

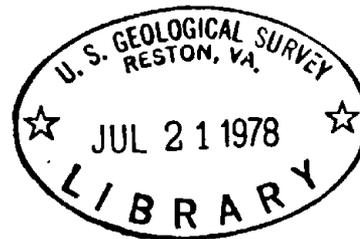
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✓ UNITED STATES (DEPARTMENT OF THE INTERIOR)

GEOLOGICAL SURVEY

MULTICHANNEL SEISMIC REFLECTION AND SONOBUOY
REFRACTION DATA IN THE OUTER SOUTHERN CALIFORNIA BORDERLAND*



By

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OPEN-FILE REPORT 78-706

This report is preliminary and has not been
edited or reviewed for conformity with
Geological Survey standards and
nomenclature

The use of trade names in this report is
for descriptive purposes only and does not
constitute an endorsement by the
U.S. Geological Survey

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*This report describes records of data collected at sea, which can be consulted at USGS offices at Rm B-164, Deer Creek Facility, 345 Middlefield Rd., Menlo Park, CA. Copies of these records are available from National Geophysical and Solar-Terrestrial Data Center, Environmental Data Service, National Oceanic and Atmospheric Administration, Boulder, CO 80302.

Introduction

During the L1-78-SC cruise of the USGS research vessel S. P. Lee (April 25 - May 11, 1978) seven sonobuoy profiles and 200 km of 24-channel seismic reflection data were recorded in the outer southern California Continental Borderland. These data were obtained, at the request of the Deep Sea Drilling Project (DSDP), to evaluate possible drill sites along the southern California continental margin.

The drill sites shown in Figure 1 were proposed by the Ocean Paleo-environmental Panel for DSDP Leg 63--scheduled for Sept. - Nov. 1978. These sites were selected in order to provide an expanded Neogene record of paleoceanographic-paleoclimatic events and associated evolutionary development of planktic communities along the eastern side of the north Pacific Ocean. Site selection was made prior to this survey on the basis of available single-channel seismic reflection profiles. Thus, the proposed sites shown on Fig. 1 may be relocated or eliminated when the data presented in this report are incorporated with earlier data. The combined data will be evaluated for safety and pollution hazards by Leg 63 site proponents and the DSDP safety panels.

The ship's tracks (Fig. 1) were located by an integrated Satellite-Loran C-Doppler Sonar navigation system. Average survey speed was about 5 kts. A 1326 cu in (21,723 CC) tuned air gun array provided the sound source for both reflection and refraction profiles. The air gun array was fired at 50 m (about 18 sec.) intervals by the integrated navigation system.

Sonobuoy Instrumentation And Data Acquisition

The locations of the sonobuoy profiles are shown in Figure 1 and on corresponding seismic reflection profiles. Both commercial and U. S. Navy (SSQ-41B)

sonobuoys were used for the DSDP site survey work; six were Navy models and one was manufactured by Refraction Technology. Sonobuoy signals were processed aboard ship using an Aquatronics (Fairfield Industries) STR-70 2-channel crystal-controlled receiver. The STR-70 was used in order to amplify and filter the seismic signal and to provide separate water break amplification controls. Lo-cut filters were normally set at 5 Hz, and the hi-cut at 62 Hz.

Surface (4-m depth) temperatures were monitored continuously during refraction operations, and sound velocity in the water was computed by a velocimeter mounted in the hull. These measurements were supplemented by a few expendable bathythermograph casts to insure proper hydrophone depth with respect to the thermocline.

Data Reduction Methods

Data from the seven unreversed refraction profiles were reduced using the slope-intercept method. Preliminary corrections for dipping interfaces were incorporated in the results. Several points representing travel time and distance (water-wave time) were picked along each of the refracted arrival (head wave) lines observed on the facsimile records. Mean horizontal and vertical water velocities were calculated from velocimeter and temperature information. Using these data points and water velocities a computer program was then used to calculate intercept time, apparent interval velocities, depths and reflection times to the various interfaces, and critical distances for each of the refracted head waves. A computer plot was then produced showing travel time versus distance (water-wave time) for each of the refracted arrivals (Figures 2-8). Wide angle reflection curves from zero time to critical distance were also plotted for each of the layers.

Multichannel Instrumentation And Data Acquisition

The processed multichannel seismic reflection profiles are located on Figure 1 and illustrated on Lines 2, 4, 7, 8, 9, 10, 11, 13, 25, and 26. The reflected signals were received by a 24-channel, 2.5 km long Seismic Engineering streamer and digitized aboard ship by a Globe Universal Science (G.U.S.) model 4200 recording system. The return signals were sampled at 2 millisecond intervals after being filtered at 5-110 Hz bandpass.

Data Processing

The seismic reflection profiles were processed as follows:

- (1) Edit, demultiplex and reformat (4 MS sample rate)
- (2) CDP sorting for velocity analysis
- (3) Velocity analysis at 2 km intervals
- (4) Statics, gain recovery, mute, and apply NMO
- (5) Stack 24 fold
- (6) Deconvolution (gapped prediction error)
- (7) Bandpass filter (8-40 Hz)
- (8) Plot with digital AGC (600 MS window)

Figure 1. Bathymetric map of outer southern California Borderland, showing ship's tracks, sonobuoy locations, and proposed DSDP sites. Contour interval is 50 m. Arrows at end of lines indicate ship's heading. Ship tracks dashed along sonobuoy profiles.

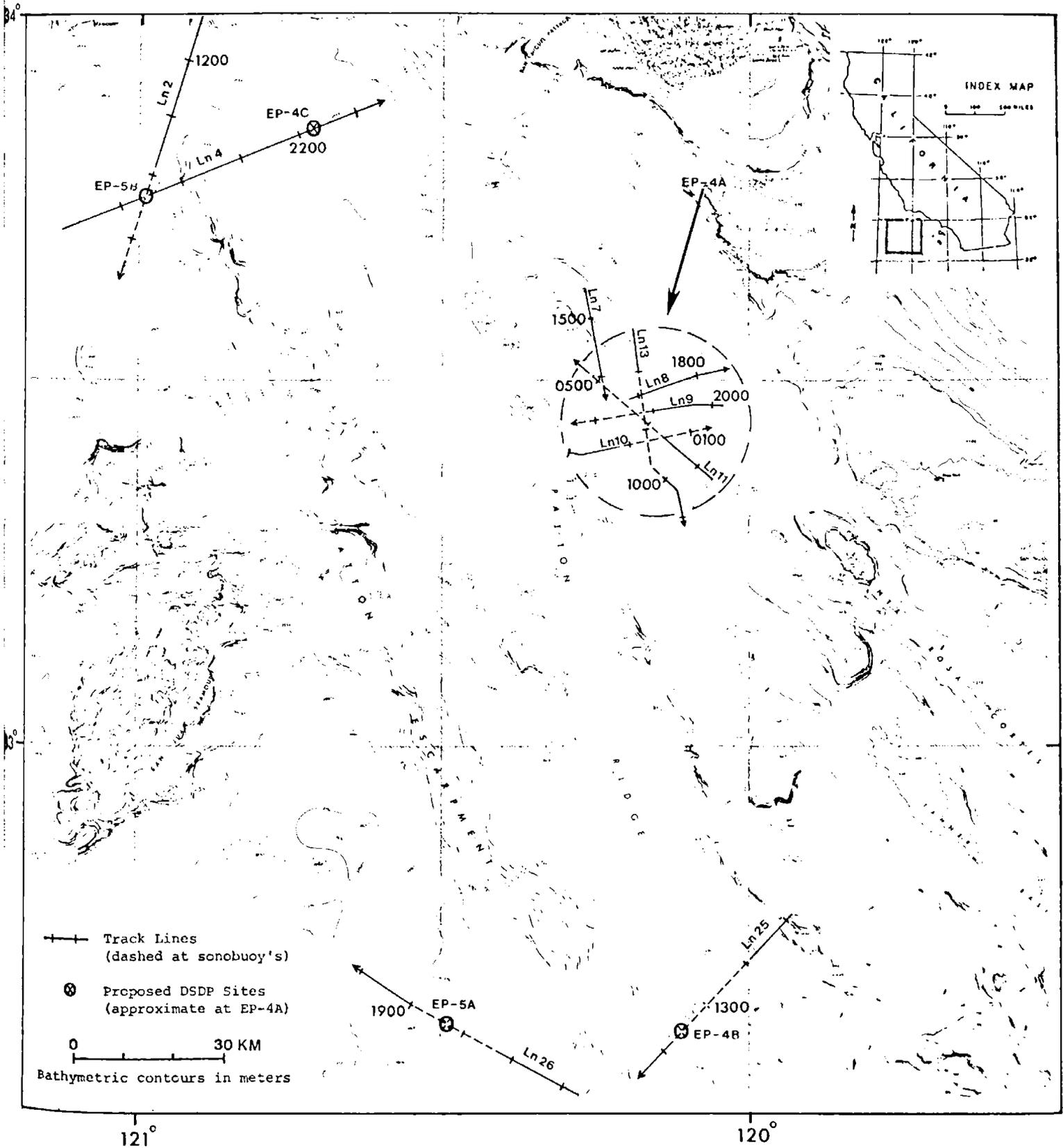


Figure 1

Figures 2-8. Time-distance computer plots for individual refraction profiles. The solutions for intercept time, interface depth, interval velocity, reflection time, and critical distance are shown above each plot. Other parameters such as sonobuoy number, sound source used, and sonobuoy type are also shown. Layer 1 represents the water column. Depths and reflection times (TT INC) are shown to the base of each layer. Depths are in kilometers and velocities in kilometers/second. The horizontal distance (seconds) shown on the plots can be converted to true distance using the horizontal water velocity shown for layer 1. The small tick mark along the individual reflection/refraction traces on the time-distance plots indicate the critical distance for the refracted arrivals. The two-way travel times to the base of each layer closely match prominent reflection horizons on seismic profiles.

	INTCPT	DEPTH	VEL	TT INC	CR DIST KM
LAYER 1	0.000	1.227	1.500	1.636	0.000
LAYER 2	0.570	1.680	1.600	2.202	6.599
LAYER 3	1.280	2.560	1.878	3.140	4.735
LAYER 4	2.600	2.740	2.932	3.262	3.519
LAYER 5	2.920	4.080	3.853	3.982	2.854
LAYER 6	3.550	5.480	5.196	4.501	4.944
LAYER 7	4.030		6.470		7.307

CRUISE : L1-78-SC
 DATE/TIME : 116 JD 0532-0735
 LINE : 13
 SONOBUOY : 2
 SOURCE : 1328 CU IN AIRGUNS
 BUOY TYPE : REFTEK

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HORIZONTAL DISTANCE IN SECONDS

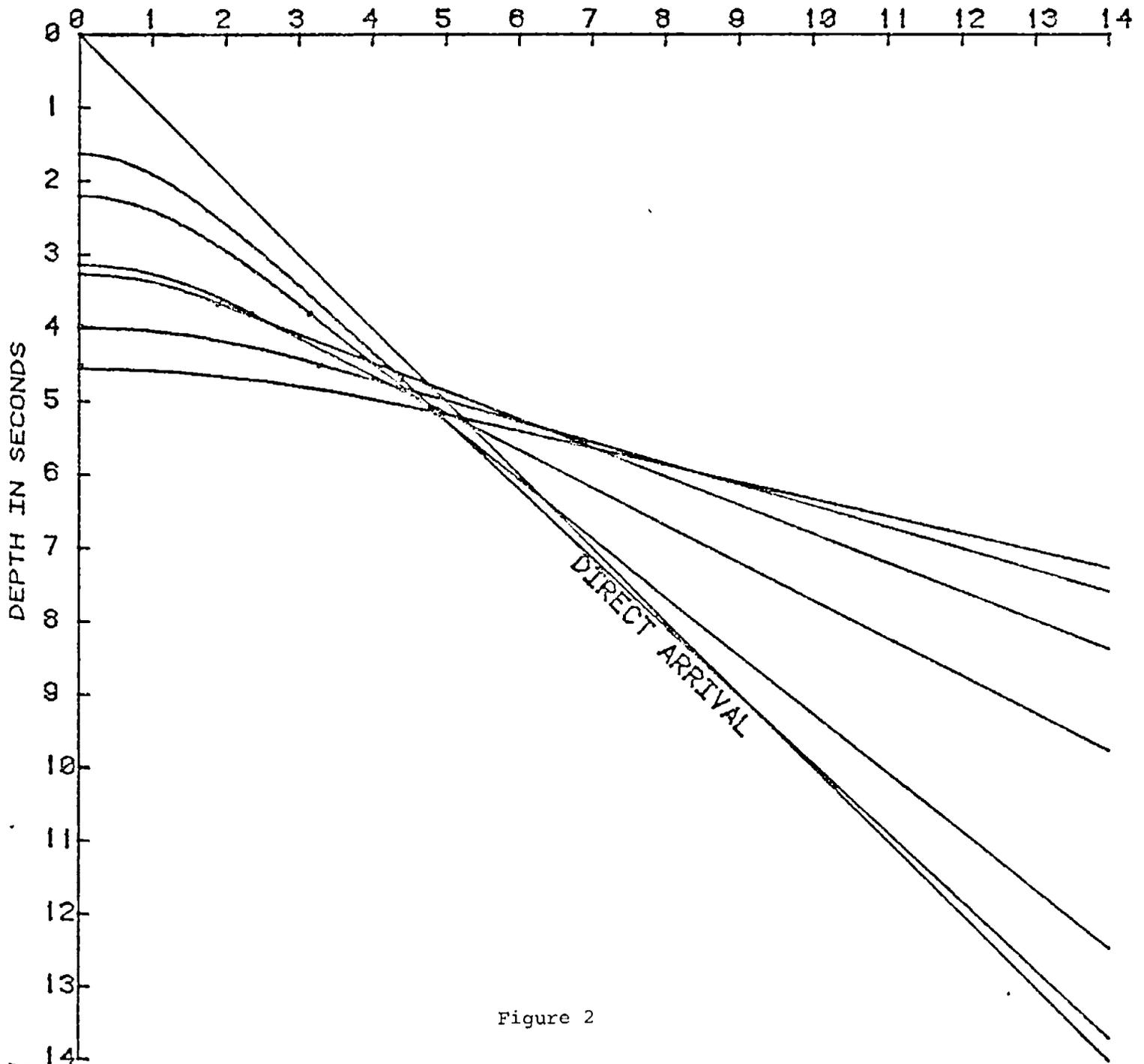


Figure 2

	INTCPT	DEPTH	VEL	TT INC	CR DIST	KM
LAYER 1	0.000	3.112	1.510	4.122	0.000	
LAYER 2	2.500	3.752	1.899	4.796	8.158	
LAYER 3	3.670		2.448		6.448	

CRUISE : L1-78-SC
 DATE/TIME : 123 JD 1358-1543
 LINE : 2
 SONOBUOY : 52
 SOURCE : 1326 CU IN AIRGUNS
 BUOY TYPE : NAVY

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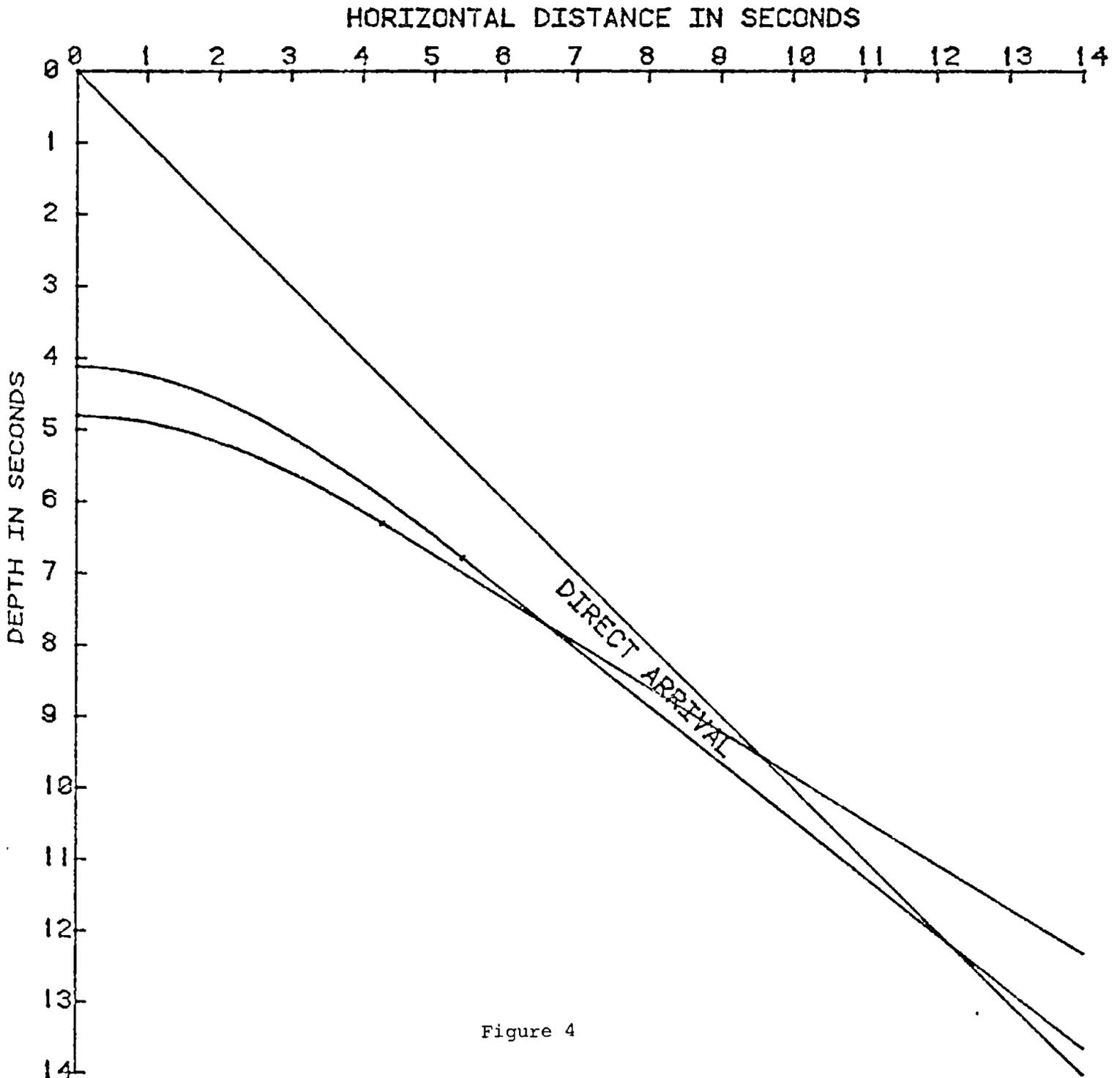


Figure 4

	INTCPT	DEPTH	VEL	TT INC	CR DIST	KM
LAYER 1	0.000	1.252	1.500	1.670	0.000	
LAYER 2	0.580	1.540	1.600	2.030	6.760	
LAYER 3	1.270	2.266	1.947	2.776	3.856	
LAYER 4	2.470	2.830	3.612	3.088	2.357	
LAYER 5	2.830		4.940		2.828	

CRUISE : L1-78-SC
 DATE/TIME : 126 JD 2352-0112
 LINE : 10
 SONOBUOY : 56
 SOURCE : 1326 CU IN AIRGUNS
 BUOY TYPE : NAVY

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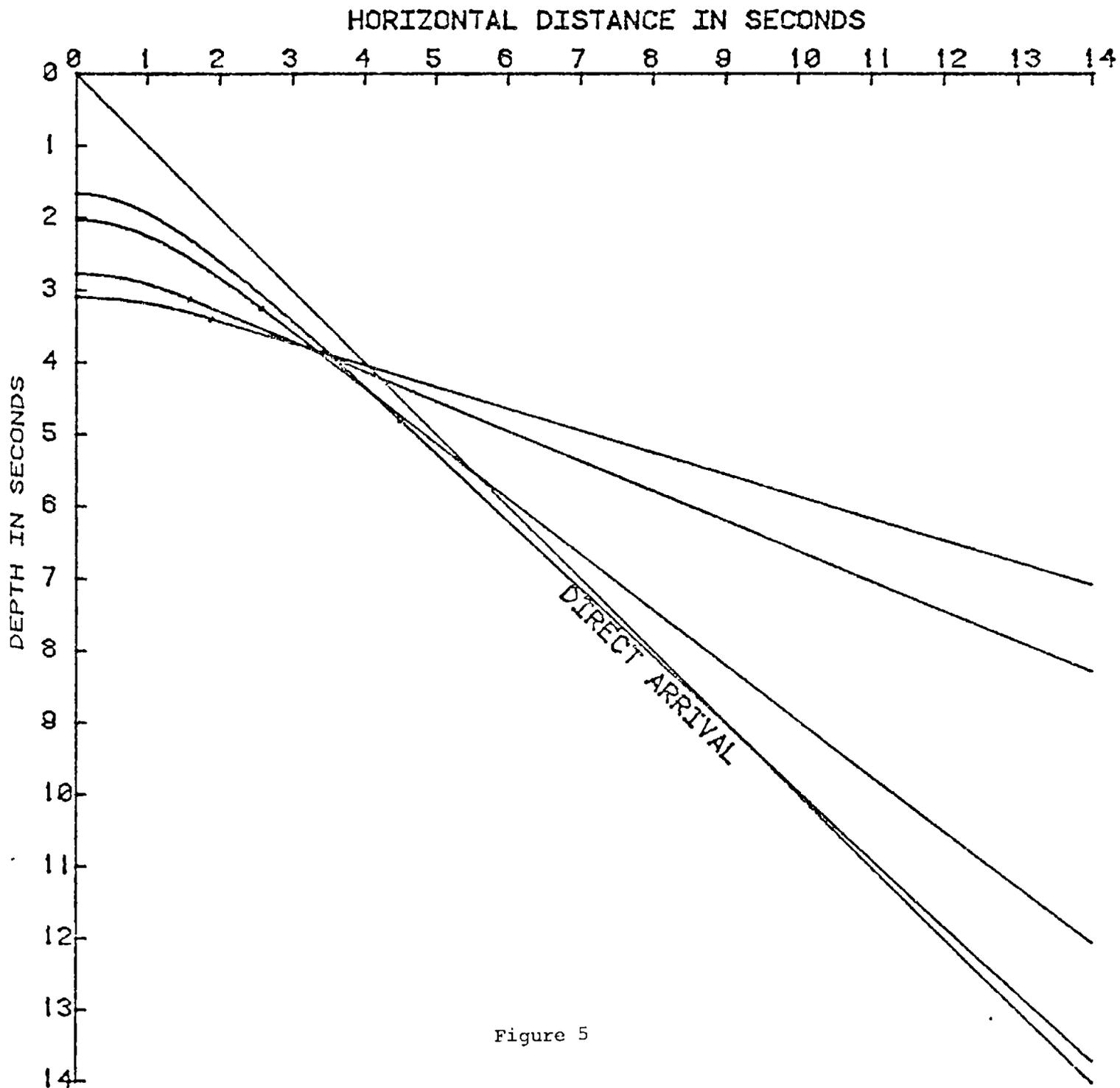


Figure 5

	INTCPT	DEPTH	VEL	TT INC	CR DIST	KM
LAYER 1	0.000	1.211	1.500	1.615	0.000	
LAYER 2	0.560	1.459	1.599	1.925	6.550	
LAYER 3	1.120	2.039	1.866	2.547	4.100	
LAYER 4	2.130	3.223	2.942	3.352	2.708	
LAYER 5	2.910	3.446	4.131	3.460	4.140	
LAYER 6	2.980	3.926	4.306	3.683	5.390	
LAYER 7	3.270		5.170		5.020	

CRUISE : L1-78-SC
 DATE/TIME : 127 JD 0345-0513
 LINE : 11
 SONOBUOY : 57
 SOURCE : 1326 CU IN AIRGUNS
 BUOY TYPE : NAVY

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HORIZONTAL DISTANCE IN SECONDS

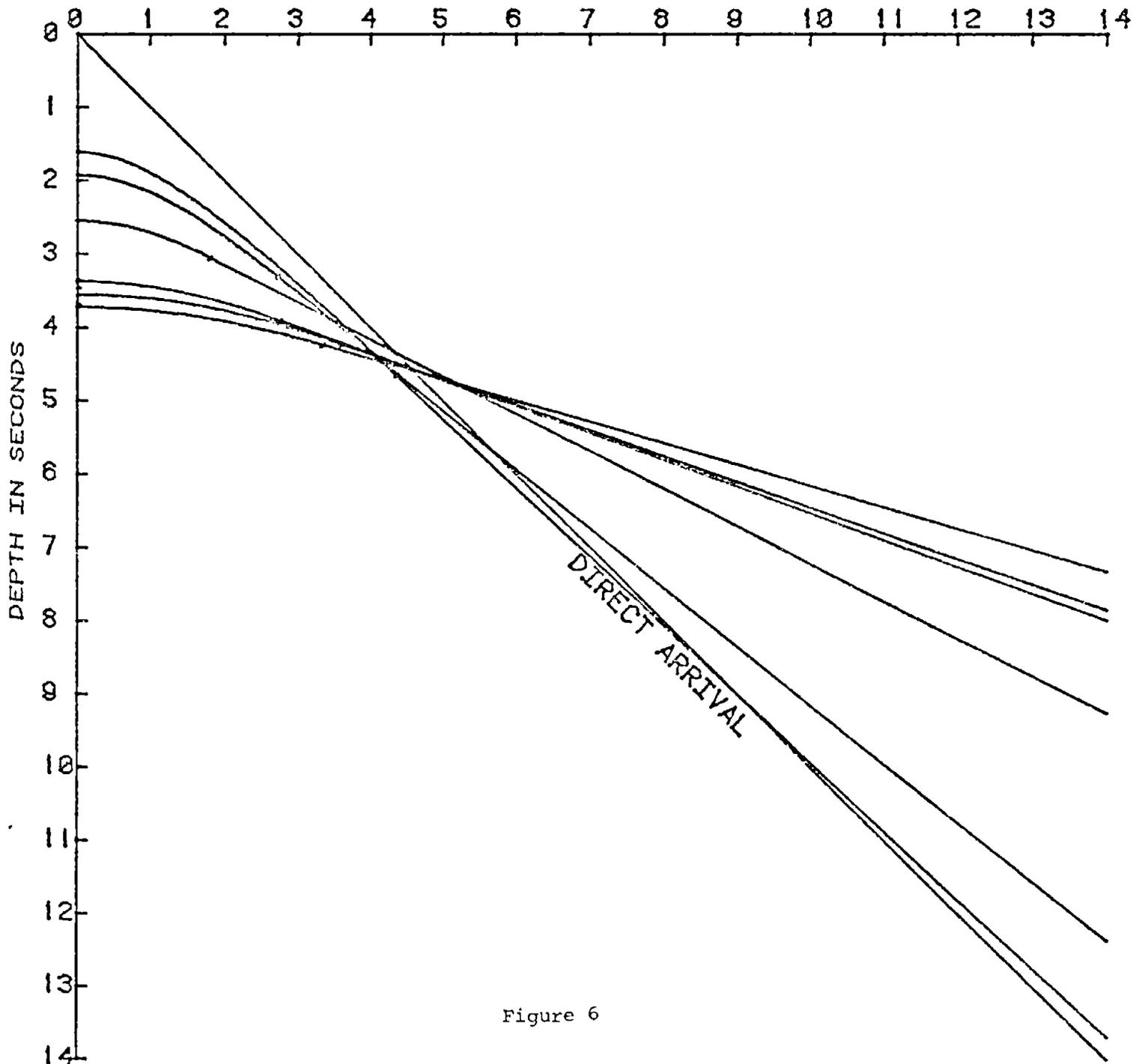


Figure 6

	INTCPT	DEPTH	VEL	TT INC	CR DIST	KM
LAYER 1	0.000	0.952	1.510	1.260	0.000	
LAYER 2	0.710	1.258	1.828	1.595	2.791	
LAYER 3	1.460	2.295	3.926	2.123	1.115	
LAYER 4	1.710		4.338		5.485	

CRUISE : L1-78-SC
 DATE/TIME : 130 JD 1146-1354
 LINE : 25
 SONOBUOY : 69
 SOURCE : 1326 CU IN AIRGUNS
 BUOY TYPE : NAVY

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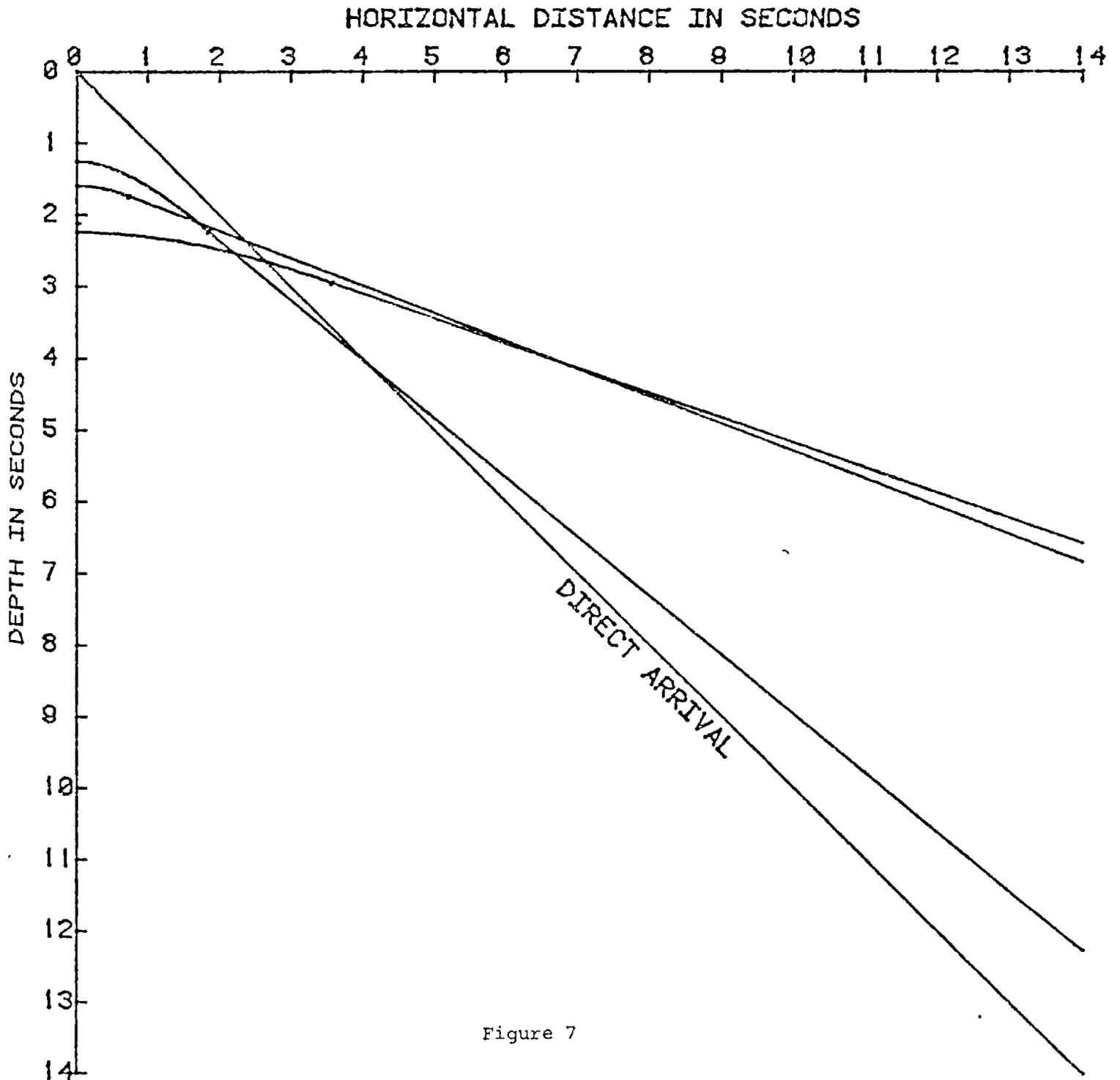


Figure 7

	INTCPT	DEPTH	VEL	TT INC	CR DIST	KM
LAYER 1	0.000	3.841	1.510	5.088	0.000	
LAYER 2	2.940	4.328	1.850	5.614	10.850	
LAYER 3	5.410	5.265	5.783	5.938	2.407	
LAYER 4	5.600		6.493		5.786	

CRUISE : L1-78-SC
 DATE/TIME : 130 JD 1721-1859
 LINE : 26
 SONOBUOY : 70
 SOURCE : 1328 CU IN AIRGUNS
 BUOY TYPE : NAVY

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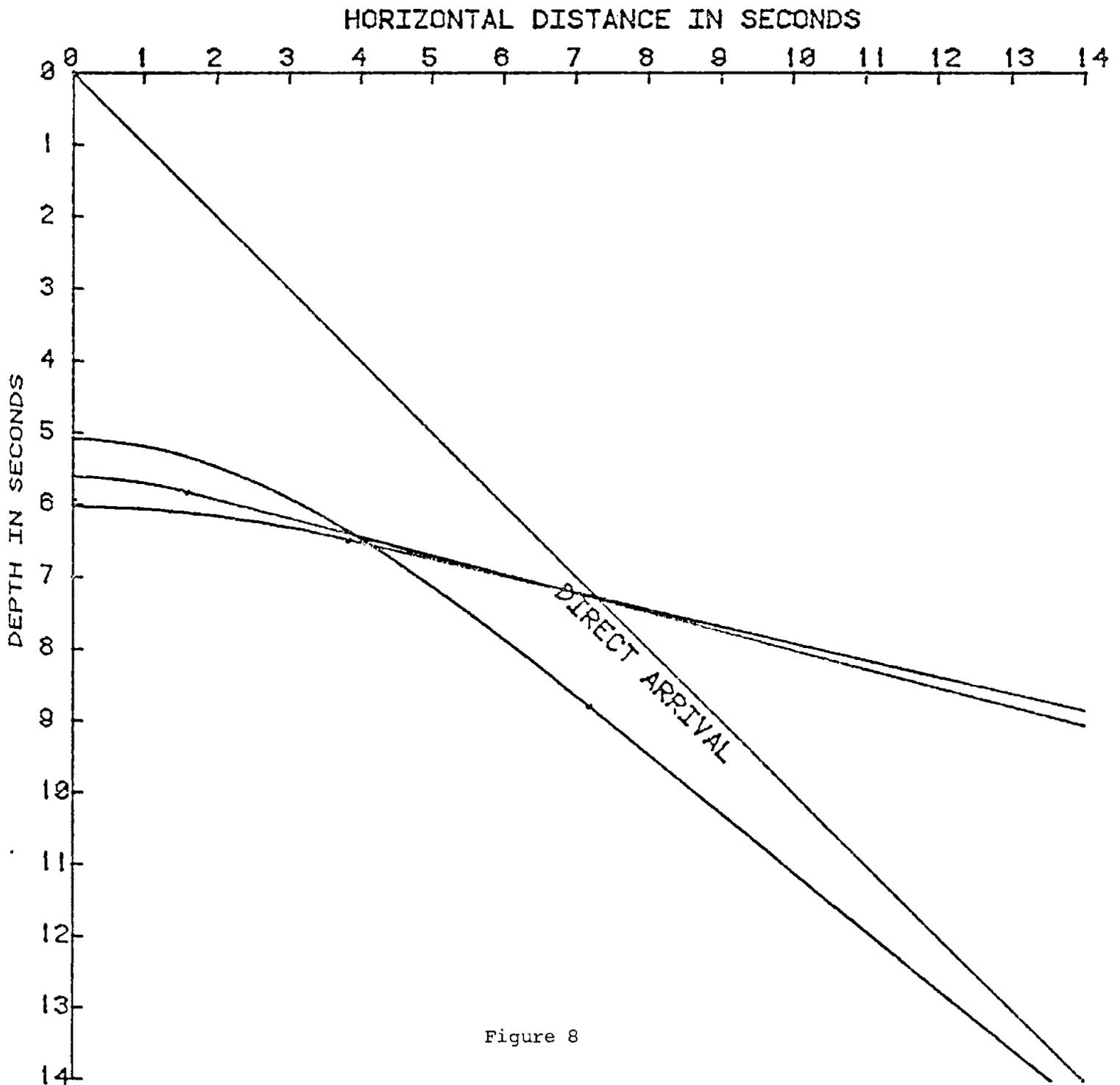
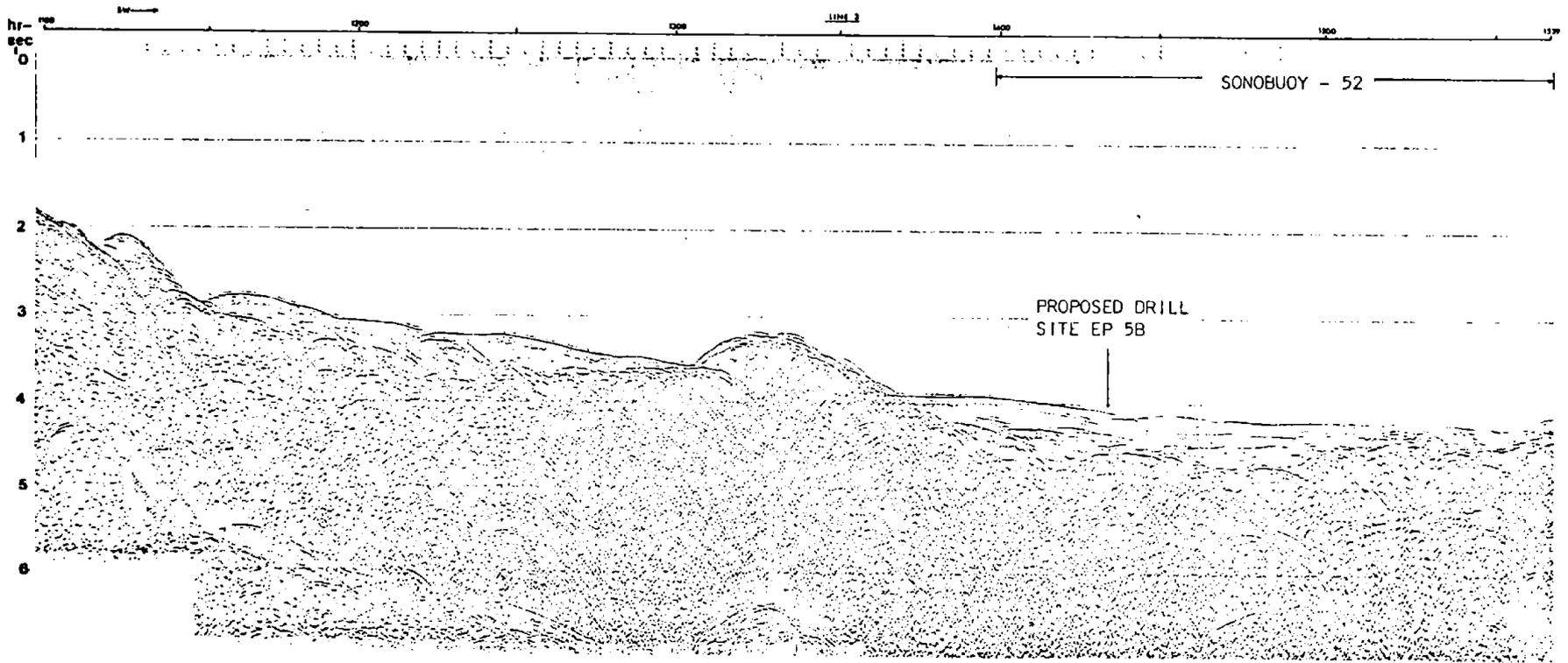
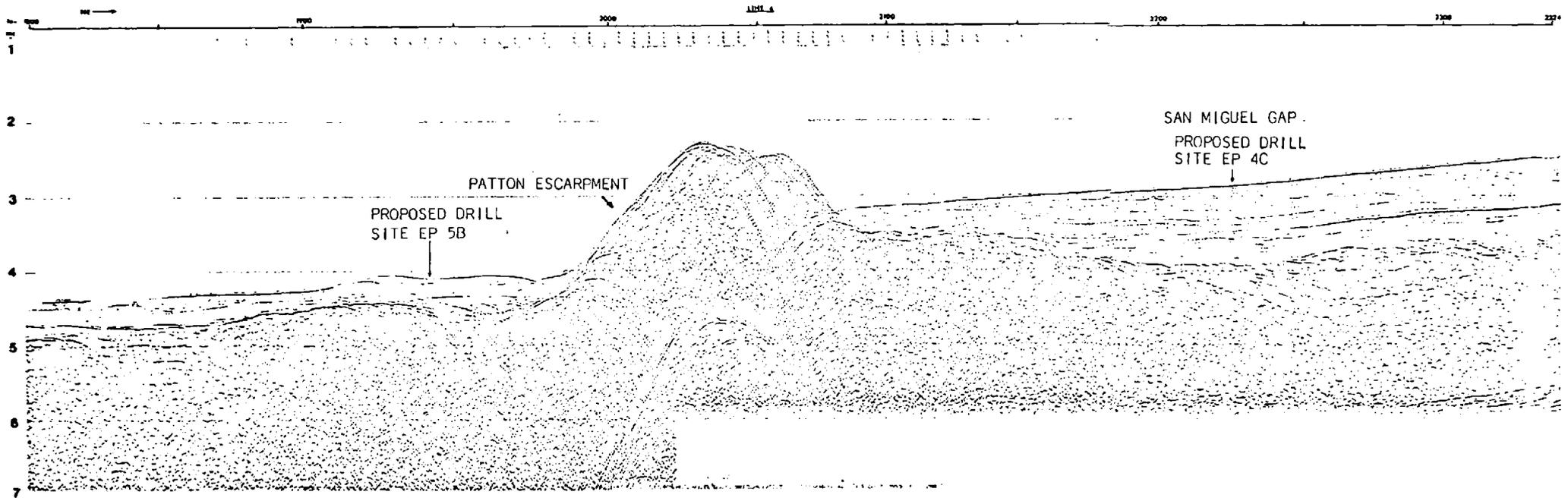


Figure 8

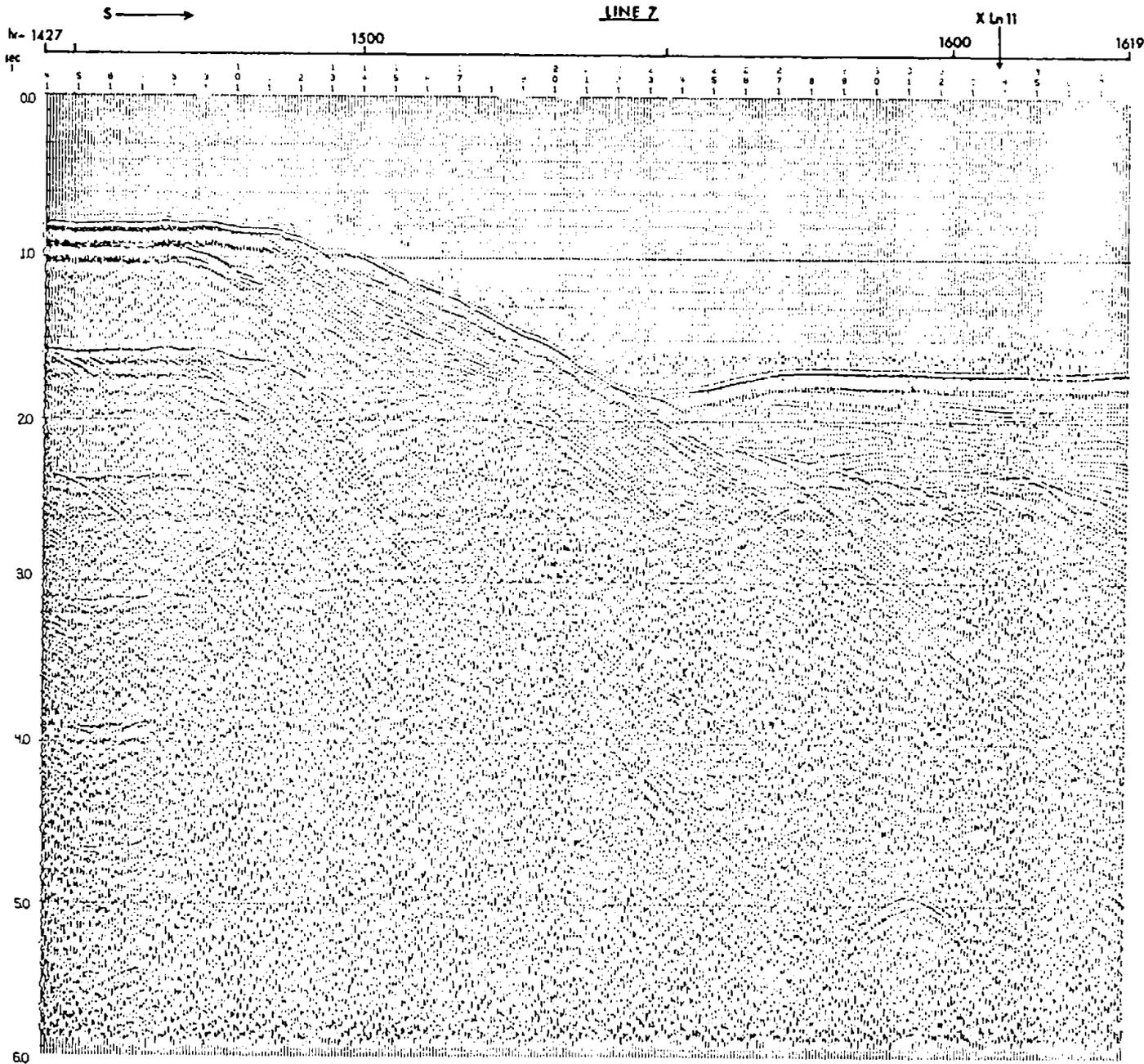
Lines 2, 4, 7, 8, 9, 10, 11, 13, 25, and 26. Processed, 24-channel seismic reflection profiles. Location of profiles shown in Figure 1. Seismic source was 1326 in³ tuned air gun array. Filters 5-110 Hz. 50 m (~18 sec) firing rate. Vertical exaggeration approximately X3. Vertical scale: 2-way travel time in seconds. 1 sec ≈ 750 m water depth. Horizontal scale in hours. 1 hr ≈ 10 km.



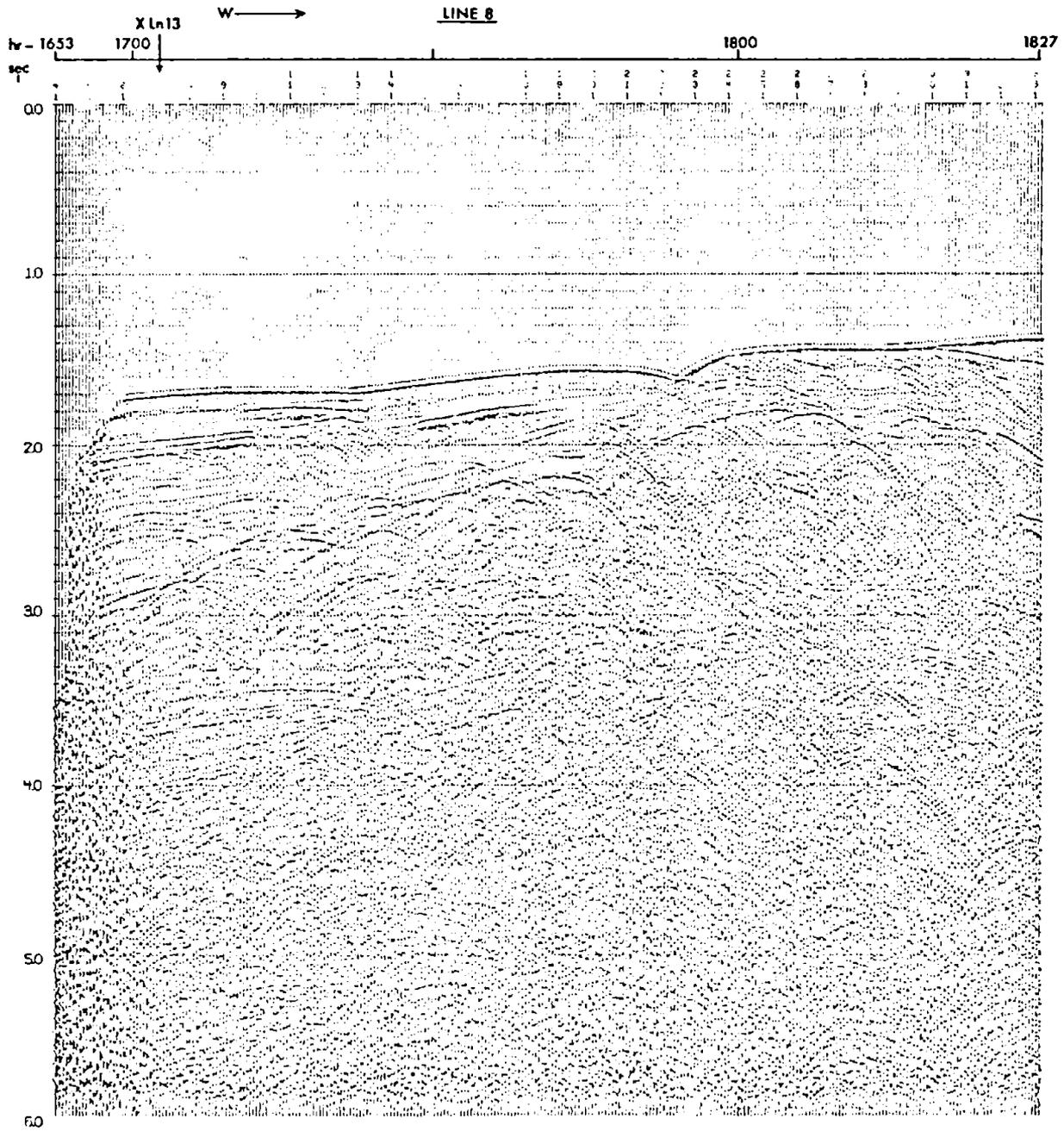
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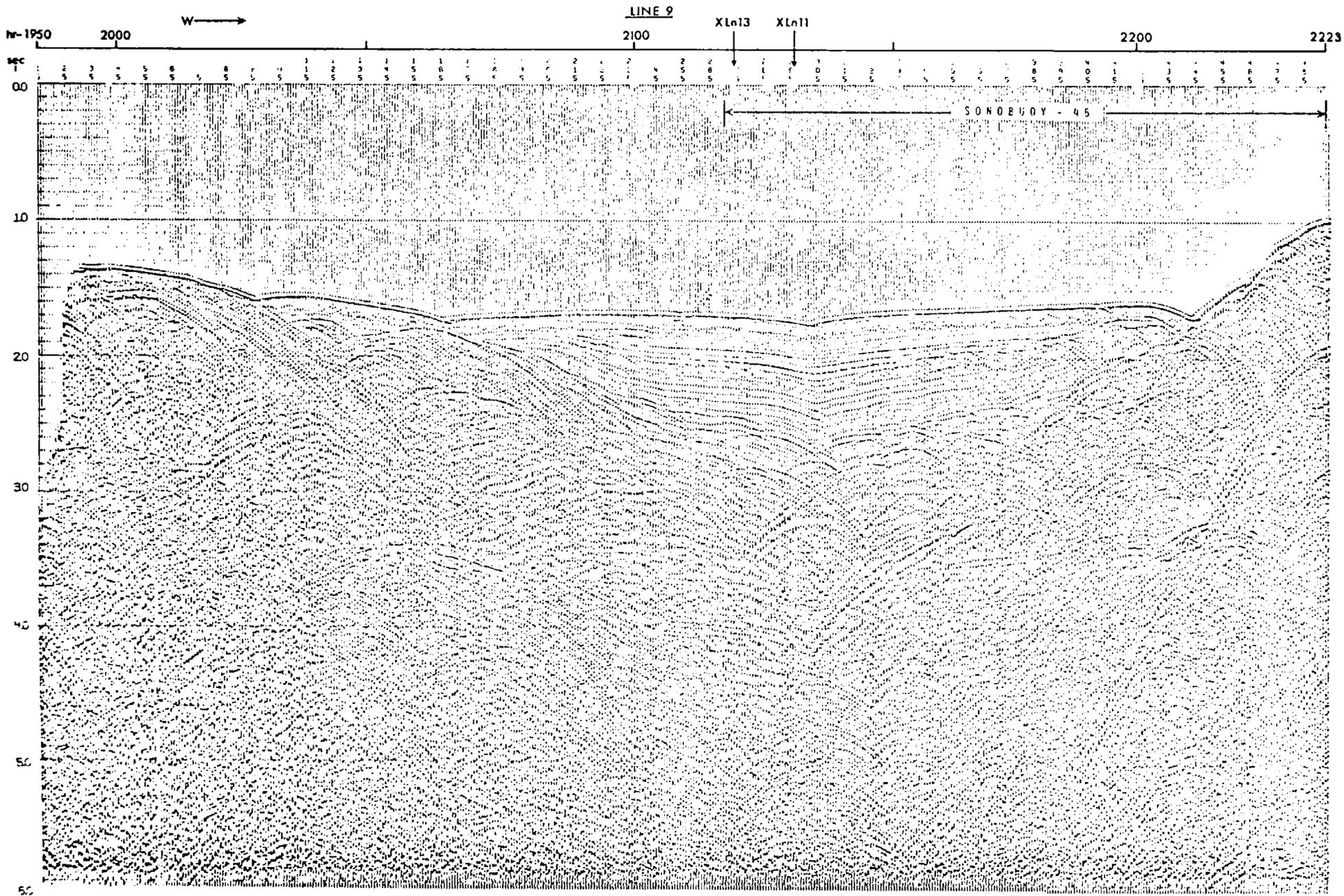
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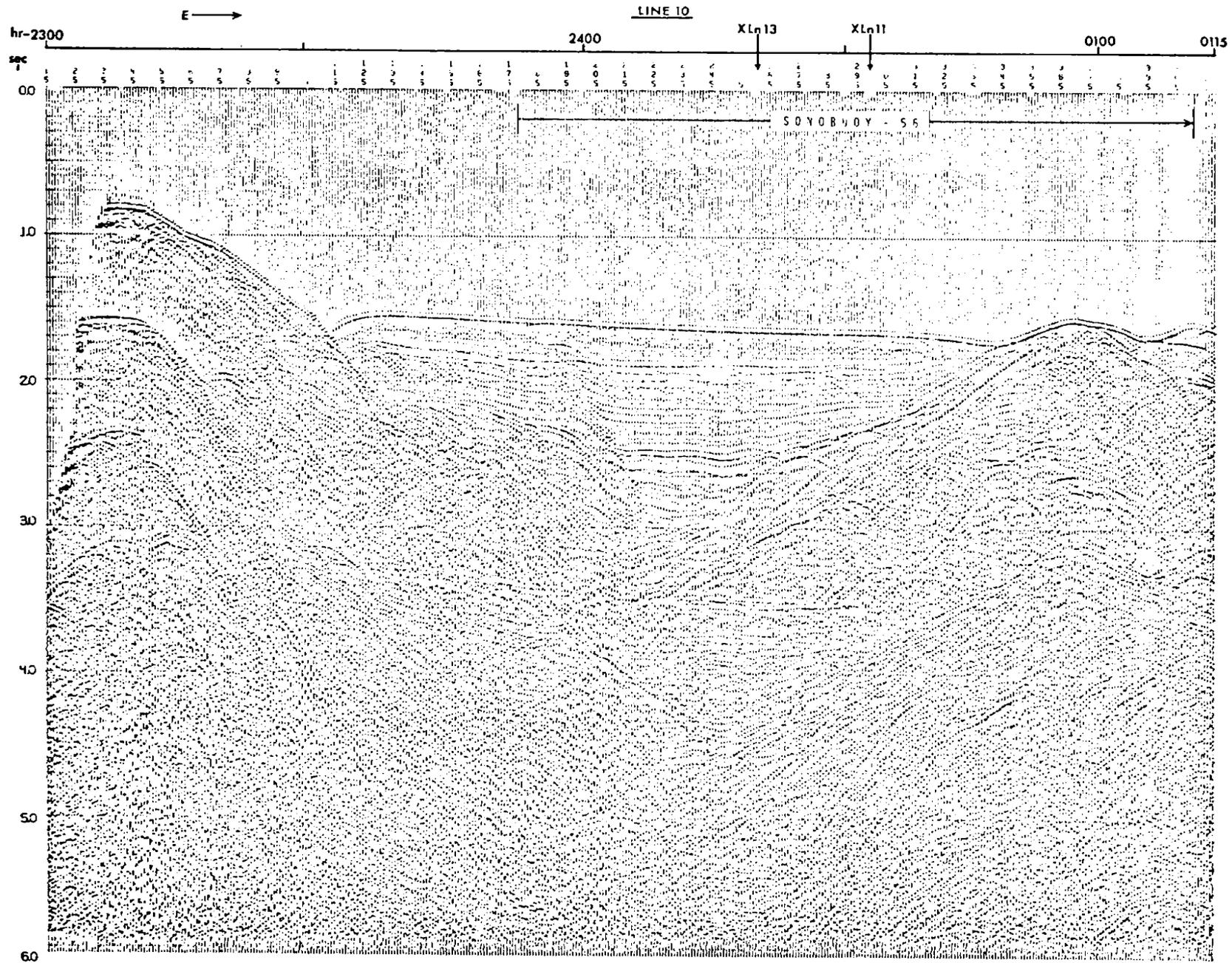
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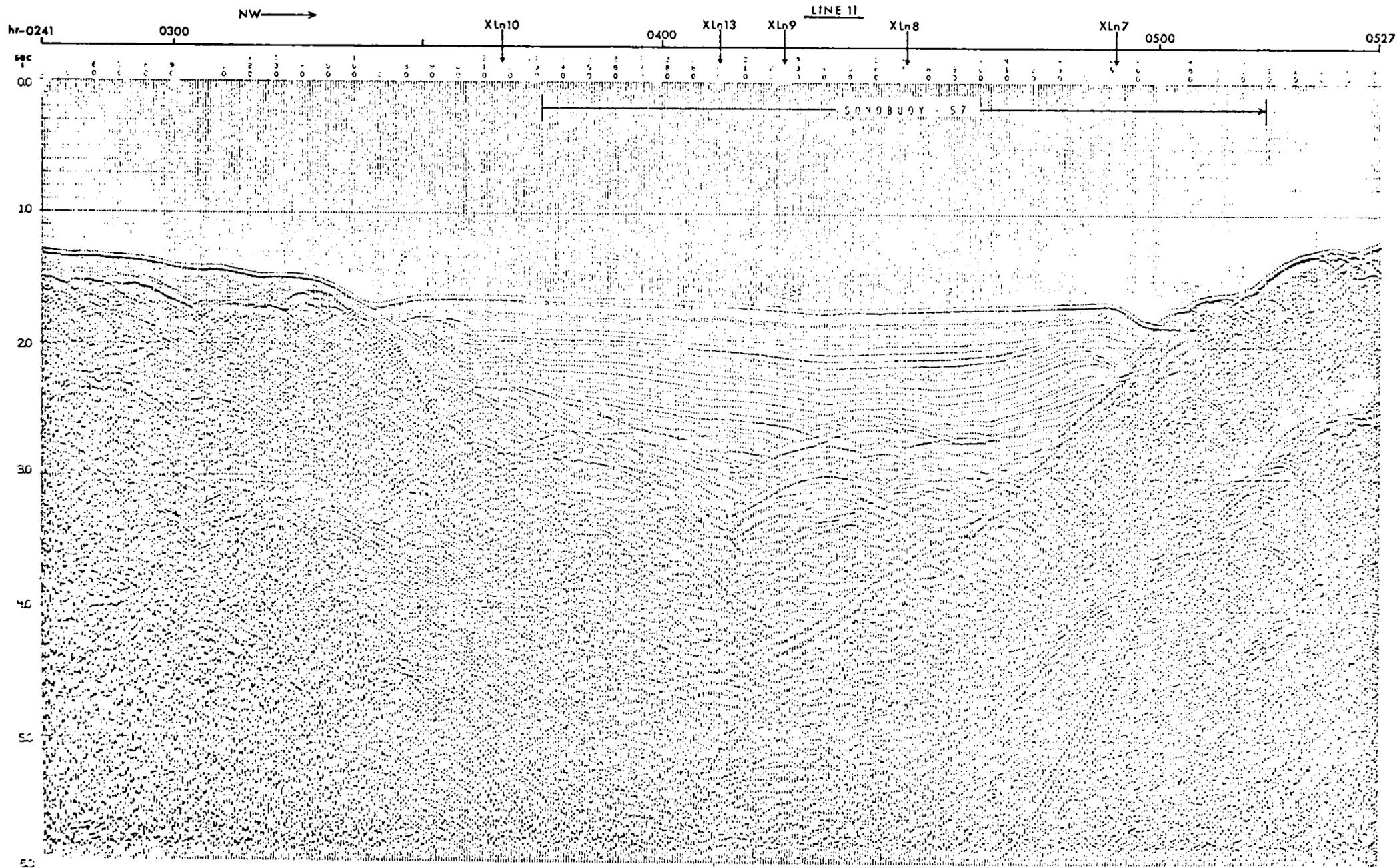
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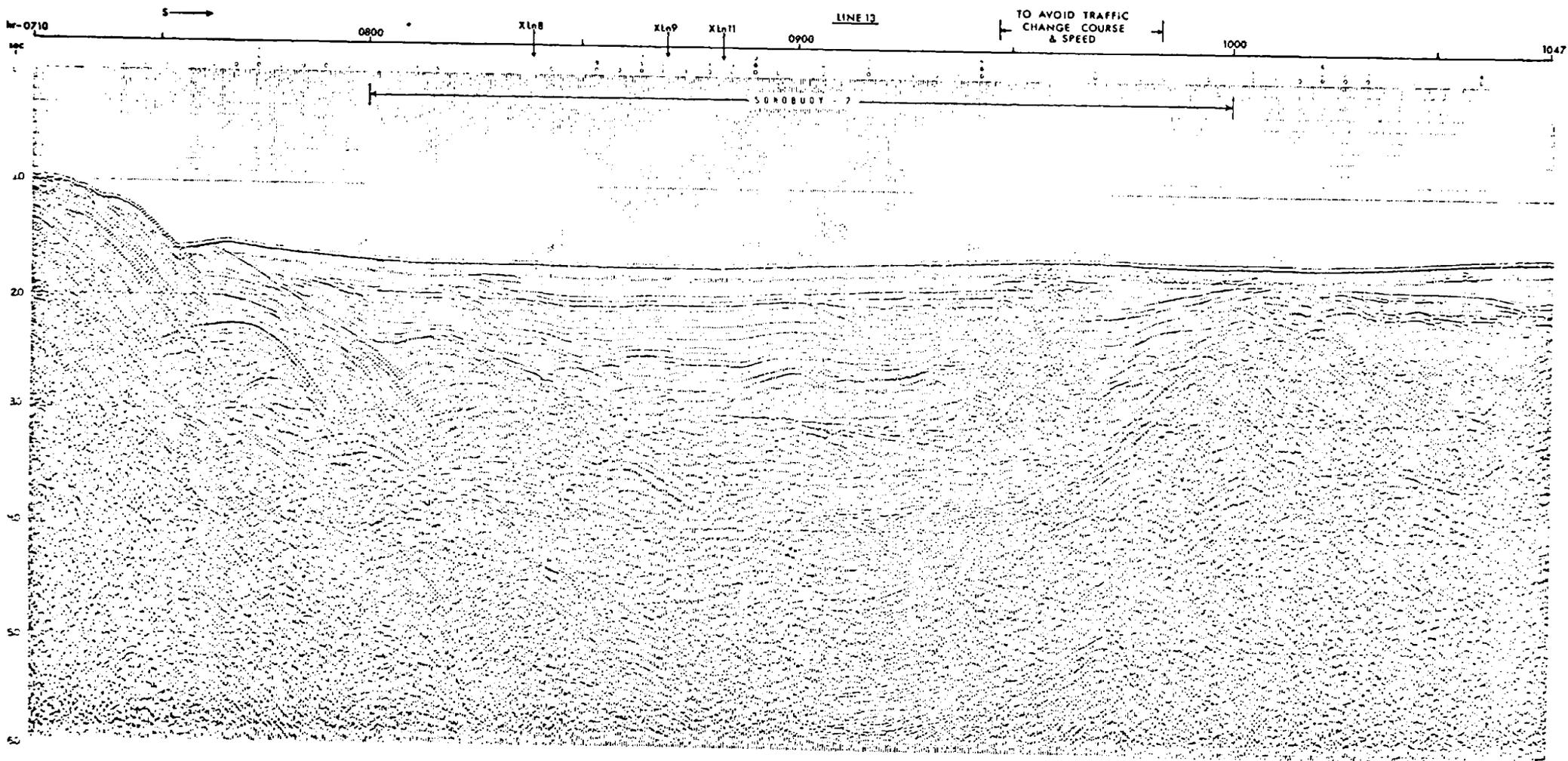
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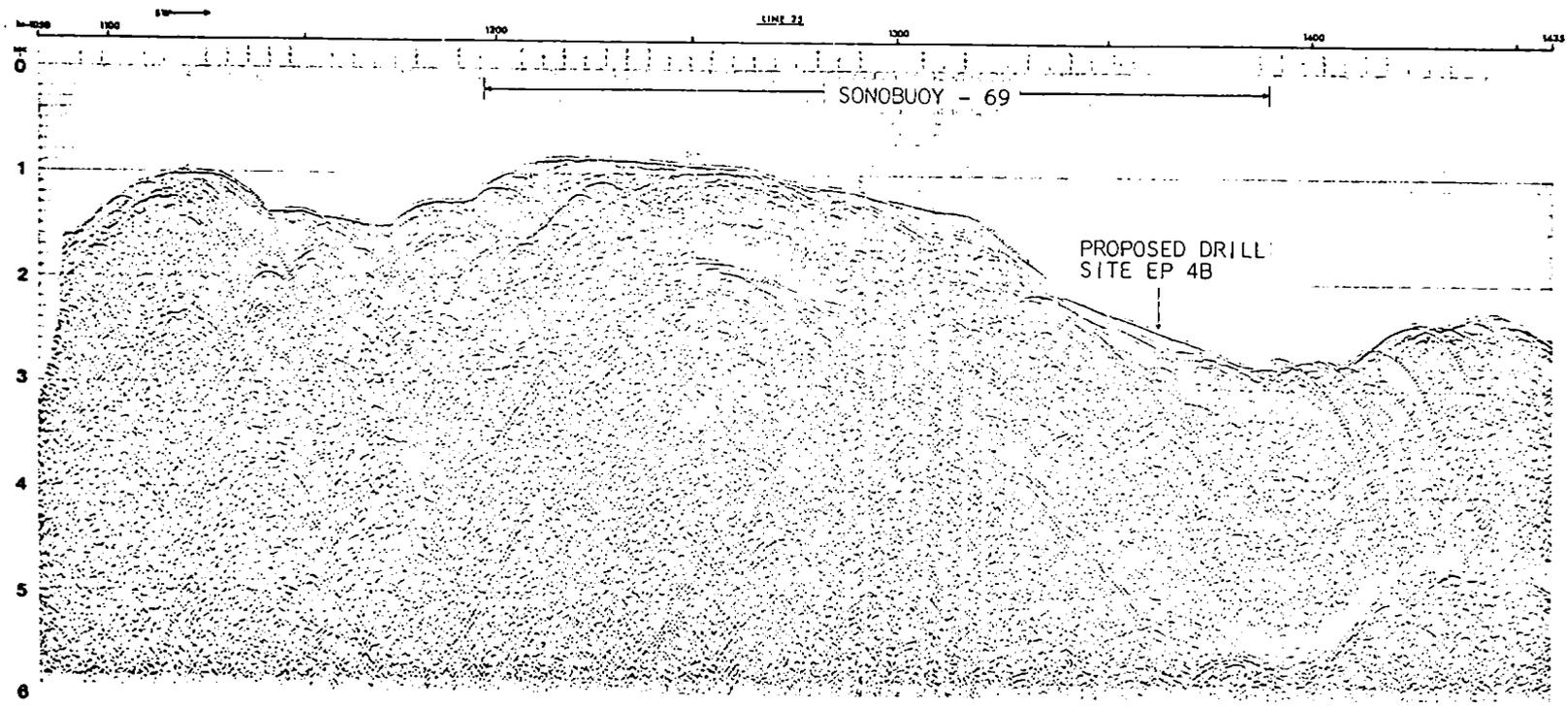
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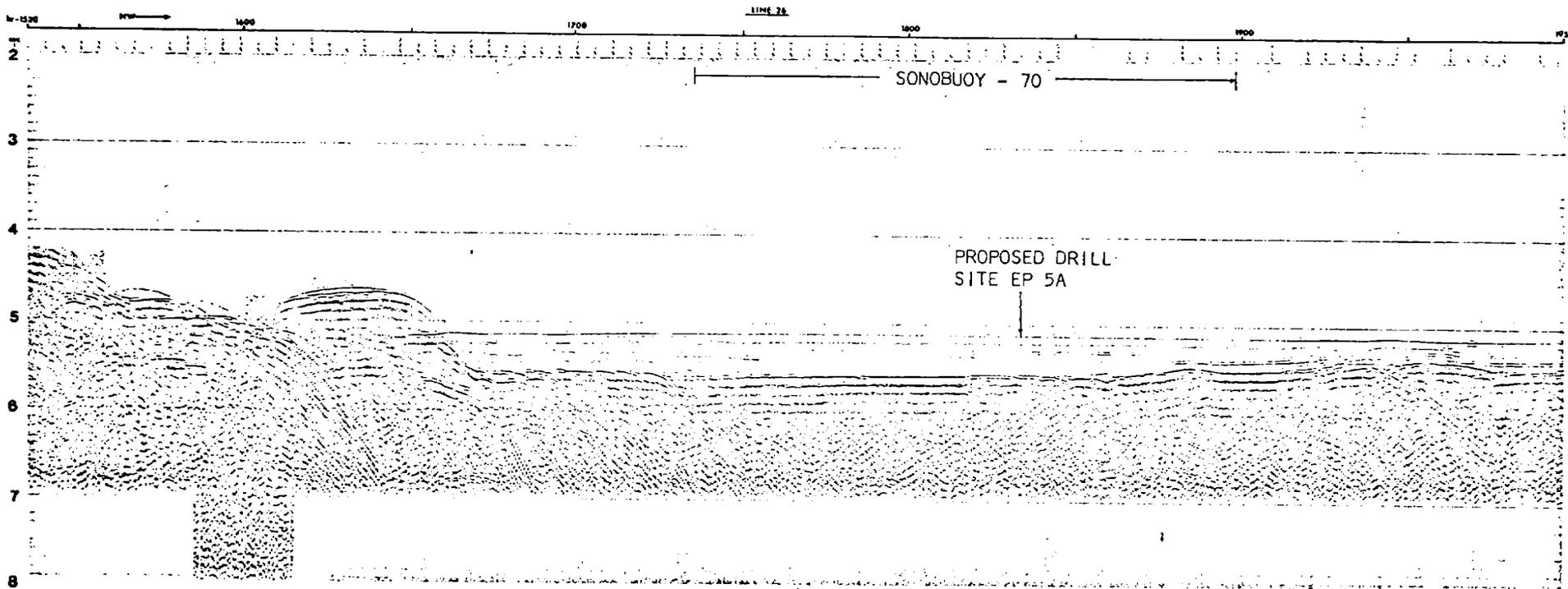
LINE 11



LINE 13



LINE 25



LINE 26

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