Table A-3

TABLE OF ARCHIVED OBH DATA

OBH FILES

FILE	SIZE	BACKUP 1	BACKUP 2
ml1_23.dat	65,011,712	whoi001	osu001
ml1_21.dat	71,106,560	whoi002	osu002
ml2_18.dat	84,312,064	whoi003	osu003
ml1_16.dat	87,359,488	whoi004	osu004
ml1_17.dat	96,501,760	whoi005	osu005
ml1_24.dat	99,549,184	whoi006	osu006
ml2_22.dat	123,928,576	whoi007	osu007
ml3_27.dat	122,912,768	whoi008	osu008
ml3_26.dat	137,134,080	whoi009	osu009
ml8_23.dat	132,055,040	whoi010	osu010
ml8_16.dat	139,165,696	whoi011	osu011
ml6_22.dat	172,687,360	whoi012	osu012
ml6_21.dat	176,750,592	whoi013	osu013
ml5_17.dat	182,845,440	whoi014	osu014
ml5_18.dat	185,892,864	whoi015	osu015
ml5_24.dat	191,987,712	whoi016	osu016
ml6_20.dat	111,738,880	whoi017	osu017
ml6_27.dat	114,786,304	whoi018	osu018
ml6_26.dat	117,833,728	whoi019	osu019

SEGY FILES

FILES	BACKUP 1	BACKUP 2
Line 1 (wa-1) obhs 16,17,18,21,22,23,24	whoisegy1	osusegy1
Line 1b (mcs-1b) obhs 16,17,18,21,22,23,24	whoisegy2	osusegy2
Line 1c (mcs-1c) obhs 16,17,18,21,22,23,24	whoisegy3	osusegy3
Line 11 (mcs-11) obhs 16,17,18,21,22,23,24	whoisegy4	osusegy4
Line 10 (mcs-10) obhs 16,17,18,22,24	whoisegy5	osusegy5
Line 2 (mcs-2) obhs 16,17,18,21,22,23,24	whoisegy6	osusegy6
Line 10b (mcs-10b) obhs 16,17,18,22,24	whoisegy7	osusegy7
Line 7,7a (mcs-7,7a) obh 22	whoisegy8	osusegy8
Line 8 (mcs-8) obhs 16,17,18,21,22,23,24	whoisegy9	osusegy9
Line 4 (mcs-4) obhs 16,17,18,21,22,23,24	whoisegy10	osusegy10
Line 5 (mcs-5) obhs 16,17,18,21,22,23,24	whoisegy11	osusegy11

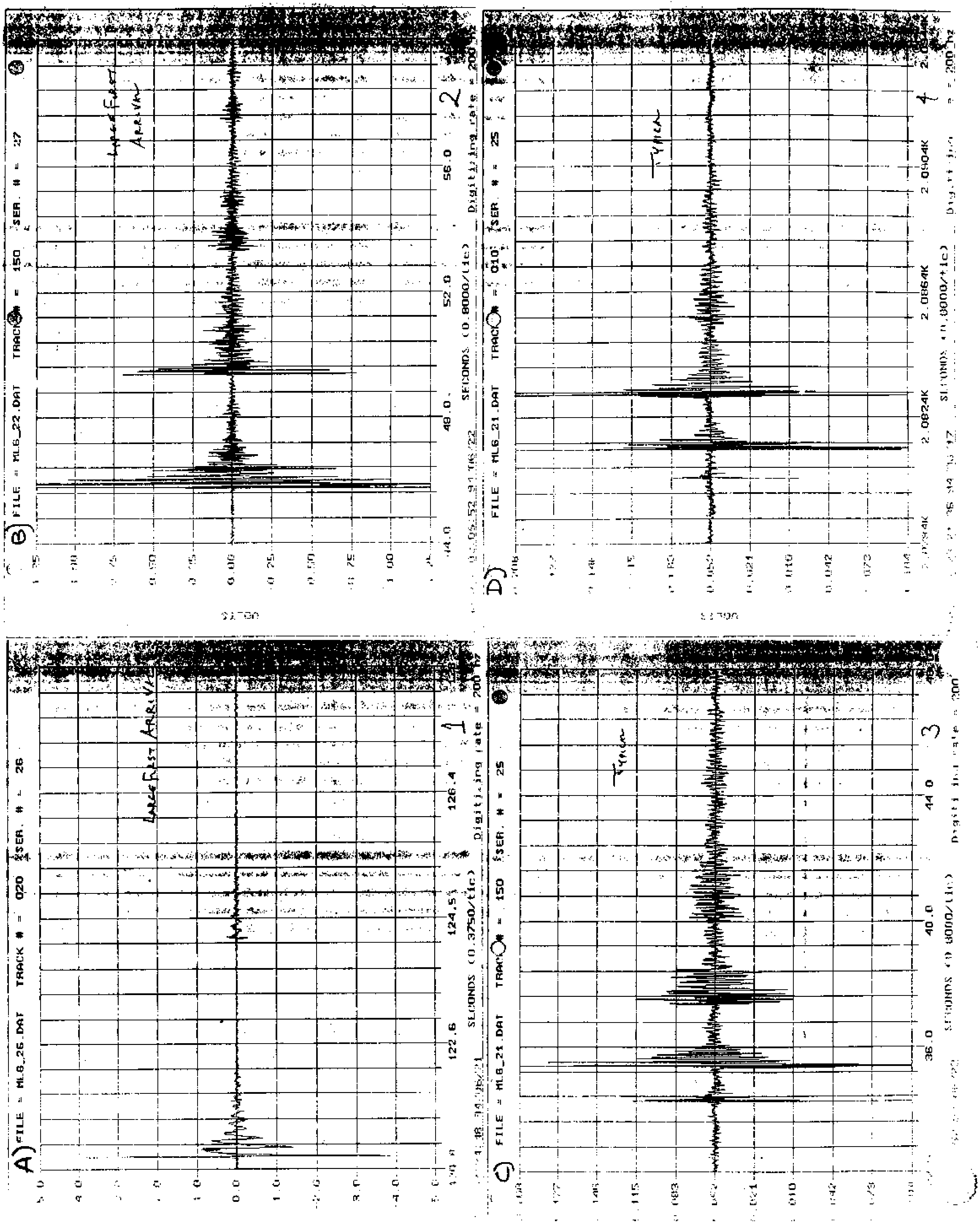

A)
FILE = ML6_26.DAT TRACK # = 020 SER. # = 26
SECONDS (0.3750/tic)
Digitizing rate = 200 hz
Large First Arrival
B)
FILE = ML6_22.DAT TRACK # = 150 SER. # = 27
SECONDS (0.8000/tic)
Digitizing rate = 200 hz
Large First Arrival
C)
FILE = ML6_21.DAT TRACK # = 150 SER. # = 25
SECONDS (0.8000/tic)
Typical
D)
FILE = ML6_21.DAT TRACK # = 010 SER. # = 25
SECONDS (0.8000/tic)
Typical
1
2
3
4

Fig. 1

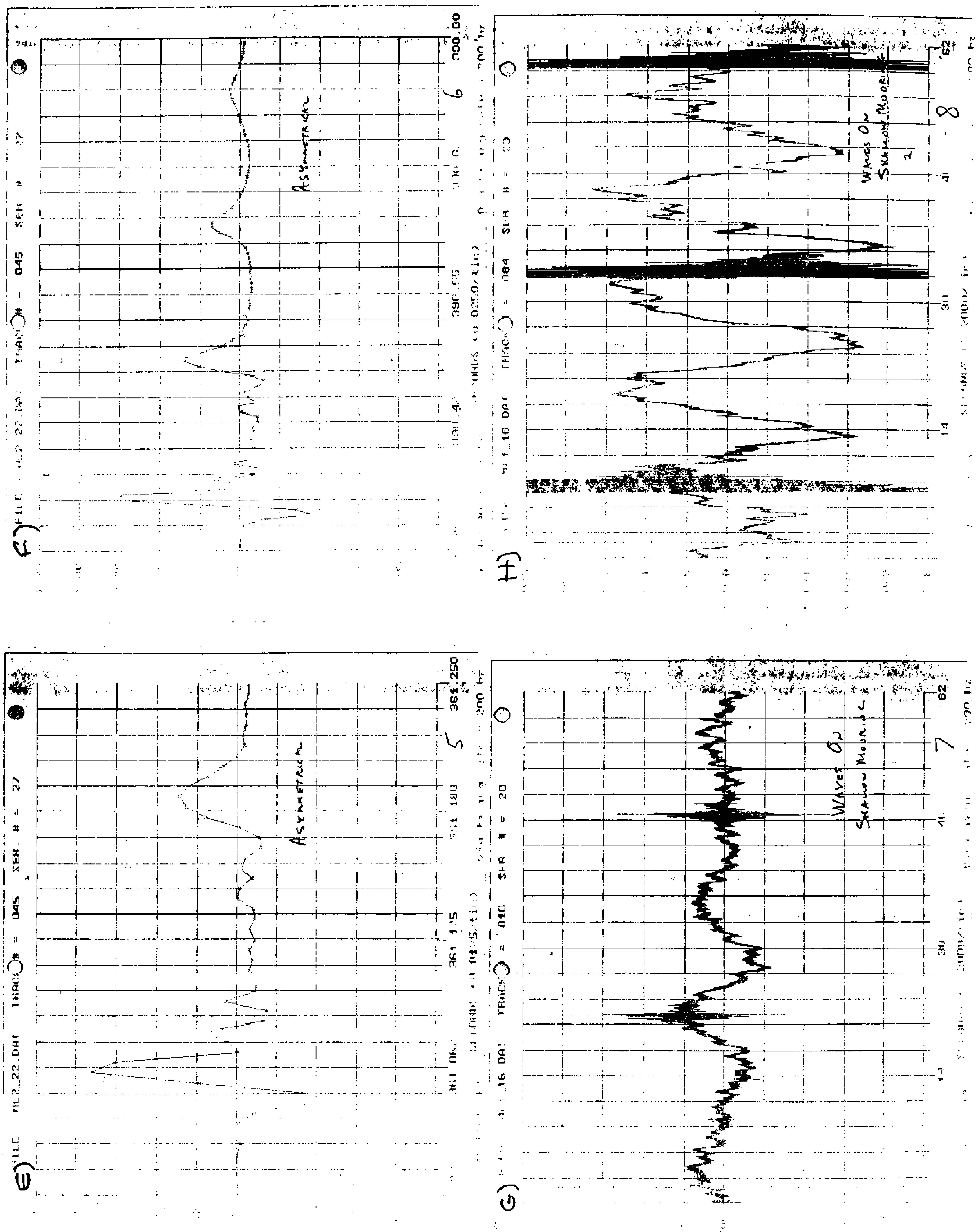
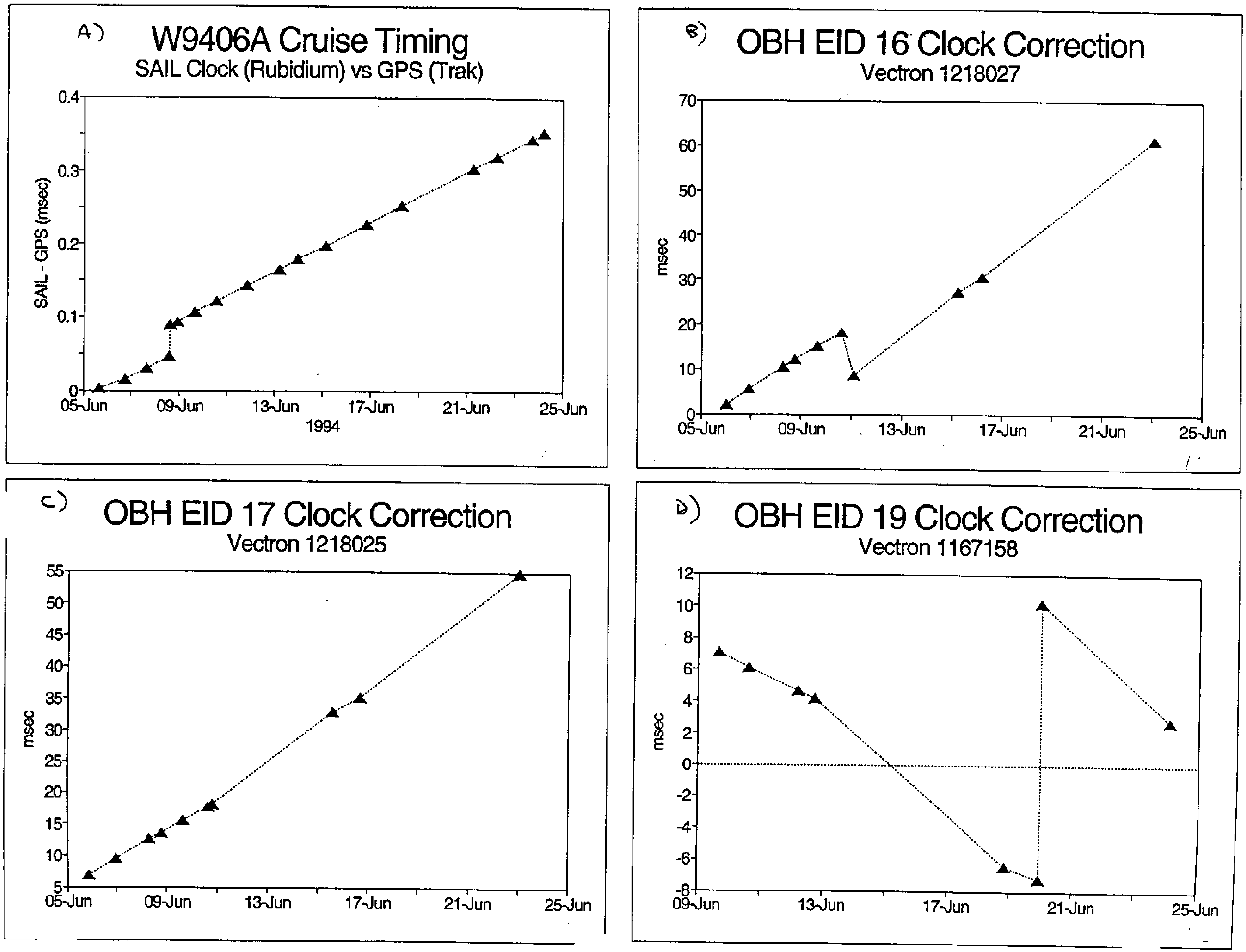
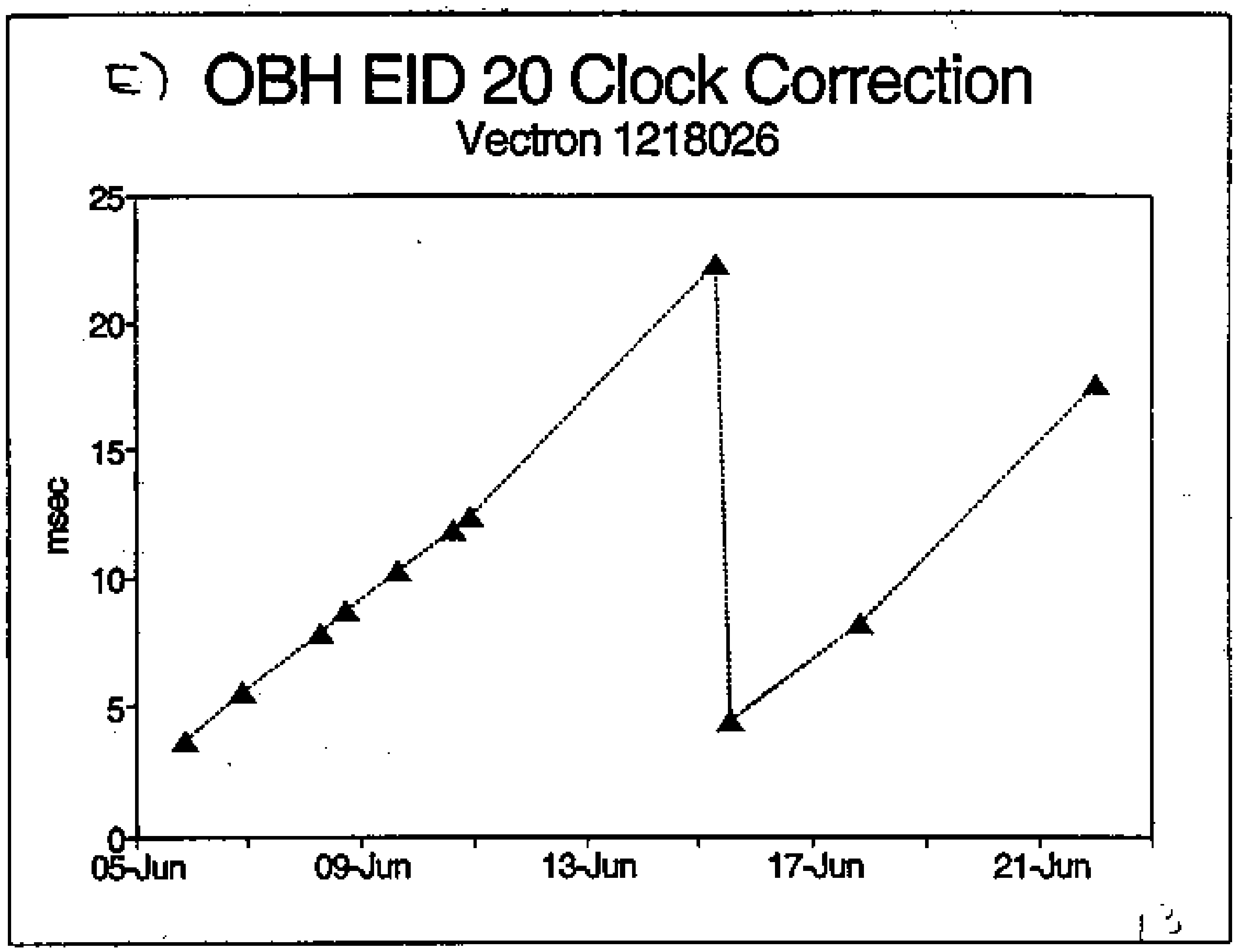


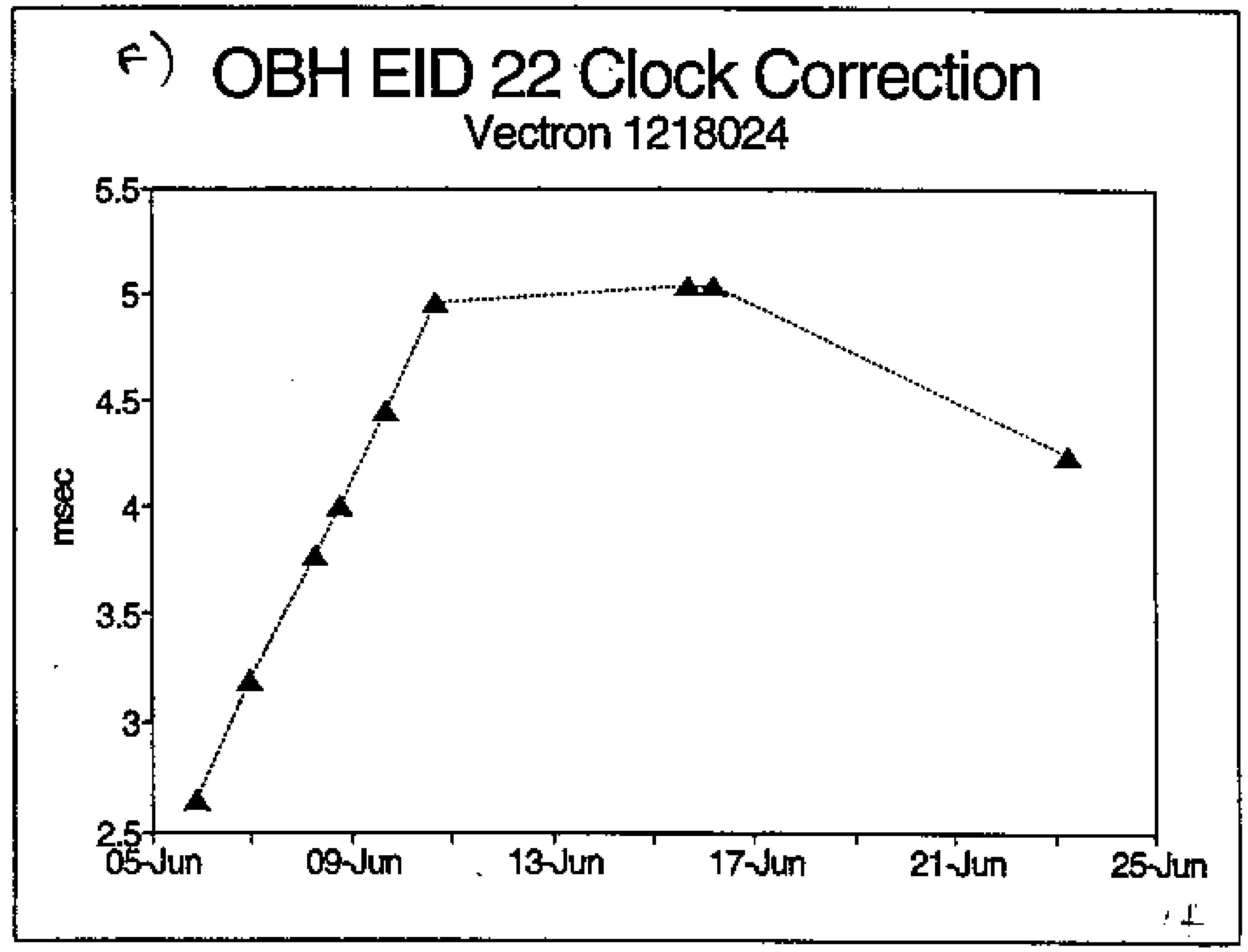
fig 1 (cont)

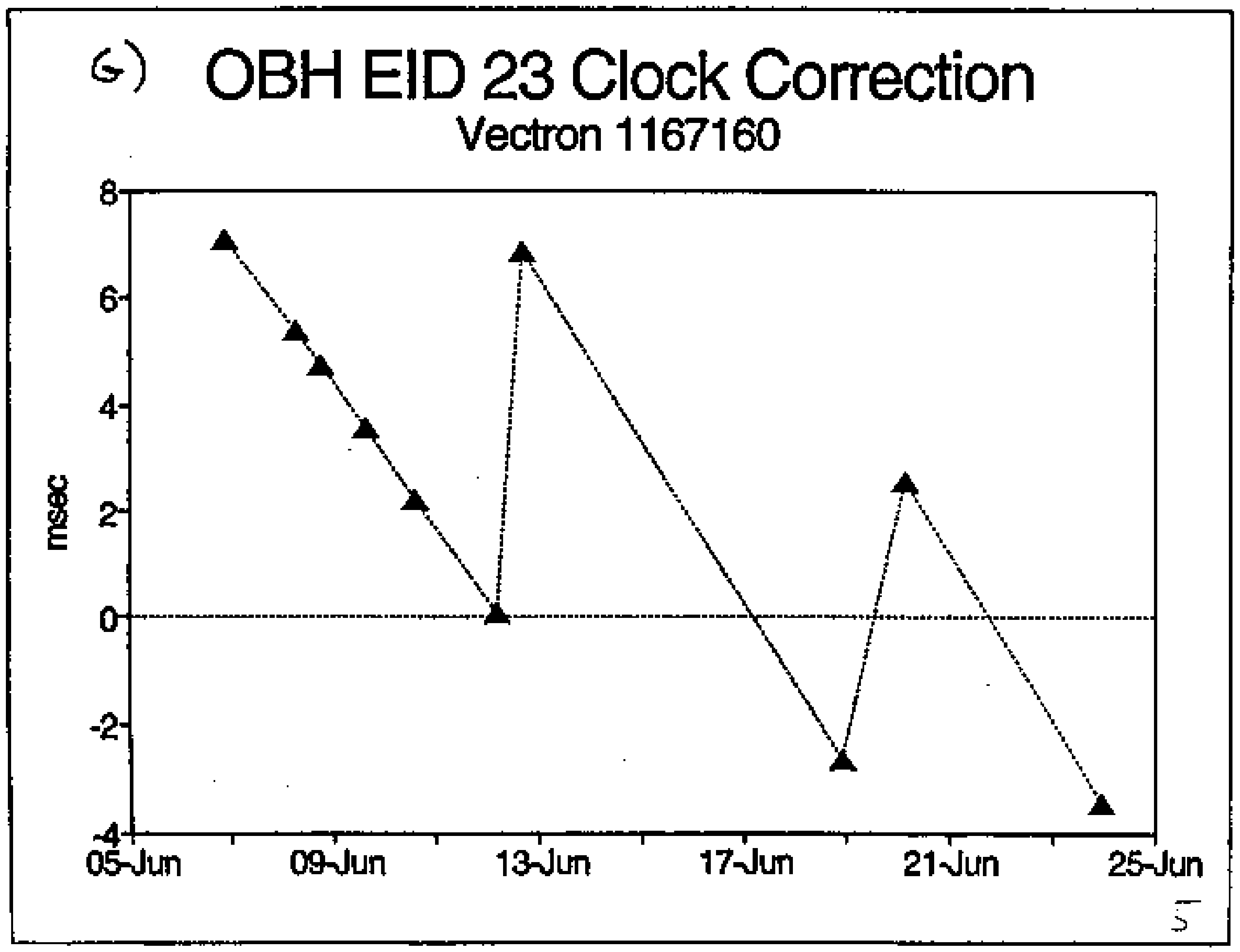


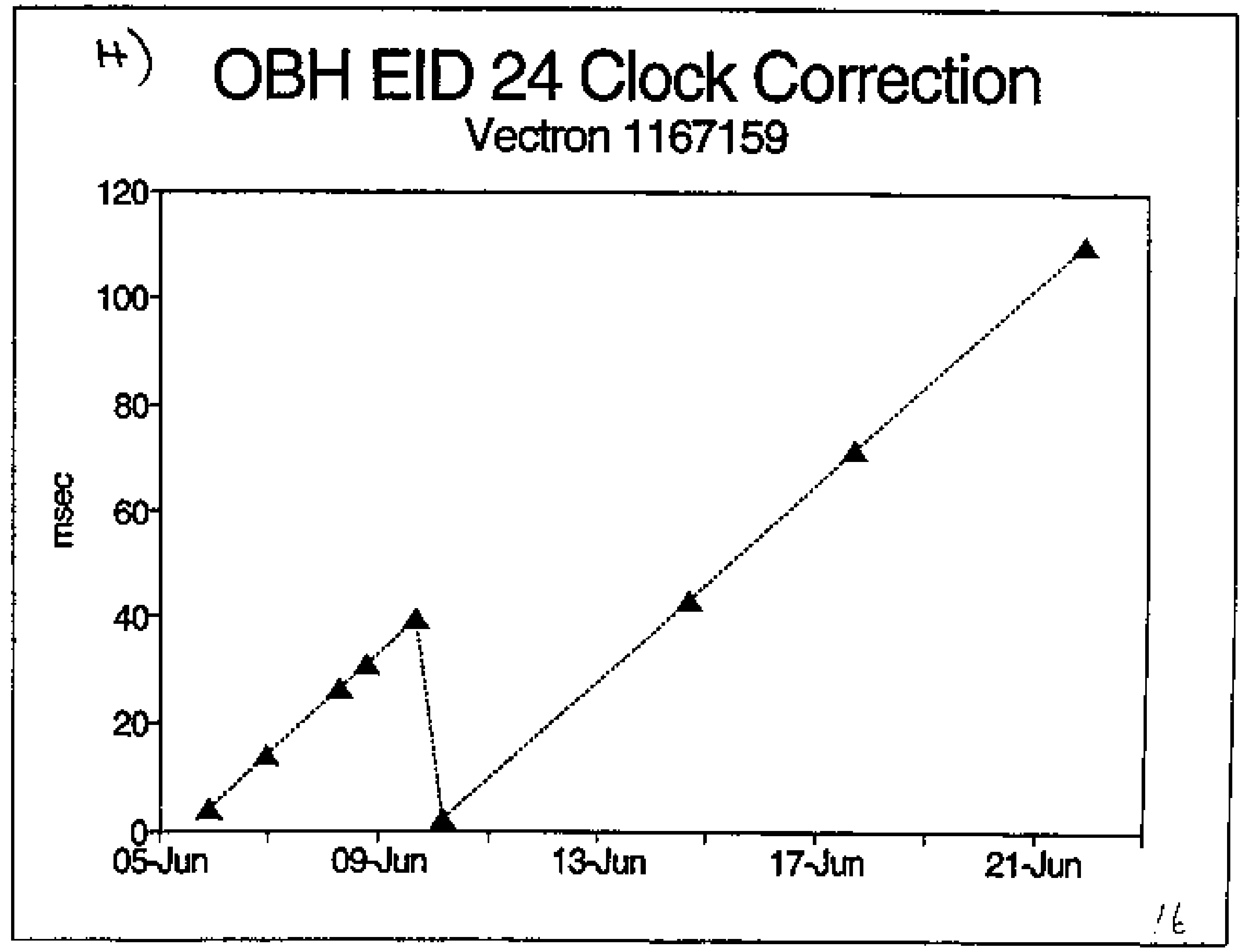
A)
W9406A Cruise Timing
SAIL Clock (Rubidium) vs GPS (Trak)
SAIL - GPS (msec)
0.4
0.3
0.2
0.1
0
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun
1994
B)
OBH EID 16 Clock Correction
Vectron 1218027
msec
70
60
50
40
30
20
10
0
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun
C)
OBH EID 17 Clock Correction
Vectron 1218025
msec
55
50
45
40
35
30
25
20
15
10
5
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun
D)
OBH EID 19 Clock Correction
Vectron 1167158
msec
12
10
8
6
4
2
0
-2
-4
-6
-8
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun

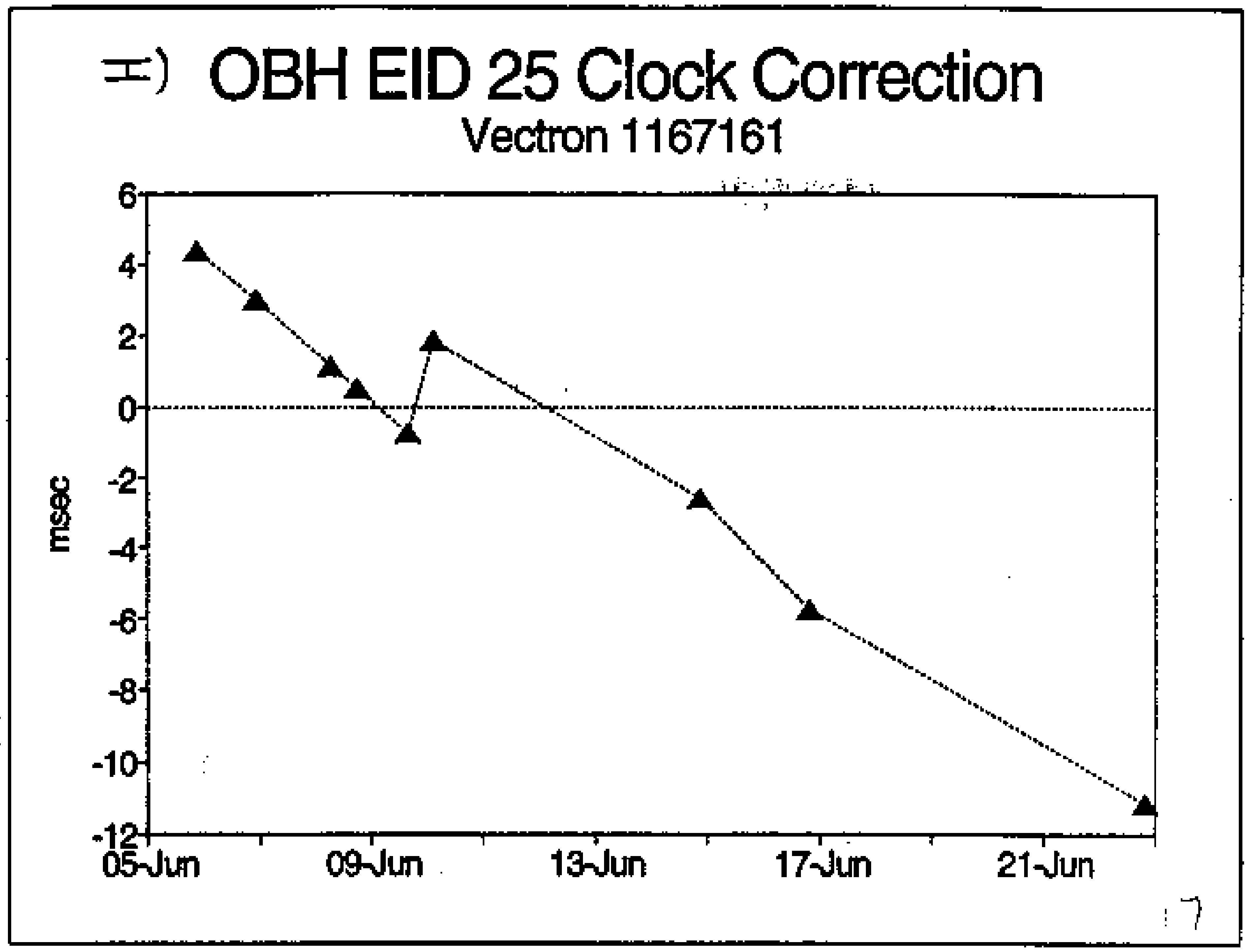
fig 2.


E) OBH EID 20 Clock Correction
Vectron 1218026
msec
25
20
15
10
5
0
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun

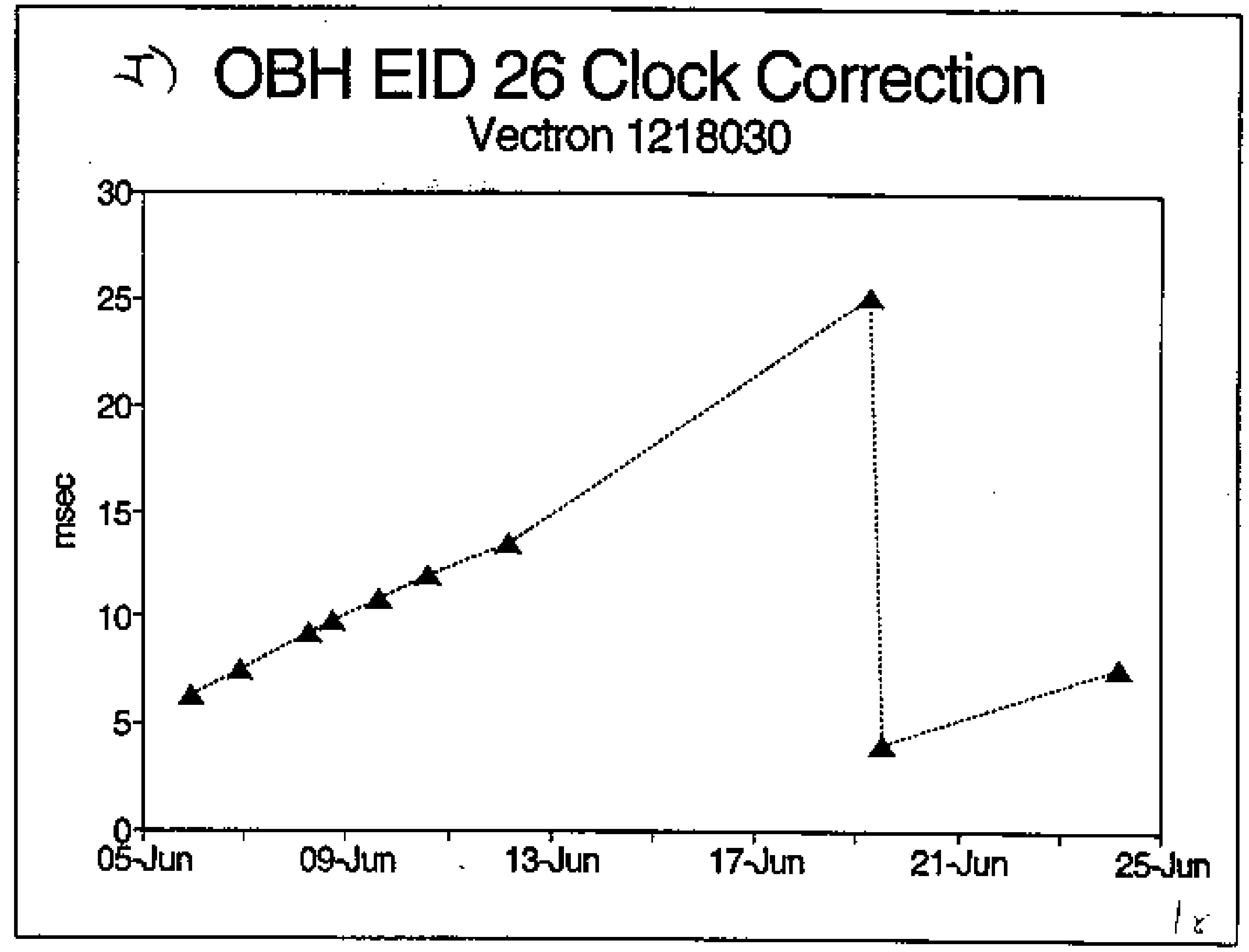

F) OBH EID 22 Clock Correction
Vectron 1218024
msec
5.5
5
4.5
4
3.5
3
2.5
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun


G) OBH EID 23 Clock Correction
Vectron 1167160
msec
8
6
4
2
0
-2
-4
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun

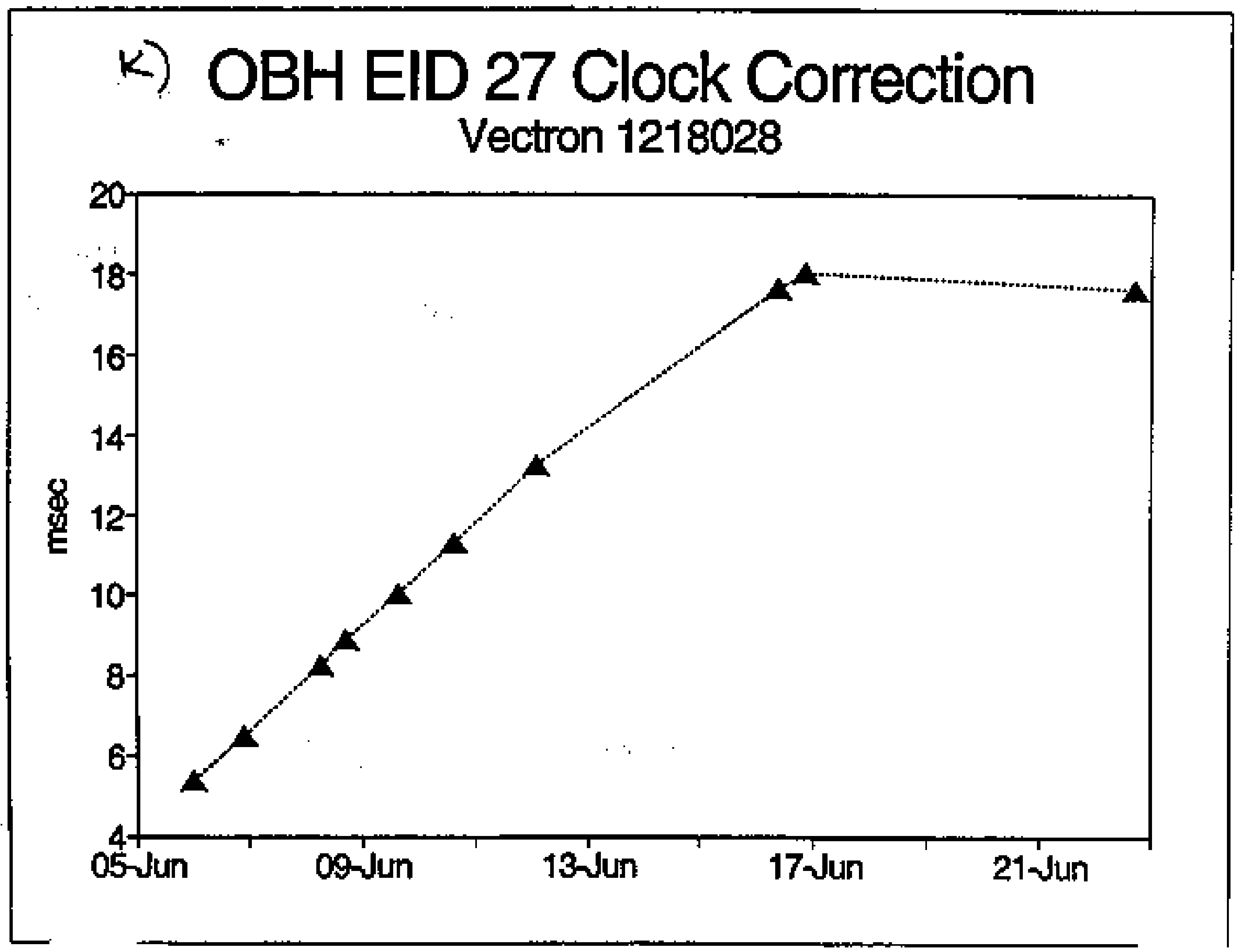

H) OBH EID 24 Clock Correction
Vectron 1167159
msec
120
100
80
60
40
20
0
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun



OBH EID 25 Clock Correction
Vectron 1167161
msec
6
4
2
0
-2
-4
-6
-8
-10
-12
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun



OBH EID 26 Clock Correction
Vectron 1218030
msec
30
25
20
15
10
5
0
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun
25-Jun



OBH EID 27 Clock Correction
Vectron 1218028
msec
20
18
16
14
12
10
8
6
4
05-Jun
09-Jun
13-Jun
17-Jun
21-Jun

THE USGS OCEAN BOTTOM SEISMOMETERS

The Ocean Bottom Seismometer (OBS) is a self-contained data-acquisition system that is deployed on the ocean floor to record wide-offset seismic data on a 200 Megabyte hard disk. There are eight OBS's; four are rated for a depth up to 500 meters, and the other four are rated to 5,000 meters. Each OBS is powered using 72 alkaline batteries which will run all of the systems for ten days. The US Geological Survey OBS has been designed as a continuous recording system set up to acquire signals from one vertical 4.5 Hertz geophone, two horizontal 4.5 Hertz geophones, and one hydrophone. The software controlling the system allows selection of any combination of these four channels to sample at 100 samples/second, providing a record time of 72 hours for all four channels.

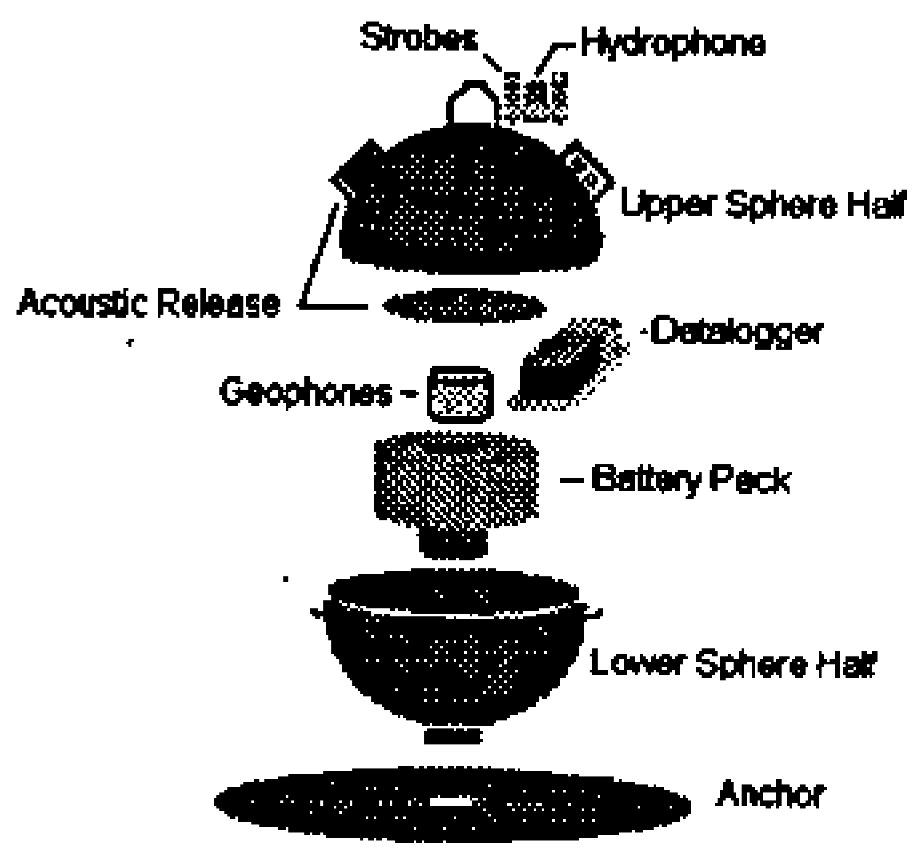


Figure 6. Major Components of the OBS

Each acquisition of data into the memory buffer is 1,015,808 bytes. The time and data pointer for that acquisition are placed into a header that gets recorded with each memory buffer of data. The OBS's record data continuously with these time-of-day marks in the data as the only reference to external events. To provide the highest possible accuracy time is recorded to the nearest millisecond. Each OBS uses an oven-controlled oscillator as a stable clock reference for which the drift in time can be as little as 0.5 milliseconds/day. This accuracy requires several days of careful calibration and the use of a rubidium (Rb) standard as a reference for the oscillators. All eight OBS data loggers are continuously powered using a 24 volt DC power supply to keep the oscillators at a constant temperature. Prior to each deployment, the frequency of each oscillator is checked, and if necessary, recalibrated. The time-of-day is set via software in each logger using the minute pulse of the GPS satellite clock as a starting trigger. When locked on a satellite, the time is accurate to within 100 nanoseconds, and the Rb standard can be used to maintain an accurate time when satellite coverage is not adequate. The offset from GPS time is determined by comparing the second pulse of the data logger with the second pulse of the GPS clock. After each deployment, the offset is measured again to determine the total drift.

The data loggers in each OBS use a 200 Megabyte hard disk to store the acquired data. The data must be transferred to another storage media each time an OBS is retrieved. A 386 PC with a 2.2 gigabyte hard disk and an exabyte tape drive is used to archive the data. Data is downloaded from the data logger onto the hard disk of the PC. The quality of the data is checked using two programs. One program reads, displays, and checks the header information of each data record. This program will report any errors found. The second program graphically displays the sensor data for all four channels. Once all of the OBS's have been downloaded, the data files are written to exabyte tape in TAR format for permanent storage.

Deployment and recovery operations are simple operations designed to work on a variety of different vessels. The OBS's are programmed, sealed, and stored on deck prior to deployment. At the deployment location, the release is tested a final time, and the OBS is then attached to its anchor. The preferred method of deployment uses a winch to lift the OBS and anchor and an A-frame to move the assembly outboard of the ship. The OBS is then lowered to the water surface where a simple rope loop and metal pin is used to release the OBS into the water to free fall to the bottom. An acoustic release is used to free the OBS from its anchor. Once released, the OBS rises to the surface at a rate of 1 meter/second. At the surface, two externally mounted strobes will flash to aid in spotting the floating OBS. The OBS is attached to the lifting line using a snap hook mounted on a pole, and once the OBS is lifted back aboard, the release is recocked to turn off the strobes. The deep water OBS and anchor weigh

320 lbs. in air, so the requirements for lifting are not much. A block and tackle are often used when no winch is available. The shallow water OBS and anchor only weigh 250 lbs. in air enabling small boat operations such as this cruise.

TREHUL1.XLS

OBS SPHERE #	A-1	A-2	A-3	B-1	C-1	C-3	C-4	C-9
Station #	15	18	8	6	2	10	14	4
Battery Connection Time	6/12/94 6:07	6/12/94 6:52	6/10/94 21:47	6/10/94 19:43	6/9/94 19:14	6/11/94 1:32	6/12/94 4:42	6/9/94 20:13
Battery Disconnect	6/19/94 0:10	6/18/94 18:15	6/15/94 8:45	LOST	6/14/94 17:30	6/15/94 3:30	6/19/94 2:40	6/15/94 5:50
Main Battery Voltage								
Start								
volts = 24	24.67	24.73	24.57	25.05	25.11	24.57	24.95	23.98
volts = 12	12.07	12.01	12.02	12.47	12.21	12.01	12.39	11.84
volts = -12	-12.71	-12.64	-12.68	-12.82	-12.84	-12.77	-12.76	-12.23
End								
volts = 24	19.53	19.4	19.93		20.29	20.39	18.63	19.03
volts = 12	9.43	9.87	9.63		9.83	9.73	9.3	9.21
volts = -12	-11.1	-11.01	-11.24		-12.13	-11.44	-10.95	-10.72
Release Battery								
Start	12.85	12.46	12.41	13.02	12.87	12.62	12.61	12.86
End	12.51	12.14	12.34		12.43	12.21	12.42	12.32
Time-of-Day								
Start	6/12/94 6:24	6/12/94 7:07	6/10/94 22:00	6/10/94 20:01	6/9/94 19:34	6/11/94 1:51	6/12/94 5:03	6/9/94 20:40
offset (ms)	1.48	3.56	8.64	4.8	2.24	1.46	3.76	1.48
End	6/19/94 0:09	6/18/94 18:11	6/15/94 8:30		6/14/94 17:25	6/15/94 3:16	Prog lock	Osc. fell out
offset (ms)	-78.8	-66.6	-38.8		-65.6	-46.4	no test	no test
Deployment								
Time								
Water Depth (m)	610	2360	495	1223	2825	115	1570	2350
Latitude	40 13.383 N	40 42.00 N	39 23.85 N	39 21 59 N	39 17.8 N	39 40.6 N	40 00.033 N	39 20.2 N
Longitude	124 38.65 W	124 57.00 W	124 00.983 W	124 15 12 W	124 49.283 W	123 53.667 W	124 54.667 W	124 30.067 W
Navigation	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
Recovery								
Time	6/18/94 23:29	6/18/94 17:04			6/14/94 16:06	6/15/94 2:40	6/19/94 1:42	6/15/94 16:28
Latitude	40 13.402 N	40 42.05 N	39 23.67 N	LOST	39 17.47 N	39 40.58 N	40 00.038 N	39 20.09 N
Longitude	124 38.703 W	124 56.817 W	124 00.83 W		124 49.145 W	123 53.62 W	124 54.766 W	124 30.116 W
Navigation	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
offset (m)	63	271	424			61	142	229
range (m)	666.9	2538.2	596.6		2906.8	141.6	1592.3	2365.5
Tracks written	126	118	131		131	no data	129	131
Track Errors	0	0	0		0	Bad start???	0	0
Total Time drift (ms) foward	80.28	70.16	47.44	4.8	67.84	47.86	#VALUE!	#VALUE!
Estimated drift (ms)							81.6	70.6
Battery drain								
volts = 24	5.14	5.33	4.64	25.05	4.82	4.18	6.32	4.95
volts = 12	2.64	2.14	2.39	12.47	2.38	2.28	3.09	2.63
volts = -12	-1.61	-1.63	-1.44	-12.82	-0.71	-1.33	-1.81	-1.51
Release	0.34	0.32	0.07	13.02	0.44	0.41	0.19	0.54

OBS SPHERE #	A-1	A-2	A-3		C-1	C-3	C-4	C-9
Station #	32	35	26		23	20	30	28
Battery Connection Time	6/20/94 4:02	6/20/94 4:41	6/16/94 4:45		6/16/94 4:00	6/16/94 2:41	6/19/94 0:00	6/17/94 15:08
Battery Disconnect	6/23/94 23:59	6/24/94 4:40	6/22/94 14:30		6/22/94 21:45	6/23/94 4:00	6/21/94 0:24	6/20/94 21:56
Main Battery Voltage								
Start								
volts = 24	24.59	24.91	24,59		25.01	24.41	25.08	24.07
volts = 12	12.06	12.44	12.03		12.17	11.85	12.46	11.89
volts = -12	-12.82	-12.65	-12.75		-12.74	-12.61	-12.72	-12.53
End								
volts = 24	20.14	19.8	19.17		19.68	18.26	21.39	19.45
volts = 12	9.77	9.84	9.3		9.55	8.53	10.5	9.52
volts = -12	-11.49	-11.14	-11.15		-11.93	-10.79	-10.68	-11.14
Release Battery								
Start	12.42	12.36	12.38		12.9	12.8	12.38	12.61
End	11.99	11.49	11.87		12.44	12.15	11.9	11.91
Time-of-Day								
Start	6/20/94 4:18	6/20/94 4:47	6/16/94 5:03		6/16/94 4:19	6/16/94 2:52	6/19/94 7:18	6/17/94 15:23
offset (ms)	8.24	0.528	2.6		3.96	6	5.84	7.84
End	Prog. error	Prog. error	6/22/94 14:22		Prog. error	Prog. error	no data	locked up
offset (ms)	no test	no test	-67.6		no test	no test	no test	no test
Deployment								
Time								
Water Depth (m)	523	2972	3131		2893	2375	1082	1085
Latitude	40 47.3 N	40 70.783 N	40 56.717 N		40 34.95 N	40 9.667 N	41 22.3 N	41 20.067 N
Longitude	124 35.783 W	124 59.967 W	125 44.75 W		125 30.15 W	125 28.2 W	124 39.183 W	124 47.75 W
Navigation	GPS	GPS	GPS		GPS	GPS	GPS	GPS
Recovery								
Time	6/23/94 23:49	6/24/94 4:11	6/22/94 12:28		6/22/94 20:34	6/23/94 2:40	6/20/94 22:12	6/20/94 20:58
Latitude	40 47.316 N	40 50.773 N	40 56.756 N		40 35.025 N	40 10.055 N	41 22.32 N	41 20.148 N
Longitude	124 35.856 W	125 00.150 W	125 45.015 W		125 30.236 W	125 28.13 W	124 39.945 W	124 47.684 W
Navigation	GPS	GPS	GPS		GPS	GPS	GPS	GPS
offset (m)	109	125	378		184	191	94	177
range (m)	547	3011.7	3121		2900.7	2381.1	1064	1102.5
Tracks written	208	208	123		208	208	No DATA	149
Track Errors	0	0	0		0	0		0
Total Time drift (ms) foward	#VALUE!	#VALUE!	70.2	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Estimated drift (ms)	45.1	44.2			90.2	83.02		38.71
Battery drain								
volts = 24	4.45	5.11	5.42	0	5.33	6.15	3.69	4.62
volts = 12	2.29	2.6	2.73	0	2.62	3.32	1.96	2.37
volts = -12	-1.33	-1.51	-1.6	0	-0.81	-1.82	-2.04	-1.39
Release	0.43	0.87	0.51	0	0.46	0.65	0.48	0.7

Appendix C
Single Channel Seismic Survey

A single channel seismic reflection survey program was added to W9406A to take advantage of slack time in the OBS/OBH program, between times when instruments were deployed and before they needed to be recovered. The surveys of proposed northern California ODP drilling sites were funded by the JOI U.S. Science Support Program. We used an 80 cubic inch water gun and a two channel hydrophone streamer from the U.S.G.S. (Woods Hole) powered by the OSU air compressor. The single channel seismic reflection data were recorded on the U.S.G.S. digital acquisition system, based on the xseismics acquisition program on a Masscomp computer.

In addition, 3.5 kHz and 12 kHz seismic reflection data were recorded on a Quester Tangent ISAH-S data acquisition system. On this cruise we used a 20 kHz sampling rate for both 3.5 and 12 kHz channels and 400 millisecond sampling window for data recording.

Table C1 is a summary of the results of the surveys. Four proposed drillsites, CA-1, CA-2, CA-4, and CA-7 were surveyed during W9406A. Problems with the SCS hydrophone streamer, and to a lesser extent with the digital recording and water gun firing line, limited the amount of data recorded during the cruise. Nevertheless, site surveys were completed at the four ODP drillsite locations.

Significant problems with the streamer occurred at the beginning and the end of W9406A. At the beginning we could not get the streamer to function during the first CA-7 survey. The problem was eventually traced to electrical interference between the two streamer channels. When one channel was disabled, the other worked well. Note that the two 'channels' of data recorded digitally are from one streamer channel with slightly different filter and gain settings. The channel 1 record represents the primary data record, while channel 2 is typically where more experimental settings were tried. At the end of the cruise the streamer failed again during its deployment for a small survey of the deformation front west of Eureka. When we recorded the streamer we noted one broken wire at a hydrophone and some evidence of seawater infiltration. This effectively ended all possibilities for future SCS work on this cruise.

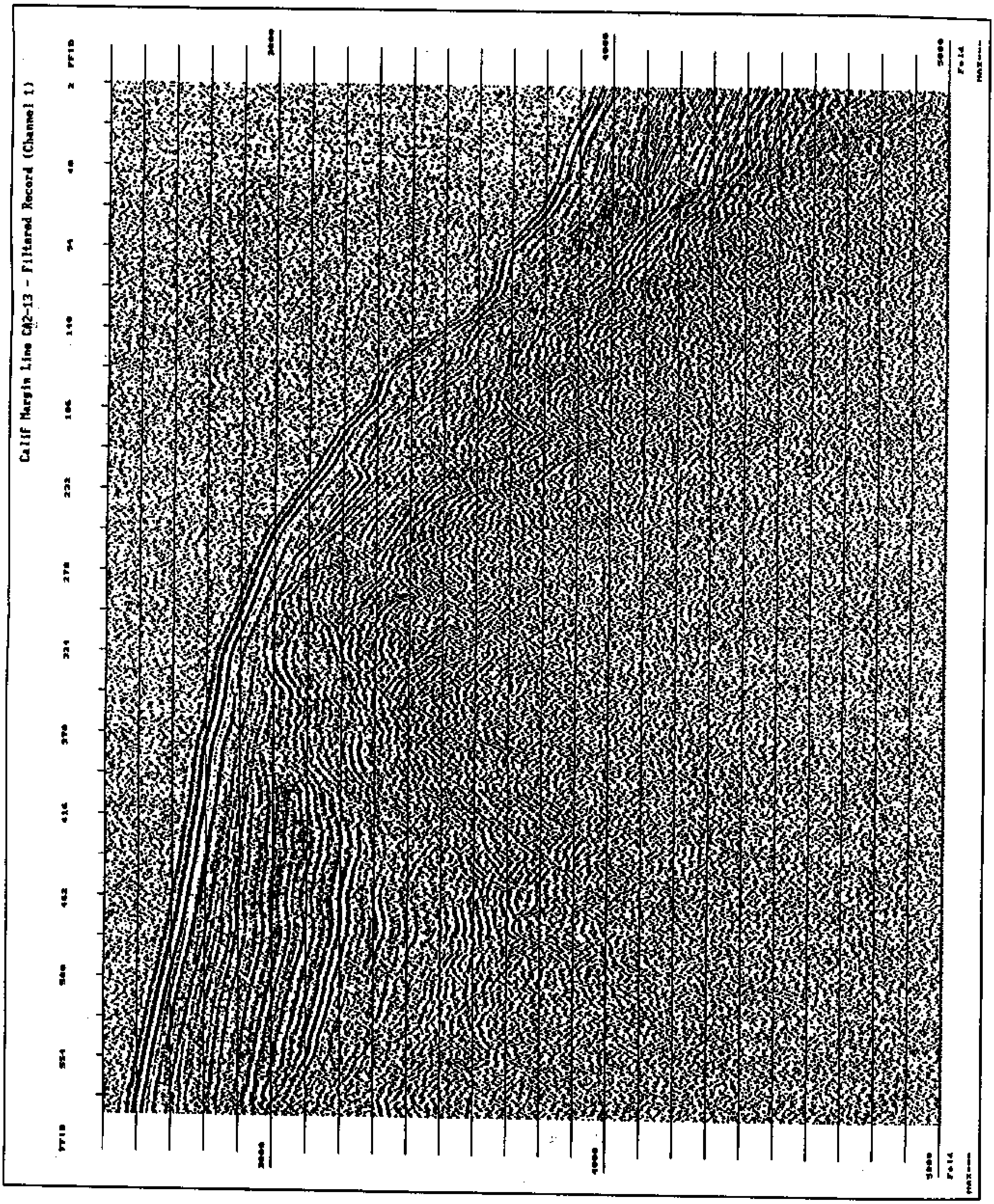
A bug in the digital acquisition program also caused data loss. It was only discovered after a significant portion of the first CA-2 survey had been accomplished. Only half of the nominal time for a data record was actually digitized. The problem was fixed after communication with the shore by setting two records per trace recorded. Only lines 11 and 12 of the first CA-2 survey were recorded properly.

Finally, some data loss occurred on the first CA-4 survey because of triggering problems on the 80 cubic inch water gun. We noted weak returns on the first line (CA4-1) surveyed. By line CA4-3, the gun was firing erratically and poor data were being recorded. We recovered the water gun and replaced the solenoid, but noticed that much of the problem seemed to occur at the connection of the solenoid and the trigger line. By manipulating the line we could get the gun to fire regularly, and restarted the CA4-3 line.

All members of the Wecoma crew cooperated to make the SCS surveys successful, and for the most part the ship's layout was conducive to the SCS operation. One improvement - a forward crutch for the ship's crane could have made using the A-frame more efficient. During W9406A a crane operator needed to be called to lift the crane from its crutch on the A-frame before we could begin deployment or recovery operations.

Table C1: SCS Survey Summary
(all times in PDT)

	Time	Date	Site	Nominal Drillsite Location °N	°W	Comments
start end	0100 0246	6/11 6/12	CA-7	39° 22'	124°16'	Streamer failed to operate - no SCS but analog & digital 3.5 & 12 kHz recorded
start end	2340 0040	6/12 6/14	CA-2	39° 58'	125°27'	Streamer functional. Recording problem on digital SCS-limits digital SCS recording to line 12. Analog SCS & analog & digital 3.5 & 12 kHz collected on lines 1 - 12
start end	1400 2130	6/15 6/15	CA-7	39° 22'	124°16'	Analog & digital records of all lines, SCS, 3.5 & 12 kHz, lines 1 - 9
start end	1958 0600	6/16 6/17	CA-4	41° 00'	126°24'	Erratic firing of water gun limits SCS survey. Digital & analog SCS, 3.5 & 12 kHz recorded, lines 1 -3
start end	1706 0447	6/17 6/18	CA-1	41° 40'	124°58'	All gear functioning. Analog & digital SCS, 3.5 & 12 kHz recorded on lines 1 - 9
start end	1130 2212	6/19 6/19	CA-1	41° 40'	124°58'	All gear functioning. Analog & digital data recorded on lines 10 - 16
start end	1236 0527	6/20 6/21	CA-4	41° 00'	126°24'	All gear functioning. Analog & digital data recorded on lines 4 - 14
start end	2322 1042	6/22 6/23	CA-2	39° 58'	125°27'	All gear functioning. Analog & digital data recorded on lines 13 - 21
start end	2301 1120	6/23 6/24	DF	40° 51'	125°00'	Small survey of deformation front. Streamer failed immediately after deployment. No SCS, but digital & analog 3.5 & 12 kHz data on lines DF 1 - 7



Example of SCS data

APPENDIX D

SCIENTIFIC STAFF FOR R/V WECOMA CRUISE:

John Chambers (Boise State)	graduate student
Vee-Ann Cross (USGS)	research associate
Jim Dolan (WHOI)	research associate
David DuBois (WHOI)	senior research assistant
Tim Holt (OSU)	faculty research assistant
Pete Kalk (OSU)	faculty research assistant
Christof Lendl (OSU)	graduate student
Mitch Lyle (Boise State)	co-chief scientist
Don Michaelson (OSU)	faculty research assistant
Greg Miller (USGS)	research associate
Ken Peal (WHOI)	senior engineer
Anne Trehu (OSU)	chief scientist
Brian Wendler (OSU)	faculty research assistant
F. Beecher Wooding (WHOI)	research associate

APPENDIX E

MENDOCINO WORKING GROUP

Project Coordinator:	Anne Trehu, Oregon State University
Co-Principal Investigators:	Bruce Beaudoin, Stanford University Simon Klemperer, Stanford University Alan Levander, Rice University Anne Meltzer, Lehigh University
Additional Investigators:	Gary Carver, Humboldt State University Kevin Furlong, Pennsylvania State University John Diebold, Lamont Doherty Geological Observatory Mike Purdy, Woods Hole Oceanographic Institution Manik Talwani, Houston Advanced Research Center Sam Clarke, US Geological Survey Walter Mooney, US Geological Survey Ray Wells, US Geological Survey George Zandt, Lawrence Livermore National Laboratory

WORKING GROUP FOR 1994 DATA ACQUISITION:

Anne Meltzer, Sam Clarke, John Diebold, Nikki Godfrey, Sean Gulick: MCS data acquisition from the R/V Ewing
Alan Levander and others: dense, linear onshore PASSCAL arrays
Bruce Beaudoin and John Hole: onshore PASSCAL 3-D array.
Anne Trehu and others: OBH and OBS deployments from the R/V Wecoma