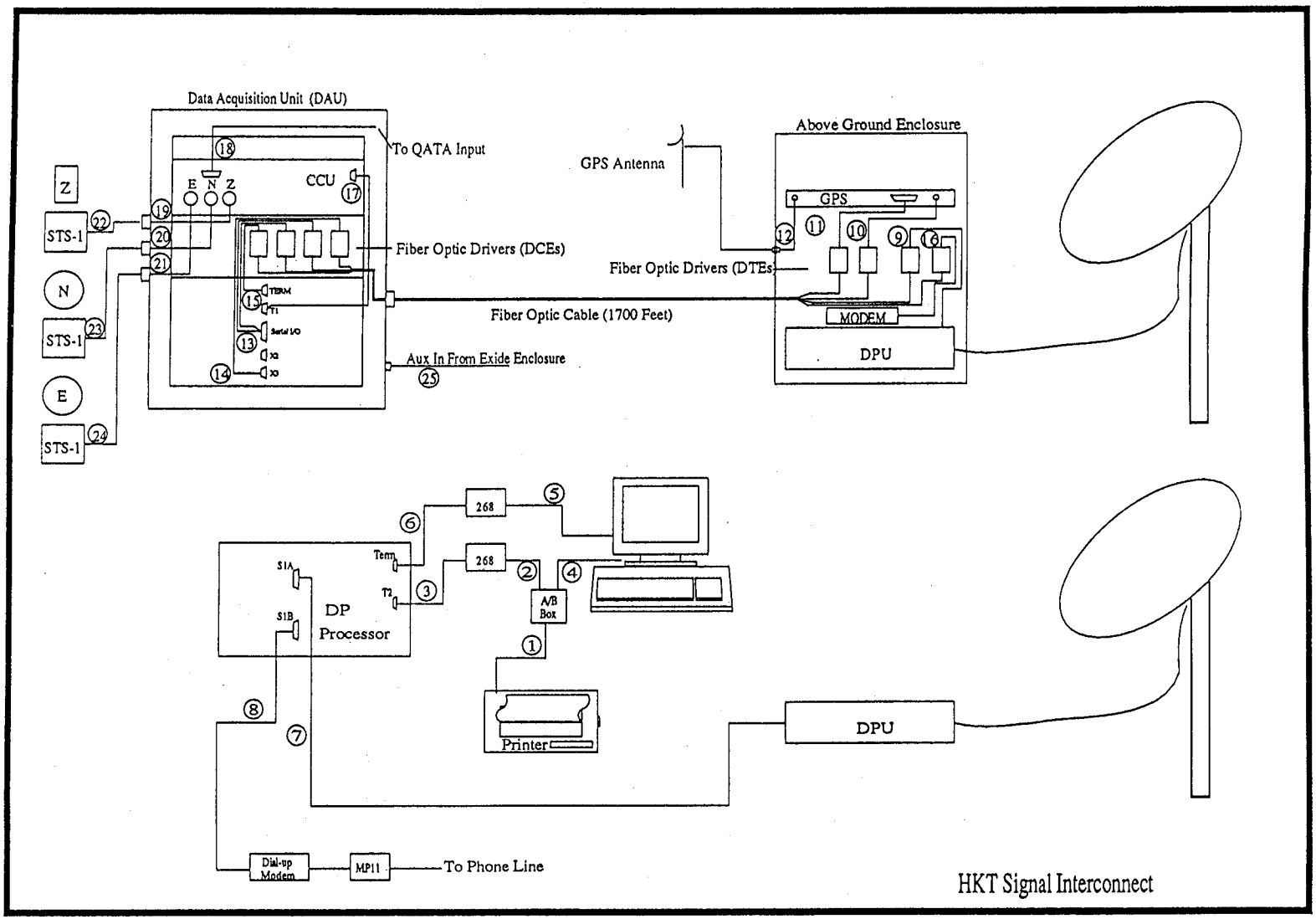

Figure 5. Schematic of the Hockley seismometer signal interconnect. The signal is measured by three Streckeisen STS-1 sensors and fed directly into the Data Aquisition Unit (DA) in the salt chamber. The signal is transmitted to the National Earthquake Information Center at Golden, Colorado, which then sends it to the Data Processor (DP) at the Institute for Geophysics in Austin. This hardware configuration is known as a split system since the Data Aquisition Unit and the Data Processor are not in the same location.

channels are recorded. In addition, a very long period mass position channel is also aquired. Channels AFP, AFV, VKI, VK1, VE1, and UE1 are used to administer the seismometer and monitor cabinet temperature and electronics, and are generally not of scientific interest.

Data Retrieval

On a UNIX system, data may be retrieved directly from the DP interactively using `telnet`. Simply type `telnet hkt.ig.utexas.edu` and you will be prompted for a login name and a password. The Quanterra UltraShear `RETRIEVE` program has two modes depending upon login name: SEEDnames mode (login SEED; password DATA) or component and stream mode (login VBB; password DATA). The major difference between these two modes is that standard SEED channel naming conventions are used in SEEDnames mode, while older Quanterra names are used in component and stream mode.

The Quanterra UltraShear `RETRIEVE` program allows users to examine data and logs and transfer data to their local machines. A help menu will be printed if a "**?**" is typed at the `Command?` prompt:

```
"C <C/E>" = Change buffer from/to continuous/event data
"T <V/F/C/CS/S/P>" = select Transmission file format
"F <W/S/L/V...>" = select optional Filters
"E [ALL]/<DATE> <DATE> [<SEEDNAMES>]" = Examine available data or logs
"S <SEEDNAME> <DATE>" = Setup single data channel to retrieve
"G" = start or resume sending selected segment
"G P[LOT]" = Plot selected segment on 4014 terminal
"G <S/B>" = Store selected segment to local/backup file
the following 4 methods are available for SEED binary transfer:
"K <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via Kermit
"X <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via STP
"V <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = archiVe local file
"I <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via uuencode
"R" = send station description
"L[|B|C] [ALL]" = view entries in event, caliB, or Clock Log
"P" = display active Processes
"U <N>" = view User log <N> entries backward
"Y[T] <N> [<M>]" = view [<M>] activitY log <N> entries backward
"M <message text>" = send Message to station operator
"Q" = Quit on-line session. CTL-"C" is ABORT key.
<SEEDNAMES> supports wildcards (i.e. BH?,?LZ,???) and DET|CAL|TIM|MSG
```

When a command is entered without any parameters the `RETRIEVE` program will list possible options and prompt the user for the required parameters.

In the following section we review some of the more useful options in the RETRIEVE program.

The "C" command allows the user to change buffers from continuous data which is the default, to event oriented data. Quanterra software uses several different channels and two algorithms to find events in the data stream, however not all events will correspond to earthquakes. Typing the "T" command lists the possible transmission formats for downloading a single channel directly to the user's computer:

```
 "C" - Compressed hexadecimal ascii
"CS" - Compressed hexadecimal ascii SEED
 "V" - Expanded variable record length ascii
 "F" - Expanded fixed record length ascii
 "S" - SAC ascii digital counts
 "X" - Exit to main command menu
```

The default transmission mode is expanded variable record length ascii.

The RETRIEVE program allows filtering of the requested data channels with the following predefined recursive filters, selected using the "F" command:

```
"DETF" - sections in short-period filter
 "W" - SPWWSS simulation of short-period world-wide from VBB:GAIN X 10
 "L" - LPWWSS simulation of long-period world-wide from LP
 "S" - LPSRO simulation of long-period SRO from LP
 "V" - VLPBP bandpass very-long-period filter from 600-150 s
 "VLPAVG" - high-pass very-long-period filter 600 s
 "ULPAVG" - high-pass ultra-long-period filter 6000 s
 "LPNULL" - sections allpass filter for SOH display
 "BBNULL" - sections allpass filter for SOH display
 "VLPNULL" - sections allpass filter for SOH display
 "U" - Unfiltered (except for FIR stream filters)
 "X" - Exit to main command menu
```

The default mode is unfiltered.

The "E" command reports entries in the continuous data buffer or the event data buffer as chosen with the "C" comand. The response of "E" depends if the user is in the SEEDnames mode or the component-stream mode. When in the SEEDnames mode and attached to the continuous data buffer the output for "E" should look something like this:

```
Command? E<cr>
```

```
UTC starting date for scan (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/19 <cr>

UTC ending date for scan (time not required):
  yy/mm/dd hh:mm:ss
? <cr>

...scanning available channels

...searching 1995/09/19 00:00:00  - 2048/01/01 00:00:00

7 segment(s) found.

Available segments:                          asterisk denotes current buffer segment

  Seg  Name  Rate Inclusive Dates                                  Event
----- ------ ---- ---------------------------------------------  -----
   62    BHZ   20 1995/09/08 04:32:30 - 1995/09/19 13:56:15  On-Line C *
   63    BHN   20 1995/09/08 04:33:09 - 1995/09/19 13:58:40  On-Line C *
   64    BHE   20 1995/09/08 04:31:26 - 1995/09/19 13:58:16  On-Line C *
   45    LHZ    1 1995/08/29 18:02:38 - 1995/09/19 13:42:26  On-Line C *
   46    LHN    1 1995/08/29 18:02:38 - 1995/09/19 13:57:03  On-Line C *
   47    LHE    1 1995/08/29 18:02:38 - 1995/09/19 13:43:15  On-Line C *
   51    AFP    1 1995/08/29 18:03:00 - 1995/09/19 13:35:54  On-Line C *
```

The "L" command allows the user to examine entries in the event, calibration, and/or clock log. Typing "L" alone results in the user being prompted for a time window and the event log being displayed:

```
Command? L<cr>

UTC starting date for search (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/19<cr>

UTC ending date for search (time not required):
  yy/mm/dd hh:mm:ss
? <cr>

...search requested from 1995/09/19 00:00:00
...system time now 1995/09/19 13:56:10
...log file last updated at 1995/09/19 11:25:36

P A L  S/N  Year Day Date    UTC Time     Peak Amp  Period  Noise Channel
- - - ----- ---- --- ----- ------------ ---------- ------ ------- ------
LPNB detector pick:
D A 1 12234 1995 262=09/19 00:28:57.104         84  22.00      19 LHZ
D A 0 00377 1995 262=09/19 02:29:59.104        141  30.00      21 LHZ
SPWW detector pick:
D A 0 00999 1995 262=09/19 03:41:30.804      10276   1.30     258 BHZ
C A 2 80154 1995 262=09/19 03:42:22.304       5169   1.20     274 BHZ
```

The "R" command prints a description of the station to the users screen. For the Hockley station, the "R" command yields:

```
Station :    HKT   Hockley, Texas
             Lat: 29.9618 N  Lon: 95.8384 W  Elev:-415.0m

Components: Z  : + = ground motion up
            N  : + = ground motion north
            E  : + = ground motion east

Streams:    VBB : 20 SPS: on 24-bit channels, from Streckeisen STS-1
                  seismometers.  Instrument response is flat
                  to velocity from 10 Hz to 360 sec;  Sensitivities are
                  Z = 2606 Vsec/m, S/N 79403;
                  N = 2284 Vsec/m, S/N 69409;
                  E = 2258 Vsec/m, S/N 69410.
                  Recorded continuously.
              LP :  1 SPS: derived by constant-time-delay Finite Impulse
                  Response (FIR) digital filter from VBB stream in real
                  time, cutoff at 2.7 S period.  Recorded continuously.
              VLP : 0.1 SPS: derived by FIR filter from LP stream in real
                  time, cutoff at 27 S period.  Recorded continuously.
              ULP : 0.01 SPS: derived by FIR filter from LP stream in real
                  time, cutoff at 270 S period.  Recorded continuously.

Note:         FIR filter delays are accounted for in the header reported
              with the data.
Response:     Basic response for the LP,  VLP,  and ULP channels is flat to
              ground velocity from the FIR filter upper cutoff to the
              second-order lower corner at 360 S period.
```

The "P" command and the "Y" command both are useful for administering the DP from an internet connection. The "P" command displays active processes on the DP, and the "Y" command displays the activity log. During normal operations the "P" command should print the following:

```
Command? P

 Id PId Grp.Usr  Prior  MemSiz Sig S    CPU Time   Age Module & I/O
  2   0   0.0     128    0.50k   0 w        0.00 669:57 sysgo <h0 >>>term
  3   2   0.0     128    6.75k   0 w        0.48 669:57 shell <h0 >>>term
  4   3   0.0     128    6.75k   0 w        0.07 669:57 shell <h0 >>>term
  5   0   0.0     128   15.50k   0 s        0.02 669:57 tsmon <h0 >>>term
  6   0   0.0     128   20.25k   0 s     8:51.38 669:57 routed <>>>nil
  7   0   0.0     128    2.00k   0      11:46.06 669:57 ifman
  8   0   0.0     128    2.00k   0 s       43.48 669:57 sockman
  9   0   0.0     128   12.00k   0 e        3.05 669:57 telnetd <>>>nil
 10   0   0.0     128   12.00k   0 e        0.17 669:57 ftpd <>>>nil
 11  13   0.0    1900  267.25k   0 s 18:18:50.44 669:56 dpsample<>nil>>pipe
 12   0   0.0    5000    6.75k   0 s    30:26.69 669:57 tmon <h0 >term >>term
 13   4   0.0     128   67.25k   0 s  6:04:01.21 669:56 dpshell <term >term >>pipe
 14   0   0.0     128    8.00k   0 s 13:28:02.96 669:56 pmsgd <nil >>>t2
 15   0   0.0     128   15.75k   0 s  1:47:50.77 669:56 tapeserv <nil >term >>pipe
```

```
16  15   0.0     128    2.00k   0 s     1:47.10 669:56 tapeio <nil >term >>pipe
17   0   0.0    1000    0.00k   0 -        0.00 669:56 sbf
18   0   0.0    2000  172.00k   0 s     8:57.38 669:56 bufserv <nil >>>pipe
19   0   0.0    2000  169.25k   0 s       13.40 669:56 bufserv <nil >>>pipe
20   0   0.0    2000   22.50k   0 s     4:21.09 669:56 dpcommo <nil >nil >>pipe
21   0   0.0     128   95.25k   0 s        1.69 669:56 auto_helem <h0 >term>>pipe
22  15   0.0     128    2.00k   0 s     2:07.99 669:55 tapeio <nil >term >>pipe
23   0   0.0    1000    0.00k   0 -        0.00 669:55 sbf
24  25   1.0      10   89.25k   0 w        0.90  0:01 retrieve <>>>pks00
25   0   0.0     128   22.00k   0 e        0.33  0:01 telnetdc <pks00
26  24   1.0      10   18.25k   0 *        0.33  0:00 procs <>>>pks00

Id PId Aging   F$calls I$calls Last      Read Written Module & I/O
 2   0   128         3       4 Wait         0       0 sysgo <h0 >>>term
 3   2   128       251      95 Wait      2048     715 shell <h0 >>>term
 4   3   128        31      31 Wait       125       4 shell <h0 >>>term
 5   0   128         8       8 Sleep        0      17 tsmon <h0 >>>term
 6   0   128    241160  629703 Sleep        0       0 routed <>>>nil
 7   0   128         0       0 <none>       0       0 ifman
 8   0   128         0       0 <none>       0       0 sockman
 9   0   128       423    2630 SetStt       0       0 telnetd <>>>nil
10   0   128        58     201 SetStt       0       0 ftpd <>>>nil
11  13  1900  93737765  178696 Sleep    13055 349090669 dpsample <>nil >>pipe
12   0  5000  18687778 30431808 Sleep  59706006 2664416 tmon <h0 >term >>term
13   4   128   6511582 69720020 Sleep 347948222 289291761 dpshell<term>term>>pipe
14   0   128   2383184 94724302 Sleep  681853423 3811003 pmsgd <nil >>>t2
15   0   128   9032100 1980362 Sleep  986240353  622975 tapeserv <nil >term>>pipe
16  15   128   5522819  885330 Sleep        0       0 tapeio <nil >term >>pipe
17   0  1000         0       0 <none>       0       0 sbf
18   0  2000   8560136  326011 Sleep  6382981 177188824 bufserv <nil >>>pipe
19   0  2000   6755163   38386 Sleep     8098 3049101 bufserv <nil >>>pipe
20   0  2000  35876853 18528993 Sleep  240838594 8002804 dpcommo <nil >nil>>pipe
21   0   128       162      98 WritLn    1640     643 auto_helem <h0 >term >>pipe
22  15   128   5387389  838331 Sleep        0       0 tapeio <nil >term >>pipe
23   0  1000         0       0 <none>       0       0 sbf
24  25    10      1738    3261 Wait     22739    3102 retrieve <>>>pks00
25   0   128       510    2300 Event     7666    7675 telnetdc <pks00
26  24    10        79      68 GPrDsc       0    1843 procs <>>>pks00
```

Using the "YT" command displays the following log entries with a time stamp on each entry (in 9 point type to reduce line wrap-around):

```
Command? YT <cr>
1995/09/26 11:59:36 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49 VHE:-17498.160 4760.227 14897.011
1995/09/26 11:59:37 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49 VMZ:  548.932    0.945  3.707
1995/09/26 11:59:37 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50 VMN:  543.322    0.019  0.019
1995/09/26 11:59:50 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50 VME:  386.370    0.014  0.014
1995/09/26 12:41:34 FROM TAPE: Starting log flush at 95/09/26 12:41:33  at record 16174 on /MT0
1995/09/26 12:41:34 FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
1995/09/26 12:45:57 FROM TAPE: Log flush complete at 95/09/26 12:45:57  at record 16379 on /MT0
1995/09/26 13:17:35 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 14:55:45 FROM NETWORK: login at 95/09/26 14:55:44 : pauln utig
1995/09/26 15:26:52 FROM NETWORK: login at 95/09/26 15:26:52 : pauln utig
1995/09/26 15:42:13 FROM TAPE: Starting log flush at 95/09/26 15:42:13  at record 16379 on /MT0
1995/09/26 15:42:13 FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
1995/09/26 15:46:59 FROM TAPE: Log flush complete at 95/09/26 15:46:59  at record 16586 on /MT0
1995/09/26 15:48:06 FROM DPCOMMO: FROM AQSAMPLE: LPNB detector pick:
```

```
1995/09/26 15:48:06 FROM DPCOMMO: FROM AQSAMPLE: C A 1 22234 1995 269=09/26 15:50:13.103 279 28.00
50 LHZ
1995/09/26 15:54:07 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 15:54:53 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 15:55:41 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 16:05:12 FROM NETWORK: login at 95/09/26 16:05:12 : IRIS DMC Spyder Project
1995/09/26 16:20:06 FROM NETWORK: login at 95/09/26 16:20:06 : pauln UTIG
```

Seismic data may be retrieved in ascii format one channel at a time using "S" to select a channel and then "G" to send the segment, "GP" to plot the segment, or "GS/GB" to store the segment on the DP. A short example of the "S" command follows:

```
Command? s<cr>

...scanning available channels

the following SEED channels/sample rates are available:

    BHZ   20,     BHN   20,     BHE   20,     LHZ    1,     LHN    1
    LHE    1,     AFP    1,     VHZ .100,     VHN .100,     VHE .100
    VKI .100,     VE1 .100,     VMZ .100,     VMN .100,     VME .100
    VK1 .100,     AFV .100,     UHZ .010,     UHN .010,     UHE .010
    UE1 .010
SEED name (e.g. BHZ)? LHZ<cr>

UTC starting time to the nearest second:
  yy/mm/dd hh:mm:ss
? 95/09/19 00:00:00<cr>

Search requested starting at 1995/09/19 00:00:00

Time window begins in segment 45 at buffer record 3290

Maximum number of samples to transfer? 100<cr>

Buffer server is processing your request

skipping first 23 samples...
transmission will begin at requested starting time within 0.103192 sec

Use the "G" command to begin transmission
or to re-transmit data received incorrectly.
```

The "G" command will then transfer the data to the user's display in ascii format. The available methods for binary data transfer are prefered for downloading seismic data in bulk since only one channel at a time can be retrieved and only10,000 maximum samples transfered using "S" and "G". However, single channel mode is useful to quickly check data quality. The "GP" command will plot the selected segment to a Tektronix 4014 type terminal, or an xterm window on a Sun workstation, or an NCSA telnet window on a Macintosh computer. Appendix B contains a sample session log

of this type from an Xterm on a Sun computer. Using "GS/GB" command will create a formatted ascii file on the DP which can be transfered using FTP.

Four methods exist to download binary mini-SEED files: Kermit, STP, via archive local file and FTP, and uuencode. Mini-SEED files are data-only SEED volumes and do not contain file headers relating to the station (c.f. Standard for the Exchange of Earthquake Data: Reference Manual). Typing "I", the option for uuencode, gives the following output, and writes the uuencoded segment directly to the users terminal:

```
Command? I<cr>

This command will send 4096-byte binary SEED "Steim-compressed"
data records to your computer using "uuencode"

Records containing all components within your selected time
interval and selected stream will be sent in a single
transmission, making possible, for example, the retrieval
of all event segments within an entire day using a single
command.

The records received are SEED V2.3, as those distributed
on tape by the Albuquerque Seismological Lab and IRIS DMC.
A Data-Only-Blockette (1000) identifies each record.
       1) there are no control headers
       2) the logical record length is 4096 bytes

the following SEED channels/sample rates are available:

    BHZ   20,     BHN   20,     BHE   20,     LHZ    1,     LHN    1
    LHE    1,     AFP    1,     VHZ .100,     VHN .100,     VHE .100
    VKI .100,     VE1 .100,     VMZ .100,     VMN .100,     VME .100
    VK1 .100,     AFV .100,     UHZ .010,     UHN .010,     UHE .010
    UE1 .010

uuencode transfer SEED name mask (e.g. B??): LHZ

UTC starting date for LP data:
  yy/mm/dd hh:mm:ss
? 95/09/19 00:00:00<cr>

UTC ending date for LP data:
  yy/mm/dd hh:mm:ss
? 95/09/19 00:02:00<cr>

...search interval 1995/09/19 00:00:00  - 1995/09/19 00:02:00
1 total records selected.
```

```
...would require about 0 minute(s) for transmission at 9600 baud.
...proceed? (y/n): y<cr>

begin 644 CL950919.A00
--- uuencoded data ---
end
```

The uuencoded file expands the size of the binary file by about 35% so large data requests can take a long time, and the file must be uudecoded back to binary on the user's computer. Binary data transfered via Kermit ("K" command) requires that Kermit be running on the user's terminal, but otherwise is similar to the "I" command excepting that the requested data is recieved by Kermit running on the user's computer and does not get written to the user's computer.

Probably the most useful method for ordinary users to retrieve data from the Hockley seismic station is to archive it on the DP's disk and then use FTP to transfer the data file. Typing the "V" command without specifying any command line options results in the following dialogue:

```
Command? V <cr>

...scanning available channels

---messages from RETRIEVE identical to those above---

the following SEED channels/sample rates are available:

    BHZ   20,     BHN   20,     BHE   20,     LHZ    1,     LHN    1
    LHE    1,     AFP    1,     VHZ .100,     VHN .100,     VHE .100
    VKI .100,     VE1 .100,     VMZ .100,     VMN .100,     VME .100
    VK1 .100,     AFV .100,     UHZ .010,     UHN .010,     UHE .010
    UE1 .010

Archive SEED name mask (e.g. B??): BHZ<cr>

UTC starting date for VBB data:
  yy/mm/dd hh:mm:ss
? 95/08/23 07:00:00<cr>

UTC ending date for VBB data:
  yy/mm/dd hh:mm:ss
? 95/08/23 08:00:00<cr>

...search interval 1995/08/23 07:00:00  - 1995/08/23 08:00:00

15 total records selected.
```

```
...creating local file

....writing local file

...creating archive file "CB950823.H00"
BHZ-08/23 07:19*!, BHZ-08/23 07:22*!, BHZ-08/23 07:24*!, BHZ-08/23 07:27*!
BHZ-08/23 07:30*!, BHZ-08/23 07:32* , BHZ-08/23 07:34*!, BHZ-08/23 07:37*
BHZ-08/23 07:40* , BHZ-08/23 07:43* , BHZ-08/23 07:46* , BHZ-08/23 07:49*!
BHZ-08/23 07:51*!, BHZ-08/23 07:55* , BHZ-08/23 07:58*

....closing local file
```

The "V" command creates the file CB950823.H00 for this data request. The user has no choice in the file name or where it is written.

Now quit the RETRIEVE program ("Q" command), and begin a FTP session on a UNIX network with the command :

```
ftp hkt.ig.utexas.edu .
```

The login will be SEED and DATA is the required password. The login directory is /H0/USR/GSN/RUN, and the user will need to change the working directory to /H0/USR/GSN/DP_DATA, or

```
cd ../DP_DATA .
```

Transfer the mini-SEED volume(s) as you would any binary file.

Data Display

Binary data downloaded from the DP is in mini-SEED format. SEED volumes are highly compressed files containing all the information necessary to specify a seismic station and data stream including the instrument response. Mini-SEED volumes are data only seed volumes and do not contain the station headers. Unfortunately, very few display tools read mini-SEED format, and there are very few mini-SEED format conversion programs available; even the current IRIS SEED reader program does not read mini-SEED volumes. Furthermore, if a user downloads more than one channel, the resulting transfer file is a block-multiplexed mini-SEED file that must be demultiplexed.

Fortunately we have obtained some software from the Northern California Earthquake Data Center at the University of California at Berkeley that allows us to perform some rudimentary operations on the mini-SEED volumes. Additional software was obtained from the IRIS Data Management

Center archive. We list the source of the software in parentheses following the first mention of the software. As we obtain more software, it will be tested, and if judged useful and robust for displaying and manipulating SEED and mini-SEED data, it will be written to the directory /disk/wadati_d1/HKT/src (source files) and /disk/wadati_d1/HKT/bin (executables).

seedsniff

The program `seedsniff` (IRIS) allows users to examine SEED header blockets. `Seedsniff` prints out the name, length, and first part of each header blockette, but ignores data blockettes. Seedsniff will work with any SEED volume and therefore is a good way to determine what type of SEED volumes a user is dealing with. Typing `seedsniff` without any arguments results in a usage line showing command syntax:

```
usage: seedsniff logrecsize physrecsize print_flag  < input
where print_flag 1= print data summary records
                 2= print each data record
                 3= print both types of records
```

where `logrecsize` is the logical record length, and `physrecsize` is the physical record length. For example, entering:

```
seedsniff 4096 32768 < HKT-1001 <cr>
```

results in:

```
logrec 1 type V

     type 005 len 0024 : V2.3121995,206,19

=====>     DATA ENCOUNTERED

logrec 17290 type D  (last record)
```

identifying the file HKT-1001 as a Field Station Volume since it contains the Field Volume Identifier blockette [5] alone. A mini-SEED file contains only the data record without any of the associated control header information. For example, the output of seedsniff for the mini-SEED volume HKT.XX.LHZ.D.1995.257.1342 looks like:

```
seedsniff 4096 32768 2 < HKT.XX.LHZ.D.1995.257.1342
```

```
======>     DATA ENCOUNTERED
STA LOC CH   YEAR    START TIME       SAMPLES   SRF   SRMF A   I   Q   #B #TC B#D
B#BLK
HKT      LHZ 1995 257_13:42:55.1031    1690     1     1 40 20   0   2   0   48 1000
HKT      LHZ 1995 257_14:11: 5.1031     949     1     1 40 20   0   2   0   48 1000
HKT      LHZ 1995 257_14:26:54.1031    1132     1     1 40 20   0   2   0   48 1000
HKT      LHZ 1995 257_14:45:46.1031    1501     1     1 40 20   0   3   0   48 1000
logrec 4 type D  (last record)
```

sdrsplit

When a user transfers several channels of binary data from the Hockley seismic station, the resulting data is block-multiplexed, and must be split into its component channels to be useful. The program `sdrsplit` (NCEDC) splits block-multiplexed SEED data records in a mini-SEED volume into individual files of non-multiplexed SEED data records. To split the block multiplexed file CB950914.O00 into component files with names based on station, channel, and network, a user would type:

`sdrsplit -c CB950914.O00 <cr>` and the computer would respond:

```
HKT BHE XX HKT BHN XX HKT BHZ XX
```

with the resulting demultiplexed mini-SEED volumes:

```
HKT.XX.BHE.D.1995.257.1358
HKT.XX.BHN.D.1995.257.1357
HKT.XX.BHZ.D.1995.257.1359
```

Several of the available programs require a leapseconds file in order to create correct time records. If the warning message

```
warning - no leap second file: /usr/local/lib/leapseconds
```

is displayed along with normal program output, simply set the enviromental variable:

```
setenv LEAPSECONDS lpath/leapseconds
```

where currently lpath is /disk/wadati_d1/HKT/bin, but may change in the future.

PASSCAL Quick Look

Once the data records are demultiplexed, the user may display the records with PASSCAL Quick Look (PQL) (IRIS PASSCAL). PQL provides a "quick look" at the data; some filtering and basic display options are available but no real analysis capability is built into PQL. PQL allows either relative or absolute time alignment of traces (*controls* button). PQL requires file arguments from the command line in order to run. To view mini-SEED volumes on a Sun workstation running SunOS with PQL, use the command:

```
pql -mseed MSEED_files
```

A PQL window will open on the user's display with the entirety of the seismic traces drawn in the main window. On Sun workstations runnning Solaris use pql.steim_1_2 . The PQL graphical user interface is nearly self explanatory, however a detailed UNIX man page is also provided with the program, thus we will not discuss the details of using PQL. Appendix A contains a demonstration on using PQL.

SeisTool

Currently, SeisTool (NCEDC) is the only other program we have for viewing data in mini-SEED format. SeisTool is an interactive, menu-driven program that allows users to view and analyse seismograms in a variety of formats, including UW, mini-SEED (a.k.a. SDR), SEG-Y, and SAC. Traces may be aligned in absolute or relative time (*align* switch). There are a number of built in time series and spectral analysis operations in SeisTool, such as rotations, filtering, instrument deconvolution, frequency-time plots, and particle motion plots. SeisTool also allows user to write in several formats, including SAC and SEG-Y. A UNIX man page for SeisTool exists, but is only useful with regard to command line options. No command line options are required to open SeisTool; just enter seistool_static (SunOS) or seistool (Solaris) on the command line and the user can load files from within the tool. Appendix A contains a demonstration on using SeisTool.

ms2sac

Currently there is only one program allowing conversion of mini-SEED data to another format without having a viewing tool start up: ms2sac

(NCEDC). The environmental variable LEAPSECONDS will have to be set to properly use `ms2sac` (c.f. `sdrsplit`). Unfortunately, `ms2sac` is not very fault tolerant, and so small errors in the mini-SEED formatted volume can cause it to crash. Using the command :

```
ms2sac -b input_file output_file
```

will cause the ouput file to be in SAC binary format. A UNIX man page exists for `ms2sac`.

SAC and MAP

We have installed one completely supported seismic analysis tool. The Seismic Analysis Code (SAC) (IRIS) comes with a rather complete users manual, thus we do not go into detail here. SAC requires data written as SAC binary or alphanumeric format, or data written to an ascii file where the user defines the format. An updated though beta version of SAC, SAC2000 for SunOS is also available. The associated mapping program MAP, which reads SAC formatted data is also available. Startup scripts which set the environmental variables required by SAC and MAP are located in /disk/wadati_d1/HKT/bin and named for the respective programs.

IRIS-Smithsonian Seismic Display

In addition, we have also installed the IRIS-Smithsonian Seismic Display for displaying SAC data, maps with ray paths, and a cross section of the earth with ray paths for important phase arrivals. The display runs commands in SAC and MAP simultaneously to construct the three windows.

The seismic display is intended for use mainly by persons already facile with the UNIX operating system. The home directory has been arranged as orderly collection of sub-directories with the intention of making the application as transparent as possible with a minimum of explanatory text. In brief the macros sac.mac and map.mac located in the macros directory control the three windows of the display. These macros call C-executables in bin and both C-shell and Bourne shell scripts in scripts. Data is located in the directory data, and must be of SAC format with a text summary file explained below.

The IRIS Seismological Display is run from the directory $IRIS_HOME/macros, where $IRIS_HOME should be /disk/wadati_d1/HKT/IRIS. Users should check their .cshrc and .login files to see if noclobber is set before running the display; noclobber cannot be set for the display to work at all. If the user's .cshrc or .login files need to be changed, they should be sourced (e.g `source .login`)before trying to run the display. Also, several environmental variables need to be set before the display can be run. Simply `source set.env` in the macros directory and all needed environmental variables will be set. Then type the command:

```
map map.mac & ; sac sac.mac.
```

The map process must be run in the background and the sac process in foreground for the display to pause between each station. A total of three windows will appear: a seismogram display, a geographical map with great circle direct ray paths, and a cross section of the earth with raypaths. It is important not to terminate any of the three windows. If the pause toggle has been set, the display will pause after each station is displayed. The display will remain frozen until a return is entered into the command window in which sac is running in the foreground.

Four C-shell scripts in $IRIS_HOME/scripts can be run to control the seismological display:
1) pause.csh : (no arguments) causes the display to pause between each station.
2) cont.csh (no arguments) causes the display to run without pausing.
3) cut.csh (one argument) changes the total number of seconds of data to display; e.g. cut.csh 3000 .
4) kill.csh (no arguments) causes the display to exit in an orderly fashion. The sac process should be shut down in this manner to avoid a corrupted blackboard file. If the blackboard file becomes corrupted, copy $IRIS_HOME/files/blackboard.bak to $IRIS_HOME/macros/blackboard.

The IRIS display expects to see 3 kinds of sub-directories under the IRIS data directory: 1) yymmddhhmm: year, month, day , hour, and minute directories containing sac data files; 2) bad: directory containing problematic events; 3) good: storage directory for good events. Any other

directories appearing in the data directory will result in possible malfunctions in the display. The iris display creates a temporary list of yymmddhhmm directories it finds in files/iris_data during each display cycle. The IRIS display will cycle through each event and each station of each event in sequence until the display is terminated.

Each event directory is expected to contain the long period data from a set of stations. For example, if the station BKS is reporting, the files, bks.lhe, bks.lhn, and bks.lphz should appear in the event directory. There should be no reason why the display cannot work with broadband channels, but it will be slower and larger files will need to be stored. A summary file must be included in each event directory which includes header information for the event and a list of reporting stations with station arrival times. The format of the summary file is fixed as follows:

Line 1: header labels

Line 2: yymmddyyhhmm seconds lat X lon Y depth mag area

yymmddyyhhmm: same as event directory name

seconds: extension of event name for seconds accuracy.

lat X: positive latitude with X = N or S for north or south.

lon Y: positive longitude with Y = E or W for east or west.

depth: depth of event in kilometers

mag: magnitude of event

area: text for map label.

Line 3: blank

Line 4: station header labels

Lines 5-end: sta type z start_time duration max P-P distance azimuth

e.g.

rar lp z 93/5/27 04:49:10 888 39226 18.3 103.8

Example data sets are located in the directory /disk/wadati_d1/HKT/IRIS/data.bak.

Recomendations

The basic tools required to retrieve and display seismic data aquired by the Hockley broad-band station has been installed on the local UTIG network. However, the current tools and configuration requires that a user

be fluent in the UNIX operating system and practiced in using these tools, and is manually intensive. We believe it necessary to construct a system such that occasional users can easily retrieve and display data, and such that everyday users can quickly display data for the purpose of data quality control.

It is necessary for this system to have a method to automatically transfer several channels of data from the HKT DP to a disk on the local UTIG network, and automatically demultiplex the data. Currently such a system is in place for broad-band instruments in the Northern California Earthquake Network and the Terrascope network run by the California Institute of Technology Seismology Laboratory. These two networks both run a program on the DP called `dacommo` and a program on a UNIX based machine called `comserv`. These programs allow the DP to basically "aquire" data and the serve that data to the UNIX machine running comserv in much the same way that the DA serves data to the DP in a split system. This system has several advantages, including that the software has been extensively tested, that there are additional software packages to automatically display data provided by `comserv`, that data is served to the UNIX system in a near real time fashion, and that all of the aformentioned software is free. However, disadvantages to such a system include increased administrative attention, the need for the local computer network to be extremely robust, and the need to run another program on the DP. Another way to do the same type of operation may be possible through UNIX utilities and programs run strictly from the local network and using the `RETRIEVE` interface on the DP. We are currently exploring automatic data retrieval schemes based strictly from the local UNIX network.

Once data can be automatically transfered to the local network, the next priority should become a way to automatically display the data and automatically plot the data. Displaying the data on a dedicated terminal is desireable for two reasons: 1) Increased ease of data quality control, and 2) Display for public relations purposes. For this seismic station to be a continued asset, it must become a more visible part of UTIG for both the on site scientists and the general public. When a local or major earthquake occurs, local television stations and newspapers often request information

from the institute, including on camera interviews. Such a display to show event oriented data as well as continuous data would be invaluable for these situations. At the same time we should develop a way to easily and nearly automatically plot daily records of the station for both data quality control and public relations purposes. In addition, we should also construct a user friendly method to search either the ISC, PDE, or Havard CMT global seismicity catalogs for past events in a region and display the data in map form with high resolution coastlines, bathymetry, and political boundaries.

Finally, a long term goal is to create an Internet resource, specifically a World-Wide-Web page featuring station HKT and data from the station. Making the station known on the Internet would increase the public profile of the station and UTIG, and simultaneously could also serve data to the scientific community.

References

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Davis, S. D., W. D. Pennington, and S. M. Carlson. A compendium of earthquake activity in Texas, Univ. of Texas Bureau of Econ. Geol. Circ. 89-3, 27 pp. (printed, 219 pp. (microfiche)), 1989.

SEED: Standard for the Exchange of Earthquake Data Reference Manual, Federation of Digital Seismographic Networks, Incorporated Research Institutions for Seismology, and the United States Geological Survey, published by Incorporated Research Institutions for Seismology, 1993.

Ultra Shear Documentation, Quanterra Corporation, Cambridge Massachusettes, 1994

The following World-Wide-Web pages were also used as reference material:

http://www.iris.washington.edu/

http://quake.geo.berkeley.edu/

Appendix A: Sample Retrieve and Display Session From A Sun Cmdtool

Following is a log of a sample retrieve and display session. Computer output is in courier font, and user input is in **courier bold font**. The font size has been reduced to 10 point in places in order to keep computer output on a single line. Annotations to the computer dialogue are in *italicized times font* and right justified, except for menu and mouse selected commands.

```
wadati:(6)%telnet hkt.ig.utexas.edu
Trying 129.116.200.84 ...
Connected to hkt.ig.utexas.edu.
Escape character is '^]'.

OS-9/68K V2.4   Motorola VME147 - 68030   95/09/26 16:19:34

User name?: seed<cr>
Password: data                                  password is not echoed to screen
Process #24 logged on    95/09/26 16:19:39
Welcome!


Q680/V system processor -  Copyright (C) 1989, 1990 Quanterra, Inc.

                WELCOME to the IRIS-2 GSN station HKT

                          Hockley, Texas

              Station Operational 21 Jul 1995 - 95,202

...please wait

Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT

Please type your name and organization - up to 50 characters:
**************************************************
pauln university of texas institute of geophysics

Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT
Copyright 1986-1994 by Joseph M. Steim & Quanterra, Inc.
Retrieve (C) 1986-1994 - Release 35/05-0131-0324- 68020- FPU

type ? for help

Command? ?<cr>

Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT
Retrieve (C) 1986-1994 Quanterra, Inc. - Release 35/05-0131-0324- 68020- FPU
```

```
"C <C/E>" = Change buffer from/to continuous/event data
"T <V/F/C/CS/S/P>" = select Transmission file format
"F <W/S/L/V...>" = select optional Filters
"E [ALL]/<DATE> <DATE> [<SEEDNAMES>]" = Examine available data or logs
"S <SEEDNAME> <DATE>" = Setup single data channel to retrieve
"G" = start or resume sending selected segment
"G P[LOT]" = Plot selected segment on 4014 terminal
"G <S/B>" = Store selected segment to local/backup file
the following 4 methods are available for SEED binary transfer:
"K <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via Kermit
"X <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via STP
"V <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = archiVe local file
"I <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via uuencode
"R" = send station description
"L[|B|C] [ALL]" = view entries in event, caliB, or Clock Log
"P" = display active Processes
"U <N>" = view User log <N> entries backward
"Y[T] <N> [<M>]" = view [<M>] activitY log <N> entries backward
"M <message text>" = send Message to station operator
"Q" = Quit on-line session. CTL-"C" is ABORT key.
<SEEDNAMES> supports wildcards (i.e. BH?,?LZ,???) and DET|CAL|TIM|MSG
```

Command? **R<cr>** *send station description*

```
Station :    HKT   Hockley, Texas
             Lat: 29.9618 N  Lon: 95.8384 W  Elev:-415.0m

Components: Z  : + = ground motion up
            N  : + = ground motion north
            E  : + = ground motion east

Streams:    VBB : 20 SPS: on 24-bit channels, from Streckeisen STS-
1
                  seismometers.  Instrument response is flat
                  to velocity from 10 Hz to 360 sec;  Sensitivities
are
                  Z = 2606 Vsec/m, S/N 79403;
                  N = 2284 Vsec/m, S/N 69409;
                  E = 2258 Vsec/m, S/N 69410.
                 Recorded continuously.
            LP :  1 SPS: derived by constant-time-delay Finite Impulse
                  Response (FIR) digital filter from VBB stream in real
                  time, cutoff at 2.7 S period.  Recorded continuously.
            VLP : 0.1 SPS: derived by FIR filter from LP stream in real
                  time, cutoff at 27 S period.  Recorded continuously.
            ULP : 0.01 SPS: derived by FIR filter from LP stream in real
                  time, cutoff at 270 S period.  Recorded continuously.

Note:       FIR filter delays are accounted for in the header reported
            with the data.
Response:   Basic response for the LP,  VLP,  and ULP channels is flat to
            ground velocity from the FIR filter upper cutoff to the
            second-order lower corner at 360 S period.
```

Command? **P<cr>** *display active Processes*

```
 Id PId Grp.Usr  Prior  MemSiz Sig S    CPU Time   Age Module & I/O
  2   0   0.0     128   0.50k   0 w        0.00 669:57 sysgo <h0 >>>term
  3   2   0.0     128   6.75k   0 w        0.48 669:57 shell <h0 >>>term
  4   3   0.0     128   6.75k   0 w        0.07 669:57 shell <h0 >>>term
  5   0   0.0     128  15.50k   0 s        0.02 669:57 tsmon <h0 >>>term
  6   0   0.0     128  20.25k   0 s     8:51.38 669:57 routed <>>>nil
  7   0   0.0     128   2.00k   0 e    11:46.06 669:57 ifman
  8   0   0.0     128   2.00k   0 s       43.48 669:57 sockman
  9   0   0.0     128  12.00k   0 e        3.05 669:57 telnetd <>>>nil
 10   0   0.0     128  12.00k   0 e        0.17 669:57 ftpd <>>>nil
 11  13   0.0    1900 267.25k   0 s 18:18:50.44 669:56 dpsample <>nil >>pipe
 12   0   0.0    5000   6.75k   0 s    30:26.69 669:57 tmon <h0 >term >>term
 13   4   0.0     128  67.25k   0 s  6:04:01.21 669:56 dpshell <term >term >>pipe
 14   0   0.0     128   8.00k   0 s 13:28:02.96 669:56 pmsgd <nil >>>t2
 15   0   0.0     128  15.75k   0 s  1:47:50.77 669:56 tapeserv <nil >term>>pipe
 16  15   0.0     128   2.00k   0 s     1:47.10 669:56 tapeio <nil >term >>pipe
 17   0   0.0    1000   0.00k   0 -        0.00 669:56 sbf
 18   0   0.0    2000 172.00k   0 s     8:57.38 669:56 bufserv <nil >>>pipe
 19   0   0.0    2000 169.25k   0 s       13.40 669:56 bufserv <nil >>>pipe
 20   0   0.0    2000  22.50k   0 s     4:21.09 669:56 dpcommo <nil >nil >>pipe
 21   0   0.0     128  95.25k   0 s        1.69 669:56 auto_helem <h0 >term>>pipe
 22  15   0.0     128   2.00k   0 s     2:07.99 669:55 tapeio <nil >term >>pipe
 23   0   0.0    1000   0.00k   0 -        0.00 669:55 sbf
 24  25   1.0      10  89.25k   0 w        0.90  0:01 retrieve <>>>pks00
 25   0   0.0     128  22.00k   0 e        0.33  0:01 telnetdc <pks00
 26  24   1.0      10  18.25k   0 *        0.33  0:00 procs <>>>pks00

 Id PId Aging   F$calls I$calls Last      Read Written Module & I/O
  2   0   128         3       4 Wait         0       0 sysgo <h0 >>>term
  3   2   128       251      95 Wait      2048     715 shell <h0 >>>term
  4   3   128        31      31 Wait       125       4 shell <h0 >>>term
  5   0   128         8       8 Sleep        0      17 tsmon <h0 >>>term
  6   0   128    241160  629703 Sleep        0       0 routed <>>>nil
  7   0   128         0       0 <none>       0       0 ifman
  8   0   128         0       0 <none>       0       0 sockman
  9   0   128       423    2630 SetStt       0       0 telnetd <>>>nil
 10   0   128        58     201 SetStt       0       0 ftpd <>>>nil
 11  13  1900  93737765  178696 Sleep    13055 349090669 dpsample <>nil >>pipe
 12   0  5000  18687778 30431808 Sleep  59706006 2664416 tmon <h0 >term >>term
 13   4   128   6511582 69720020 Sleep 347948222 289291761 dpshell<term>term>>pipe
 14   0   128   2383184 94724302 Sleep  681853423 3811003 pmsgd <nil >>>t2
 15   0   128   9032100 1980362 Sleep  986240353  622975 tapeserv <nil >term>>pipe
 16  15   128   5522819  885330 Sleep        0       0 tapeio <nil >term >>pipe
 17   0  1000         0       0 <none>       0       0 sbf
 18   0  2000   8560136  326011 Sleep  6382981 177188824 bufserv <nil >>>pipe
 19   0  2000   6755163   38386 Sleep     8098 3049101 bufserv <nil >>>pipe
 20   0  2000  35876853 18528993 Sleep  240838594 8002804 dpcommo <nil >nil >>pipe
 21   0   128       162      98 WritLn    1640     643 auto_helem <h0 >term >>pipe
 22  15   128   5387389  838331 Sleep        0       0 tapeio <nil >term >>pipe
 23   0  1000         0       0 <none>       0       0 sbf
 24  25    10      1738    3261 Wait     22739    3102 retrieve <>>>pks00
 25   0   128       510    2300 Event     7666    7675 telnetdc <pks00
 26  24    10        79      68 GPrDsc       0    1843 procs <>>>pks00

Command? Y<cr>                                          view activity log
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49 VHE:-17498.160 4760.227 14897.011
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49  VMZ: 548.932     0.945     3.707
```

```
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50  VMN: 543.322      0.019      0.019
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50  VME: 386.370      0.014      0.014
FROM TAPE: Starting log flush at 95/09/26 12:41:33  at record 16174 on /MT0
FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
FROM TAPE: Log flush complete at 95/09/26 12:45:57  at record 16379 on /MT0
FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
FROM NETWORK: login at 95/09/26 14:55:44 : pauln utig
FROM NETWORK: login at 95/09/26 15:26:52 : pauln utig
FROM TAPE: Starting log flush at 95/09/26 15:42:13  at record 16379 on /MT0
FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
FROM TAPE: Log flush complete at 95/09/26 15:46:59  at record 16586 on /MT0
FROM DPCOMMO: FROM AQSAMPLE: LPNB detector pick:
FROM DPCOMMO: FROM AQSAMPLE: C A 1 22234 1995 269=09/26 15:50:13.103 279 28.00 50
LHZ
FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
FROM NETWORK: login at 95/09/26 16:05:12 : IRIS DMC Spyder Project
FROM NETWORK: login at 95/09/26 16:20:06 : pauln UTIG
```

Command? **YT<cr>** *view activity log with time stamp*

```
1995/09/26 11:59:36 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49 VHE:-17498.160 4760.227 14897.011
1995/09/26 11:59:37 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:49 VMZ:   548.932    0.945   3.707
1995/09/26 11:59:37 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50 VMN:   543.322    0.019   0.019
1995/09/26 11:59:50 FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 12:02:50 VME:   386.370    0.014   0.014
1995/09/26 12:41:34 FROM TAPE: Starting log flush at 95/09/26 12:41:33  at record 16174 on /MT0
1995/09/26 12:41:34 FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
1995/09/26 12:45:57 FROM TAPE: Log flush complete at 95/09/26 12:45:57  at record 16379 on /MT0
1995/09/26 13:17:35 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 14:55:45 FROM NETWORK: login at 95/09/26 14:55:44 : pauln utig
1995/09/26 15:26:52 FROM NETWORK: login at 95/09/26 15:26:52 : pauln utig
1995/09/26 15:42:13 FROM TAPE: Starting log flush at 95/09/26 15:42:13  at record 16379 on /MT0
1995/09/26 15:42:13 FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
1995/09/26 15:46:59 FROM TAPE: Log flush complete at 95/09/26 15:46:59  at record 16586 on /MT0
1995/09/26 15:48:06 FROM DPCOMMO: FROM AQSAMPLE: LPNB detector pick:
1995/09/26 15:48:06 FROM DPCOMMO: FROM AQSAMPLE: C A 1 22234 1995 269=09/26 15:50:13.103 279 28.00
50 LHZ
1995/09/26 15:54:07 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 15:54:53 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 15:55:41 FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
1995/09/26 16:05:12 FROM NETWORK: login at 95/09/26 16:05:12 : IRIS DMC Spyder Project
1995/09/26 16:20:06 FROM NETWORK: login at 95/09/26 16:20:06 : pauln UTIG
```

Command? **E<cr>** *examine available data or logs*

```
UTC starting date for scan (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/13 00:00:00<cr>

UTC ending date for scan (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/20 00:00:00<cr>

...scanning available channels

...searching 1995/09/13 00:00:00  - 1995/09/20 00:00:00

21 segment(s) found.
```

```
Available segments:

  Seg  Name  Rate Inclusive Dates                                  Event
----- ------ ---- ---------------------------------------------  -----
   62    BHZ   20 1995/09/14 10:12:04 - 1995/09/19 22:23:46  On-Line C
   63    BHN   20 1995/09/14 10:15:08 - 1995/09/19 22:23:42  On-Line C
   64    BHE   20 1995/09/14 10:13:13 - 1995/09/19 22:23:59  On-Line C
   45    LHZ    1 1995/08/29 18:02:38 - 1995/09/26 16:09:41  On-Line C *
   46    LHN    1 1995/08/29 18:02:38 - 1995/09/26 16:15:23  On-Line C *
   47    LHE    1 1995/08/29 18:02:38 - 1995/09/26 16:10:47  On-Line C *
   51    AFP    1 1995/08/29 18:03:00 - 1995/09/26 15:32:46  On-Line C *
   54    VHZ .100 1995/09/05 09:08:38 - 1995/09/26 11:01:28  On-Line C *
   53    VHN .100 1995/09/05 12:55:18 - 1995/09/26 15:12:28  On-Line C *
   52    VHE .100 1995/09/05 10:43:58 - 1995/09/26 13:37:48  On-Line C *
   59    VKI .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   60    VE1 .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   56    VMZ .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   57    VMN .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   58    VME .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   61    VK1 .100 1995/09/05 04:29:20 - 1995/09/26 15:29:20  On-Line C *
   55    AFV .100 1995/09/05 14:42:40 - 1995/09/26 15:17:20  On-Line C *
   68    UE1 .010 1995/08/29 17:26:20 - 1995/09/24 11:19:40  On-Line C *
   67    UHZ .010 1995/08/29 17:25:58 - 1995/09/25 18:14:18  On-Line C *
   65    UHN .010 1995/08/29 17:25:58 - 1995/09/24 16:09:18  On-Line C *
   66    UHE .010 1995/08/29 17:25:58 - 1995/09/24 16:09:18  On-Line C *

Command? L<cr>                                   view entries in event log

UTC starting date for search (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/13 00:00:00<cr>

UTC ending date for search (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/20 00:00:00<cr>

...search requested from 1995/09/13 00:00:00 up to 1995/09/20
00:00:00
...system time now 1995/09/26 16:24:17
...log file last updated at 1995/09/26 15:48:05

P A L  S/N  Year Day Date    UTC Time     Peak Amp  Period  Noise  Channel
- - - ----- ---- --- ----- ------------ ---------- ------ ------- -------
SPWW detector pick:
C A 1 00165 1995 256=09/13 01:50:42.954      10616   0.35     245 BHZ
D A 1 21331 1995 256=09/13 01:51:33.954        970   0.65     260 BHZ
LPNB detector pick:
C A 0 02354 1995 256=09/13 04:50:14.104        550  28.00      73 LHZ
D A 0 01368 1995 256=09/13 08:13:10.103        313  27.00      40 LHZ
SPWW detector pick:
C A 2 22223 1995 256=09/13 10:40:08.703        716   0.35     206 BHZ
MANTLE detector pick:
C A 0 11255 1995 256=09/13 11:06:57.103       1099 200.00     201 VHZ
SPWW detector pick:
C B 2 23323 1995 256=09/13 11:18:45.453        930   0.40     227 BHZ
```

```
LPNB detector pick:
D A 1 22233 1995 256=09/13 11:39:48.103        377   28.00       59 LHZ
SPWW detector pick:
C A 1 10134 1995 256=09/13 13:57:51.103       1608    0.90      202 BHZ
      .
      .
      .
      .
```

Command? **v<cr>** *archive local file*

```
This command will archive 4096-byte binary SEED "Steim-compressed"
data records locally for transmission via "FTP".
Files are uniquely named by stream and date

Records containing all components within your selected time
interval and selected stream will be sent in a single
transmission, making possible, for example, the retrieval
of all event segments within an entire day using a single
command.

The records received are SEED V2.3, as those distributed
on tape by the Albuquerque Seismological Lab and IRIS DMC.
A Data-Only-Blockette (1000) identifies each record.
       1) there are no control headers
       2) the logical record length is 4096 bytes

the following SEED channels/sample rates are available:

    BHZ   20,     BHN   20,     BHE   20,     LHZ    1,     LHN    1
    LHE    1,     AFP    1,     VHZ .100,     VHN .100,     VHE .100
    VKI .100,     VE1 .100,     VMZ .100,     VMN .100,     VME .100
    VK1 .100,     AFV .100,     UHZ .010,     UHN .010,     UHE .010
    UE1 .010

Archive SEED name mask (e.g. B??): LH?<cr>

UTC starting date for LP data:
  yy/mm/dd hh:mm:ss
? 95/09/14 14:00:00<cr>

UTC ending date for LP data:
  yy/mm/dd hh:mm:ss
? 05/09/14 15:00:00<cr>

Invalid date...

UTC ending date for LP data:
  yy/mm/dd hh:mm:ss
? 95/09/14 15:00:00<cr>

...search interval 1995/09/14 14:00:00  - 1995/09/14 15:00:00
```

```
12 total records selected.


...creating archive file "CL950914.O00"
LHZ-09/14 13:42*!, LHN-09/14 13:55*!, LHE-09/14 13:52*!, LHZ-09/14
14:11*!
LHN-09/14 14:17*!, LHE-09/14 14:16*!, LHZ-09/14 14:26*!, LHN-09/14
14:32*!
LHE-09/14 14:32*!, LHZ-09/14 14:45*!, LHN-09/14 14:52*!, LHE-09/14
14:51*!

....closing local file

Command? q<cr>                                          quit RETRIEVE

...normal termination

...vbb data retrieval system logged out
Connection closed by foreign host.

wadati:(7)%ftp hkt.ig.utexas.edu<cr>          open ftp connection to HKT
Connected to hkt.ig.utexas.edu.
220 hkt OS-9 ftp server V1.0 ready
Name (hkt.ig.utexas.edu:pauln): seed<cr>
331 password required for seed
Password: data<cr>                        password is not echoed to screen
230 user seed logged in
tp> pwd<cr>                                       user SEED home directory
251 "/h0/USR/GSN/RUN" is current directory
ftp> ls<cr>
200 PORT command ok
150 Opening data connection for dir -ua  (129.116.200.89,34485) (0
bytes).
.login
MODEMPRGS
T3000
aqgo
aqstop
autoload
buildauto
buildautoq
dkclean.disk
load_aq
login_dp
restart
setport
226 Transfer complete
124 bytes received in 0.0088 seconds (14 Kbytes/s)
ftp> cd ..<cr>
200 CWD command ok
ftp> ls<cr>
200 PORT command ok
```

```
150 Opening data connection for dir -ua  (129.116.200.89,34486) (0
bytes).
CFG
DPBIN
DP_DATA
DP_LOGS
FILTERS
FTPDATA
RUN
SRC
226 Transfer complete
58 bytes received in 0.0038 seconds (15 Kbytes/s)
ftp> cd ..<cr>
200 CWD command ok
ftp> ls<cr>
200 PORT command ok
150 Opening data connection for dir -ua  (129.116.200.89,34487) (0
bytes).
CMDS
GSN
TMON
226 Transfer complete
17 bytes received in 0.0039 seconds (4.2 Kbytes/s)
ftp> cd GSN/DP_DATA<cr>                    change directory to DP data archive
200 CWD command ok
ftp> ls<cr>
200 PORT command ok
150 Opening data connection for dir -ua  (129.116.200.89,34491) (0
bytes).
CL950914.O00
CV950914.O00
KSCRATCH_PKS00
KSCRATCH_S1B
KSCRATCH_TERM
ONLINE_LP_C
ONLINE_LP_C_DIR
ONLINE_ULP_C
ONLINE_ULP_C_DIR
ONLINE_VBB_C
ONLINE_VBB_C_DIR
ONLINE_VBB_E
ONLINE_VBB_E_DIR
ONLINE_VLP_C
ONLINE_VLP_C_DIR
226 Transfer complete
371 bytes received in 0.044 seconds (8.2 Kbytes/s)
ftp> binary<cr>                                    set up file transfer
200 Type set to I.
ftp> get CL950914.O00<cr>                          file transfer
```

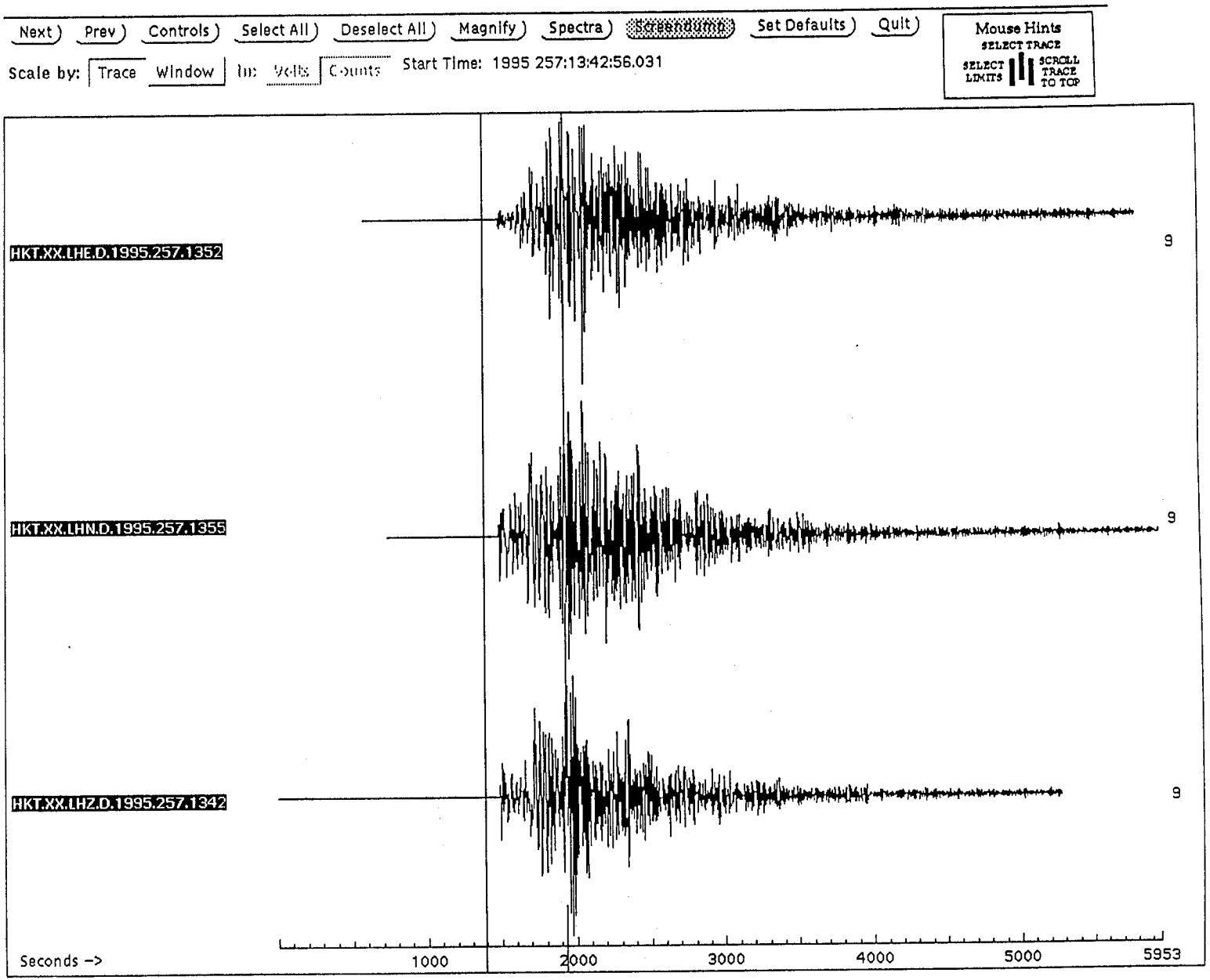

Figure A1. PASSCAL Quick Look data window showing three seismic traces (highlighted white on black text) and selected time limits (vertical lines running the height of the window).

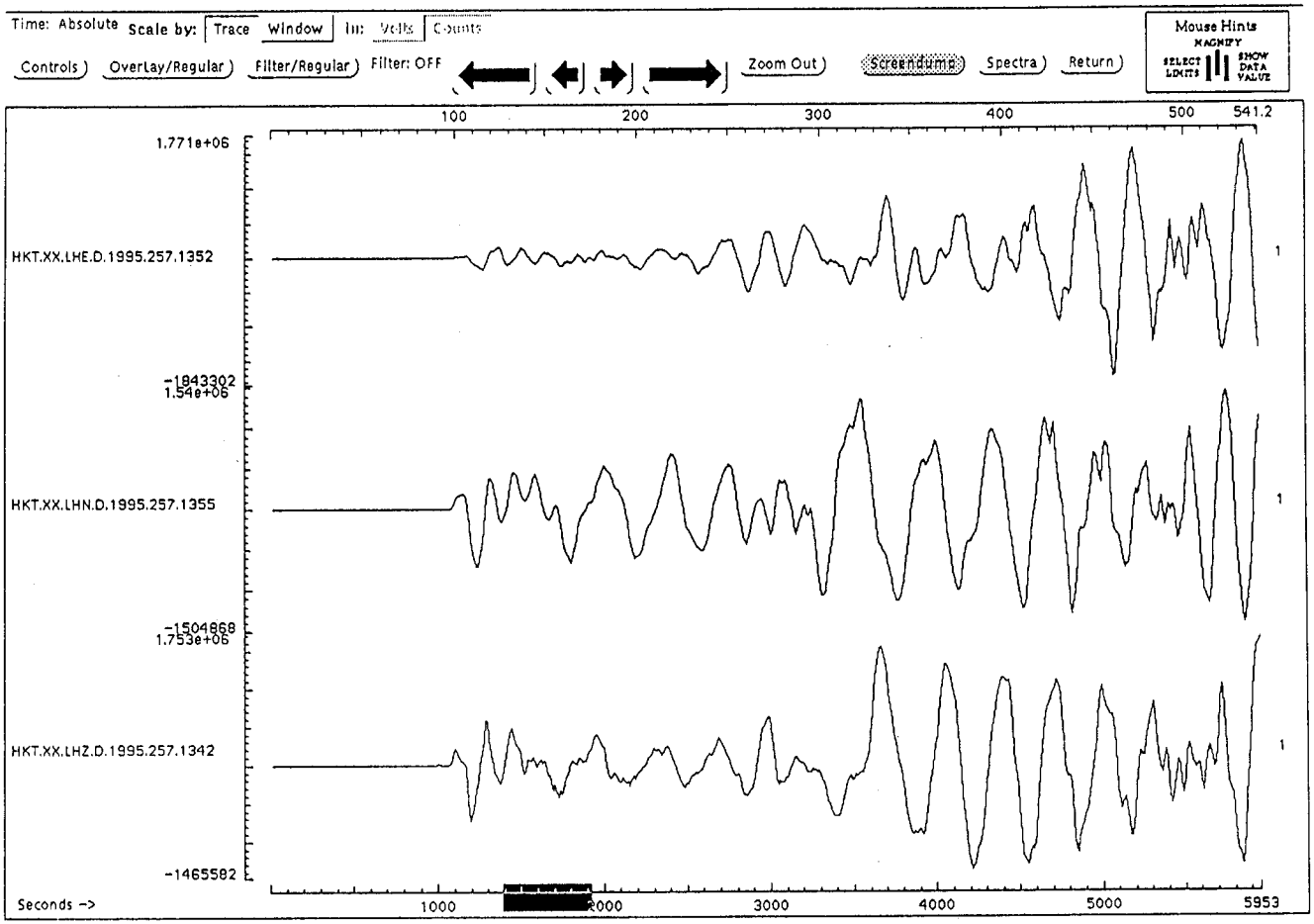

Figure A2. PASSCAL Quick Look magnify window.

```
200 PORT command ok
150 Opening data connection for CL950914.O00 (129.116.200.89,34493)
(49152 bytes).
226 Transfer complete
local: CL950914.O00 remote: CL950914.O00
49152 bytes received in 0.17 seconds (2.8e+02 Kbytes/s)
ftp> bye<cr>                                          close ftp connection
200 Goodbye

wadati:(9)%../bin/seedsniff 4096 32768 < CL950914.O00<cr>

logrec 12 type D  (last record)

wadati:(10)%../bin/sdrsplit -c < CL950914.O00<cr>          demultiplex
                                                        transfered file

warning - no leap second file: /usr/local/lib/leapseconds
HKT LHE XX HKT LHN XX HKT LHZ XX
wadati:(11)%setenv LEAPSECONDS /disk/wadati_d1/HKT/bin/leapseconds<cr>
                                              define local leapseconds file
wadati:(12)%../bin/sdrsplit -c < CL950914.O00<cr>          demultiplex
                                                        transfered file

HKT LHE XX HKT LHN XX HKT LHZ XX
wadati:(14)%../bin/pql.steim_1_2 -mseed HKT.XX.LH*<cr>

PASSCAL Quick Look 2.1, Rev 94.129--
written by Richard Boaz
Version 2.x by Sid Hellman
at the PASSCAL Instrument Center
     Lamont-Doherty Earth Observatory

Initializing windows  --

pql command Select All
pql command select limits (mouse)
pql command Screendump                              Screendump Figure A1
pql command Magnify
pql command Screendump                              Screendump Figure A2
pql command Quit

wadati:(15)%../bin/seistool_static<cr>
Welcome to SeisTool Version 2.1.2
(c) Andrew K. Yu, LBL & UCB, 1992-3.

Initializing... done.

SeisTool button Files-(Load file)-(MSEED format)  Screendump Figure A3
SeisTool popup window (Load MSEED file)           Screendump Figure A4
```

SeisTool command Zoom
SeisTool popup window (Zoom Window)
SeisTool command Quit

Screendump Figure A5

convert to SAC format

```
wadati:(16)%../bin/ms2sac -b HKT.XX.LHZ.D.1995.257.1342 HKT.XX.LHZ.SAC
Warning - unable to open coord file: /usr/contrib/data/bdsn/bdsn.coord
wadati:(17)%../bin/ms2sac -b HKT.XX.LHN.D.1995.257.1355  HKT.XX.LHN.SAC
Warning - unable to open coord file: /usr/contrib/data/bdsn/bdsn.coord
wadati:(19)%../bin/ms2sac -b HKT.XX.LHE.D.1995.257.1352 HKT.XX.LHE.SAC
Warning - unable to open coord file: /usr/contrib/data/bdsn/bdsn.coord
```

ignore the Warning messages: they apply only at NCEDC

```
wadati:(21)%../bin/sac<cr>
 SEISMIC ANALYSIS CODE [August 11, 1992 (Version 10.6f)]
 Copyright 1992 Regents of the University of California
    modified by Paul Nyffenegger [Update = Jul 20 1995]

SAC> read *.SAC<cr>
HKT.XX.LHE.SAC HKT.XX.LHN.SAC HKT.XX.LHZ.SAC
SAC> bd xw<cr>
SAC> qdp off<cr>
SAC> plot1<cr>
SAC> quit<cr>
wadati:(22)%
```

Screendump Figure A6

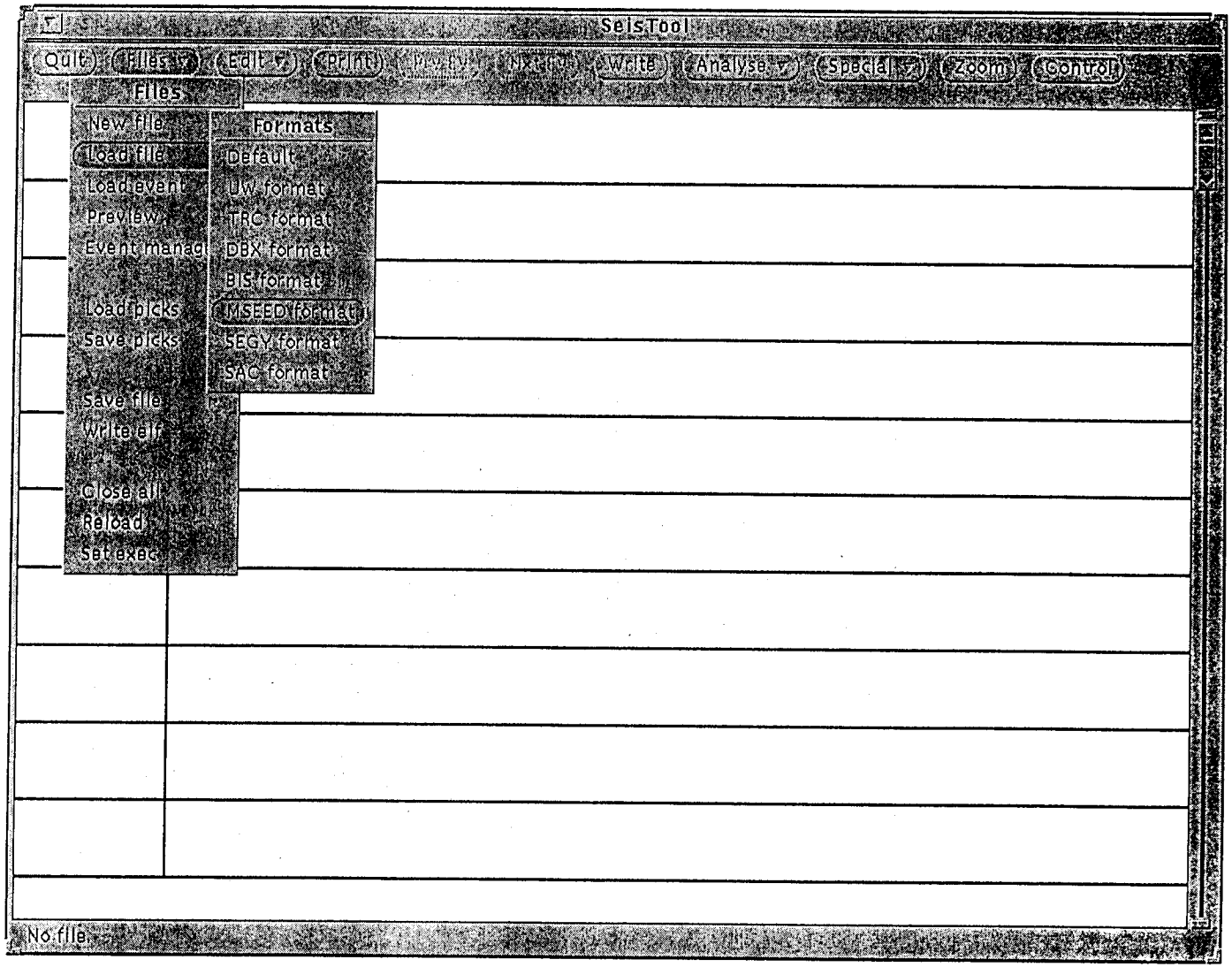

Figure A3. SeisTool command window, with the commands (Load file)-(MSEED format) chosen from the Files pull down menu.

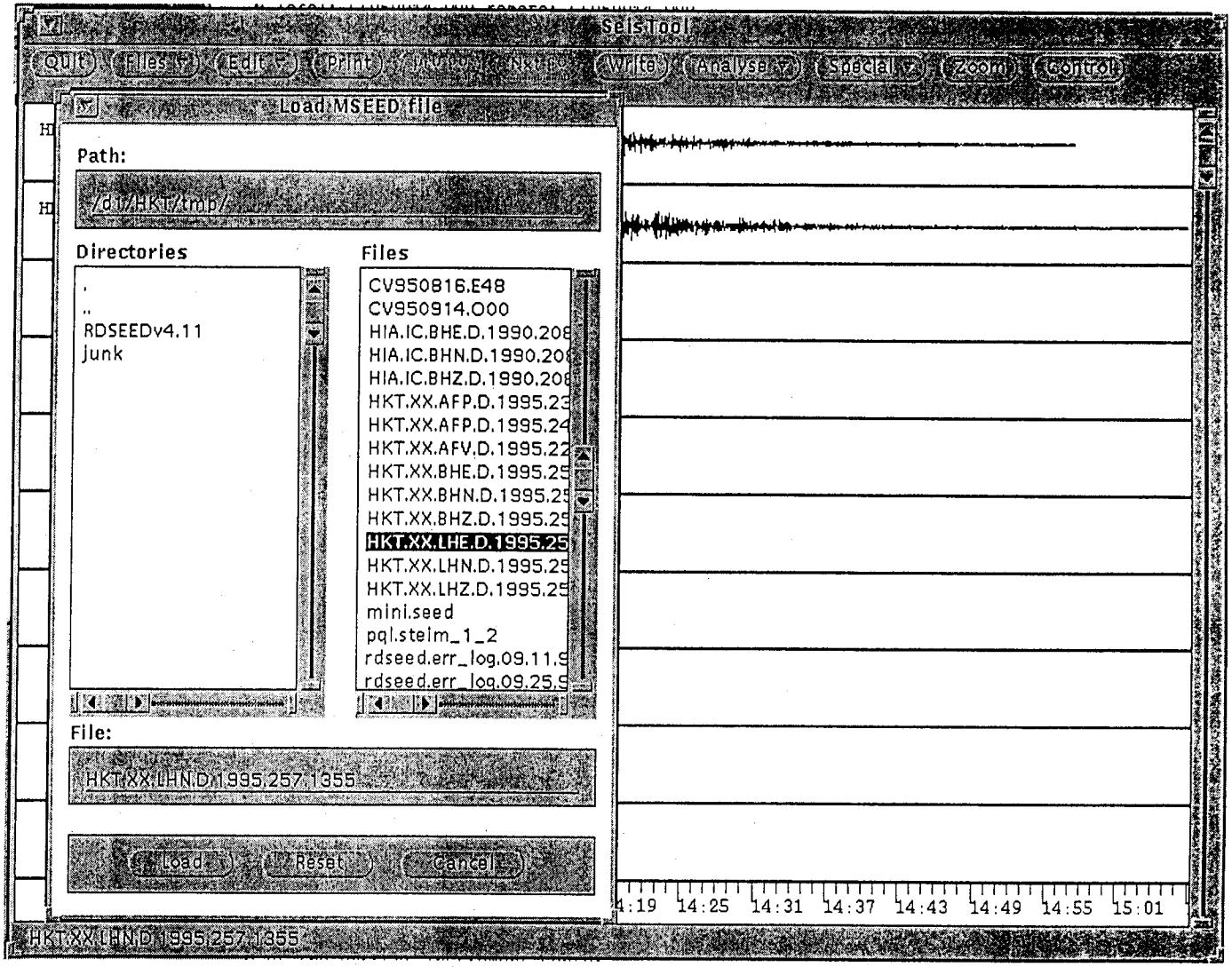

Figure A4. SeisTool command window in the background displaying two seismic traces, with the (Load MSEED file) popup window in the foreground showing a third trace selected.

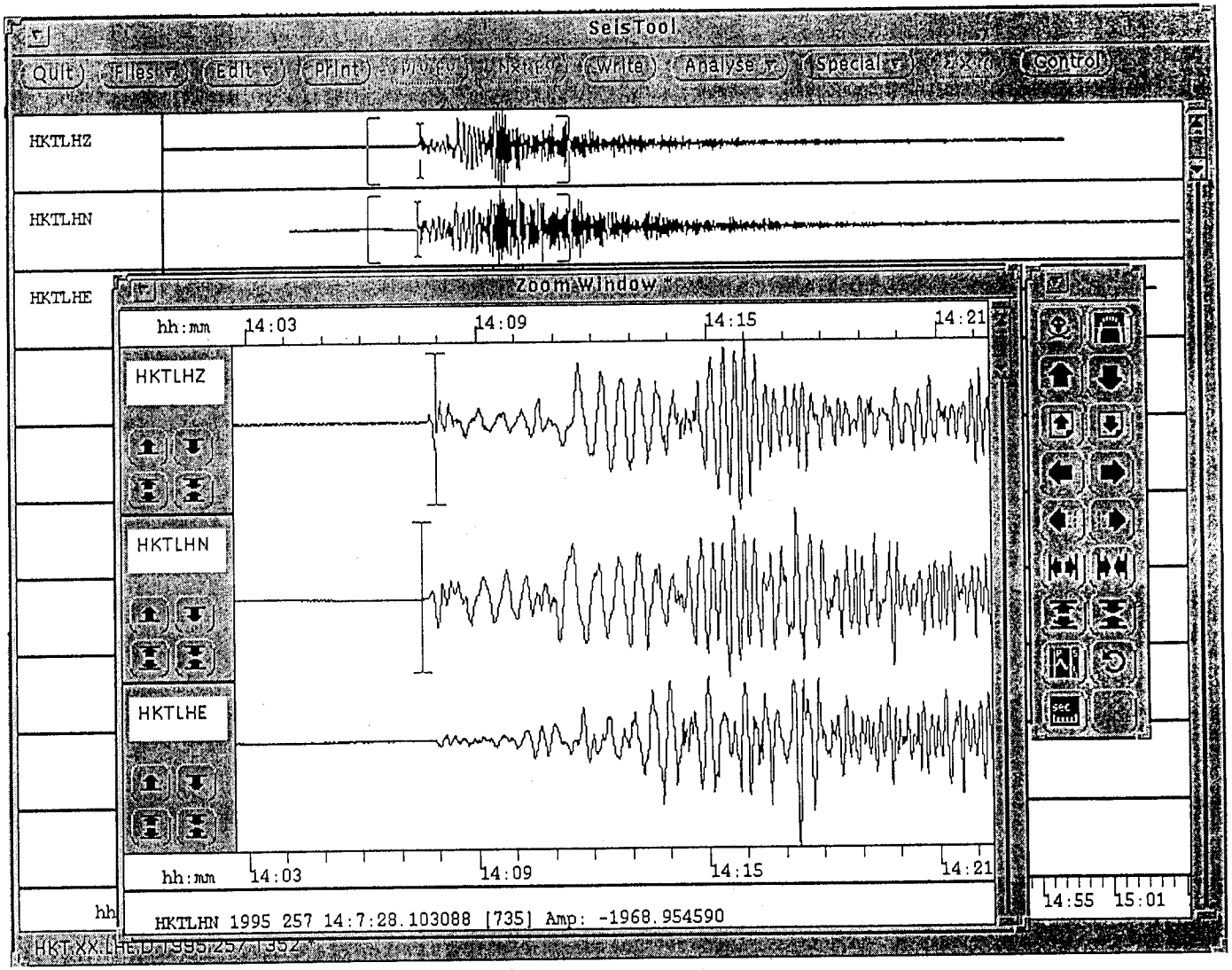

Figure A5. SeisTool command window in the background displaying two seismic traces, with the (Zoom) popup window in the foreground showing three traces.

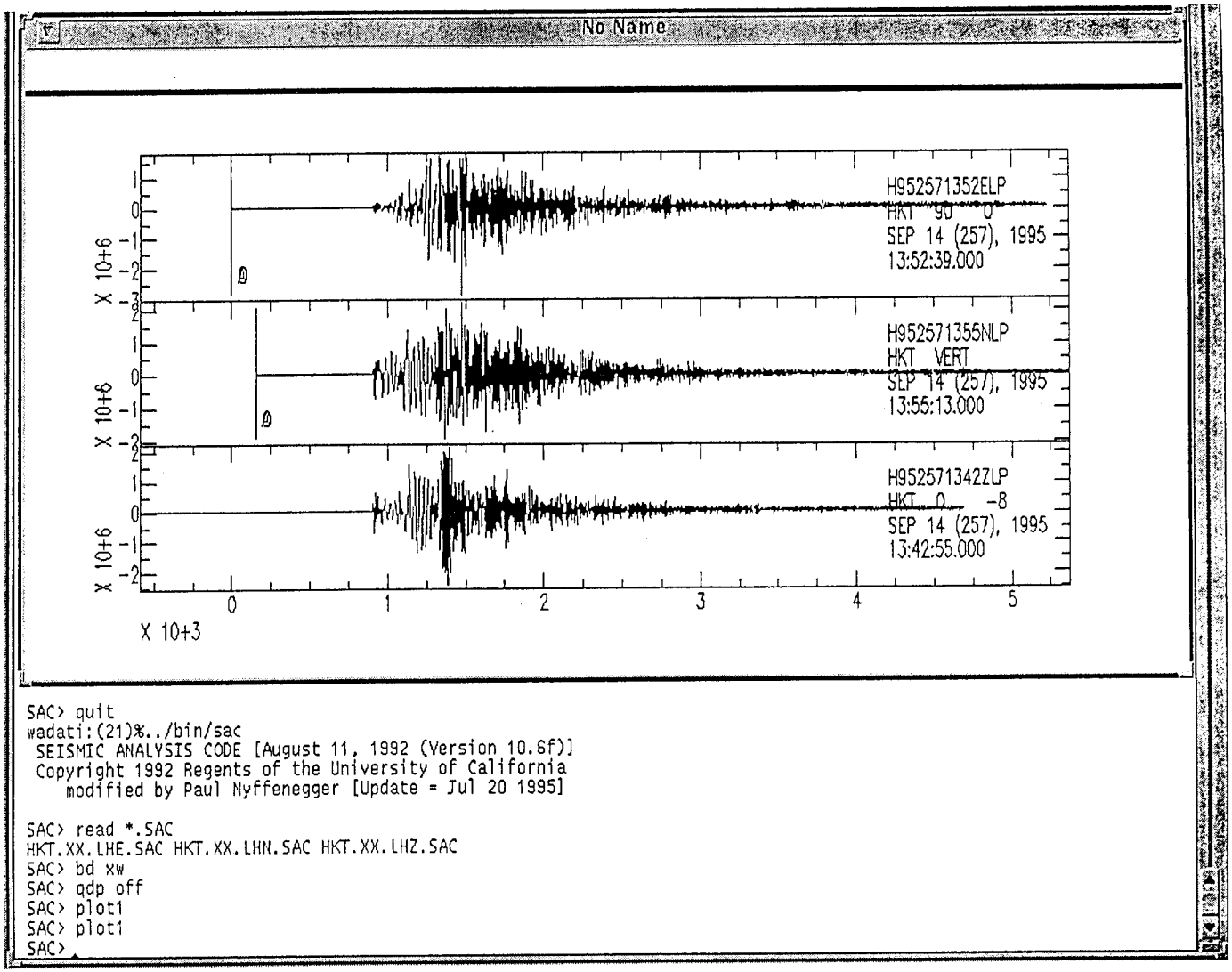

Figure A6. Screendump of a SAC plot x-window and a Sun cmdtool in the background listing the SAC commands used to obtain the plot.

Appendix B: Monitoring The Station Through An Xterm

Following is a log of a sample monitoring session on a Xterm window on a Sun computer. Computer output is in courier font, and user input is in **courier bold font**. The font size has been reduced to 10 point in places in order to keep computer output on a single line. Annotations to the computer dialogue are in *italicized times font* and right justified.

```
wadati> telnet hkt.ig.utexas.edu                                  connect to HKT
Trying 129.116.200.84 ...
Connected to hkt.ig.utexas.edu.
Escape character is '^]'.


OS-9/68K V2.4   Motorola VME147 - 68030   95/09/26 20:19:32


User name?: seed<cr>
Password: data<cr>                                  password is not echoed to screen
Process #24 logged on    95/09/26 20:19:37
Welcome!


Q680/V system processor -  Copyright (C) 1989, 1990 Quanterra, Inc.

                WELCOME to the IRIS-2 GSN station HKT

                        Hockley, Texas

               Station Operational 21 Jul 1995 - 95,202

...please wait

Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT

Please type your name and organization - up to 50 characters:
**************************************************
pauln utig

Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT
Copyright 1986-1994 by Joseph M. Steim & Quanterra, Inc.
Retrieve (C) 1986-1994 - Release 35/05-0131-0324- 68020- FPU

type ? for help

Command? ?<cr>
Quanterra VBB Data Retrieval System (C) 1995 Quanterra STATION: HKT
Retrieve (C) 1986-1994 Quanterra, Inc. - Release 35/05-0131-0324- 68020- FPU
  "C <C/E>" = Change buffer from/to continuous/event data
```

```
"T <V/F/C/CS/S/P>" = select Transmission file format
"F <W/S/L/V...>" = select optional Filters
"E [ALL]/<DATE> <DATE> [<SEEDNAMES>]" = Examine available data or logs
"S <SEEDNAME> <DATE>" = Setup single data channel to retrieve
"G" = start or resume sending selected segment
"G P[LOT]" = Plot selected segment on 4014 terminal
"G <S/B>" = Store selected segment to local/backup file
the following 4 methods are available for SEED binary transfer:
"K <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via Kermit
"X <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via STP
"V <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = archiVe local file
"I <SEEDNAMES> <DATE> <DATE> [MAXREC] [TIMETOL]" = via uuencode
"R" = send station description
"L[|B|C] [ALL]" = view entries in event, caliB, or Clock Log
"P" = display active Processes
"U <N>" = view User log <N> entries backward
"Y[T] <N> [<M>]" = view [<M>] activitY log <N> entries backward
"M <message text>" = send Message to station operator
"Q" = Quit on-line session. CTL-"C" is ABORT key.
<SEEDNAMES> supports wildcards (i.e. BH?,?LZ,???) and DET|CAL|TIM|MSG
```

Command? **L<cr>** *view entries in event log*

```
UTC starting date for search (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/23 00:00:00<cr>

UTC ending date for search (time not required):
  yy/mm/dd hh:mm:ss
? 95/09/25 00:00:00<cr>

...search requested from 1995/09/23 00:00:00 up to 1995/09/25
00:00:00

...system time now 1995/09/26 20:20:30
...log file last updated at 1995/09/26 19:28:45

P A L  S/N  Year Day Date    UTC Time     Peak Amp  Period  Noise  Channel

- - - ----- ---- --- ----- ------------ ---------- ------ ------- -------

LPNB detector pick:

C A 0 01999 1995 266=09/23 01:48:07.104       9347  28.00      27 LHZ
MANTLE detector pick:
D B 1 10133 1995 266=09/23 03:38:57.104        839 140.00     274 VHZ
LPNB detector pick:
C A 2 99999 1995 266=09/23 03:48:27.104        624  24.00      28 LHZ
D A 2 22223 1995 266=09/23 15:23:48.103        101  28.00      27 LHZ
SPWW detector pick:
C A 1 01158 1995 266=09/23 16:25:32.303      17968   1.55     504 BHZ
D A 2 45999 1995 266=09/23 16:26:24.803       6707   1.45     535 BHZ
D B 2 43223 1995 266=09/23 16:27:19.603       2172   1.35     569 BHZ
LPNB detector pick:
C A 2 99999 1995 266=09/23 17:24:26.103       2014  25.00      28 LHZ
MANTLE detector pick:
```

```
D B 0 01232 1995 266=09/23 17:17:37.103        911   60.00      238 VHZ
SPWW detector pick:
D A 1 10258 1995 266=09/23 21:06:30.503       3882    1.45      320 BHZ
LPNB detector pick:
C A 0 12455 1995 266=09/23 21:16:52.103        140   27.00       26 LHZ

SPWW detector pick:
C A 1 01234 1995 266=09/23 22:39:57.853      35180    1.30      412 BHZ
C A 2 99923 1995 266=09/23 22:40:49.903       8344    1.30      438 BHZ
D A 2 14677 1995 266=09/23 22:41:41.353      12413    1.80      465 BHZ
D A 2 00223 1995 266=09/23 22:42:37.653       2930    1.65      494 BHZ
MANTLE detector pick:
D B 1 00144 1995 266=09/23 22:39:47.103        990   60.00      228 VHZ
LPNB detector pick:
C A 2 99999 1995 266=09/23 23:18:00.103       3578   31.00       27 LHZ
C A 2 99643 1995 267=09/24 01:17:39.103        851   26.00       29 LHZ
SPWW detector pick:
D A 1 00234 1995 267=09/24 01:34:18.103       1191    1.25      288 BHZ
LPNB detector pick:
C B 1 12233 1995 267=09/24 09:34:46.103        100   22.00       33 LHZ

Command? s<cr>                          Setup single data channel to retrieve
...scanning available channels

the following SEED channels/sample rates are available:

    BHZ   20,   BHN   20,     BHE   20,     LHZ    1,  LHN    1
    LHE    1,   AFP    1,   VHZ .100,   VHN .100,   VHE .100
    VKI .100,   VE1 .100,   VMZ .100,   VMN .100,   VME .100
    VK1 .100,   AFV .100,   UHZ .010,   UHN .010,   UHE .010
    UE1 .010

SEED name (e.g. BHZ)? BHZ<cr>

UTC starting time to the nearest second:
  yy/mm/dd hh:mm:ss
? 95/09/23 22:39:50<cr>

Search requested starting at 1995/09/23 22:39:50

Time window begins in segment 10 at buffer record 3197

Maximum number of samples to transfer? 3000<cr>

Buffer server is processing your request

skipping first 635 samples...
transmission will begin at requested starting time within 0.002836
sec

...event detector on in record starting at 1995/09/23 22:39:18

Use the "G" command to begin transmission
or to re-transmit data received incorrectly.
```

Command? **gp<cr>**

plot selected segment to a TEK 4014 window on users computer
Screendump Figure B1

The xterm menu must be used after typing Q to return control to the vt100 window from the tek window: control-middle mouse button Switch to Tek Mode (off)

Command? **U<cr>**

view user log

```
S \ e lp \ 95/09/26 07:26:37 \ 3484  \ G \ Q \ logout: \
1995/09/26 16:10:15  \
login userid=1:0 \
pauln university of texas institute of geophysics \
1995/09/26 16:20:06  \
? \ R \ P \ ? \ E \ 95/09/13 00:00:00 \ 95/09/20 00:00:00 \ L \
95/09/13 00:00:00 \ 95/09/20 00:00:00 \ ? \ Y \ YT \ ? \ v \ LH? \
95/09/14 14:00:00 \ 05/09/14 15:00:00 \ 95/09/14 15:00:00 \ q \
logout: \
1995/09/26 16:28:14  \
login userid=1:0 \ pauln utig.ig.utexas.edu \
1995/09/26 19:21:05  \
? \ C \ E \ C \ C \ YT 10 \ P \ U 10 \ ? \ E \ 95/09/20 00:00:00 \
L \ 95/09/20 00:00:00 \ C \ E \ L \ 95/09/23 00:00:00 \ s \ BHZ \
95/09/26 06:11:00 \ s \ BHZ \ 95/09/26 07:26:00 \ s \ BHZ \
95/09/26 07:26:42 \ 1000 \ ? \ GP \ L \ 95/09/26 00:00:00 \ s \ BHZ \
login userid=1:0 \ pauln utig.ig.utexas.edu \
1995/09/26 19:47:00  \
login userid=1:0 \ pauln utig \
1995/09/26 19:53:07  \
? \ L \ 95/09/24 00:00:00 \ 95/09/25 00:00:00 \ L \
95/09/23 00:00:00 \ 95/09/24 00:00:00 \ s \ LHZ \ 95/09/23 23:16:00 \
2000 \ gp \ s \ BHZ \
95/09/23 22:39:00 \ 2000 \ gp \ ? \ R \ q \ logout: \
1995/09/26 20:02:57  \
login userid=1:0 \ pauln utig \
1995/09/26 20:19:43  \
```

Command? **Y <cr>**

view activity log

```
FROM NETWORK: login at 95/09/26 16:05:12 : IRIS DMC Spyder Project
FROM NETWORK: login at 95/09/26 16:20:06 : pauln UTIG
FROM DPSAMPLE: ***** 30 SECONDS ELAPSED SINCE LAST PACKET RECEIVED
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:49  VHZ:-1010.892   66.423   460.559
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:49  VHN: 21965.652 3680.121 12802.363
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:50  VHE:-23317.186 5925.669 14165.486
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:50  VMZ:   548.095    0.778     3.821
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:50  VMN:   543.322    0.019     0.019
FROM DPCOMMO: FROM AQSAMPLE: 95/09/26 18:02:50  VM     386.370    0.014     0.014
```

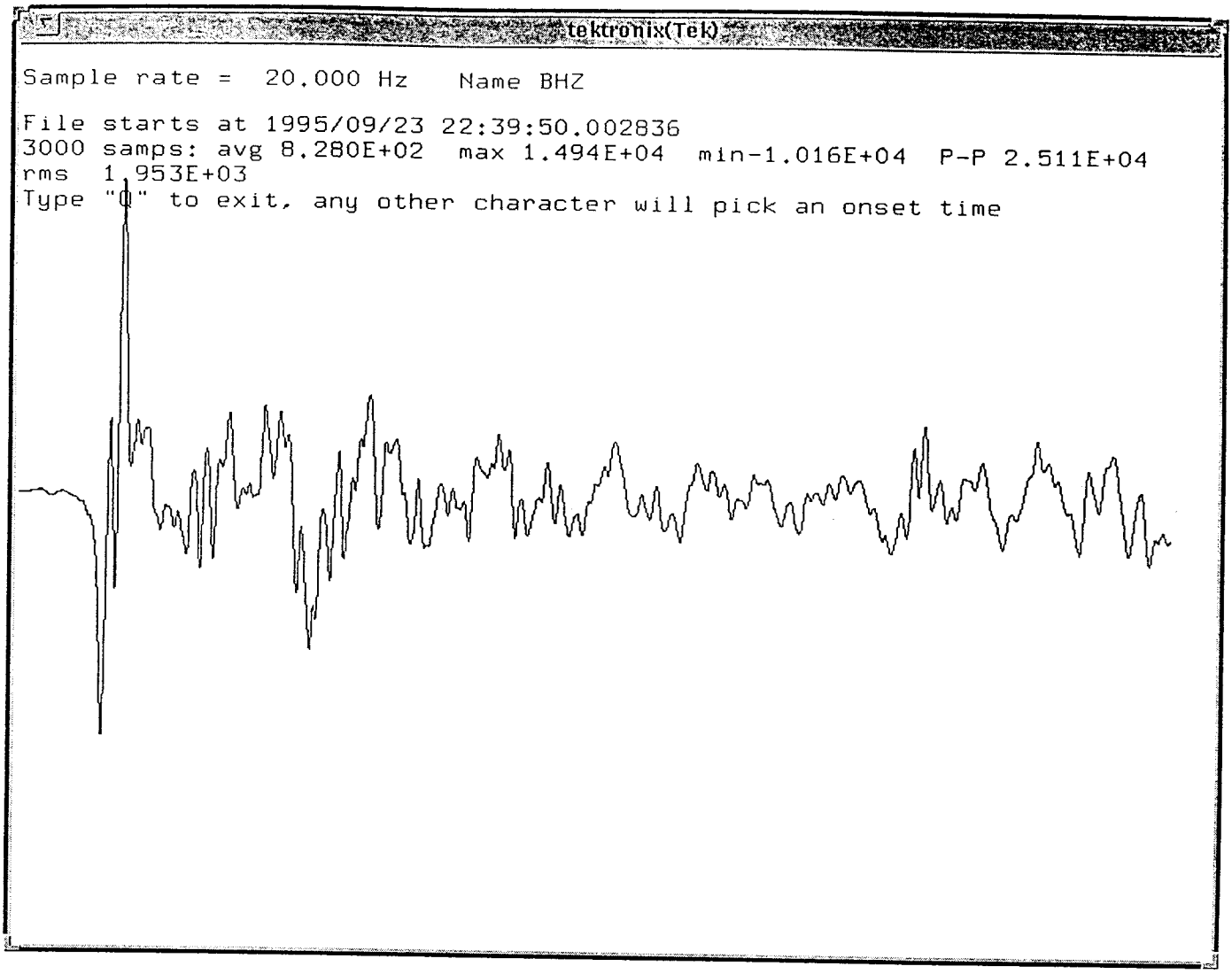

Figure B1. Screendump of a Tecktronix 4014 window attatched to an Xterm tool on a Sun computer. The RETRIEVE command "GP" was used to send the requested channel and data from the DP to the user's terminal.

```
FROM DPCOMMO: FROM AQSAMPLE: LPNB detector pick:FROM DPCOMMO: FROM AQSAMPLE: D A 0
00354 1995 269=09/26 18:52:43.103 282 31.00 55 LHZ
FROM TAPE: Starting log flush at 95/09/26 18:51:18  at record 16586 on /MT0
FROM TAPE: Log Percentages :  TIM=0  MSG=0  DATA=20
FROM TAPE: Log flush complete at 95/09/26 18:55:50  at record 16798 on /MT0
FROM NETWORK: login at 95/09/26 19:21:05 : pauln utig.ig.utexas.edu
FROM DPCOMMO: FROM AQSAMPLE: MANTLE detector pick:
FROM DPCOMMO: FROM AQSAMPLE: C A 2 12222 1995 269=09/26 19:22:07.103 1201 180.00
190 VHZ
FROM NETWORK: login at 95/09/26 19:47:00 : pauln utig
FROM NETWORK: login at 95/09/26 19:53:07 : pauln utig
FROM NETWORK: login at 95/09/26 20:19:43 : pauln utig
```

Command? **q<cr>** *quit RETRIEVE*

```
...normal termination
...vbb data retrieval system logged out
Connection closed by foreign host.
```

Appendix C: Personnel

Director, Institute For Geophysics
Dr. Paul Stoffa

Director, Hockley Seismic Station
Dr. Fumiko Tajima
353 UTIG
512-471-0461

Alternate Directors, Hockley Seismic Station
Dr. Steven P. Grand
215a UT Geological Sciences
512-471-3005
Dr. Cliff Frohlich
354 UTIG
512-471-0460

Technical Coordinator
Charlie Windisch
319 UTIG
512-471-0412

Hardware/Software System Administration
Mark Wiederspahn
364 UTIG
512-471-0406
Glen Caglarcan
370 UTIG
512-471-0492
Scott Kempf
177 UTIG (SOAR office)
512-471-0204

Data Quality Control
Ran Zhou
380 UTIG
512-471-0470
Paul Nyffenegger
356 UTIG
512-471-0478

Public Service
Dr. Cliff Frohlich
354 UTIG
512-471-0460
Paul Nyffenegger
356 UTIG
512-471-0478

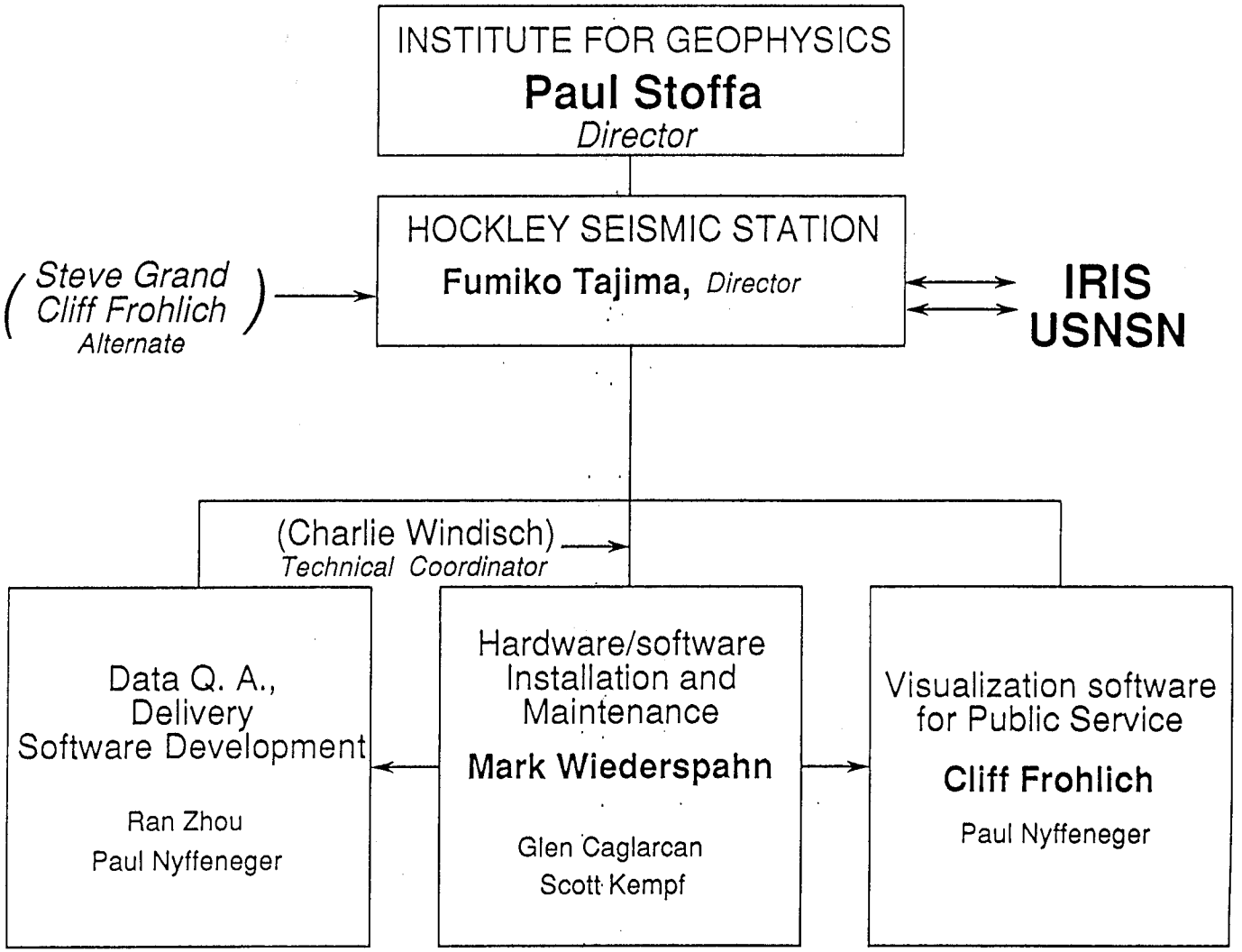

Figure C1. Organizational chart of personnel responsible for the operation of the Hockley Seismic Station.