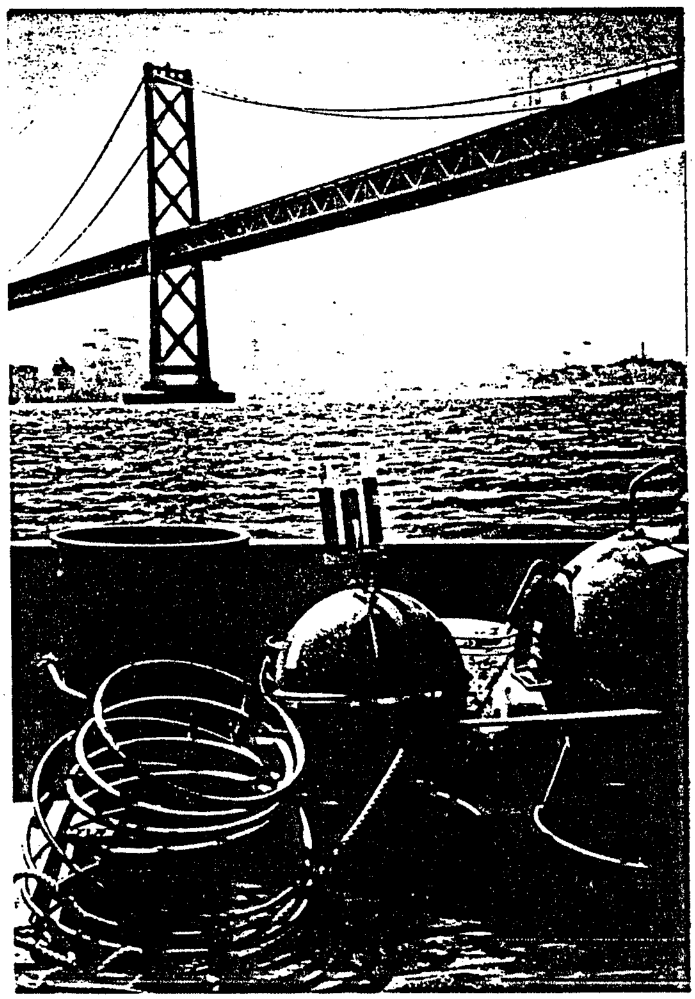
DJHN 91030
SHAN 91032
RP 2

SAN FRANCISCO BAY AND MARGIN SEISMIC EXPERIMENT

OCEAN BOTTM SEISMOMETER OPERATION

SEPTEMBER 1991



PRELIMINARY CRUISE REPORT

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SUMMARY

This cruise report summarizes ocean-bottom seismometer operations during the Bay Area Seismic Imaging eXperiment (BASIX) in September 1991. Six U.S. Geological Survey OBS's were deployed on one north-south profile in San Francisco Bay, and five OBS's were deployed along a northeast-southwest transect across the continental margin off San Francisco Peninsula. Airgun shots fired by the R/V *S.P. Lee* were recorded at offsets up to 100 km. The objectives of this experiment were to characterize the deep crustal structure of the Bay and across the margin, in order to better understand the tectonic evolution of the region. Operations were successful despite a tight shooting schedule: all instruments were recovered, and data was recorded on ten of the eleven instruments deployed. Initial record sections show useful data on both profiles; data on the offshore profile are particularly good.

SCIENTIFIC OBJECTIVES

- Determine an accurate two-dimensional velocity structure across the central California margin in the vicinity of San Francisco, from an accretionary prism overlying continental crust to normal oceanic crust.
- Image the lower crust and moho beneath the marginal sedimentary pile that is invisible in available multichannel seismic reflection lines across the margin.
- Estalish the extent of subducted oceanic crust under the margin.
- Determine an accurate two-dimensional velocity structure along the San Francisco Bay.
- Search for major faults crossing the Bay and the continental margin.
- Augment the BASIX data set of marine multichannel seismic reflection and land seismic refraction to help determine whether major faults in the Bay area are connected at depth.

OPERATIONAL OBJECTIVES

- Deploy six USGS ocean-bottom seismometers along a north-south profile in San Francisco Bay and record the airgun shots of the R/V *S.P. Lee.*
- Recover all six OBS's, download data quickly, and reprogram the instruments for redploparticular within 24 hours.
- Redeploy six OBS's along a northeast-southwest margin transect off the coast of the San Francisco Peninsula, coincident with a preexisting multichannel seismic transect.
- Recover all instruments after recording the shots of the R/V *S.P. Lee* along the margin line.
- Maintain good communications with personnel on board the *Lee* at all times.

NARRATIVE

San Francisco Bay Profile (Line 1)

Day 1 (15 Sept 1991)

We met the R/V *David Johnston* at 1230 LT on Sunday, 15 Sept 1991, which had just docked at the USGS Marine Operations Facility (MarFac) in Redwood City. While the OBS gear was loaded onto the *D.J.*, last-minute updates to plans concerning instrument locations and time of shooting were made in consultation with Jill McCarthy, Chief Scientist aboard the R/V *S.P. Lee* (the *Lee* had also just docked alongside the *D.J.* to take on water). Meanwhile Greg Miller and Capt. Gordon Smith rigged a block and tackle on the *D.J.*'s stern A-frame for use in manually lifting the OBS overside, as the hydraulic system was not configured to operate the stern winch. The *Lee* was to sail from Redwood City at 1900 LT, would deploy its air gun array and begin shooting Line 1 upon communication from us that all OBS were deployed (but no later than 2100 LT). Because the *D.J.* had neither single sideband radio nor a cellular phone, we had to assume that we would be unable to contact the *Lee* during most of our deployment operations. We therefore decided that if we needed to communicate with the *Lee* while we were still aboard the *D.J.*, we would do so via Ron Mandel, the experiment's "land party," who would be within hailing range. Our plan was to deploy the OBS from south to north in the channel in San Francisco Bay, where water depths were sufficient (>40 ft) for the *Lee* to navigate (Fig. 1). All six OBS had been programmed to begin recording data at 1700 LT.

We sailed from Redwood City at 1348 LT, with a total of five personnel on board (Appendix 1). The Bay waters were calm, with no whitecaps visible. We reached the first deployment site at 1420 LT, hove to and deployed OBS A1 at 1427 LT (Appendix 2). We proceeded to the next deployment position, OBS C3, just north of the San Mateo Bridge. (We had decided to deploy OBS's C3 and C9 at opposite ends of the profile, as the spare acoustic release Greg Miller had swapped into OBS C3 had the same release code as that of OBS C9).

We reached the next deployment location at 1500 LT and deployed OBS C3 at 1506 LT. By 1508 LT we were underway to the third station, OBS A2, located at the latitude of South San Francisco. At 1545 LT we hove to on station, and OBS A2 was deployed at 1549 LT in 32 feet of water. We were underway again at 1551 LT, making 8.5 knots over ground. We pulled up on station C4, located between San Francisco and Alameda, at 1634 LT and deployed OBS C4 at 1637 LT in 56 feet of water. On the way to station A8 we began rolling as the seas became choppy, especially in the long fetch east of the Golden Gate. Fortunately this subsided at we approached station A8, which was in relatively sheltered waters behind Angel Island. Once on station (at 1724 LT) we experienced an 8 minute delay to replace a broken spring on instrument A8 (which manifested itself as a loose anchor). During the deployment of OBS A8, a hydraulic hose controlling the stern A-frame burst, spilling hydraulic fluid onto the deck, but this resulted in only a minor delay, and by 1738 LT OBS A8 was deployed in 52 ft of water. We arrived at our final station, C9, located off Point San Pablo, at 1818 LT, and at 1826 LT we deployed OBS C9 in 62 ft of water. At 1827 LT we were underway to port, and by 1850 LT the *D.J.* was secure at the dock in Loch Lomond Harbor, near San Rafael.

Day 2 (16 Sept 1991)

On Monday morning, Holbrook contacted Jill McCarthy aboard the Lee and verifed that the shooting of Line 1 had been successfully completed during the night. Shooting times were 0346 to 1056 Z (i.e. 2046 to 0356 LT). We learned that the Lee was not able to steam directly over all the instruments, so that there will be some offline component to our data. We also discussed plans for shooting the offshore line, and established that the shooting would begin early morning on Thursday, 19 Sept 1991, and continue throughout the day.

During the morning hours of 16 Sept 1991 the *D.J.* was occupied with activities for the *Lee*'s Teleseis experiment. We met the *D.J.* at 1200 LT upon her return to the dock at Loch Lomond. After Capt. Smith repaired the damaged hydraulic hose, we sailed at 1254 LT. By 1311 LT we arrived on station and released OBS C9 on the fourth release command, and at 1317 LT OBS C9 was on board. Minutes later we were underway, passing beneath the San Rafael Bridge at 1328 LT, and by 1357 LT we were on station A8. The instrument released on the first command, surfaced about 70 m off the port beam, and was on board by 1401 LT. We next steamed to station C4, arriving at 1445 LT. OBS C4 released on the first command, surfaced off the starboard quarter, and was on board by 1449 LT. At 1450 LT the USGS boat Revenge came alongside in order to transfer the *Lee*'s GPS operation manual to us, so that we could use the GPS unit for Line 2. This took only a minute, after which we steamed to station A2, arriving there at 1526 LT. OBS A2 released on the first command, surfaced about 70 m astern, and was on board by 1529 LT. We next steamed to station C3, arriving at 1601 LT. We attempted to release OBS C3 for several minutes with no success (we were able to range to the instrument). Finally at 1613 LT, after many attempts, OBS C3 released. The instrument surfaced about 20 m astern and was on board by 1615 LT. Greg Miller had no immediate explanation for the recalcitrance of the release on OBS C3, although we suspect that multipathing in the shallow water may have contributed to the difficulty. We next steamed to our final station, A1, arriving at 1639 LT. OBS A1 released on the first command, surfaced about 20 m astern, and was on board by 1642 LT. A minute later we were underway to Redwood City, and by 1704 LT we were securely docked at MarFac and began unloading the gear.

After our gear was unloaded that evening, we drove from MarFac to Half Moon Bay in order to establish a new base of operations for the offshore profile. Greg Miller began the tedious process of downloading data from the OBS disk drives, so that the instruments could be reprogrammed for Line 2. Greg worked through the night on this.

Continental Margin Profile (Line 2)

Day 1 (17 Sept 1991)

Most of Tuesday was spent making preparations for the offshore line. During the morning we met the *R/V Shana Rae* and her skipper, Jim Christmann, familiarized ourselves with the boat, and discussed logistics and operational plans. We learned that Capt. Christmann operates the Shana Rae without a crew, and considering the demanding schedule required for this experiment (i.e. deploying and recovering throughout the night on consecutive nights), this raised an operational concern with regard to sleep schedules. We agreed that our plan was workable if members of the OBS team took turns on the bridge. We also talked with several fishermen on the docks to exhange information, as we were quite concerned about the dangers posed to our instruments by the extremely active drag fishing on the shelf and slope. We decided to deploy buoys near those instruments most at risk, and spent part of the afternoon rigging them. We also loaded the OBS's onto the boat during the afternoon.

Day 2 (18 Sept 1991)

On Wednesday morning Holbrook, Miller, and Coleman boarded the Shana Rae and made final preparations for the cruise. At 1100 LT, Holbrook called McCarthy for final verification of plans; McCarthy reported that shooting of the Bay Teleseis experiment was proceeding according to schedule, and that the best projection for beginning the shooting of the offshore line was Thursday 0400-0500 LT.

At 1236 LT we sailed from the dock in Pillar Point Harbor under gray skies. In the open ocean, visibility was good (6-8 miles), and seas were calm, with 1-3' surface chop on gentle 4-5' swells. Our cruising speed was 8-9 knots. Our original cruise plan was designed to minimize the bottom time of those instruments most at risk from drag fishing

(OBS's C3 and A1), by deploying them last and recovering them first. During operations, however, we observed that fishing vessels were not as abundant as expected, and we modified that plan to a more time-efficient one. At 1805 LT, we brought up the GPS receiver and verified its operation. The GPS-LORAN offset was about 0.13' latitude, 0.35' longitude. We decided to navigate primarily on the basis of GPS for the duration of the cruise.

At 1835 we arrived on station A8, at the western end of the line, hove to, and rigged prepared OBS A8 for deployment from the starboard boom. OBS A8 was deployed at 1900 LT, and at 1905 LT we were underway for station A2. As dusk fell, the fog began to settle in; seas were still calm, with no whitecaps. We arrived on station A2 in complete darkness at 2006 LT, hove to, and deployed OBS A2 at 2017 LT. Minutes later we were underway to station A1, where we arrived at 2110 LT. OBS A1 was deployed at 2114 LT, and at 2117 LT we were underway to station C4. By now thick fog had settled in, reducing visibility to about 200 m. At 2255 LT we stopped briefly to watch a giant tortoise; visibility was now about 3/4 mi. We reached station C4 at 2326 LT, and deployed OBS C4 at 2336 LT. By 2339 LT we were underway to station C9 at the landward end of the line; we arrived there at 0046 LT (now Thursday). At 0056 LT we deployed OBS C9 in 20 fathoms of water. We next turned about and steamed west toward station C3. At 0320 LT we placed a call via the marine operator to the cellular phone aboard the *S.P. Lee*. Dave Scholl informed us that the *Lee* was slightly behind schedule and that they now projected coming onto Line 2 around 0600-0800 LT. During the phone call, the release on OBS C3 failed its shipboard air test, and we decided not to deploy it; this information was passed on to Dave Scholl. After the call (0335 LT), we steamed at 3.5 knots to our "wait point" near the middle of the line. For the rest of the night and early morning, we each took turns on the bridge.

<u>Day 3 (19 Sept 1991)</u>

By 0900 LT, morning had brightened, but the skies remained overcast with high fog. Visibility was good at about 4-5 miles, and seas were still calm: ideal weather for recovery. At 1015 LT we placed another call to the Lee via the marine operator, and learned shooting had begun and they were about 10 n.m. into the line. At 1300 LT we spotted the *Lee* from our wait point and pulled alongside her at 37° 27.67' N, 122° 59.00' W for a "photo op." (Because we were about 10 km from the nearest OBS, we were not concerned about adding ship noise to the data.) We remained several hundred yards off the Lee's port side until 1400 LT, when we pulled away and returned to our wait point at 37° 26.49' N, 122° 59.50' W, in order to protect OBS A1 from fishing boats. At 1553 LT we decided to abandon this plan, judging the risk to OBS A1 to be extremely small. Instead we decided to steam a southwestward course parallel to the line, keeping the *Lee* about 3.5 Nm to port. This plan would position us at the west end of the line at the end of shooting, saving about 2 hours during recovery. We began steaming at 6 knots to catch up to the *Lee*.

At 1632 LT we placed a call to the R/V *Golden Fleece*, which was working in the area and appeared on radar to be heading directly for OBS A1. We learned that their work involved dragging the bottom, so we apprised them of the position of OBS A1, and they agreed to avoid it.

By 1806 LT the Lee was directly off our port beam at about 3 Nm; we slowed to 4 knots to keep pace. At 2133 LT we received a VHF call from the *Lee* that shooting had finished. We proceeded to station A8 to begin recovery. We arrived on station A8 at 2220 LT, and ranged to the instrument at 2750 m. OBS A8 released on the first command at 2221 LT and surfaced at 2300 LT about 600 m off the port quarter. (The rise rate of the instrument was thus roughly 70 m/min or 1.2 m/s.) At 2311 LT, OBS A8 was on board and we steamed toward the next station. We arrived at station A2 at 0027 LT (now Friday), deployed the transponder and ranged to the instrument (1317 m). OBS A2 released on the first command at 0028 LT and surfaced about 100 m off the port bow 19 minutes later at 0047 LT. At 0052 LT, OBS A2 was on board, and we began steaming toward the next station. We arrived on station A1 at 0153 LT, ranged to the instrument (876 m), and released OBS A1 on the first command at 0154 LT. The instrument surfacedat 0207 LT about 50 m off the starboard beam and was on board three minutes later. By 0212 LT we were underway to the next station. We arrived on station C4 at 0428 LT, ranged to the instrument (93 m), and released OBS C4 on the first command at 0431 LT. The instrument surfaced one minute later, about 10 m off starboard, and was on board by 0434 LT. Two minutes later we began steaming toward our final station, at which we arrived at 0558 LT. We ranged to the instrument (107 m) and released OBS C9 on the first command at 0600 LT. The sphere surfaced about 100 m off the starboard quarter at 0602 LT and was on board four minutes later. At 0606 LT we began steaming for Half Moon Bay.

We arrived at Pillar Point Harbor about two hours later; by 0806 LT we were secured at the dock and began unloading our gear.

APPENDIX 1

Crew List, *R/V David Johnston*

W.S. Holbrook	-	WHOI, Scientist
Greg Miller	-	USGS, Woods Hole
Dwight Coleman	-	USGS, Woods Hole
Gordon Smith	-	Skipper
Michael Haman	-	USGS, Menlo Park, Navigation
Pete Dartnell (Mon. only)	-	USGS, Menlo Park

Crew List, *R/V Shana Rae*

W.S. Holbrook	-	WHOI, Scientist
Greg Miller	-	USGS, Woods Hole
Dwight Coleman	-	USGS, Woods Hole
Jim Christmann	-	.Skipper

APPENDIX 2

Instrument Deployments

LINE 1

Inst. ID	SP #	Line Coord. (from SW end of line (km)	Drop Time (GMT)	Start Time (GMT)	Recovery Time (GMT)	DEPLOYMENT Latitude	DEPLOYMENT Longitude	Depth (m)	Nav. Quality	Comments
OBSA1	-	-	9/15/91 2127	9/15/91 2359	9/16/91 2342	37°33.4046'N	122°11.7081'W	15	GPS	No hydrophone data.
OBSC3	-	-	9/15/91 2206	9/15/91 2359	9/16/91 2315	37°35.7542'N	122°15.9578'N	-	GPS	Difficulty releasing from bottom. Voltage regulator on data logger failed. No data recorded
OBSA2	-	-	9/15/91 2249	9/15/91 2359	9/16/90 2229	37°40.5028'N	122°18.9071'W	10	GPS	
OBSC4	-	-	9/15/91 2337	9/15/91 2359	9/16/90 2149	37°46.1819'N	122°20.8038'W	17	GPS	Voltage regulator on data logger failed. Disk errors, No hydrophone data.
OBSA8	-	-	9/16/91 0038	9/15/91 2359	9/16/90 2101	37°52.1990'N	122°24.2006'W	16	GPS	No hydrophone data.
OBSC9	-	-	9/16/90 0126	9/15/91 2359	9/16/90 2017	37°57.5991'N	122°26.9887'W	-	GPS	

LINE 2

Inst. ID	SP #	Line Coord. (from SW end of line (km)	Drop Time (GMT)	Start Time (GMT)	Recovery Time (GMT)	DEPLOYMENT RECOVERY Latitude	Longitude	Depth (m)	Nav. Quality	Comments
OBSA8	1025+	9.9	9/18/91 0200	*	9/20/90 0611	37°14.962'N 37°15.05'N	123°25.21'W 123°25.34'W	-	GPS	No hydrophone data.
OBSA2	853+	26.9	9/18/91 0317	*	9/20/90 0752	37°19.185'N 37°19.18'N	123°15.684'W 123°15.71'W	-	GPS	No hydrophone data.
OBSA1	725+	39.5	9/18/91 -	*	9/20/91 0910	37°22.36'N 37°22.32'N	123°08.30'W 123°08.26'W	-	GPS	
OBSC4	426	67.9	9/18/91 0636	*	9/20/90 1134	37°31.60'N -	122°50.94'W -	-	GPS	
OBSC9	240	86.2	9/18/90 0756	*	9/20/90 1306	37°37.008'N 37°37.05'N	122°40.469'W 122°40.50'W	37	GPS	

* OBS was programmed to start recording before being deployed.
+ Shooting system crashed at SP # 582. First SP after shooting resumed was assigned # 583 without leaving a gap of 11 SP.

Note: OBSC3 failed to release during air test and was not deployed in LINE 2.

APPENDIX 3

Ship Operations

Operations on both the *David Johnston* and the *Shana Rae* went smoothly. Some flexibility was necessary on the part of both scientific and ships' personnel, due to the small size of the crews and the rather tight scheduling of operations. Fortunately, the professionalism and dedication of all involved, as well as the relative ease of handling the small USGS OBS's, made the experiment possible.

Although the skipper and crew of the *David Johnston* were very professional and helpful, the *D.J.* itself was only minimally suitable for OBS operations. The lack of a hydraulic winch for the stern A-frame introduced some inconvenience into the deployments and recoveries, and the hand-hoisted block-and-tackle system we used would not have been safe or feasible in heavy seas. Lab space was also limited, though adequate for one-day operations.

The *Shana Rae* was entirely appropriate for the OBS operations offshore, and would have remained so even in substantially heavier sea states. The *Shana Rae* had more than ample deck space for the six OBS's, and the starboard boom was convenient for deployments and recoveries. The bunk area was not spacious, but was certainly adequate, and the galley and dining area was comfortable. It is impossible to overemphasize the importance of skipper Jim Christmann's enthusiasm, energy, and flexibility to the success of the OBS project. Despite being understaffed, Capt. Christmann was willing to work around-the-clock on an erratic sleep schedule in order to get the job done. This praise applies equally to the OBS team of Miller and Coleman. The only suggestions for improving the Shana Rae's suitability to OBS work might be (1) a more permanent science work space (shelf and fold-down table) on the bridge, (2) installation of an onboard GPS unit, and (3) acquisition of a cellular phone.

The cooperation of the scientific staff and crew aboard the Lee was crucial to the success of the OBS experiment: their flexibility and responsiveness on matters of line location and shooting parameters enabled the collection of an ideally designed OBS data set. The cooperation and enthusiasm of Dr. Jill McCarthy throughout the planning and execution of the OBS experiment was crucial to its ultimate success. Communication with the *Lee* via marine radio-to-celluar phone patch was adequate, although a direct cellular link from both the *David Johnston* and *Shana Rae* would have been preferable.

APPENDIX 4

Time

APPENDIX 5

Line 112 - OBS LINE 1
Sept. 16, 1991

Time (GMT)	SP #	Latitude	Longitude	Comments
0346	-	-	-	Recorder not enabled
0452	167	37°36.47'	122°17.02'	Start single channel recording
0541	291	37°39.23'	122°19.16'	?
0633	415	37°42.34	122°20.49'	
0723	539	37°45.56'	122°21.27'	
0811	663	37°48.44'	122°22.54'	
0906	788	37°51.19'	122°24.05'	
0959	913	37°54.57'	122°25.38'	
1053	1037	37°57.58'	122°26.69'	

OBS LINE 2
Sept. 19-20, 1991

Time (GMT)	File #	Latitude	Longitude	Comments
1313	1	37°46.08'	122°32.52'	
1417	102	37°40.08'	122°32.8'	
1417	103	37°40.8'	122°32.8'	Start LINE 2
1435	.126	37°40.226'	122°34.196'	
1505	-	-	-	Nav system crashed
1509	-	-	-	Nav system up
1619	250	37°36.63'	122°41.2'	
1759	374	37°33.0'	122°48.2'	
1937	499	37°29.39'	122°54.95'	
?	582?	-	-	System crash
2101	583			
2244	708	37°22.7'	123°07.4'	
0027	831	37°19.7'	123°14.5'	
0210	955	37°16.69'	123°21.52'	
0355	1081	37°13.51'	123°28.63'	
0430	1126	37°12.52'	123°31.22'	

Note: SP # 1 at 1311.
SP # = File # - 2 between File # 1-582.
SP # = File # + 8 between File # 583-1126.

APPENDIX 6

USGS OBS STATUS AND PERFORMANCE

Greg Miller

CURRENT SYSTEM OVERVIEW

The USGS OBS has been designed as a continuous recording system setup to record signals from one vertical 4.5 Hz geophone, two horizontal 4.5 Hz geophones (oriented at 90 degrees from each other), and one hydrophone. The software controlling the system can select any combination of the sensors to sample at 200 Hz. Once during the acquisition of data into the memory buffer (roughly 1 Megabyte in size), the system will record the time of the sample. The time and a pointer to the position in the data memory when the time was taken are recorded in a header that gets recorded at the beginning of each disk write.

CHANGES SINCE THE LAST DEPLOYMENT

1. Analog Circuitry - The amplifier, filter, and gain-ranging circuits have been completely redesigned since the last operation. The circuits have been moved from the Tattletale data logger to two circuit boards mounted directly on top of the geophone package. This not only frees up space on the data logger board, but also provides the need for wires to connect to the geophone sensors.
The new preamplifiers are fixed gain at a gain of 100. The new filter is an 8-pole Butterworth active filter providing 48 dB/octave attenuation. The gain-ranging amplifier now has a gain difference of 32 instead of 10 providing some additional dynamic range.

2. System Power - The main battery supply now is set at +24/-12 volts using Alkaline batteries and +15/-15 volts using Lithium batteries. An additional power control board has been designed to regulate and distribute the power to the various components of the system. The system should be capable of remaining on the bottom for at least one week (this needs testing before I can determine exactly how long the OBS's can be deployed). The old system could remain on the bottom only 48 hours.

3. Data Logger Mounting - A new mounting plate has been built to ease the process of installing and removing the data loggers between deployments. The new plate incorporates the gel-cell battery and power conditioning circuits, so the data loggers can be removed from the sphere while remaining powered.

4. Data Logger Upgrades - All data loggers have been upgraded from a 229376 byte memory buffer to 1015808 bytes buffer.

5. Software Changes - The software used to control the OBS has been completely rewritten to accommodate the larger memory buffer and the new analog circuits. The header data has been expanded and now recorded as binary rather than ASCII to provide more room for expansion.

PERFORMANCE EVALUATION

LINE 1 - All six OBS's were deployed, and recovered. OBS C-3 required a great deal of effort to release. The voltage regulators on the data loggers failed on OBS C-3 and OBS C-4. As a result C-3 recorded no data, and OBS C-4 had only the vertical geophone and one horizontal geophone of data recorded. Of the six OBS's only C-9 and A-2 had valid hydrophone data.

LINE 2 - The release on C-3 failed during the air test prior to deployment, so it was not deployed. All other OBS's were deployed and recovered with no problems. Of the 5 instruments deployed A-1, C-4, and C-9 recorded valid hydrophone data.

In general, all of the upgrades seemed to have done their job well. The longest deployment time was slightly over 3 days and the batteries still had a lot of life left in them. The analog circuitry performed well providing data that is 10 times quieter (electronically) than the previous version. Because the system is quieter the noise from the disk writes is now very noticeable in the data, but that was not unexpected. There has been no opportunity to evaluate the systems' performance beyond what I have stated. It will probably be February or March of 1992 before I have time to study the results of this operation any further.

Several aspects of the physical operation need to be considered before the next time. To provide the maximum possible coverage, the instruments were programmed to start recording data before the instruments were deployed. This has resulted in disk errors which can be serious (C-4's data set of line 1 was severely compromised by the disk head not moving to the correct track). Recovery seems to also cause disk errors, but it does not seem to affect the data. The rapid turn around of the instruments is also difficult to achieve. Its takes a couple of days to equilibrate the oven controlled oscillators enough to achieve the manufacturers spec for drift values. If less time is available, operations will have to go with reduced timing accuracy. It also takes twenty hours to turn the instruments around for another deployment. This has proven to be a severe drawback when doing more than one line. In the future, the support computer system requires more data capacity, and a second data logger for each OBS may be required to achieve rapid turnarounds.

WORK NEEDED

1. The release on OBS C-3 has failed completely and needs replacement before it can be used again.

2. The analog circuits need to be tested and calibrated. Once confirmed to meet the desired specifications, printed circuit boards need to be made.

3. Build printed circuit boards for power control and battery packs.

4. Evaluate the problems recording hydrophone data. I currently suspect that there is a mechanical connector problem.

5. Finish constructing and acquiring the necessary support equipment.

6. Add gain words the Tattletale software and record the OBS # somewhere in the header.

7. Rework the backup power supply for the release.

8. Develop software to monitor the success (or failure) of the OBS's in the field.

9. Design a new clock circuit for OBS timing.

10. Write Exabyte software to write data tapes of raw data that can be read on any computer.

11. Incorporate a timed window mode and event detection.

12. Order spares and shipping containers.

13. Evaluate oscillator performance.

APPENDIX 7

Recording of Shot-instant Times on the R/V LEE

APPENDIX 8

Ambient Noise Samples from the Ocean Bottom Seismometers

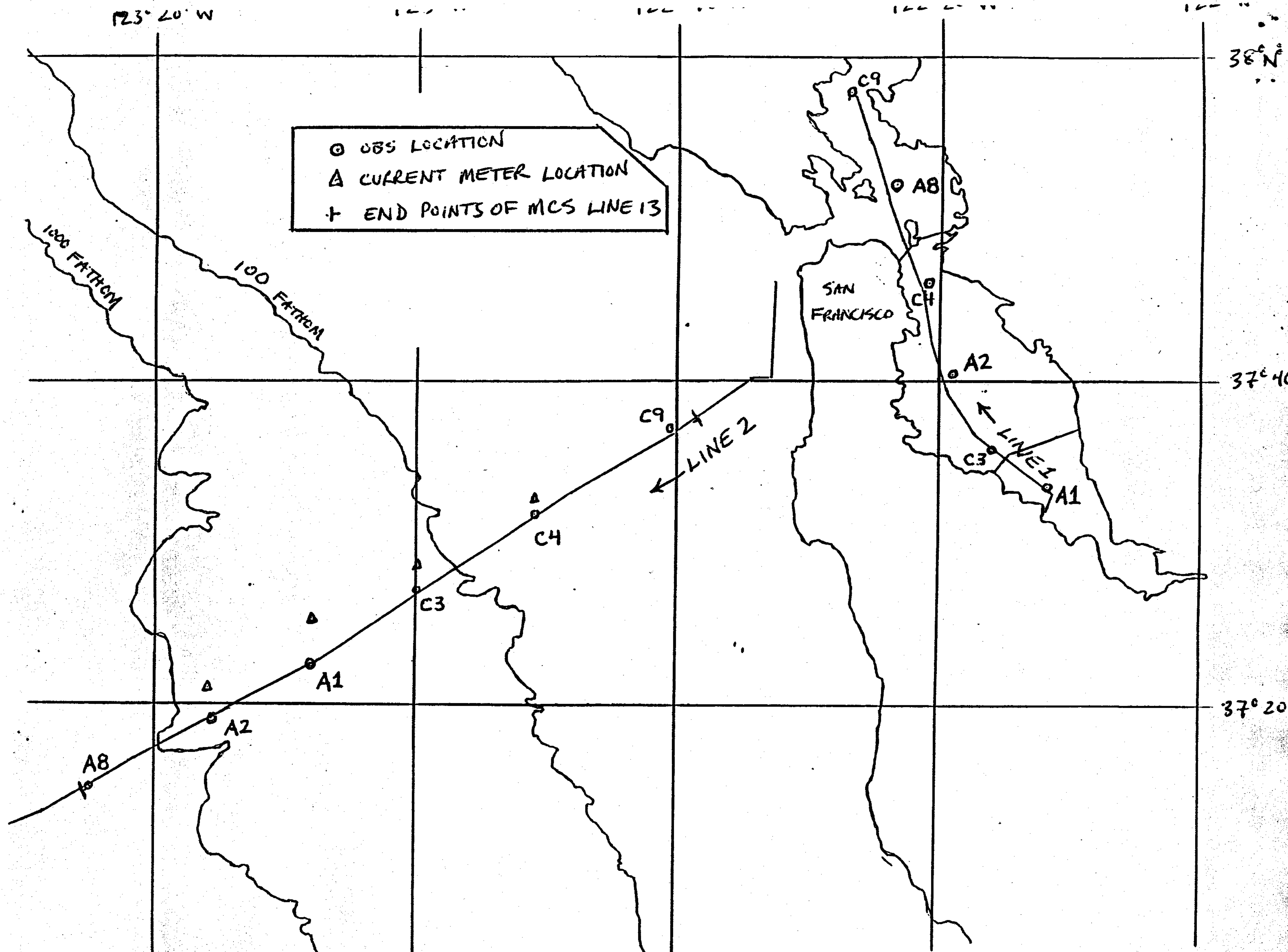
APPENDIX 9

Lessons and Recommendations

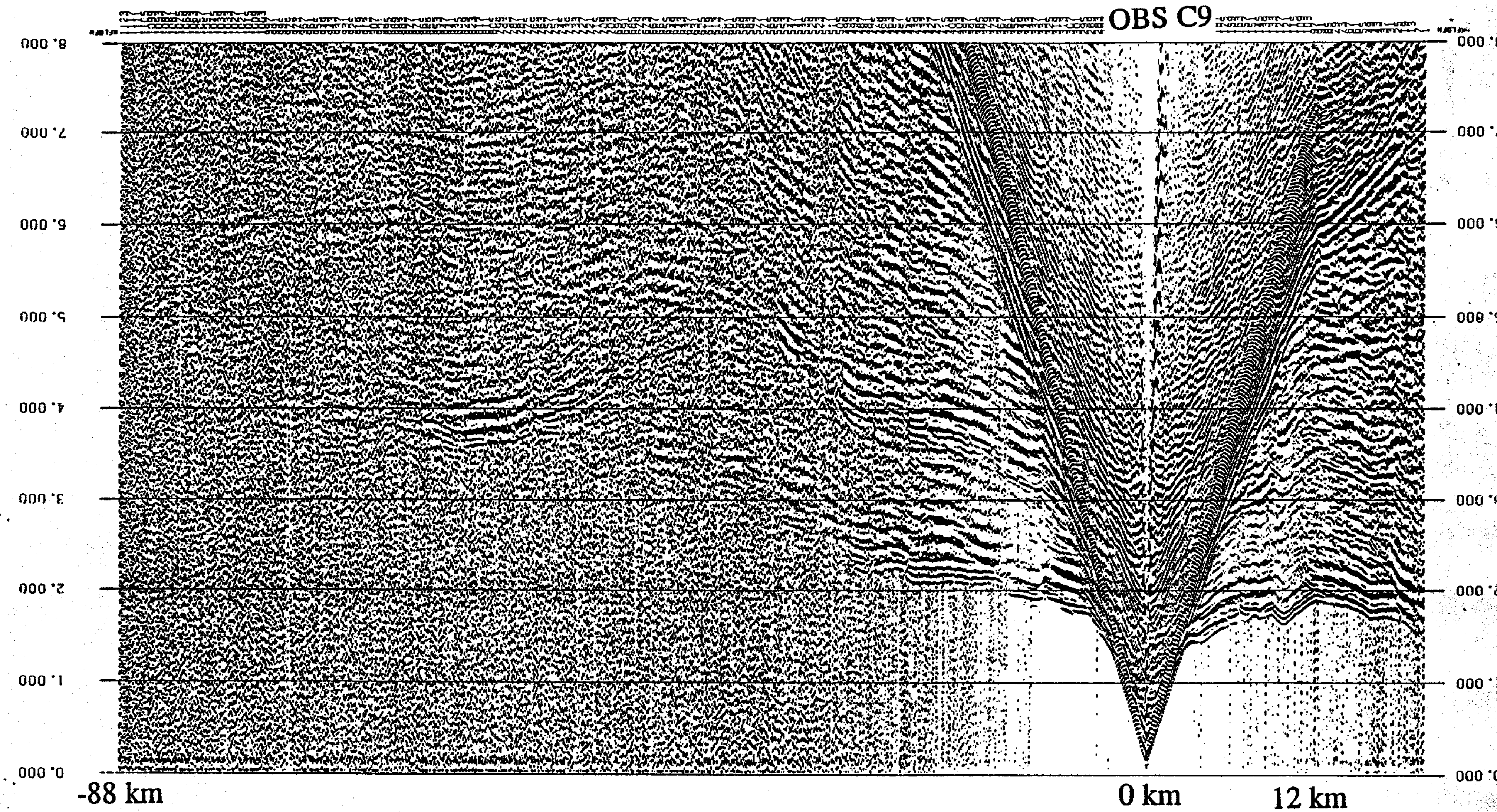
APPENDIX 10

Record Sections of OBS Data

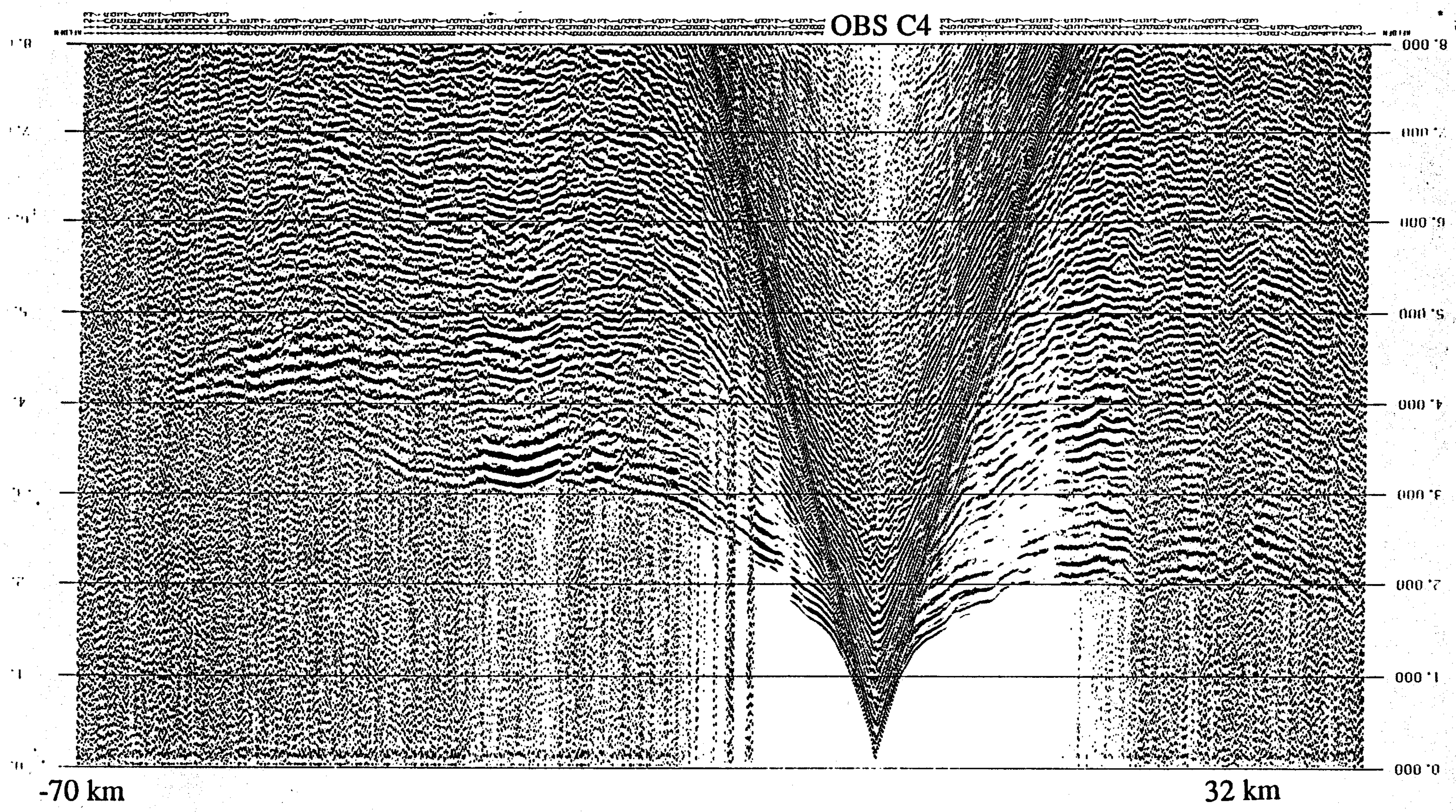
The following pages show preliminary record sections from each OBS on each of the two lines. The first five sections are from Line 2 (margin transect), the next five from Line 1 (S.F. Bay). In all cases, vertical component geophone records are plotted, except for OBS C9 on Line 2, for which a hydrophone record section is shown. Record sections from Line 2 are plotted with a reduction velocity of 6 km/s, assuming an equal shot spacing of 98.5 m; these records may change slightly when full navigation from the *Lee* becomes available. All records from Line 1 are plotted with no reduction velocity.

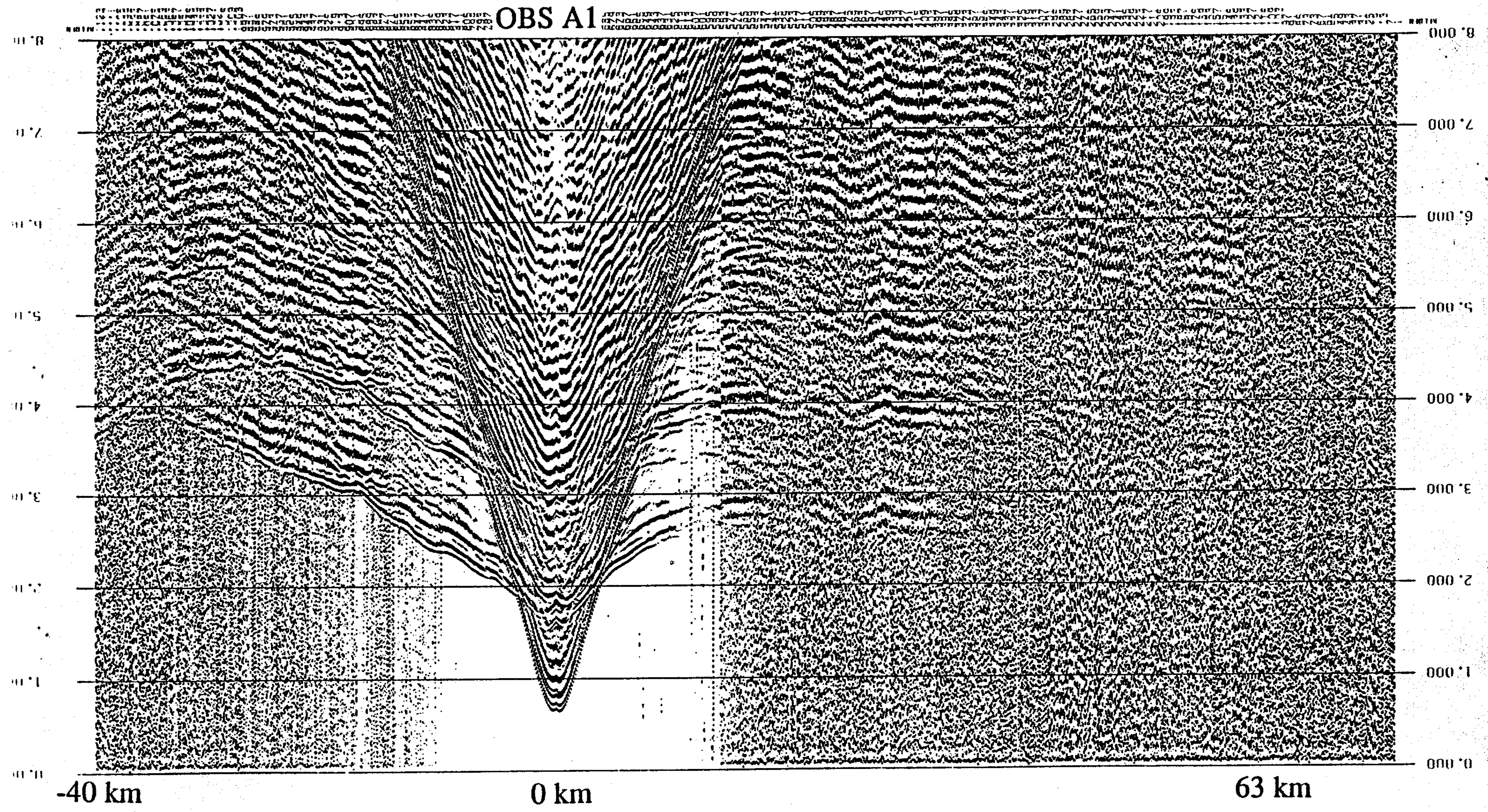


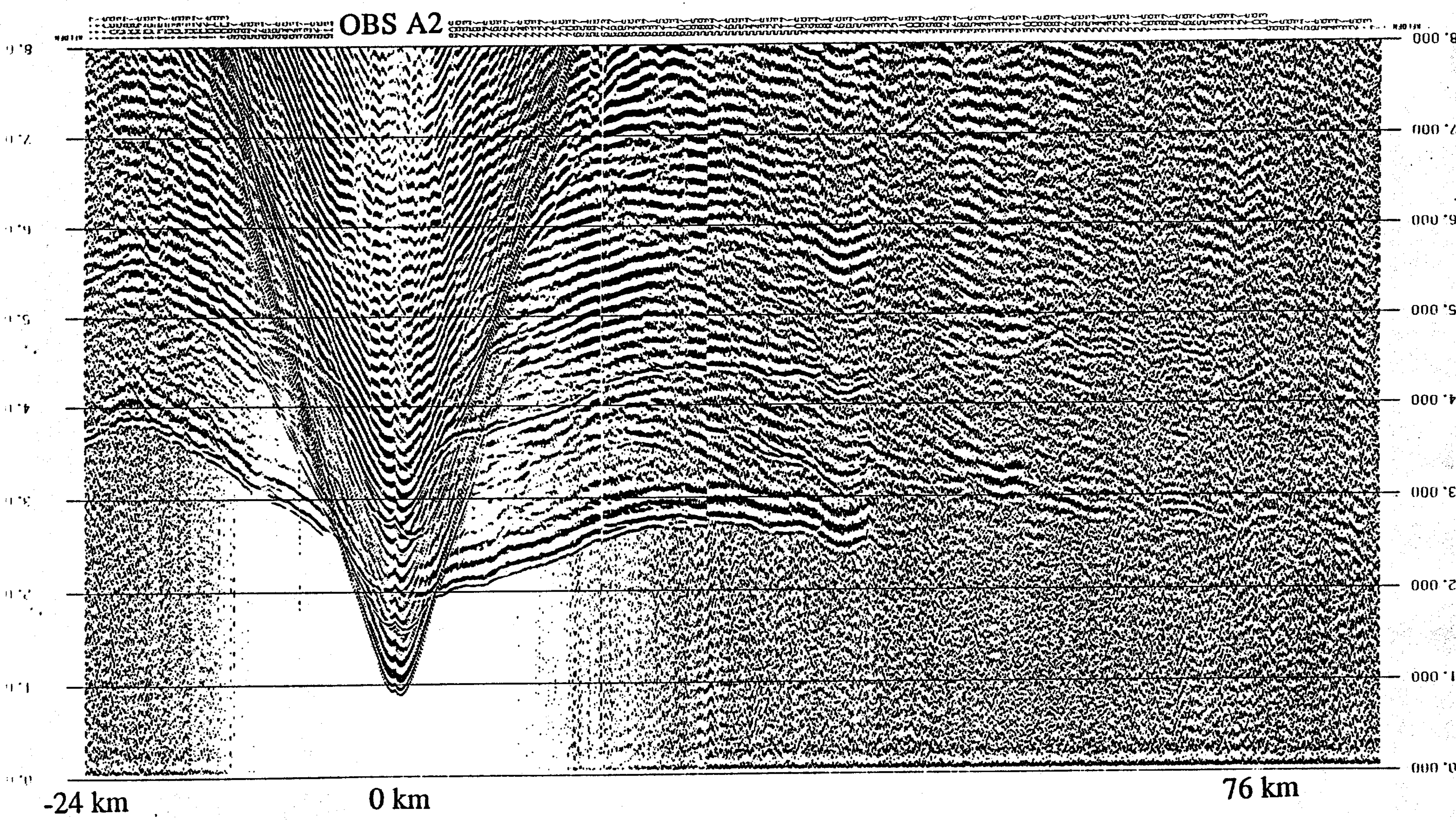
123° 20' W
38° N
37° 40'
37° 20'
OBS LOCATION
CURRENT METER LOCATION
END POINTS OF MCS LINE 13
100 FATHOM
1000 FATHOM
SAN FRANCISCO
LINE 1
LINE 2
C9
A8
C4
A2
C3
A1

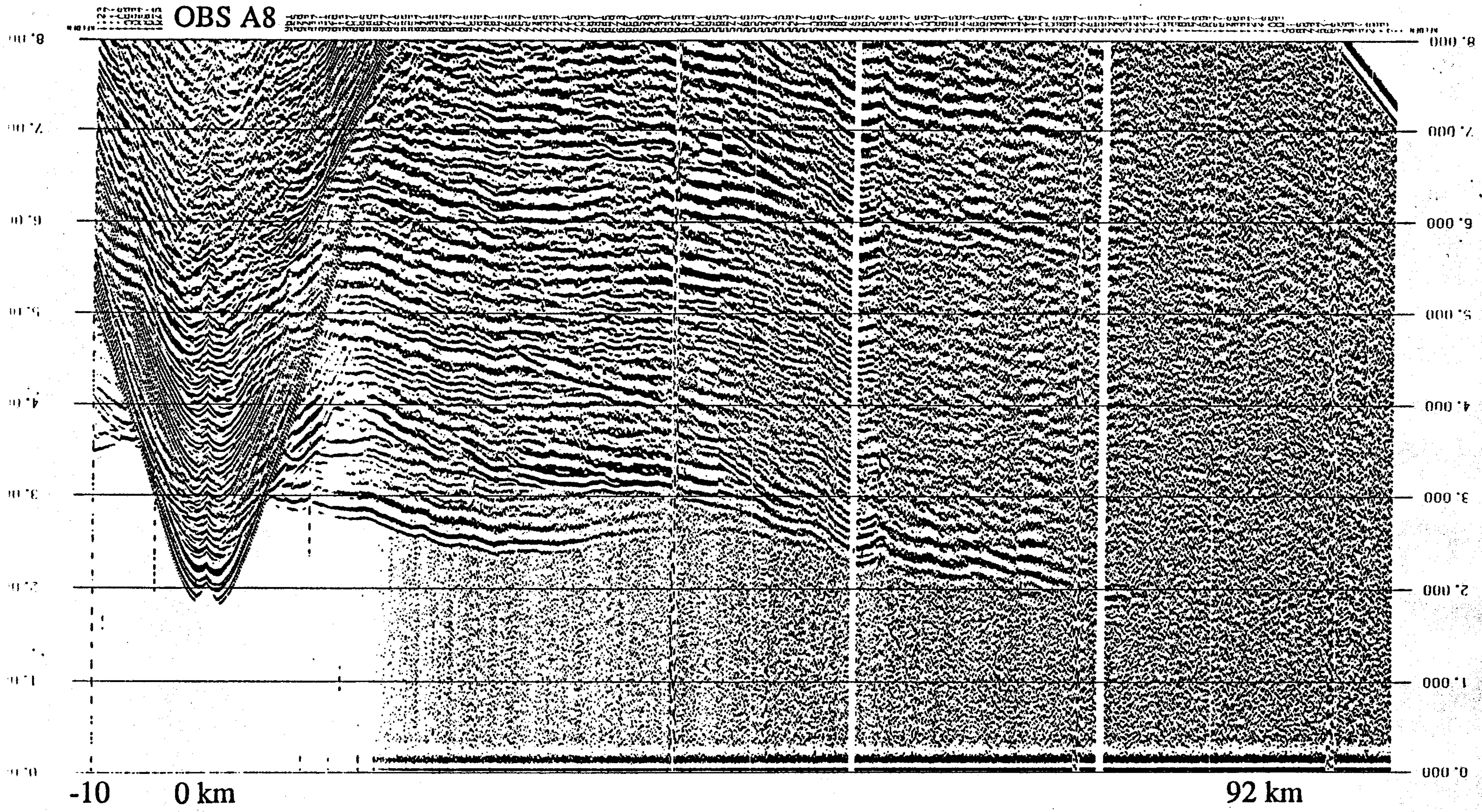


OBS C9
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-88 km
0 km
12 km


OBS C4
-70 km
32 km
0.000
1.000
2.000
3.000
4.000
5.000
6.000
8.000

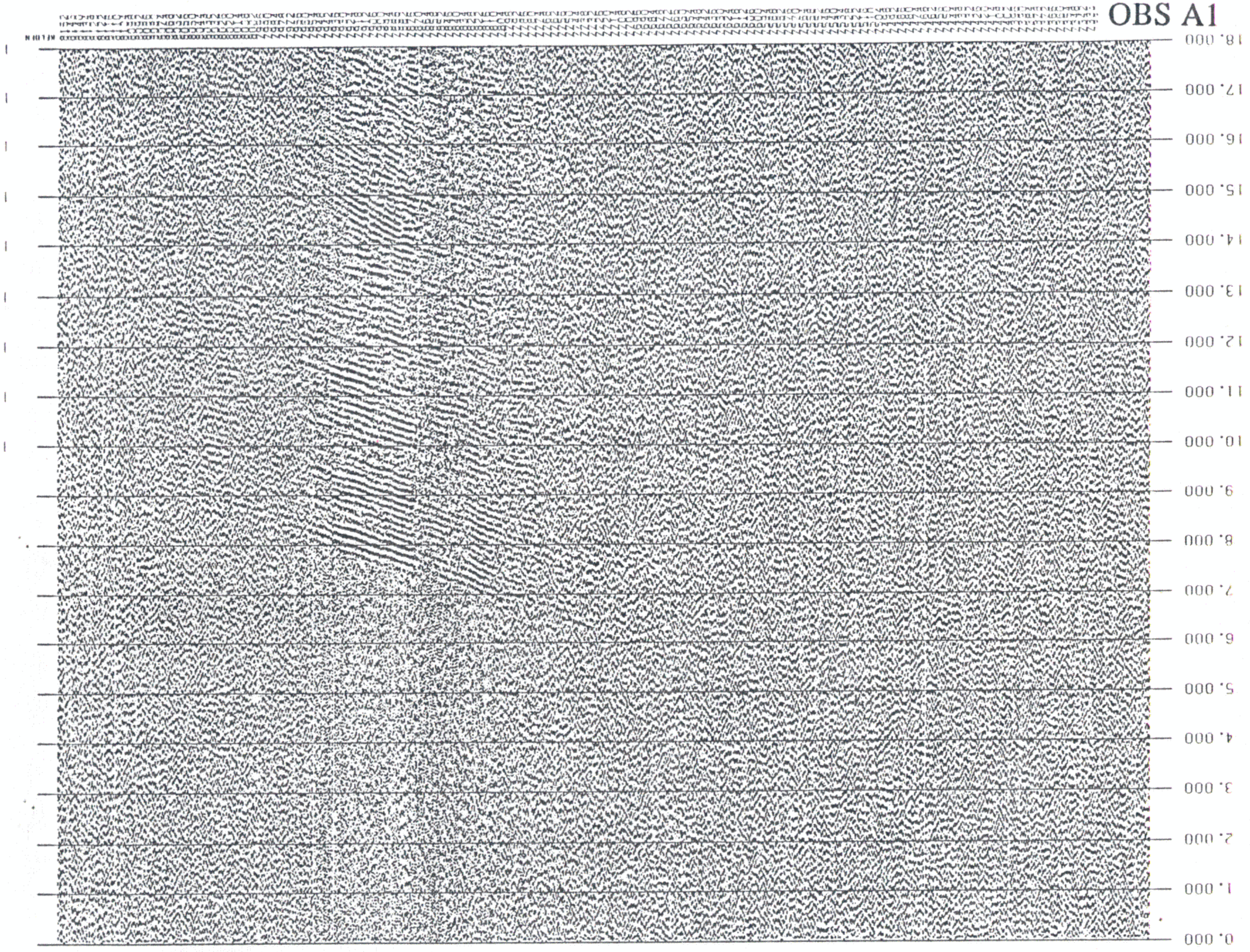

OBS A1
-40 km
0 km
63 km

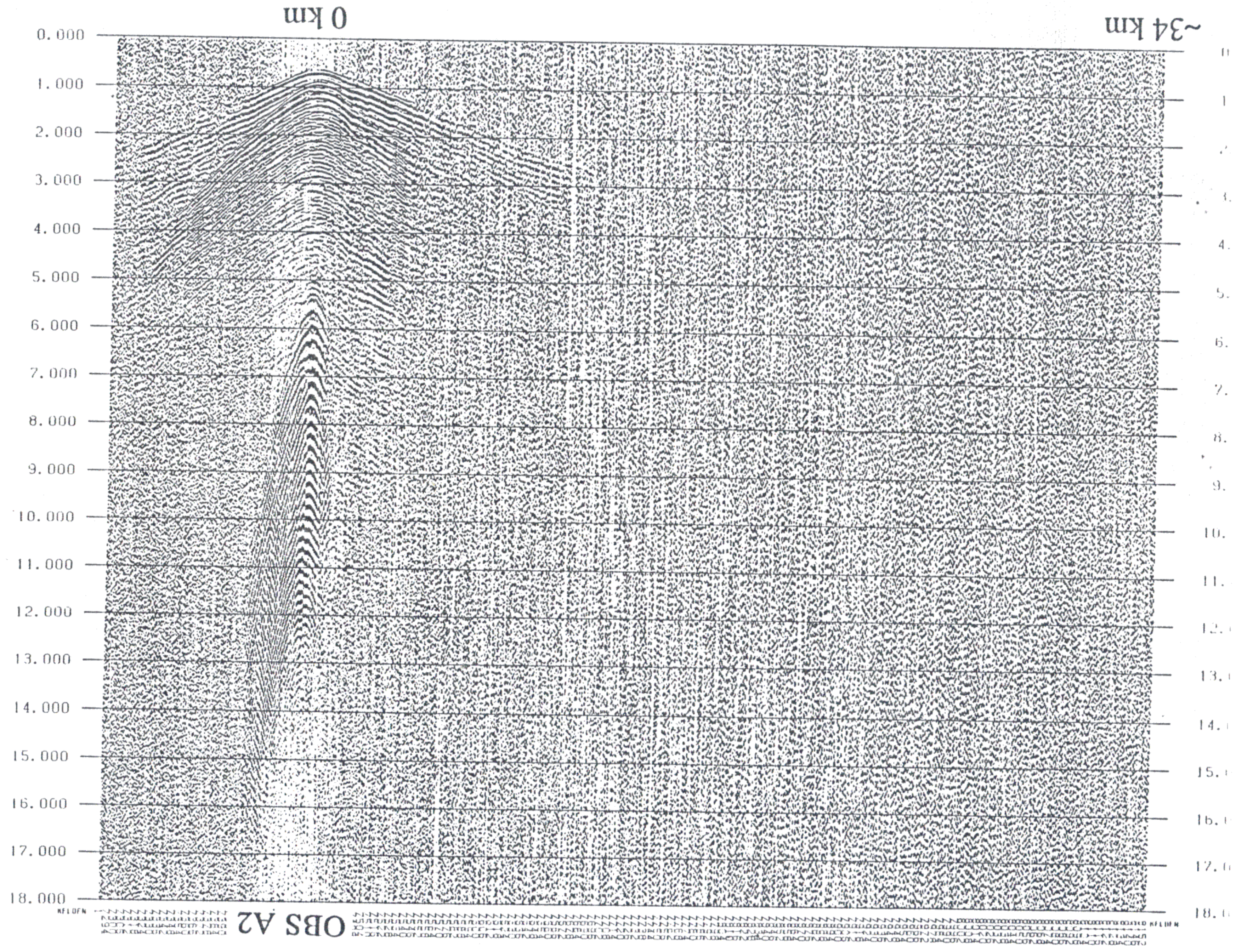

OBS A2
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-24 km
0 km
76 km



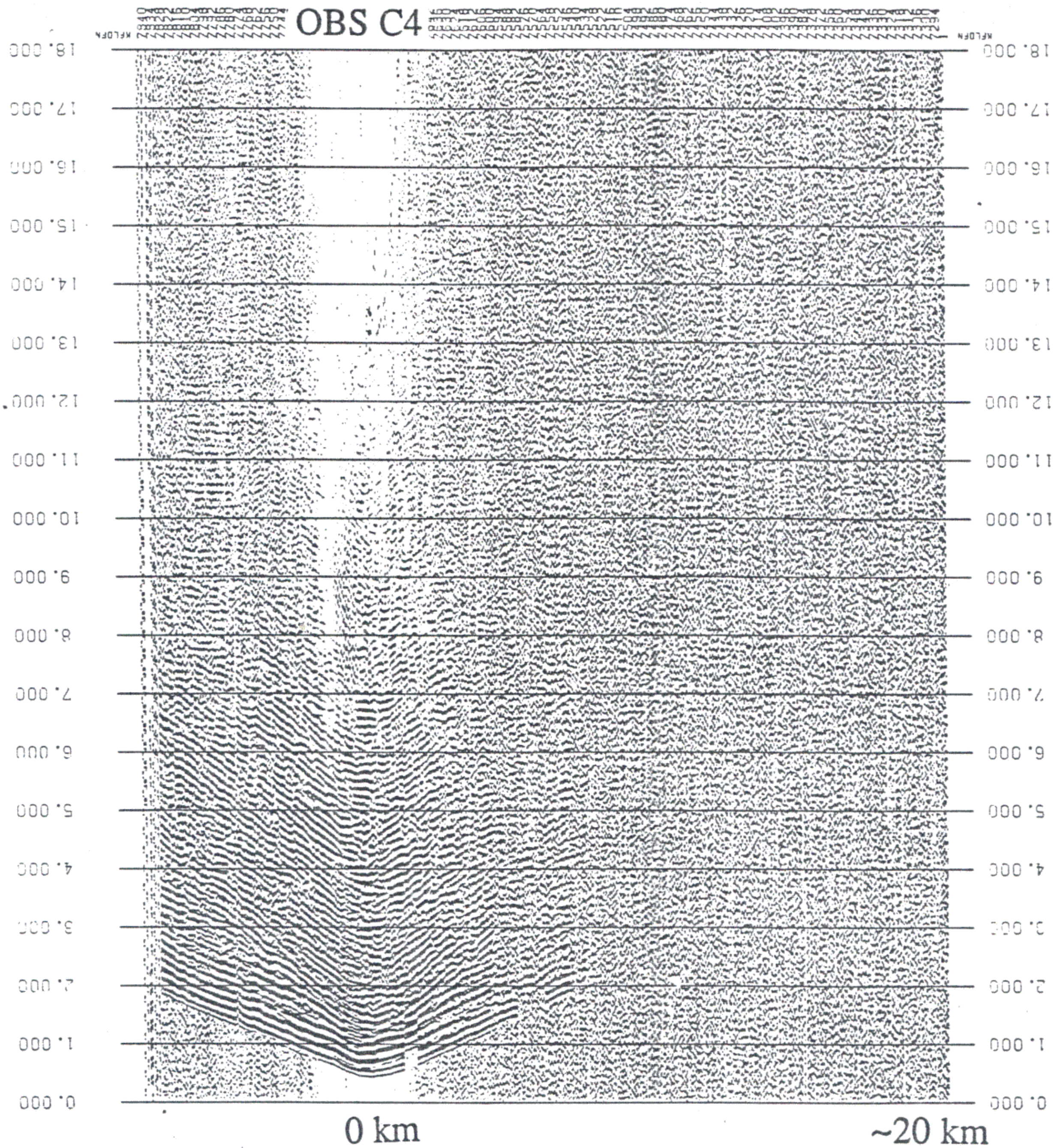
OBS A8
-10
0 km
92 km

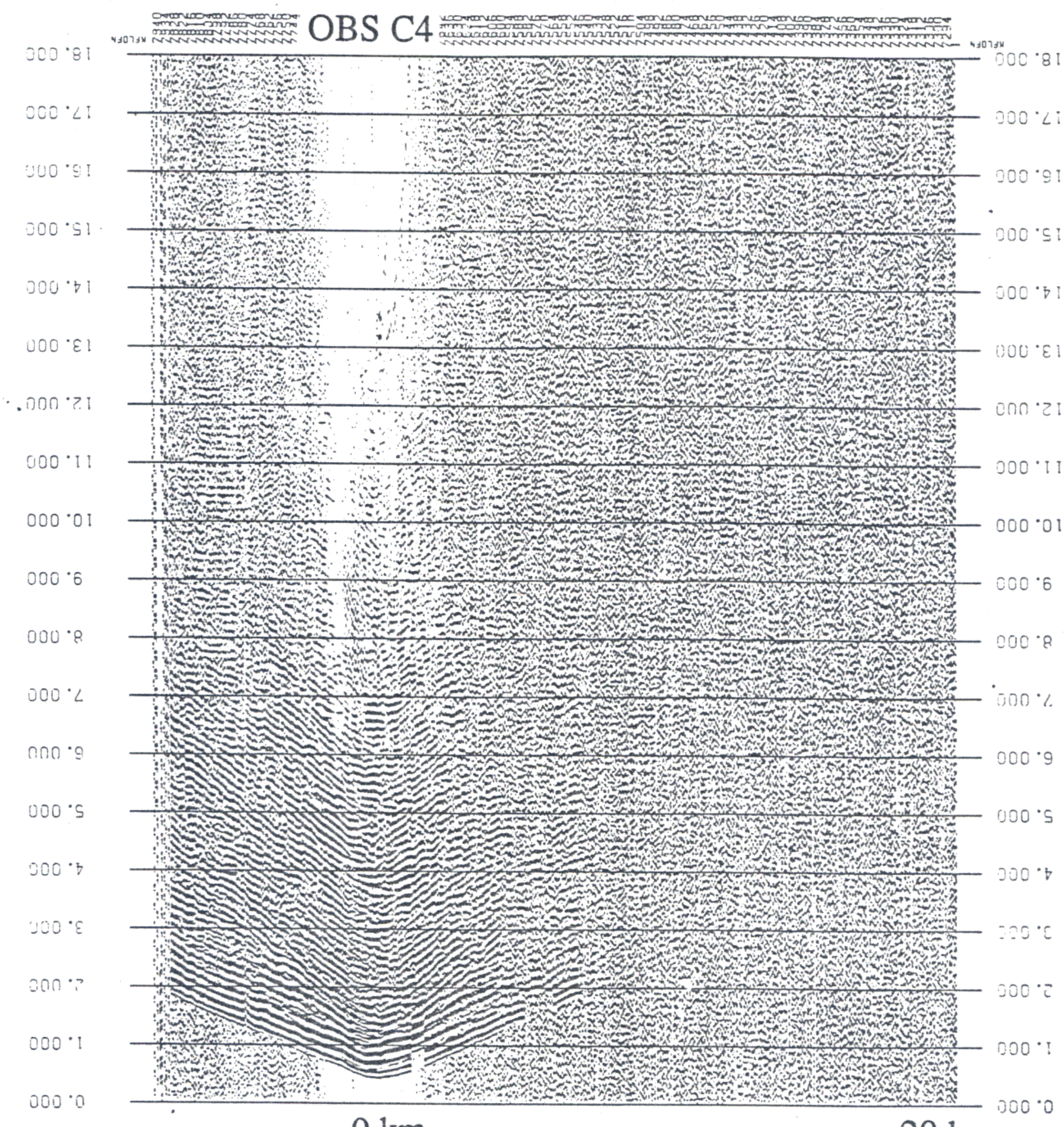
OBS A1

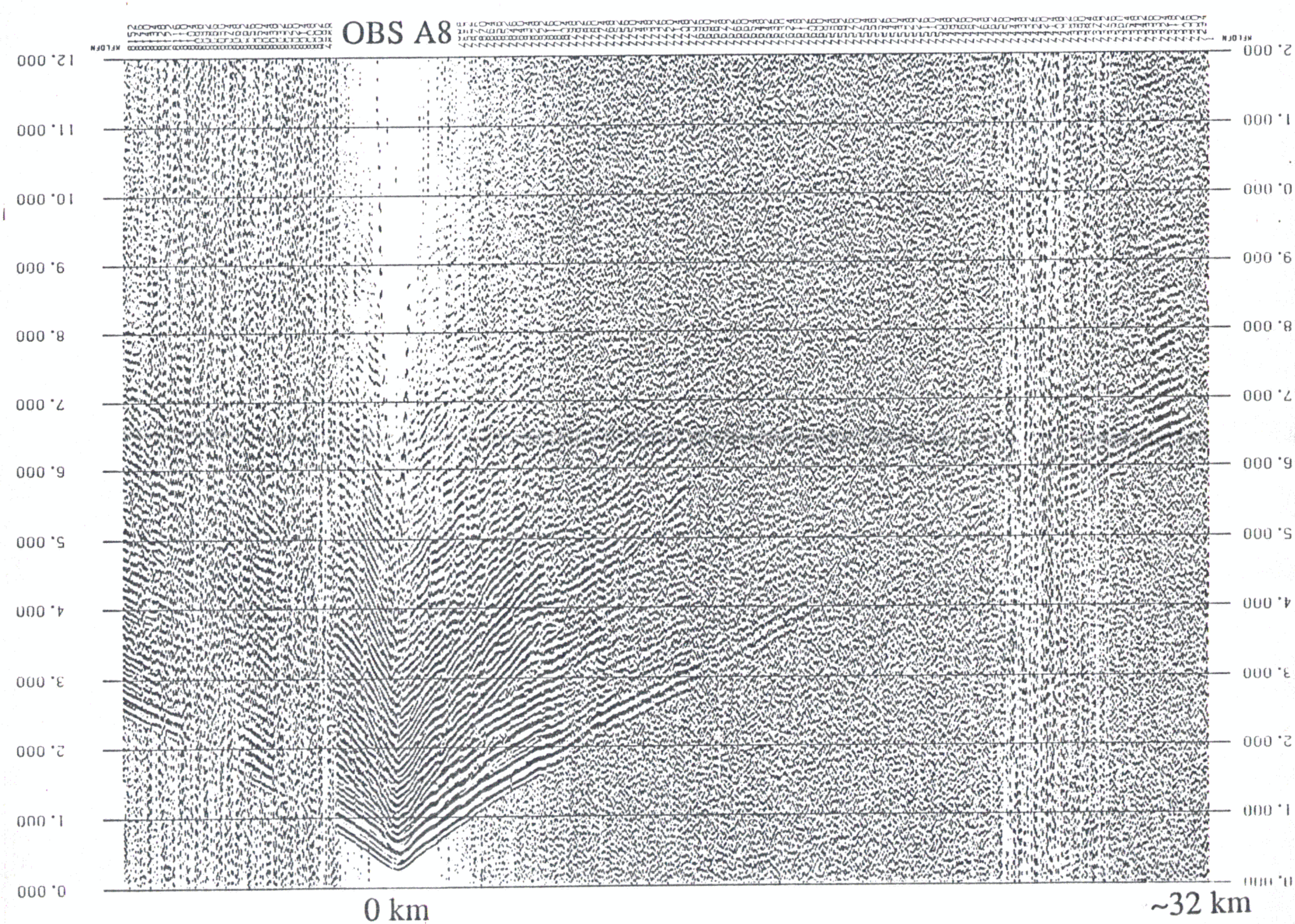

0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
11.000
12.000
13.000
14.000
15.000
16.000
17.000
18.000



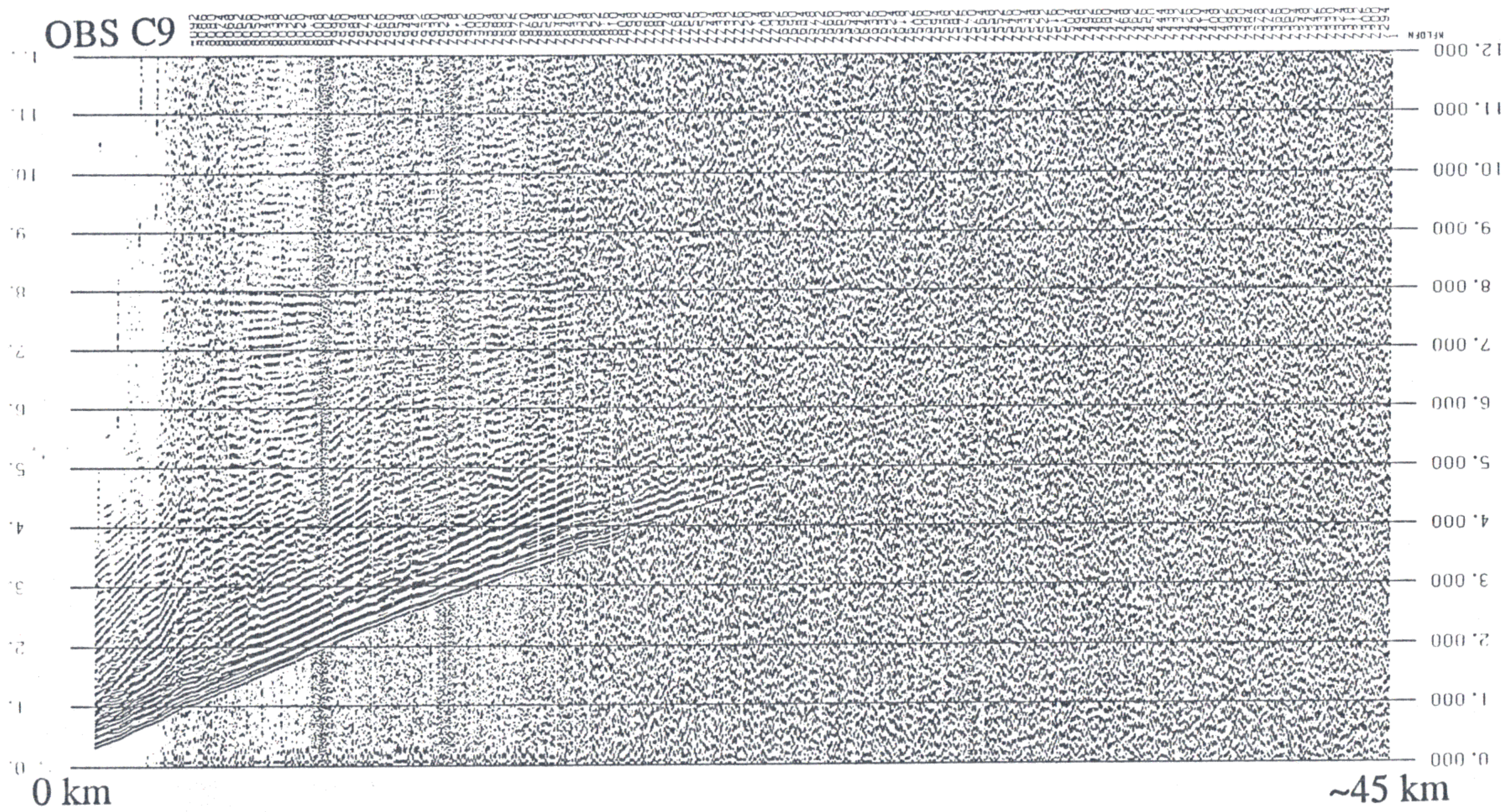
0 km
~34 km
OBS A2
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
11.000
12.000
13.000
14.000
15.000
16.000
17.000
18.000


OBS C4
0 km
~20 km


OBS C4
0 km
~20 km



OBS A8
0 km
~32 km
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
11.000
12.000


OBS C9
0 km
~45 km