

Cruise Report

Conrad 2308

Cruise objectives

The purpose of the cruise was to determine the configuration of oceanic crustal layers and the M-discontinuity in the vicinity of the volcanic load of the Hawaiian islands. The cruise utilized the multichannel seismic profiling technique to determine the "stratigraphy" of the material infilling the depressions flanking the islands and two-ship multichannel seismic data to determine the detailed crustal velocity and depth to the M-discontinuity. The seismic data, along with gravity and bathymetry measurements, will provide important new constraints on models for long-term mechanical properties of the oceanic lithosphere. The cruise was a joint project between Lamont-Doherty Geological Observatory and the Hawaii Institute of Geophysics.

The ship track's in Figs. 1 - 3 show the Common Depth Point (CDP), Constant Offset Profiles (COP), Expanding Spread Profiles (ESP) and gravity measurements obtained during the cruise.

Narrative

R/V Robert D. Conrad cruise 23 Leg 8 left the Hawaii Institute of Geophysics Marine Center at Snug Harbor, Oahu, Hawaii at 1200 hrs. August 12th, 1982. The members of the scientific party were as follows

A. B. Watts	Co-Chief Scientist
P. Buhl	Co-Chief Scientist
S. Hudson	Science Officer
U. Ten Brink	Graduate Student
J. Glasser	Graduate Student
C. Mountain	Technician
E. Vera	Graduate Student
R. Crimmins	Marine Technician
E. Hominoff	Marine Technician
W. Robinson	Marine Technician
J. Stennett	Marine Technician

In addition, the following people were also aboard the vessel:

J. Mutter	Scientist
D. Medlicott	Marine Technician
I. Bitte	Marine Technician
A. Montes	Engineer, Seismic Engineering Co., Dallas, Texas

From Snug Harbor, Conrad proceeded to a location a few miles Southwest of Barber's Point, Oahu and began deploying the Lamont multichannel seismic streamer. Deployment of the streamer included "ballasting" the eel (using flotation "birds" and lead weights), calibrating the water depth transducers, and deploying the tail buoy and took a total of 2 1/2 days. Following deployment of the streamer at 2100 hrs on August 14th a work boat from Honolulu transferred Mutter to the Hawaii Institute of Geophysics vessel R.V Kana Keoki

and Bitte and Montes to Oahu. At 2200 hrs. on August 14th the Conrad and Kana Keoki began the first of the two-ship multichannel seismic experiments.

The scientific equipment on the two vessels comprised of the following:

	<u>CONRAD</u>	<u>KANA KEOKI</u>
Streamer	Seismic Engineering 3.5 km long streamer	
Source	2 x 1000 cu. in. and 1 x 466 cu. in. airgun source	1 x 1000 cu. in. and 2 x 466 cu. in. airgun source 210 Tovex charges @ 60 lb/charge
Navigation	Loran C Magnavox satellite system	Loran C
Gravimeter	Graf-Askania Aeroflex Platform	LaCoste-Romberg Sperry
Seismic Recording System	Texas Instruments DFS IV	

During the two-ship work range between the two vessels was obtained using a Miniranger/Raydist system rented from Hastings-Teledyne.

The scientific survey began at 2200 hrs on August 14th when Conrad and Kana Keoki began a Constant Offset Profile (COP) from Oahu to the flexural bulge, located south of the Hawaiian islands. During the COP the lead ship, the Kana Keoki, maintained a distance of 1 array length (3.6 km) from the Conrad. Following a pre-arranged shooting schedule, the Kana Keoki fired its airgun array approximately on the $\frac{1}{2}$ minute while Conrad fired its airgun array approximately on the 1 minute. The actual shot times were recorded on each vessel. Data from each channel in the Lamont streamer (a total of 48 channels were available) were recorded on the DFS IV with a 4 msec sampling rate and a 20 sec long recording window (Fig. 4).

On arrival at a locality a few km south of the flexural bulge Conrad maneuvered to begin the first Expanding Spread Profile (ESP1) with the Kana Keoki. During this experiment the two ships separated in opposite directions from a "mid-point" on the COP to an "end point" about 60 km from the mid-point. At the end point the two ships turned and approached each other. During the "out going" portion of the ESP the Kana Keoki fired its airgun array and Conrad received (eg. Figs. 5-7). During the "ingoing" portion, Kana Keoki fired its explosive charges on a 10 minute schedule (eg. Fig. 8) while Conrad fired its airgun array on a 1 minute interval (with each 10th minute shot missing). On completion of the explosive charges ($2\frac{1}{2}$ hours), the Kana Keoki re-joined the Conrad in a COP mode (offset of 3.6 km) and continued to the end point previously occupied by Kana Keoki. At the end point, the vessels maneuvered to the ESP mid-point and re-joined in a COP mode (offset of 16 km).

The remaining part of the two-ship experiments south of the islands continued in this alternating ESP/COP mode. Following completion of ESP 5, between Molokoi and Oahu, the experiments were repeated north of the islands.

By August 30th we had carried out a total of 11 ESP's and approximately 1170 km of COP data. The breakdown of the ESP's was as follows:

	<u>No. of ESP's</u>
Hawaiian ridge	2
Flexural moat	5
Flexural node	2
Flexural arch	2
Total	<u>11</u>

The Kana Keoki returned to Oahu on August 31st after successfully completing all the planned two-ship work. The Conrad then began a Common Depth Point (CDP) loop of the previously surveyed region by connecting each ESP end point. During this experiment the Conrad fired its airgun array on a 20 sec. schedule. All data was recorded on the DFS IV using a sampling rate of 4 msec and a recording window of 12 secs. Conrad successfully completed the CDP loop on September 6th.

The Lamont streamer was pulled in at 0600 hrs. on Sept. 6th and secured by 1130 hrs. The tail buoy, which had only been sighted once or twice during the cruise, was still upright, although the strobe light was not operative. Once the streamer was on board and the vessel hove to a water gun and hydrophone were deployed in order to determine the source characteristics of the gun. The data was digitally recorded for different depths of the gun. The scientific study was completed by 0130 hrs. on September 7th, following a brief gravity survey.

A. B. Watts

Enclosures:

1. Conrad Schedule
2. COP Times
3. ESP Parameters
4. Sonobuoy Data
5. CDP Parameters
6. Single Channel Monitor Profiles

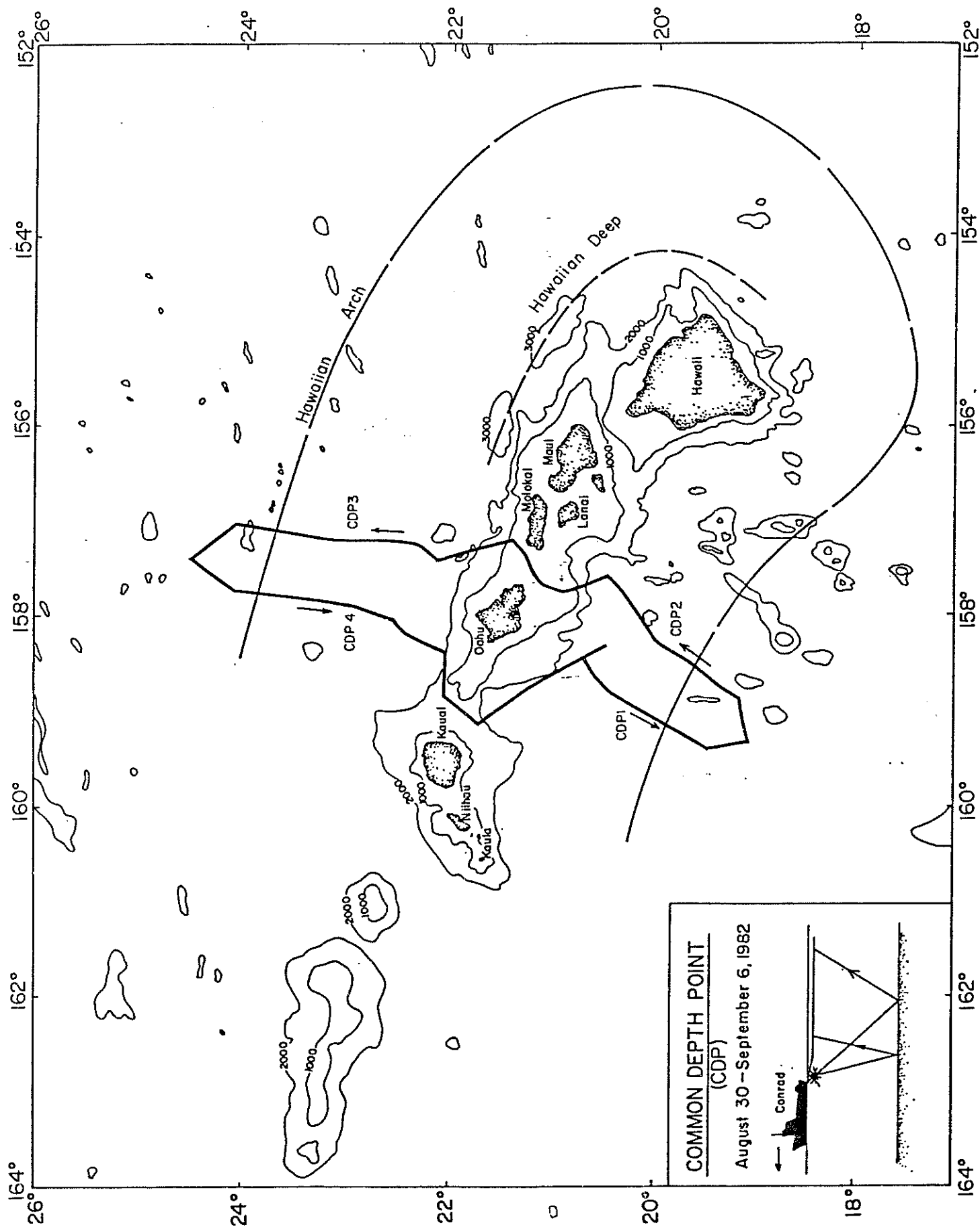
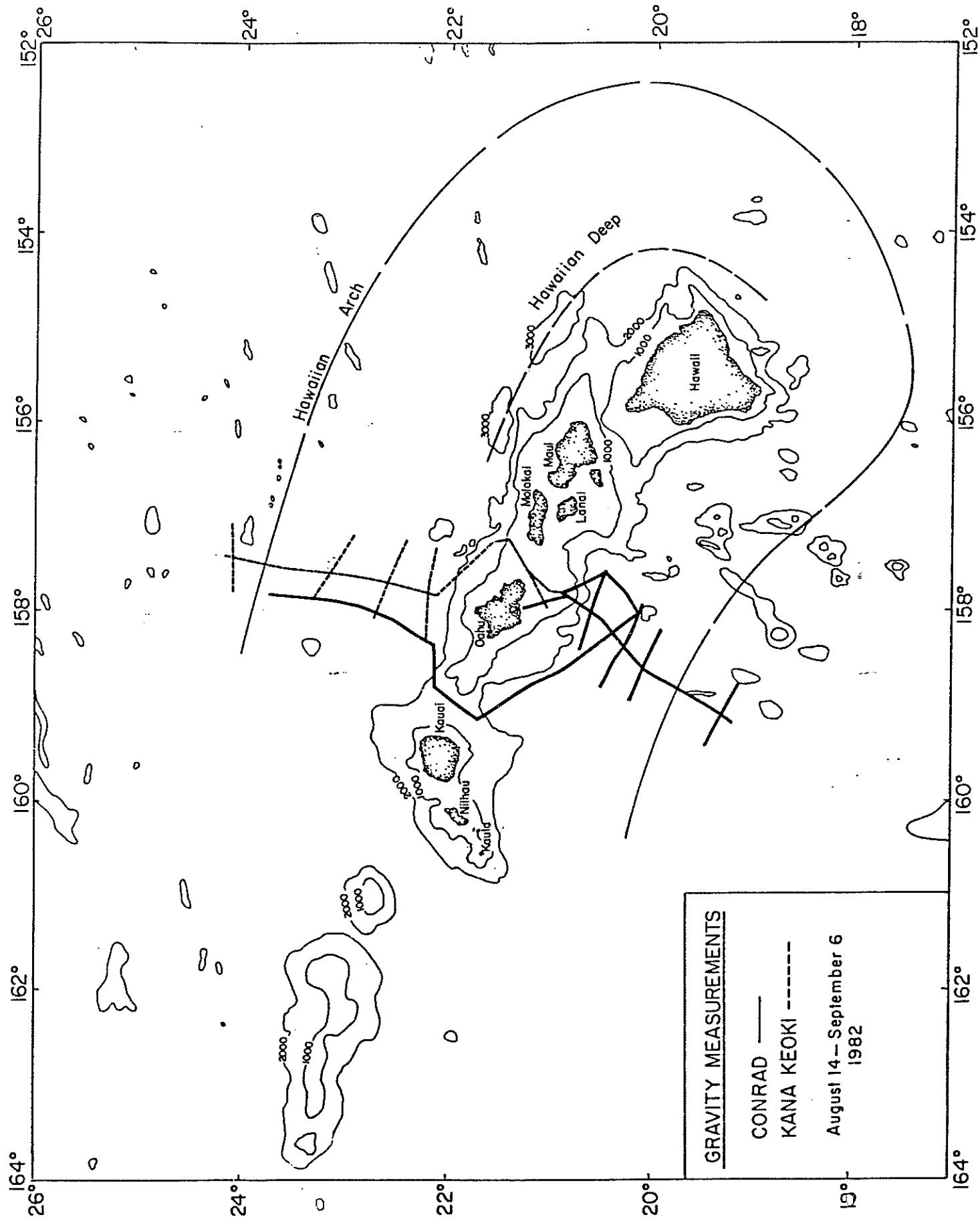


Figure 2



0000	22	23	24	25	26	27	28	29	30
0100	ESP 5 TOVEX				TO MIDPOINT	ESP 8 TOVEX	TURN	COP J	ESP 11 AIRGUN
0200			ESP 6 AIRGUN	COP G		TURN			
0300							ESP 9 AIRGUN	ESP 10 AIRGUN	
0400	TURN		TURN				TURN	TURN	
0500			ESP 6 TOVEX		COP H	ESP 8 COP			TRANSIT TO PORT
0600	ESP 5 COP		TURN	TURN		TRANSIT TO MIDPOINT	ESP 9 TOVEX	ESP 10 TOVEX	
0700							TURN		
0800									
0900									
1000									
1100									
1200	TRANSIT IN COP MODE TO MIDPOINT OF ESP 9	COP F	ESP 6 COP	ESP 7 AIRGUN	REPAIR BROKEN RETRIEVAL LINE				
1300				TURN					
1400									
1500									
1600			TRANSIT TO MIDPOINT	ESP 7 TOVEX			ESP 9 COP	TRANSIT TO MIDPOINT	
1700				TURN					
1800									
1900									
2000									
2100									
2200	COP F		COP G	ESP 7 COP	ESP 8 AIRGUN	COP I		COP K	
2300					TURN		COP J		
2400				TRANSIT					

COP

COP #	Begin	End	Ship Separation (km)	A/G Off
A	0830Z 15 AUG	2114Z 16 AUG	3.6	
B	1827Z 17 AUG	0519Z 18 AUG	16	
C	0214Z 19 AUG	0603Z 19 AUG	16	
D	0857Z 20 AUG	1346Z 20 AUG	16	LPA (1331Z)
E	1557Z 21 AUG	0220Z 22 AUG	18	
	1934Z 22 AUG	0543Z 23 AUG	3.6	ALL OFF (0149Z) PT-STB ON (0210Z) ALL ON (0327Z)
F	0543Z 23 AUG	0845Z 24 AUG	3.6	
G	0613Z 25 AUG	1825Z 25 AUG	16	
H	1345Z 26 AUG	2130Z 26 AUG	16	
I	0215Z 28 AUG	0910Z 28 AUG	16	
J	0530Z 29 AUG	1300Z 29 AUG	3.6	
K	0234Z 30 AUG	0936Z 30 AUG	3.6	

LPA = Low Pressure Alarm (Pressure \leq 1200 PSI)

ESP PARAMETERS

ESP #	Midpoint		Passing Distance (N.M.)	Times	
	Latitude	Longitude		Begin	End
1	19°18.76'N	159°06.54'W	0.60	2122Z 16 AUG - 1852Z	17 AUG
2	20°03.17'N	159°38.12'W	0.09	0706Z 18 AUG - 0130Z	19 AUG
3	20°17.83'N	158°26.04'W	0.50	0552Z 19 AUG - 0820Z	20 AUG
4	20°35.98'N	158°00.32'W		1354Z 20 AUG - 1556Z	21 AUG
5	21°11.5'N	157°37.5'W		0220Z 22 AUG - 0543Z	23 AUG
6	24°05.79'N	157°26.97'W	0.25	0845Z 24 AUG - 0613Z	25 AUG
7	23°06.59'N	157°35.56'W	0.44	1809Z 25 AUG - 1331Z	26 AUG
8	22°34.60'N	157°41.08'W	0.25	2130Z 26 AUG - 0215Z	28 AUG
9	22°12.41'W	157°53.55'W	0.55	0910Z 28 AUG - 0555Z	29 AUG
10	21°44.17'W	157°11.21'W	0.25	0556Z 29 AUG - 0234Z	30 AUG
11	21°13.94'N	158°52.63'W	0.33	0736Z 30 AUG - 1445Z	30 AUG

HAWAII FLEXURE CRUISE SONOBUOY DATA

SB #	GMT DATE	GMT TIME IN	GMT TIME OFF	LAT.	LONG.	SEA STATE	DEPTH (METERS)	BATHY RANGE (METERS)	A/G ON	COURSE CHANGES	SPEED CHANGES	GYRO	QUALITY EXCELLENT GOOD FAIR POOR	REFRAC. PERCENT
1	8/15/82	1900	1955	20° 27.06'N	158° 11.55'W	3	4550	45 RISING	2 466 1 1000			238°	F	
2	8/15	2005	2250	24.19	16.33	"	4500	60 "	"	2125Z 221°		228	F	
3	8/15-16	2255:08	0252:40	16.70	25.82	"	4440	65 "	"	0217Z 200°		221	P	
4	8/16	0300	0600	05.6	37.79	"	4380	0 FLAT	"			206	E	✓
5	"	0730	0850	19° 52.97'	45.56	"	4350	15 GENTLE ARCH	"			207	F	
6	"	0907	1430	48.45	48.59	"	4400	390 SEAHUC	"	1041Z 190°		198	E	✓
7	"	1500	1905	34.7	57.68	"	4460	0 FLAT	"	1600Z 210°	1715Z 1/5 5.5 KTS	204	E	✓
8	8/17	0720	0847	22.07	159° 08.78'	"	4520	40 BUMPY	"	0744Z 330°		318	F	✓
9	"	0855	1200	27.19	13.63	"	4470	5 FLAT	"	1140Z 157°		299	G	✓
10	"	2000	2315	25.05	01.92	"	4390	930 SEAHUC	"	2032Z 034°		036	E	✓
11	8/18	0050	0157	47.59	158° 52.23'	1-2	4390	90 RISING	"			056	P	
12	"	0200	0259:07	53.26	45.08	"	4300	60 DROPPING	"			034	F	✓
13	"	0300	0521	57.83	41.56	"	4360	5 FLAT	"	0515Z 225°		032	G	✓
14	"	1755	1955	20° 01.30'	27.94	"	4340	30 DROPPING	"			123	F	
15	8/19	0250	0558	10.13	29.14	2	4380	100 "	"		0503Z 1/5 6.0 KTS	038	E	
16	"	0400	0619	16.41	23.93	"	4425	65 "	"	0600Z 214°		038	E	✓
17	8/20	0905	1630	23.02	14.68	1	4495	250 "	1 466 1 1000	1405Z 1514Z 110°	1405Z 1/5 9.0 KTS	051	E	
18	8/21	0230	0257	33.21	157° 59.05'	"	4730	15 "	2 466 1 1000			113	G	
19	"	0302	0736	32.33	57.04	"	4715	300 SEAHUC	"			113	E	
20	"	1945	2241	47	48	2	535	60 RISING	"	2218Z 038°		003- 039	F	✓
21	"	2250	2348	21° 02.03'	46.69	"	510	50 DROPPING	"			037	F	✓
22	8/23	0846	1100	22° 16.26'	46.57	3	4910	85 RISING	"			021	F	

HAWAII FLEXURE CRUISE SONOBUOY DATA

SB #	GMT DATE	GMT TIME IN	GMT TIME OFF	LAT.	LONG.	SEA STATE	DEPTH (METERS)	BATHY RANGE (METERS)	A/G ON	COURSE CHANGES	SPEED CHANGES	GYRO	QUALITY EXCELLENT GOOD FAIR POOR	REFRAC. PRESENT
23	8/23	1110	1514	22° 29.43' N	157° 43.72' W	3	4820	225 RISING	2 466 1 100	12312 013°		020°	G	✓
24	"	1515	1915	49.90	39.11	"	4590	145 "	"	1522E 025° 1849E 011°		019	G	✓
25	"	1925	2212	23° 08.83'	38.66	3-4	4440	45 "	"			020	G	✓
26	8/23-24	2220	0109	20.72	33.14	3	4410	5 "	"			016	E	✓
27	8/24	0115	0305	33.68	31.35	"	4380	365 SEAMUT.	"			017	G	✓
28	"	0310	0421	43.03	30.40	"	4320	0 FLAT	"			015	P	
29	"	0425	0737:20	48.90	29.75	4	4300	535 SEAMUT.	"			012	E	✓
30	"	2010	2019:30	24° 05.28'	27.20	"	4380	0 FLAT	"	0112E 256		088	P	
31	8/24-25	2025	0148	05.27	26.04	3	4385	40 "	"			086	F	✓
32	8/25	0620	0906	23° 58.74	28.04	"	4345	50 BUDDY	"			191	G	
33	"	0916	1300	44.02	33.67	"	4305	100 DRAPPING	"	1041E 170		170	F	
34	"	1310	1642	23.03	32.79	"	4400	60 "	"	1317E 175		177	G	✓
35	8/26	0505	0923	04.44	31.51	2	4450	5 FLAT	"	0803E 284	0830E R/S 3.4 KTS	116	E	✓
36	"	1515	1830	22° 52.8'	39.6	3	4570	145 DRAPPING	"			173	E	✓
37	"	1840	2139	36.82	40.80	3-4	4720	115 "	"			178	G	✓
38	8/27	1640:02	2000	29.58	27.32	3	4470	15 BUDDY	2 466 1 100			118	F	
39	"	2055:03	2121	20.71	18.91	"	4730	" "	"			288	P	
40	8/27-28	2136:03	0025	21.8	22.66	"	4720	75 DRAPPING	"			290	F	
41	8/28	0027:03	0139	27.85	36.52	"	4795	15 "	"			281	G	
42	"	0255	0430	25.98	43.23	"	4835	60 "	"			187	E	✓
43	"	0430	0730	18.98	44.57	3-4	4890	250 RISING	"			188	G	
44	8/29	0020	0400	13.08	158° 05.83	3	4800	80 "	"			273	E	✓

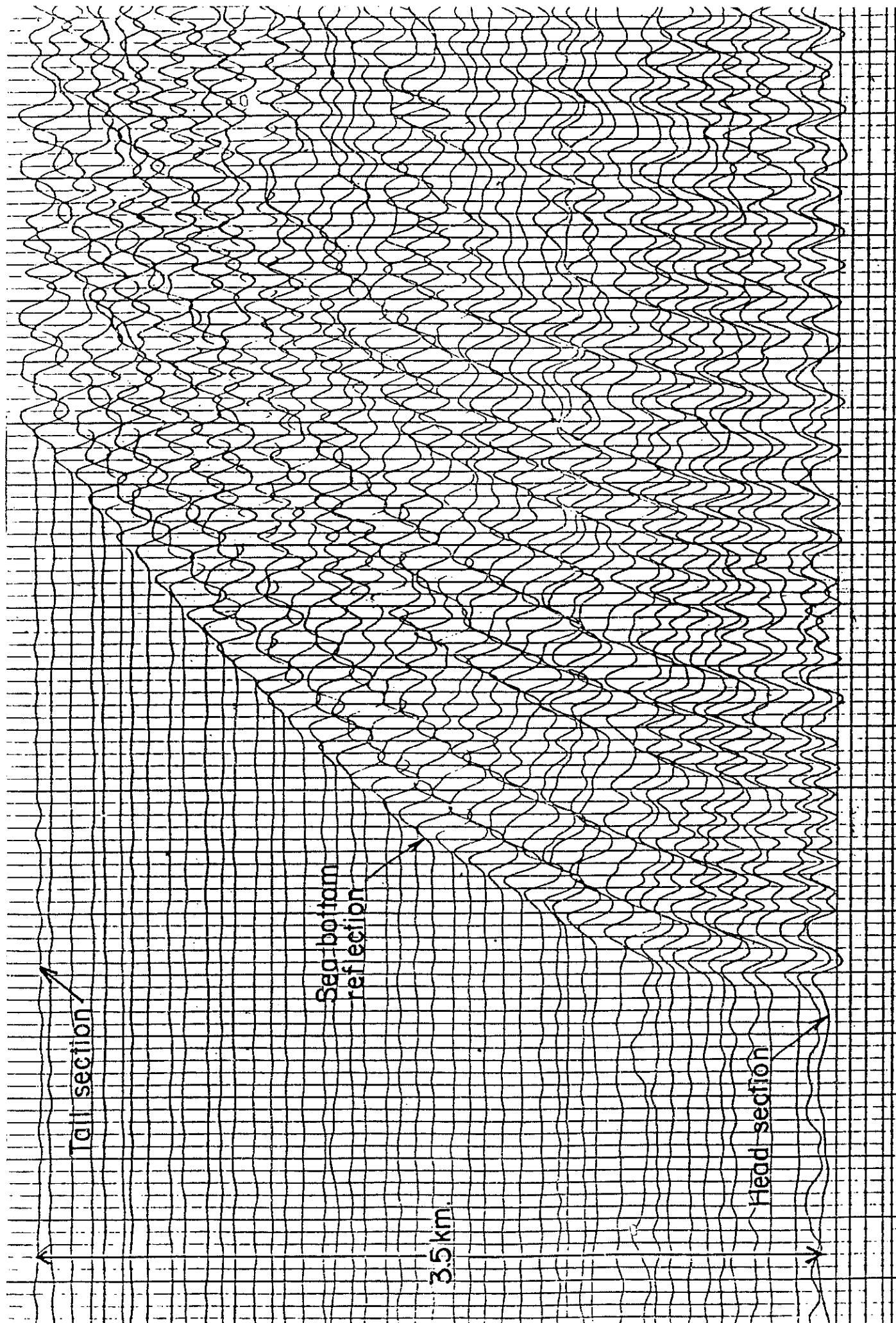


Figure 4. Monitor record showing 48 channel data received from a single CONRAD airgun shot during COP A.

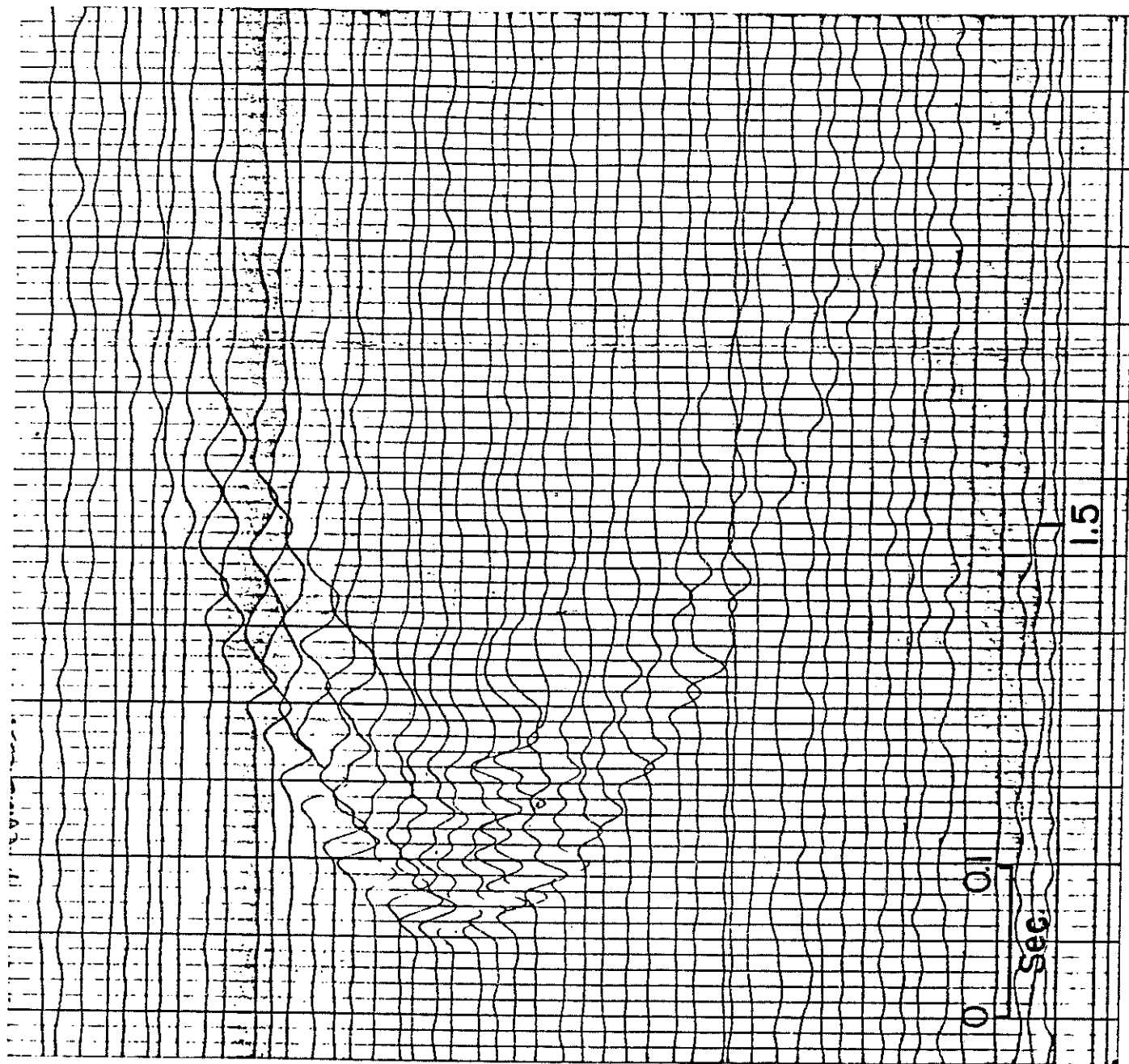


Figure 5. Monitor record showing 48 channel data received from a "broadside" airgun shot from KANA KFOKI during ESP 1

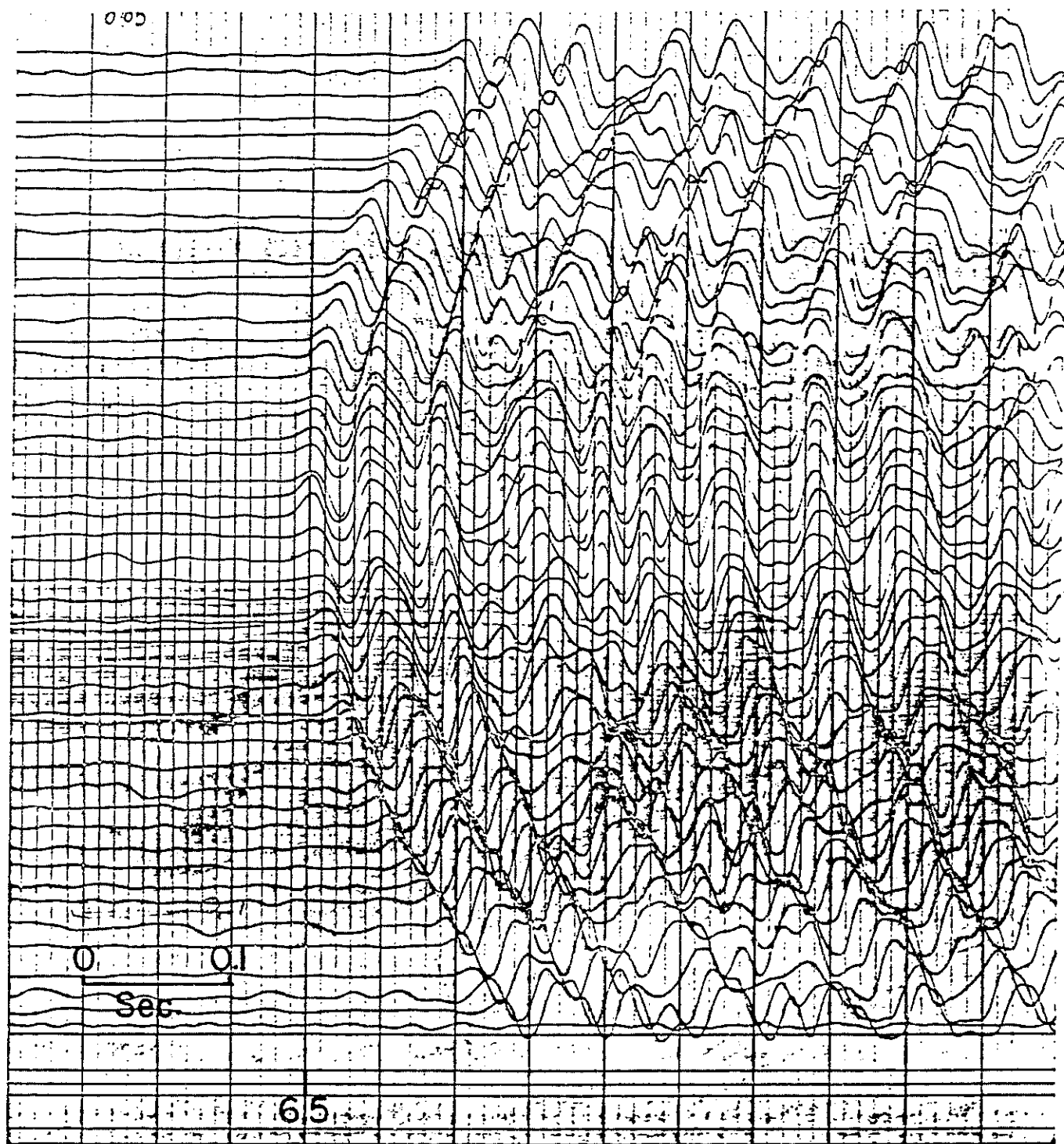
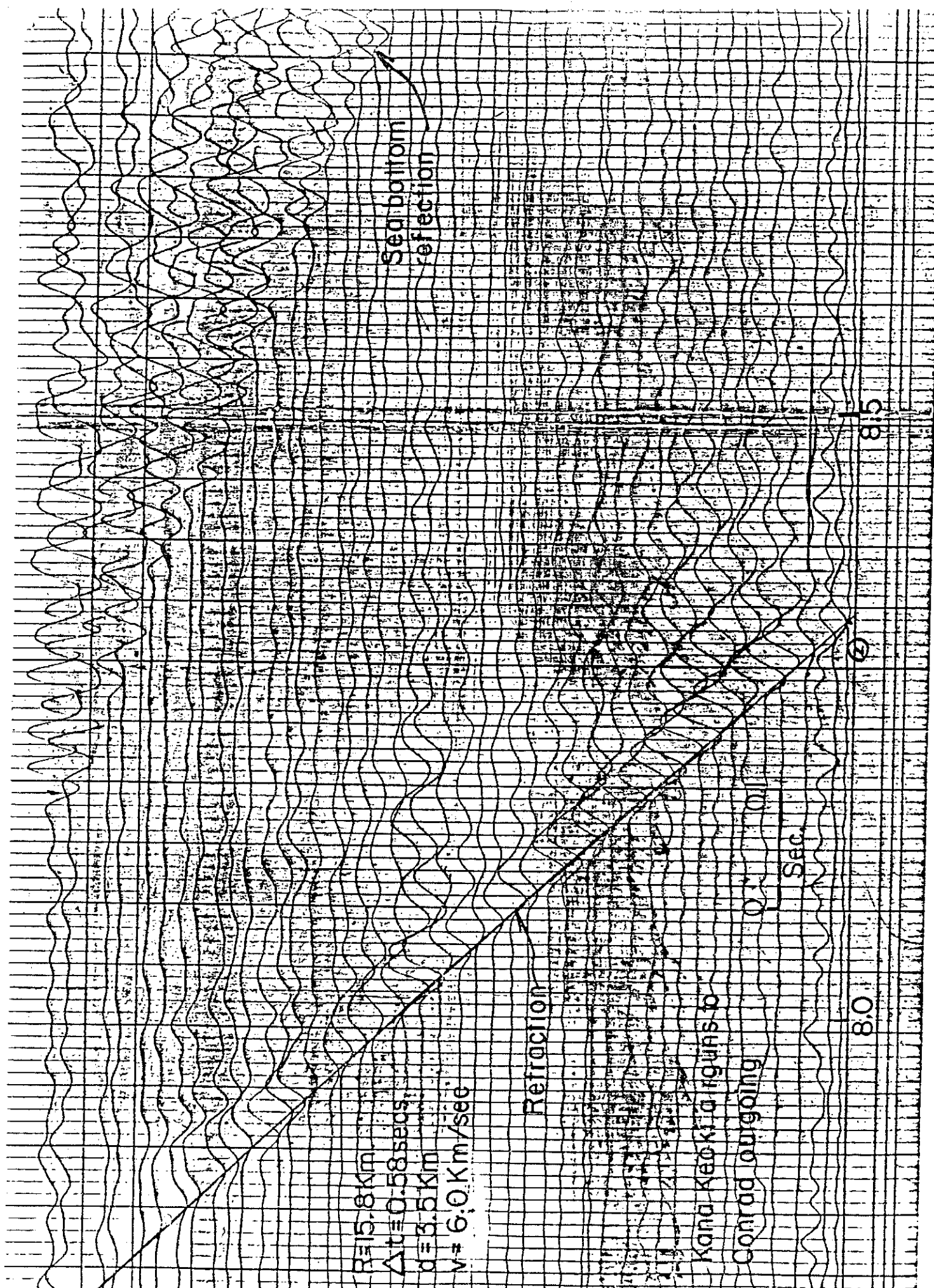


Figure 6. Monitor record showing 48 channel data received from a single airgun shot from KANA KEOKI.



R=15.8km

$\Delta t \approx 0.58 \text{ sec}$

$d = 3.5 \text{ km}$

$v = 6.0 \text{ km/sec}$

Refraction

Kana Keeki a' equals to

Conrad outgoing

Sea bottom
reflection

Sec

8.0

8.5

20

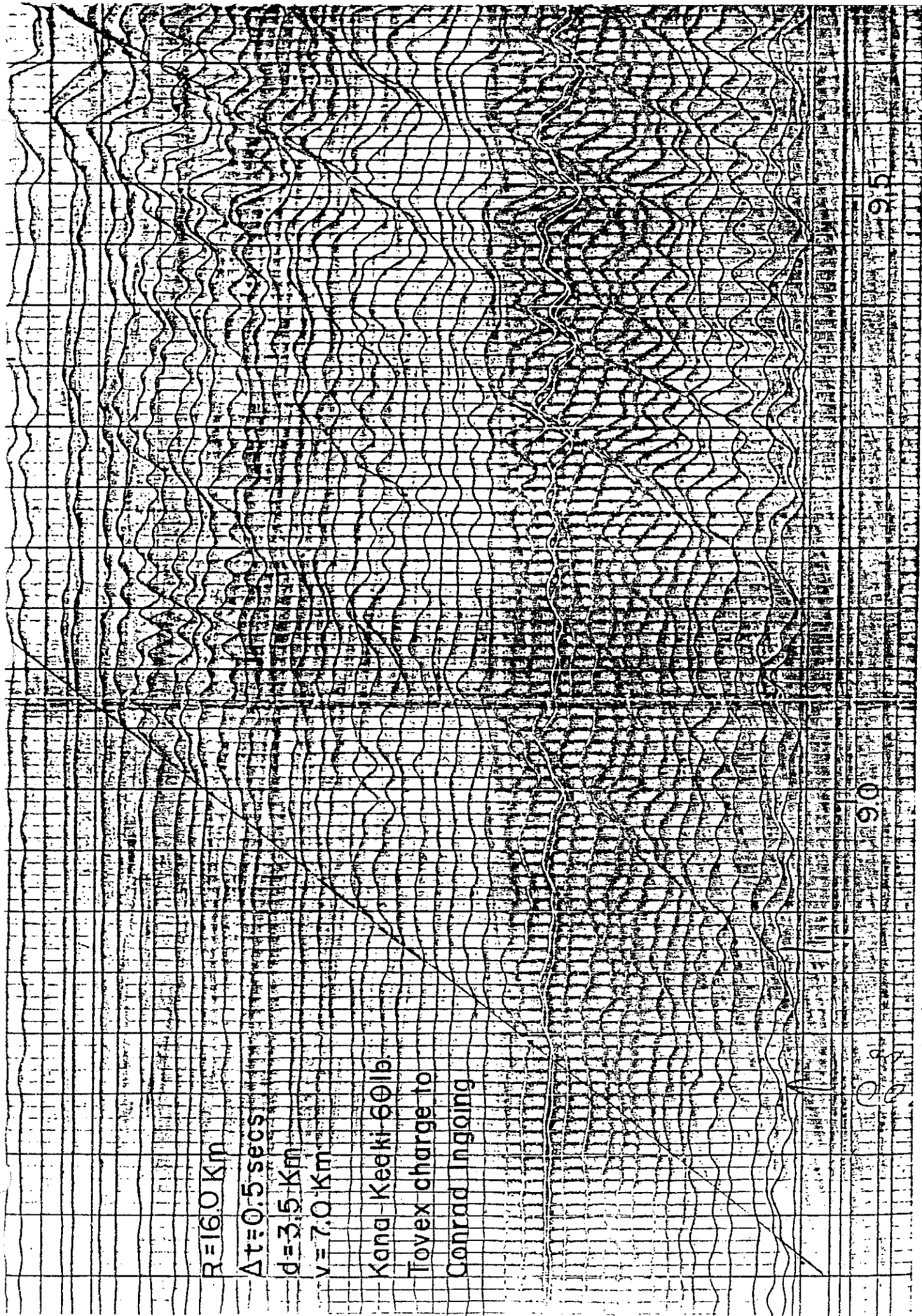
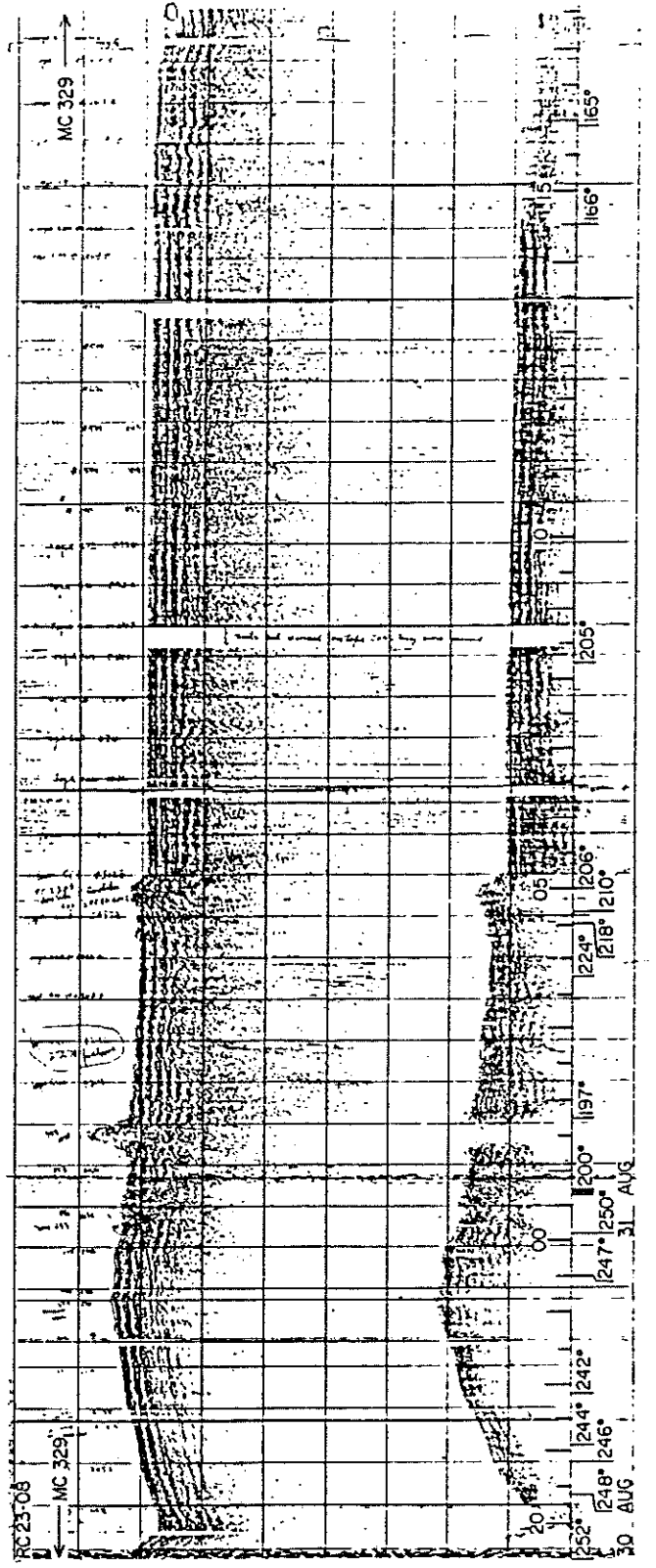


Figure 8.

CDP

1.	1930Z	30 Aug.	2200Z	31 Aug.
2.	0902Z	1 Sept.	0900	2 Sept.
3.	1930Z	2 Sept.	0845	4 Sept.
4.	1320Z	4 Sept.	1545Z	6 Sept.



SECONDS

6

8

10

12

1982

HONOLULU, HAWAII

MC 329

MC 329

20 24 28 30 31 AUG

1165°

1166°

1205°

1206°

1210°

1218°

1224°

1247°

1250°

1250°

1250°

1250°

1250°

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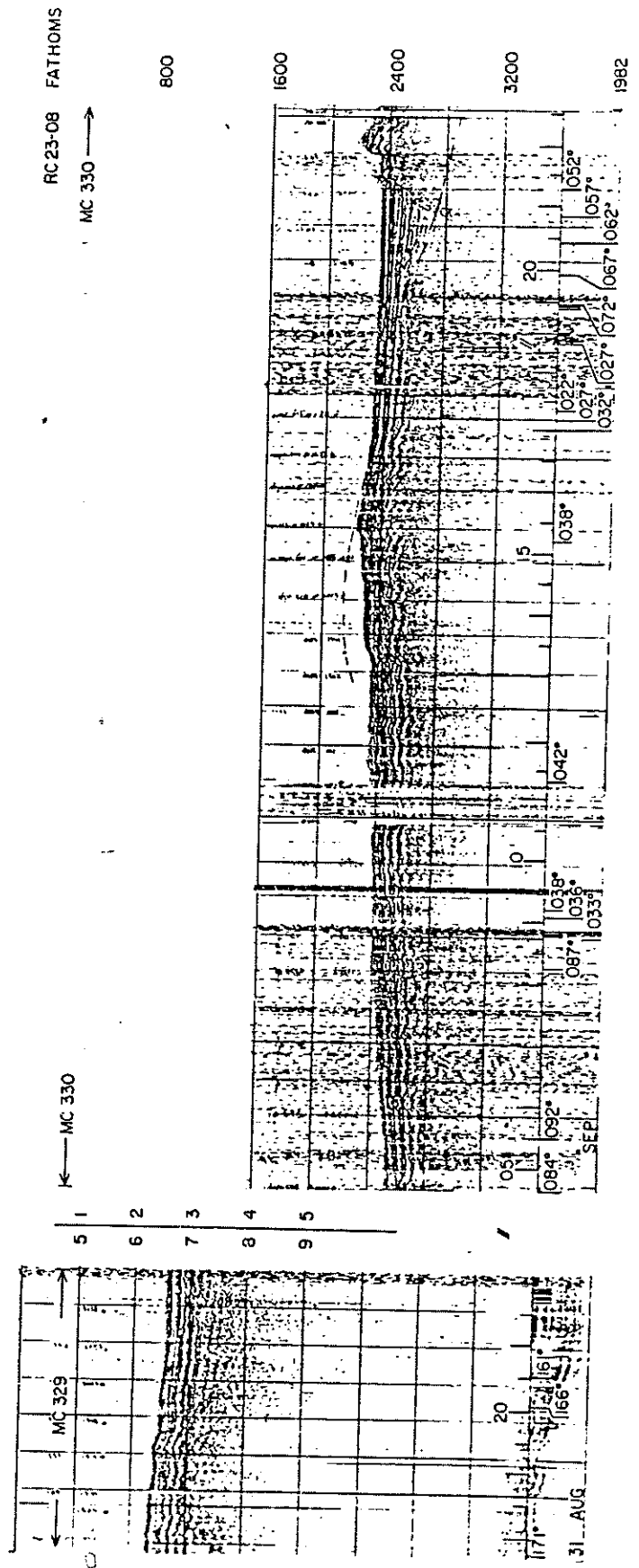
1250°

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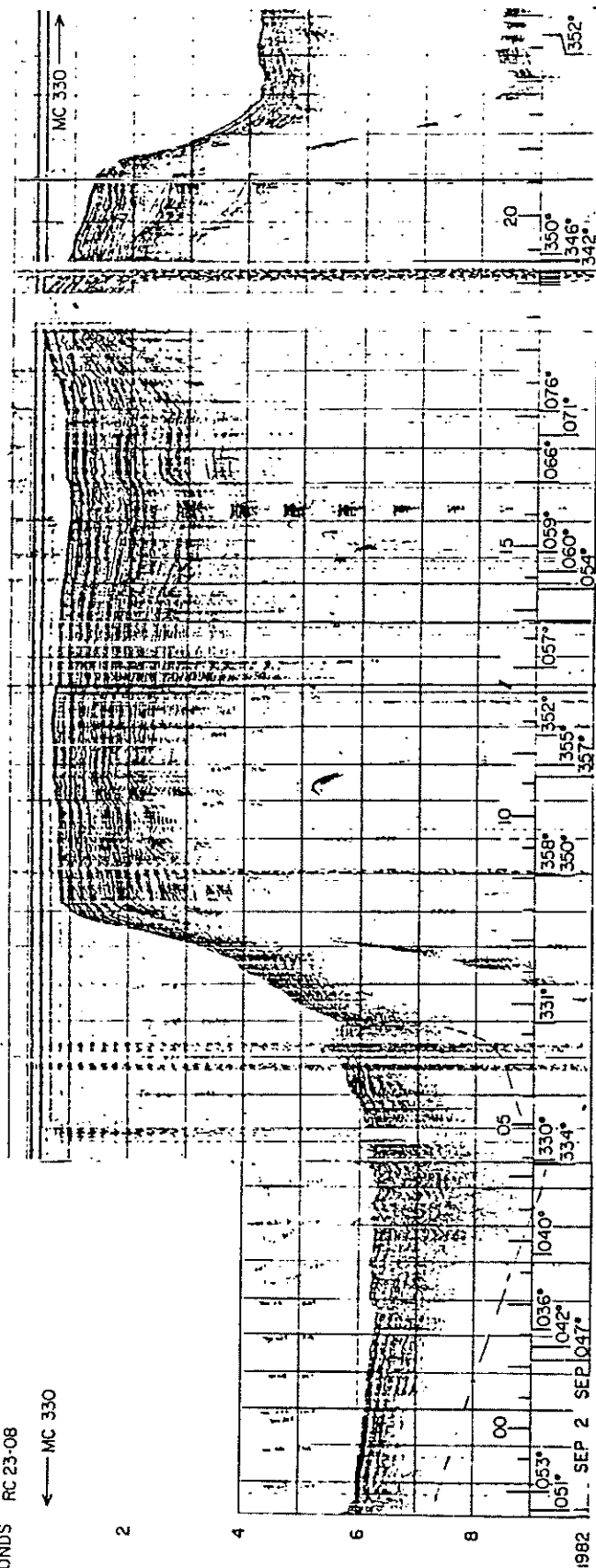
1250°

1250°

1250°



← MC 330



← MC 331

