

#### IV-C. Comparison of Network and Portable Arrival Times (Common Site).

In February of 1993 a Reftek instrument was installed at the top of Little Skull Mountain directly adjacent to (within 20 meters of) one of the permanent stations of the UNR Southern Great Basin Network. The station operated for several weeks during which time a number of triggered events were recorded coincidentally with the permanent net. Timing control for permanent network stations is provided by IRIG which is received at the University of Nevada Seismological Laboratory in Reno. IRIG is transmitted by satellite and its time accuracy is maintained by the U.S. Bureau of Standards. Trace data is time marked in Reno as it arrives via microwave from southern Nevada. Both the portable and network data are sampled at 100 samples per second.

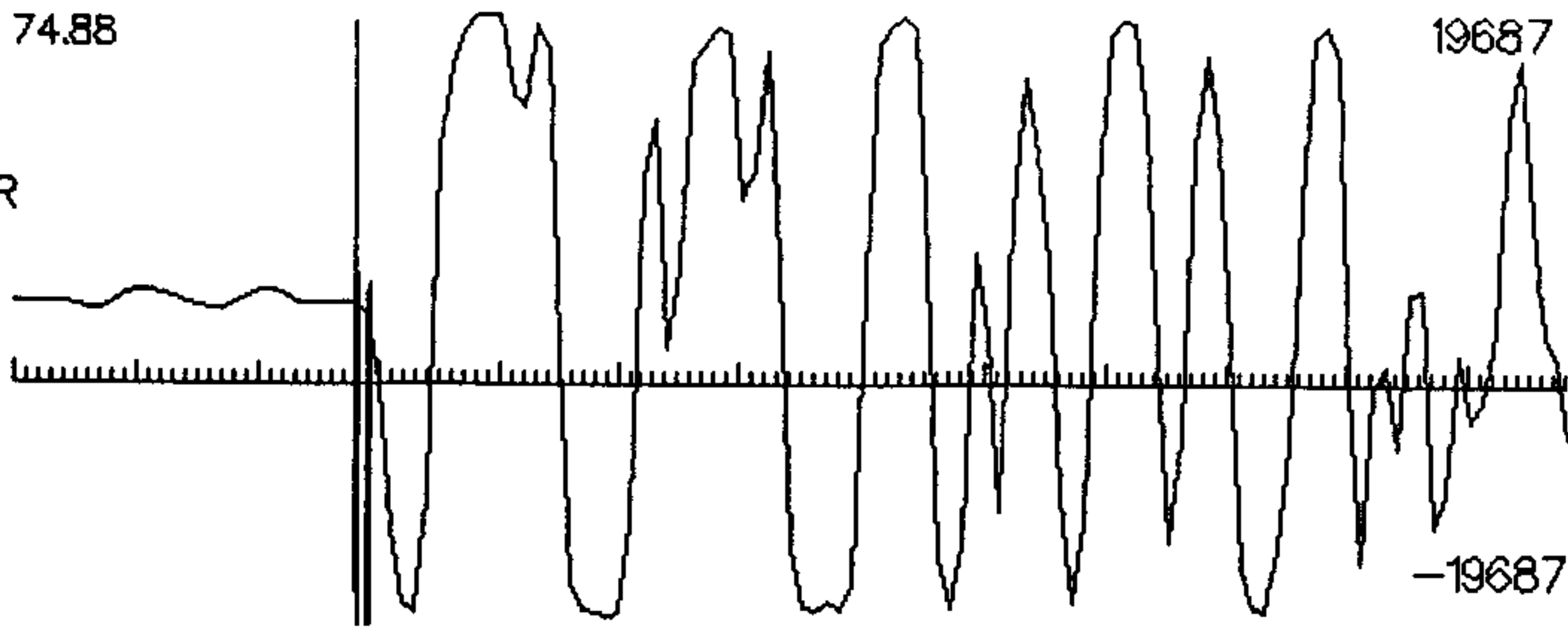
The following set of pairs of plots show arrival time picks and traces for five coincidentally recorded events at the station LTSR of the permanent network and the portable Reftek station. The plots of P-wave arrival time picks for station LTSR are screen dumps from the VMS system which runs the CUSP processing software and program "PICKEM". Plots and P-wave arrival picks for the Reftek arrivals are from program PQL acquired from the IRIS/PASSCAL data center. Unfortunately there are problems with the seismometer response at the Reftek site which do not allow us to directly compare waveform data, although first arrival times compare to within +/- 2 samples (.02 seconds). Also, a non-causal anti-aliasing filter within the Reftek data acquisition system tends to introduce a high-frequency precursory signal for very impulsive arrivals, which sometimes obscures the precise P-wave arrival. (This problem is accentuated by the faulty seismometer response at this site.)

P-wave arrival times from the permanent network are referenced to the minute during which the system actually triggered and may appear to be off by 60 seconds. The P-wave arrival time for the CUSP triggered data is written at the top left of the plot and the Reftek picks are found at the top center of each plots. Each pick time is referenced as a vertical bar and as an "x" for the network data and the Reftek data, respectively. All events included in the comparison are aftershocks of the Little Skull Mountain earthquake.

pd 74.88  
S

19687

.TSR



-19687

1993 Mar 08 1326 46.82

CINCO\$DKA500:UNRNET.93.93JUN.KENNY'S X225867.GRM:

18631  
LTSR  
-19687.

20211  
LMTR  
-19569.

19276.  
LSMS  
-20713.

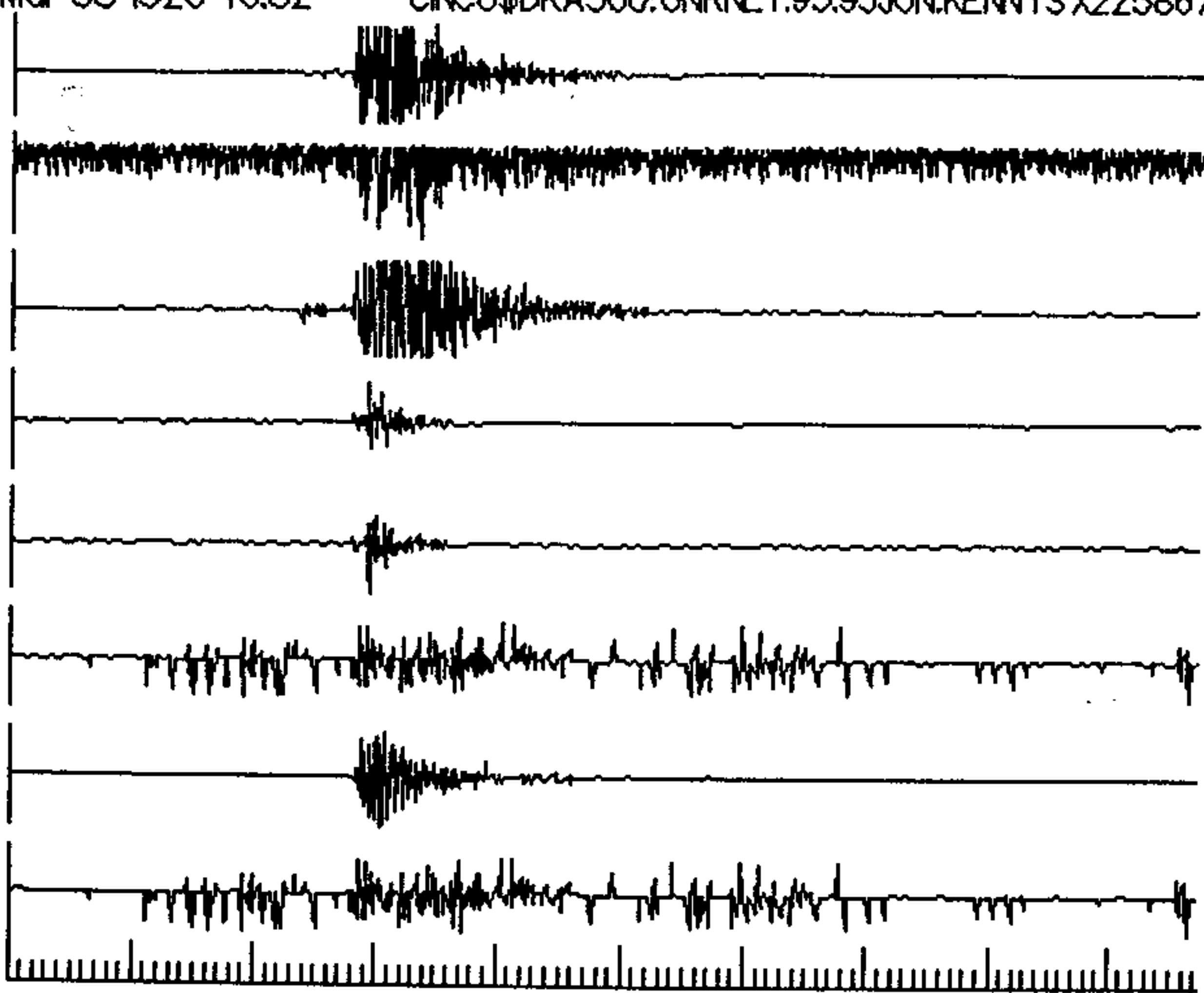
2894.  
LSMS  
-1247.

2209.  
LSMS  
-2440.

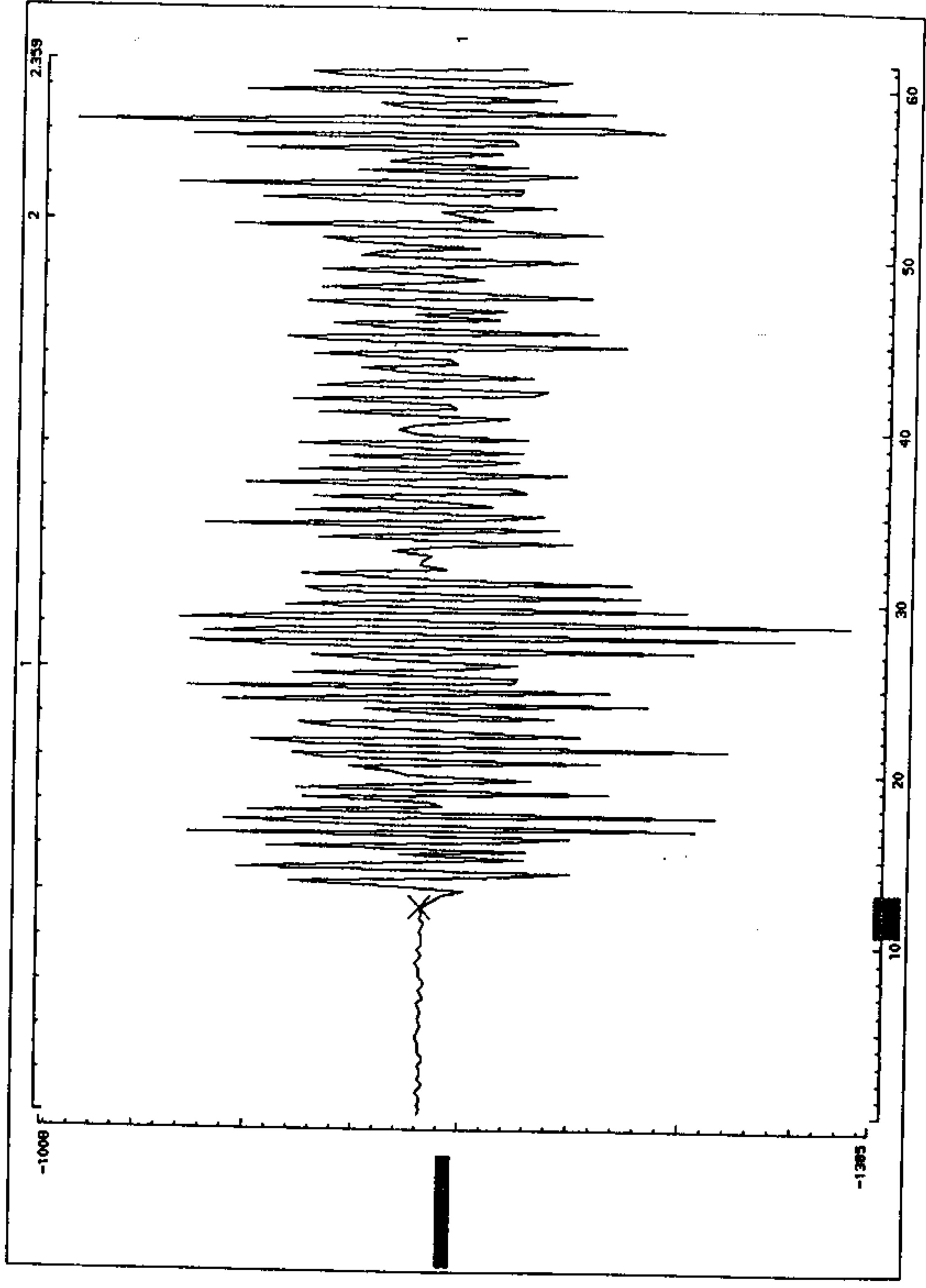
2474.  
KRVR  
-2495.

17777.  
TWRR  
-19432.

2481  
NSPR  
-2477.



Time: 1993 06 13 27:14.961    Amplitude is: -1181 Counts     Traces       



Pd0 77.10  
S

.TSR

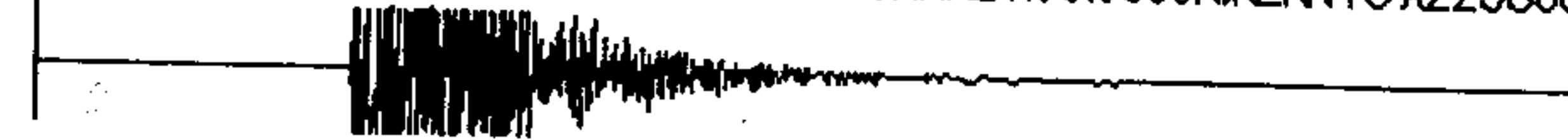
19822

-19822

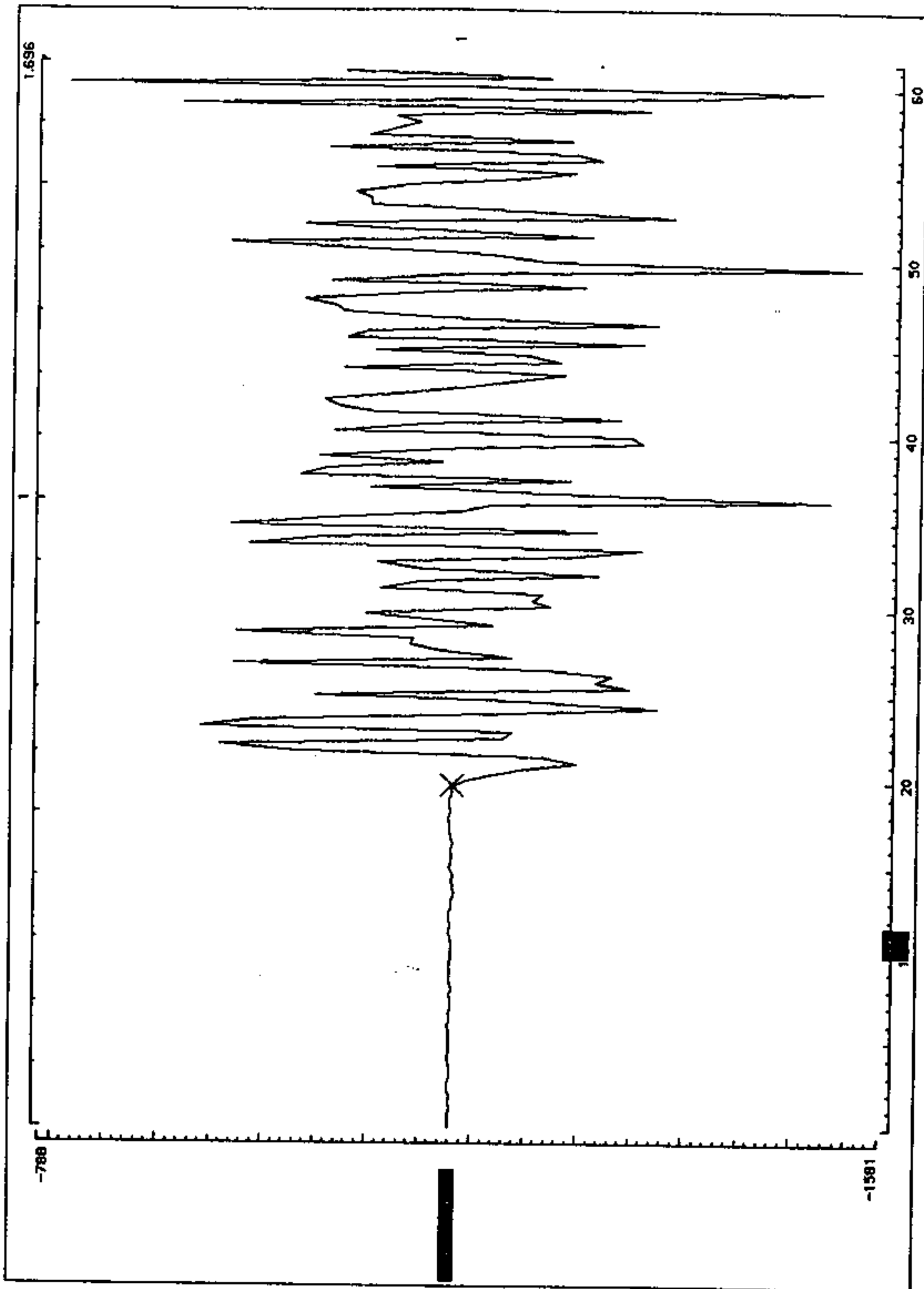
1993 Mar 08 1246 48.20

CINCO\$DKA500:UNRNET.93.93JUN.KENNYX225866.GRM

18923.  
LTSR  
-19822.



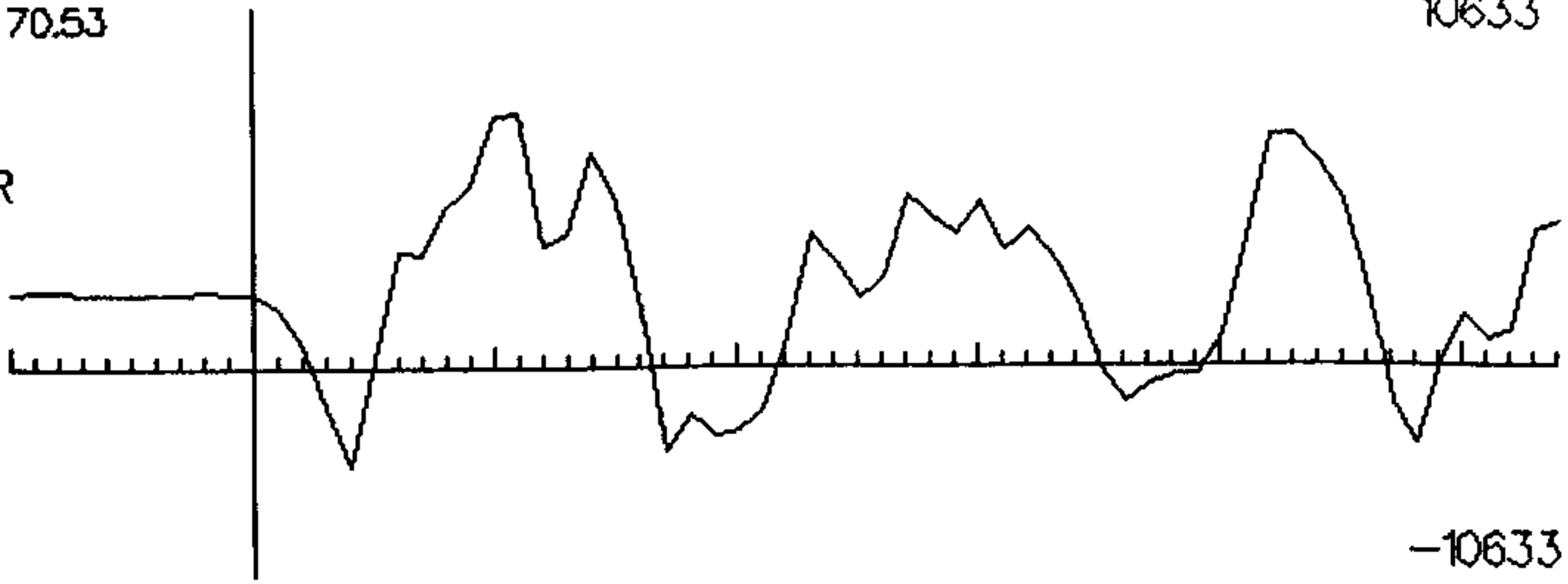
Time: Relative Amplitude Scaled by:  Trace Time is: 1993 06 17 12:47:17.099 Amplitude is: -1160 Counts



2d0 70.53  
3

10633

.TSR

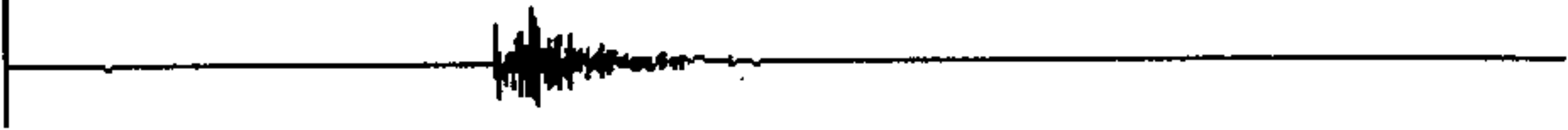


-10633

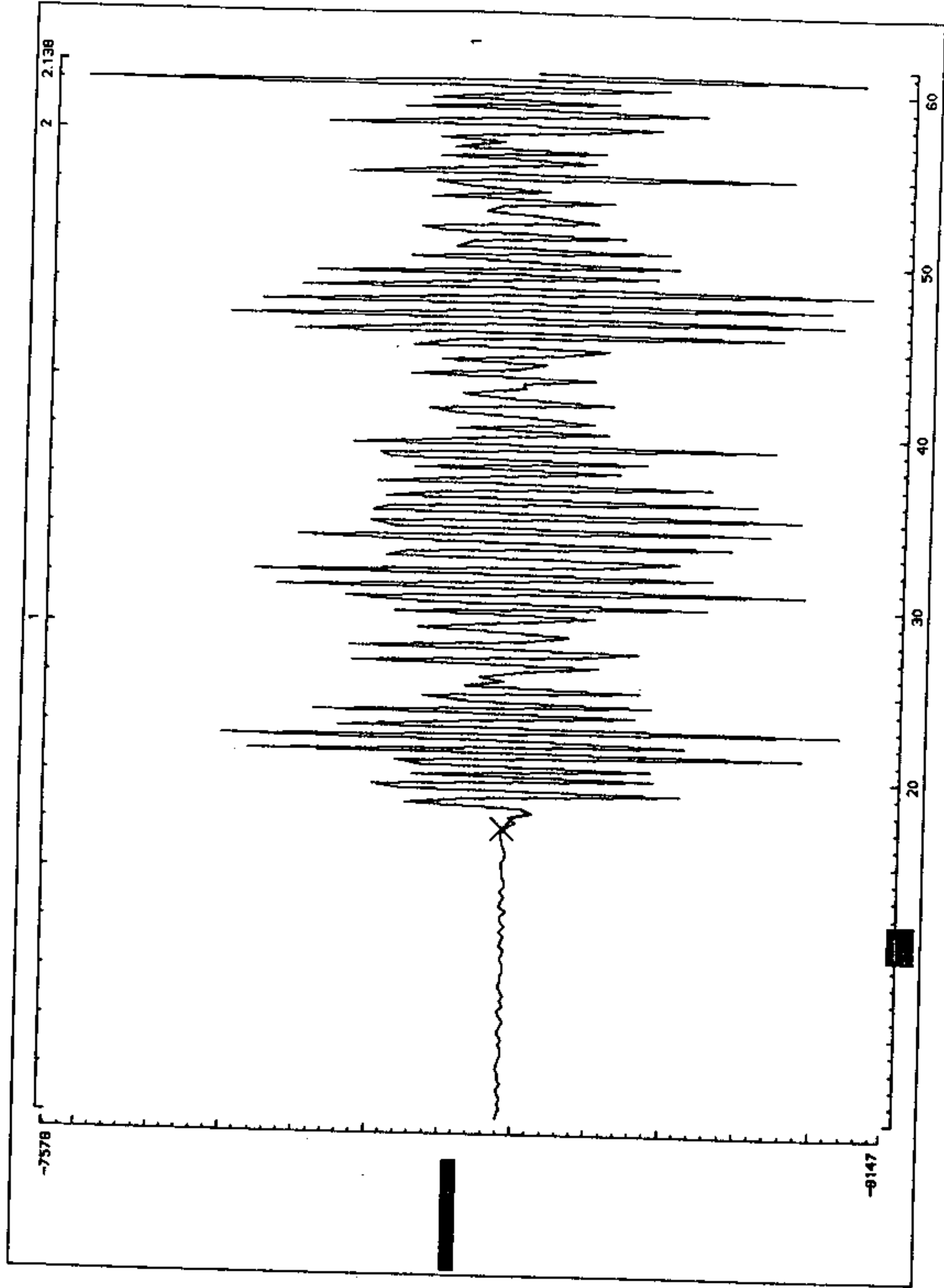
1993 Mar 08 1156 43.23

CINCO\$DKA500:UNRNET.93.93JUN.KENNY'S X225861.GRM;1

10106  
LTSR  
-10633.



Time: Relative Amplitude Scaled by:  Trace Time is: 1993 067:11:57:10.503 Amplitude is: -7890 Counts



## **V. EDA/PRS4 Portable Data (Deployment off the Test Site).**

### **V-A. Processing of EDA/PRS4 Data**

In addition to the Reftek Instruments that were deployed on the Test Site, three EDA/PRS4 portable stations configured with three component Teledyne Geotech S-13 velocity seismometers were deployed off the Test Site in the Specter Range and south of Crater Flat. These stations were installed early in the aftershock sequence and were operated through mid-July 1992. This type of recording system (PRS4) requires almost daily attention since the units are only capable of storing 1 Megabyte of data in their static memory as compared to local storage of 175 Megabytes at Reftek sites. From middle of July through the end of the year PRS4 sites were reoccupied with Reftek instruments.

Time is set on a master clock from a WWVB radio signal. The master clock synchronizes with the radio signal for correct absolute time. The station deployment code and trigger parameters are established on an IBM PC compatible computer which is downloaded to each instrument prior to field deployment. At this time the internal clock of the PRS4 instruments is synchronized with absolute time. When the instruments are recovered from the field, a time differential is calculated at the time of uploading of the field data from the portable instrument to a PC. A linear time drift of the internal clock is assumed and timing correction are generated for each deployment period per instrument for timing corrections of individual phase picks.

Below is a summary of the field deployment for the EDA/PRS4 instruments. Listed is the field station name, the PRS4 serial number, the local time for set of time, the time of deployment, the calculated drift in seconds for that time period, the station location and the number of triggers that were recorded on that instrument for that particular deployment. Also listed are the serial number of the S-13 seismometers deployed at each site.

V-B. Deployment Information

EDA Little Skull Mountain Deployment - Field Notes

STA	EDA	LOCAL TIME	TIME SET	TIME DEPLOYED	DRIFT	STA LOCATIONS	strig	
YUC1	40	6/29 4:30PM						
			181:21:17:24	182:07:23:52	+0.003	36N39.1141 116W12.4549		
			182:03:46:07	183:06:32:37	+0.956	(leap second)		
YUC1'	66	6/30 11:00AM 7/1	11:30AM					
LSM	56	6/30 5:30PM	182:14:39:46	183:22:41:45	+0.815	36N38.8630 116W12.4581	67	
		strong motion setup	182:23:31:22	185:16:58:15	+0.940	(leap second)	9	
YUC	39	6/29 5:30PM	181:21:19:41	182:07:15:54	+0.035	36N37.2184 116W12.8394	4	
		57 6/29 10:00PM	182:03:51:41	183:06:21:17	+0.984	(leap second)		
		39 6/30 11:50PM	low battery data lost					
		57 7/1 11:50PM	183:15:08:25	184:15:21:46	+0.008			
		66 7/1 10:10PM	lost data				14	
		57 7/2 11:40AM 7/4	5:50PM	185:17:18:00	184:02:38:55	-0.015		
		57 7/4 5:50PM 7/5	5:10PM	186:15:42:52	184:04:46:18	+0.029	10	
		56 7/5 5:10PM 7/6		187:21:25:15	189:05:02:25	-0.055	33	
		57 7/6 7:32PM 7/7	4:50PM	188:20:58:05	190:02:42:12	+0.019	42	
		56 7/7 4:50PM	no data power failure				76	
		57 7/8 3:40PM 7/9	2:10PM	190:19:57:50	192:00:06:50	+0.011		
		56 7/9 2:10PM 7/10	7:05PM	191:17:18:43	193:04:30:35	-0.026	33	
		57 7/10 7:05PM 7/11	5:40PM	192:17:07:19	194:15:24:46	+0.029	4	
		56 7/11 5:40PM 7/12	2:40PM	193:21:06:53	195:01:47:04	-0.008	34	
		57 7/12 2:40PM 7/13	1:15PM	194:17:02:25	196:00:51:38	+0.067	13	
		56 7/13 1:15PM 7/13	2:30PM	195:17:05:02	197:00:31:12	-0.058	23	
		57 7/14 2:30PM 7/15	9:00AM	196:17:46:30	197:19:10:37	+0.005	31	
BND	40	6/30 11:00AM	182:41:28:19	183:23:47:10	+0.978	36N39.87 116W12.29	40	
		36 6/30 7/1	9:20PM	183:15:06:23	184:15:35:24		(leap second error)	
		39 7/1 9:20PM		184:02:43:51	185:16:00:30	-0.194	15	
		36 7/2 11:00AM 7/3	12:50PM	184:16:12:39	186:04:55:02	-0.064	25	
		66 7/3 12:50PM 7/4	5:10PM	185:17:14:56	187:02:55:06	-0.200	35	
		36 7/4 5:10 7/5	4:15	186:15:49:03	188:04:37:06	-0.055	26	
		66 7/5 4:15 7/6	6:45	187:21:22:51	189:04:42:42	-0.2257	6	
		36 7/6 6:45 7/7	4:12	188:20:58:05	190:01:54:46	0.000	get error message: error: Lithosais crashed? -0.0257	
		66 7/7 4:15 7/8	2:50	189:19:58:58	191:01:47:03	-0.167	10	
		36 7/8 2:50 7/9	1:15PM	190:20:00:23	192:00:24:02	-0.014	95	
		66 7/9 1:25PM 7/10	4:40PM	191:17:23:07	193:04:38:35	-0.205	79	
		36 7/10 4:40PM 7/11	4:10PM	192:17:05:12	194:05:11:38	-0.017	36	
		66 7/11 4:10PM 7/12	1:55PM	193:21:09:17	195:01:58:46	-0.150	60	
		36 7/12 1:55PM 7/13	12:30PM	194:17:04:45	195:21:54:58	+0.040	41	
		66 7/13 12:30PM 7/14	1:45	195:17:09:31	196:23:15:02	-0.217	30	
		36 7/14 1:45PM 7/15	7:40PM	196:17:48:52	197:19:25:03	-0.019	31	
		8-13 seismometers	#1416 E				42	
			#1404 W				29	
			#1416 E					
DUN	43	7/1 2:00PM 7/3	11:29AM	183:16:09:58	186:04:34:57	-0.043	36N41.13 116W32.25	45
		39 7/3 11:29AM 7/4	6:40PM	185:17:21:27	187:02:23:20	-0.177		
		43 7/4 6:40PM 7/5	6:00PM	186:15:45:01	188:05:02:24	-0.023	27	
		39 7/5 6:00PM 7/6	8:30PM	187:21:27:58	189:05:27:10	-0.206	38	
		43 7/6 8:30PM 7/7	3:25	data lost due to power failure			15	
		39 7/7 3:25PM 7/8	4:40PM	189:19:54:05	191:02:23:17	-0.136		
		43 7/8 4:40 7/9	12:20PM	190:19:54:58	191:22:22:06	-0.017	91	
		39 7/9 12:20PM 7/9	8:50PM	191:17:20:53	193:06:22:56	-0.197	37	
		43 7/10 8:50PM 7/10	6:30PM	192:17:09:22	194:05:28:12	-0.019	79	
		39 7/11 6:30PM		193:21:04:50	195:03:06:59	-0.127		
		43 7/12		194:17:06:52	195:21:38:03	+0.031	80	
		39 7/13 2:00PM 7/14	3:30PM	195:17:07:10	197:03:30:05	-0.324	14	
		40 7/14 3:30PM 7/15	6:20PM	196:17:44:19	197:18:27:48	-0.032	23	
		8-13 seismometers	#1415 E				34	
			#1406 W				72	

EDA is EDA serial number.  
 Drift is in seconds.  
 strig is the number of triggers during the deployment.

**V-C. Calibration and Instrument Parameters**

Waveforms from the EDA instruments included on the data tapes cover the first 2 weeks of the aftershock sequence from approximately 1 day after the mainshock. Many of the regional recordings that are also included in this data set are larger aftershocks from the Landers, California, area that triggered the portable stations. Also within the data set are a number of calibration pulses from calibration sequences that were periodically performed. These pulses were the result of a 5 volt boxcar impulse signal. In order to determine true ground motion the coil constants of the S-13 velocity seismometers must be considered. Specifications for all S-13 seismometers, both vertical and horizontal components, report a transfer function by the manufacturer of 629 V/m/s. Seismometers are configured at a 1 Hz free period. We have measured the output of the EDA digitizer as  $2.35 \pm 0.06 \times 10^{-6}$  V/count.

## VI. First Motion Database

### VI-A. First Motion Determination from Portable Data

Reftek and PRS4 data were converted to SAC (Tapley and Tull, 1991) format and picked with SAC internal processing function "ppk" (Tapley and Tull, 1991). Programs to convert PRS4 and Reftek format data to SAC are included in this data submittal.

### VI-B. Pick File Format

The first motion data base included on magnetic media was compiled from a number of sources. These include the network first motion data picked by the USGS in Boulder (prior to September 1, 1992), Colorado, portable first motion data from the USGS (smoked paper records and DR200 data), network first motion determined at UNR (after September 1, 1992), portable data from the UNRSL deployment (Reftek and PRS4 EDA instruments). Pickfiles are organized by month and file name is on a month-day-hour-minute format with an arbitrary file extension. File extensions may be different for events that occurred on the same minute and this is done to account for more than one event during that minute. The file naming convention was developed so that files could easily be manipulated on a PC.

An event association scheme was developed to merge UNRSL network, UNRSL portable and USGS data into a common pickfile data base. The following is an example of the input format of the first motion data base used in the earthquake relocation process. The format is essentially that used in-house at UNR. More information is provided in the pick files for the October through December time periods which cover the time UNRSL was determining first motions. P-wave and S-wave arrival times are referenced to the minute during which they occurred and are weighted by the analyst. Polarity information of the first arrival is also included, either u for up or d for down. Polarity information for the September through December time period (UNRSL first motion data) must be corrected with a reversed station list. See von Seggern (1993) for a detailed description of network processing parameters.

Reference Minute		Magnitude	
A	9207161434 .00		1.36
E			
RLSM	Pe 6.14 0	S	7.29 2
LSM	Piu 6.13 1		7.28 3
LOP	Piu 7.87 1		
CDH1	Ped 7.22 1		
YMT1	Piu 9.35 2		
YMT2	Piu 8.00 1		
YMT3	Pid 6.97 1		
YMT4	Peu 8.08 1		10.63 4
YMT5	Peu 8.70 2		10.61 4
MCY	Ped 10.15 3		
TMBR	Peu 10.67 3		
Station	Ptime Wt.		Stime Wt.

### VI-C. Little Skull Mountain Earthquake Location, Station Files, and Velocity Model.

The final technical report contains details on the relocation procedure. The following data files are included on 9-track tape. Program FASTPONG (von Seggern, 1993) was used in the relocation of Little Skull Mountain earthquakes. See technical report for details on relocation procedure.

Relocated Hypocenters - lsm.hypo

Station file with P-wave station corrections - sta\_4.str

Velocity Model - vel.hof

#### Hypo71 Format - Fastpong Output File

Origin Time	Lat	Lon	Depth	ML	#	GAP	rms	close	far
920629 1014	22.47 36	43.17 116	17.76	11.77	5.6	16 27	0.08	3.33	419.31

close - closest station

far - most distant station

# - number of station used in location less than 75 km.

#### Velocity Model - a variation of the Hoffman and Mooney (1984) Velocity Model

vel	depth
5.85	0.0
6.0	1.0
6.35	25.0
6.6	30.0
7.8	35.0

#### Station Location File - example of input station location file.

Sta	Lat	Lon	Elev	P-wave residual
BGB	37 2.24	116 13.75	1730	0.0500

#### References:

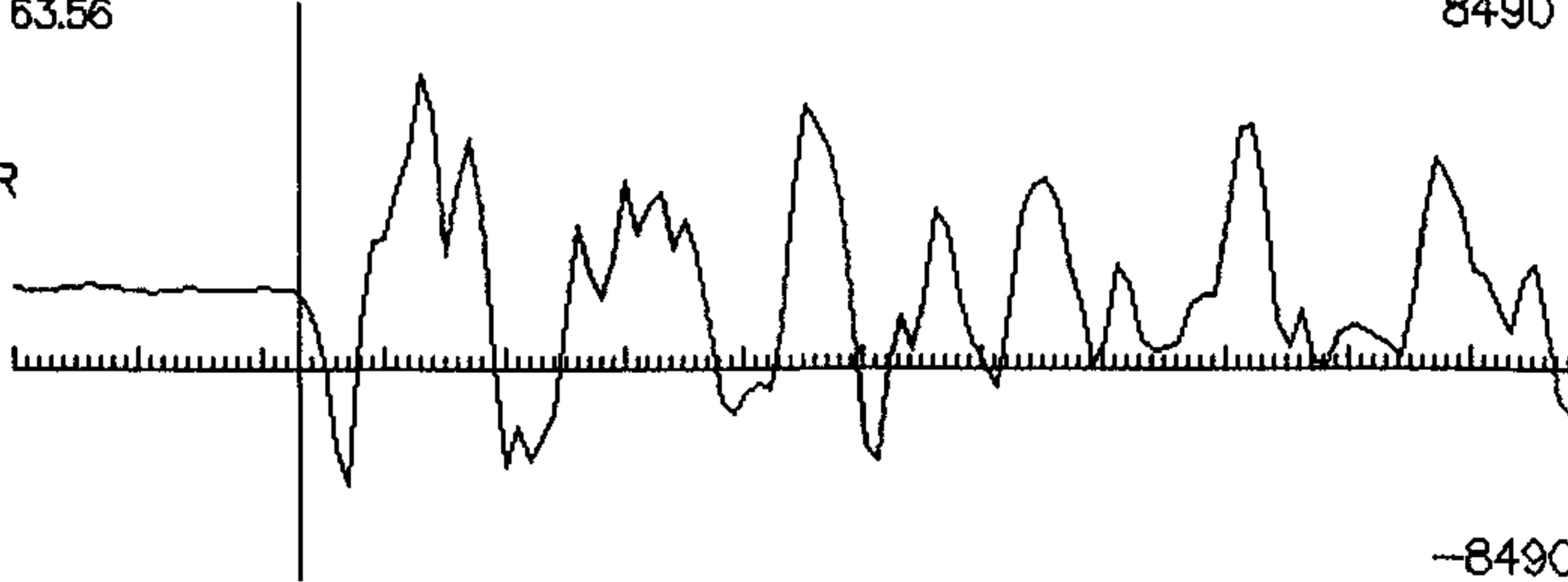
Hoffman, L.R. and W.D. Mooney, A seismic study of Yucca Mountain and vicinity, Southern Nevada; Data report and preliminary results, U.S. Geological Survey, Open File Report 83-588, 1984.

- Meremonte, M, E. Cranswick, J. Gomberg,, D. Worley, D. Carver, J. Brooks, J. Banfill, R Overturf, and T. Bice, Report on the seismological field investigations of the 29, June 1992 Little Skul Mountain earthquake, U.S. Geological Survey, Open-File Report 93-555, 1993.
- Tapley, W.C. and J.E. Tull, Guide to the Unix version of Sac, Lawrence Livermore National Labortory, Revision 4, 1991.
- von Seggern, D., Seismic event waveforms for the southern Great Basin Seismic Network; October 1, 1992 to December 31, 1992, Tech. Data Record Package GS940183117412.001, submitted to the USGS/Yucca Mountain Project, Denver, Colorado, 1993.

d0 63.56  
S

8490

.TSR

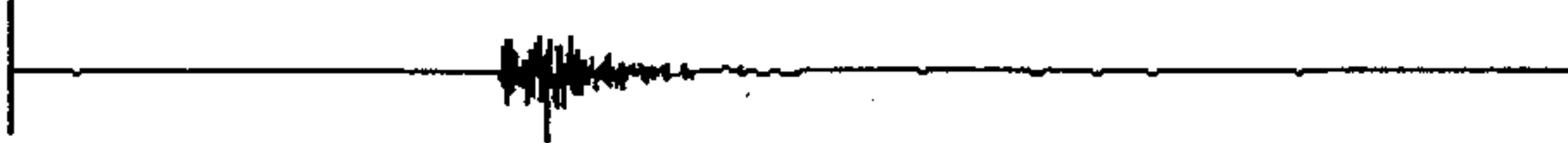


-8490

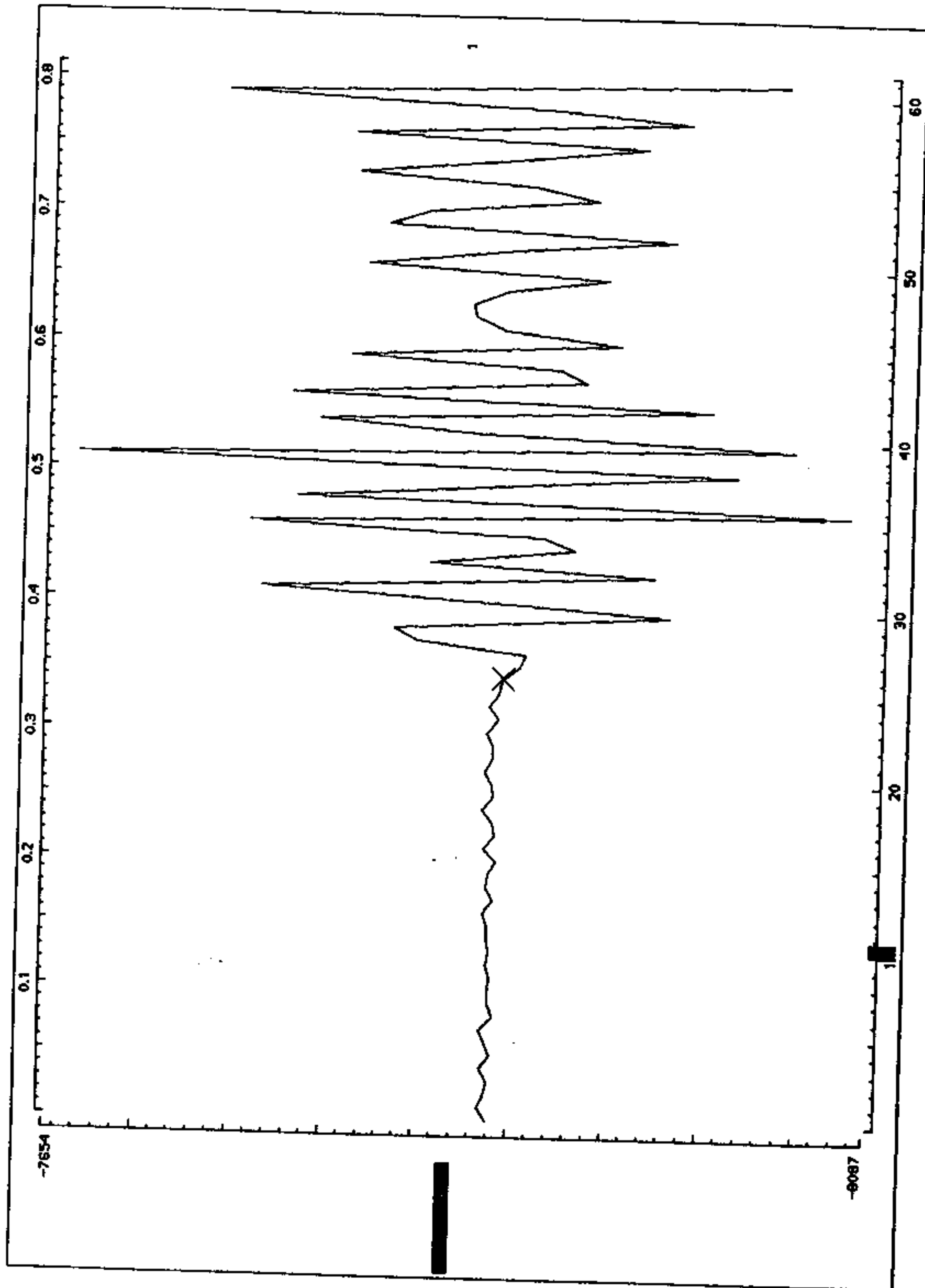
1993 Mar 08 1205 37.22

CINCO\$DKA500:UNRNET.93.93JUN.KENNYS X225863.GRM:

7548.  
LTSR  
-8490.



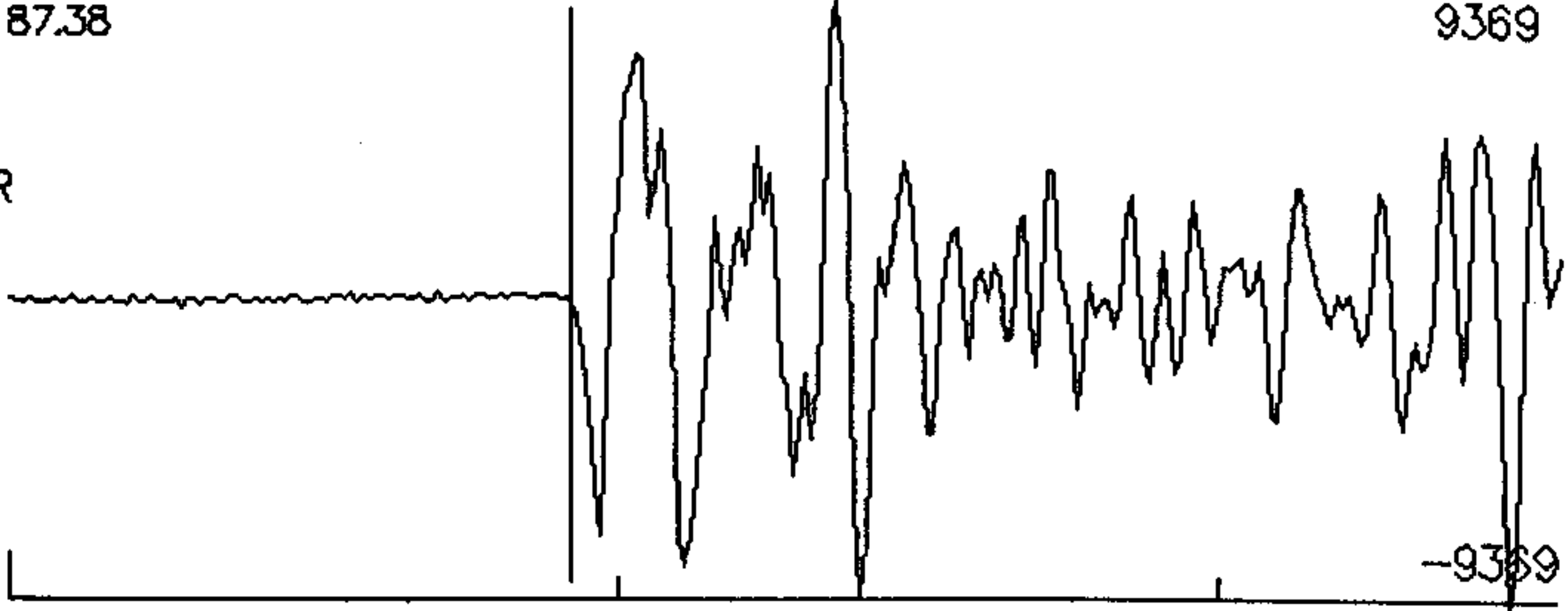
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87.38  
S

9369

.TSR

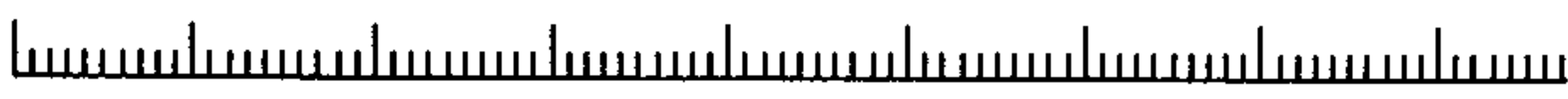
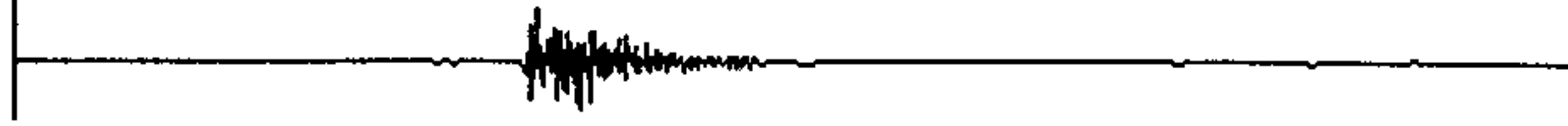


-9369

1993 Mar 08 1121 58.84

CINCOSDKA500:UNRNET.93.93JUN.KENNY5 X225860.GRM;

9016.  
LTSR  
-9369.



Time: Relative Amplitude Scaled by:  Traces Time is: 1993 06 27 11:22:27.383 Amplitude is: -7864 Counts

