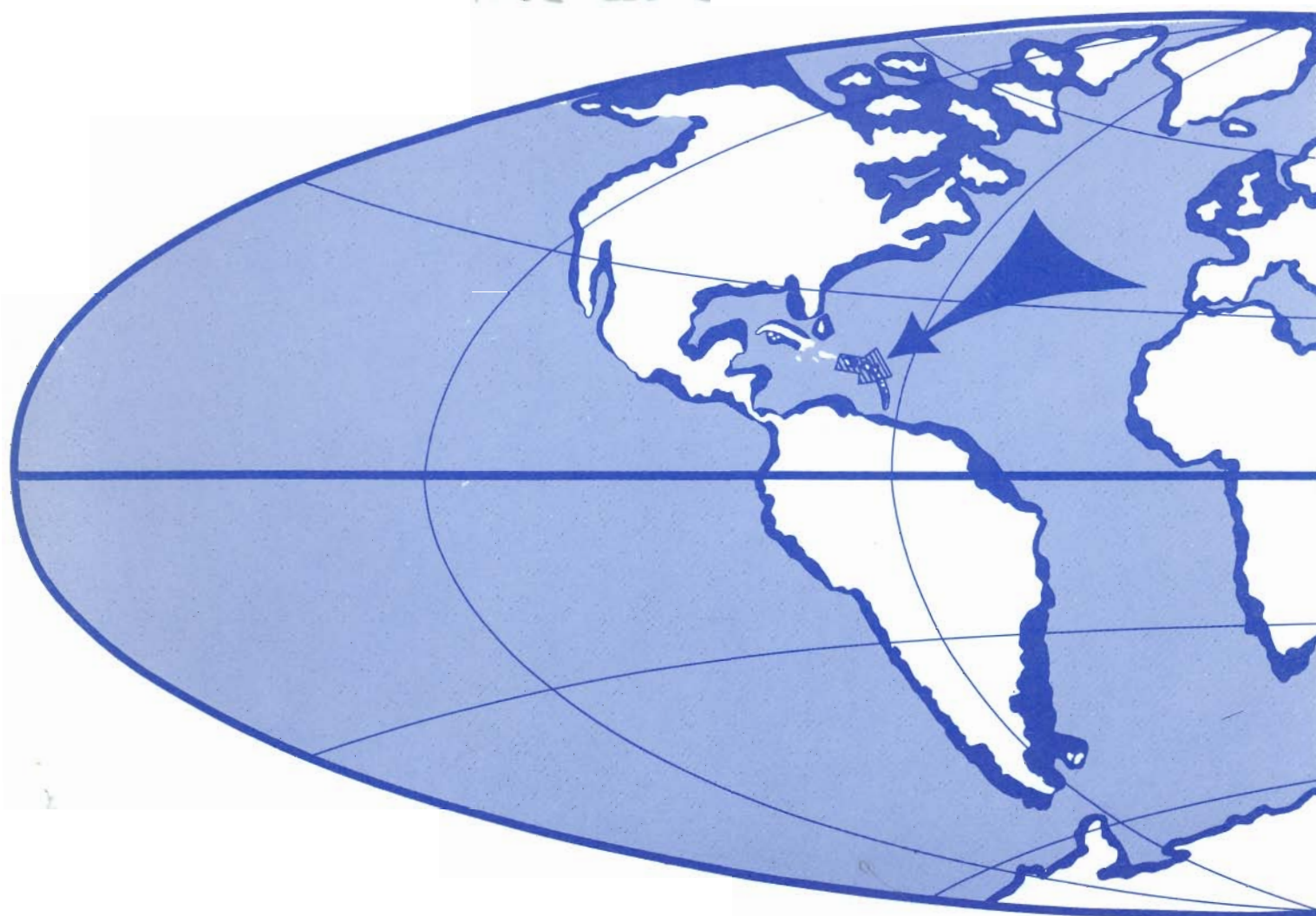


**Acoustic Reflection Profiles**

3  
**EASTERN**

**GREATER ANTILLES**

1 DOE LEG 2



**INTERNATIONAL DECADE OF OCEAN EXPLORATION**  
**U. S. GEOLOGICAL SURVEY**

**USGS-GD-72-004**  
**PB-207-596**

INTERNATIONAL DECADE OF OCEAN EXPLORATION

U.S. GEOLOGICAL SURVEY

LEG 3, 1971 CRUISE, UNITEDGEO I

L. E. GARRISON, CHIEF SCIENTIST

ACOUSTIC-REFLECTION PROFILES

EASTERN GREATER ANTILLES

USGS-GD-72-004

1972

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## INTRODUCTION

As part of a cooperative marine research program designated the Internataional Decade of Ocean Exploration (IDOE), the United States Geological Survey is participating in an investigation of the geologic framework and resource potential of continental margins and small ocean basins in the Gulf of Mexico, Caribbean Sea, and west African continental shelf areas. These studies are funded through the National Science Foundation. Legs 1 and 2, completed June 22 and July 8, respectively, were concerned with subbottom features of the Bay of Campeche and with the tectonic framework of the continental margin east of the Yucatan Peninsula. Leg 3, described in this report was conducted in the Antilles region of the northeastern Caribbean between July 17 and August 4, 1971.

This report presents the unedited records of the approximately 5840 km of acoustic reflection profiling made during Leg 3 (fig. 1). Magnetic and gravity data were collected also but are being reported elsewhere in conjunction with the results of the study.

## SCIENTIFIC PARTY

### U.S. Geological Survey

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## SHIP SCHEDULE

A total of 19 days was spent at sea in the eastern Greater Antilles during Leg 3 which began at San Juan, Puerto Rico, on July 17, 1971 and ended at St. Thomas, Virgin Islands, on August 4, 1971. Subbottom acoustic profiles were obtained over about 5840 km of track line in the project area. These records were made at an average ship's speed of 8.3 knots. One dredging station was occupied and three sonobuoy refraction profiles made.

Departure from San Juan was approximately 36 hours later than scheduled due to delays in filling out ship's crew list and loading ship's stores. The work schedule was as follows:



Day 198	(17 July 1971)	Departed San Juan. Began work in Mona Passage and Muertos Trough area.
Day 202	(21 July 1971)	Began work around Anegada Trough.
Day 203	(22 July 1971)	In St. Thomas (0730-1100) to pick up Dr. John Albers, Associate Chief Geologist, U.S. Geological Survey.
Day 205	(24 July 1971)	Returned to St. Thomas (0930-1300) to debark Dr. Albers. Resumed work in Anegada Trough.
Day 207	(26 July 1971)	Began Puerto Rico Trench crossings.
Day 213	(1 August 1971)	Began work on northern part of Aves Swell.
Day 216	(4 August 1971)	Terminated work off St. Thomas, picked up freight shipment there, and made for San Juan for generator repairs.
Day 217 -		
219	(5-7 August 1971)	In port San Juan replacing generator unit and briefing the on-coming Leg 4 crew.

#### OBJECTIVES OF INVESTIGATION

Scientific objectives of this cruise leg were: (1) to investigate the zone of juncture between the south flank of the Antillean ridge and the north edge of the Venezuelan Basin along the depressed Muertos Trough; (2) to examine structural deformation in the Anegada Trough where the Greater Antilles are joined by the Lesser Antilles and Aves Swell; and (3) to study the northeastern sector of the Puerto Rico Trench where predicted relative plate motion should be transitional between westward underthrusting of the Lesser Antilles and east-west strike-slip motion north of the Greater Antilles.

#### GEOLOGIC SETTING

The eastern margin of the Caribbean lithosphere plate is marked by a zone of intermediate-depth earthquakes lying beneath the eastern Greater Antilles and curving southeastward along the Lesser Antilles arc (Sykes and Ewing, 1965). Exterior to the islands, the Puerto Rico trench is a strong topographic depression north of Puerto Rico but diminishes in relief southeastward as it follows the curve of the Antilles and disappears topographically near latitude 15°N. The pronounced gravity minimum associated with this feature, however, continues across the island of Barbados toward the South American continent. Evidence from first-motion earthquake studies (Molnar and Sykes, 1969) and from acoustic-reflection profiles (Chase and Bunce, 1969) suggests that the Atlantic sea floor is being thrust beneath the Lesser Antilles in a west-dipping zone of subduction.

The principal positive features in the northeastern Caribbean are the ridges of the Greater Antilles, the Lesser Antilles, and the Aves

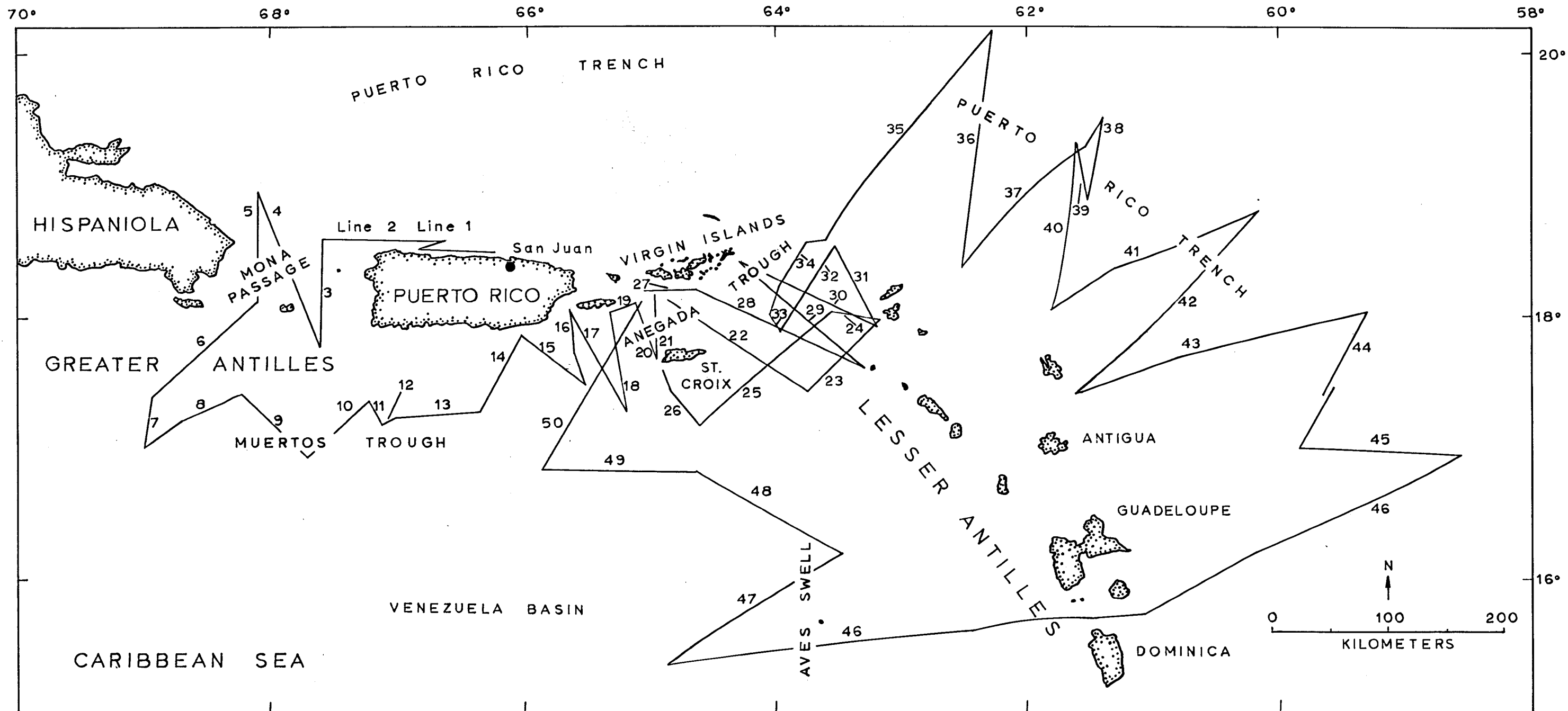


Figure 1.--Index map showing locations of major structural features and track lines in the eastern Greater Antilles.

Swell. These structures are complicated by the separation from the Greater Antilles of the St. Croix ridge, and the division of the Lesser Antilles into inner and outer arcs. A narrow gap, the Anegada Trough, separates all of these features in the area of their convergence.

In the region south of the ridge of the Greater Antilles, seismic reflectors in the Venezuelan Basin, possibly as young as Oligocene in age, are depressed into a monoclinical feature called Muertos Trough (Martin and Garrison, 1971). Beneath this trough is the junction of Caribbean crust and Antillean structure. The junction has been described as a major strike-slip fault (Hess and Maxwell, 1953).

#### PRELIMINARY RESULTS

In the vicinity of Mona Passage and the Muertos Trough, about 986 km of geophysical track was run in order to examine the structural pattern of the Antillean ridge crest where it is cut by Mona Passage and to determine the structure of the Muertos Trough. The acoustic-reflection profiles that crossed Mona Passage (lines 3, 4, and 5) indicate widespread tensional faulting south of the ridge crest, whereas north of the crest the strata are relatively undisturbed. The profiles that crossed the Muertos Trough (lines 6-14) indicate that acoustic reflectors belonging to the Venezuela Basin continue northward beneath the Antillean ridge structure for a distance of at least 18 km with little or no internal deformation. Superficially at least, the overlap of ridge structure on depressed ocean floor resembles the structural relationships east of the Lesser Antilles where acoustic reflection profiles suggest that Atlantic crust is being thrust westward under the island arc (Chase and Bunce, 1969). Lines 35 to 46 of this report cross the latter area.

In the Anegada Trough area, about 1620 km of track was run to examine the interrelations of the principal positive features that converge in that region. The acoustic-reflection profiles show the great complexity of this region and indicate possible major faulting along the north flank of the St. Croix ridge. Thus, the Virgin Islands Basin to the north of St. Croix Island may be a down-dropped block. Normal faulting also appears to play a major role in the separation of the Lesser Antilles from the eastern tip of the Greater Antilles, but the faults are relatively short and discontinuous. As a whole, the region appears to be affected principally by tensional forces. Sediment thickness in the Virgin Islands Basin ranged from none at the northeastern end to almost 2 km in the central portion.

In the eastern segment of the Puerto Rico Trench (lines 35 through the eastern half of 46), approximately 2070 km of geophysical track was made as a series of near-normal crossings of the trench. Topographic relief across the trench axis diminishes markedly with the gradual disappearance of the outer ridge on the Atlantic floor to the north.

The entire central section of the trench (between 17° and 19°N) is barren of turbidite deposits, but both to the north and to the south of this section the trench axis contains up to 1.1 seconds of horizontally stratified material. The continuation of oceanic reflectors for several kilometers beneath the outer toe of the Antillean structure, as described by Chase and Bunce (1969), was seen in almost every crossing of 19°N. In the vicinity of 17°N, Atlantic sea-floor reflectors were recorded beneath the island-arc terrace as much as 52 km west of the trench axis.

The eastern margin of the Venezuela Basin, at its junction with the Aves Swell, was surveyed in greater detail than originally planned, because several dredge stations planned for the earlier part of Leg 3 were cancelled due to sea conditions and about 48 hours of extra time became available. The last few lines were modified to give two additional trench crossings, an extra line was carried south of Aves Island, and new lines were run near the Aves Swell.

Published acoustic-reflection profiles from the Venezuela Basin show a zone of strong reflectors (Horizon B"), which normally represent acoustic basement at a two-way travel time distance about 0.8 sec below the sea floor (Ewing and others, 1967). In recent deep-sea drillings, this zone was identified as basalt and dolerite of Coniacian age (Edgar and others, 1971b). Previous reflection profile data have yielded a mere indication that layered material may be present below B" (Edgar and others, 1971a), but the profiles from Leg 3 (lines 46-50) show a zone of prominent sub-B" reflectors in the northeast corner of the Venezuela Basin. The interval between Horizon B" and the zone of deeper reflectors is representing a two-way travel time that varies from 0.4 to 0.6 sec, thinning northwestward off the flank of Aves Swell.

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#### OPERATIONAL DATA

##### Navigation

A satellite navigation system, supplemented by radar, was used for positioning. The satellite system consisted of an ITT 4007 AB satellite navigation receiver, a DEC PDP-8L computer, and an ITT Teletypewriter. In a 48-hour test, while at the dock in San Juan harbor, 15 satellite fixes were within about 70 m (230 ft) of a plotted average; 10 were within about 45 m (150 ft) of the average position. Precision of satellite fixes while underway was estimated at about 180 m (600 ft).

The radar system was a Decca RM 329, with 25 kw of power and a range up to about 65 m (40 mi). A 9-foot wave-guide antenna giving a beam width of less than 1° at the half-power points provided high azimuth resolution. Accuracy of radar fixes was subject to many variables, but the average positioning error was estimated at 0.5 nautical mile, or about 925 m (3000 ft.). Plotting was done on bottom-contour charts 703 and 704 of the U.S. Navy's Hydrographic Office.

Times for navigation and scientific records were referred to Greenwich Mean Time (Z), and days are numbered consecutively from the first day of the year. Time signals broadcast by WWV were used to set and standardize scientific clocks throughout the ship.

##### Acoustic-reflection System

The acoustic-reflection profiles were obtained using a sparker system consisting of separate, van-mounted, self-contained 160-and 120-kilojoule units triggered from a single source. Total usable power was about 220 kilojoules. The triggered discharge of large capacitors through 6 twin-electrode "ladders" trailed behind the ship created sparks that produced the low-frequency acoustic pulses. These pulses

were reflected from the sea bottom and from subbottom surfaces and were received and preamplified by a 100-hydrophone streamer. They were then selectively filtered (mainly in the 15 to 125 hz range) and were recorded graphically on a Raytheon recorder. An Ampex CP 100 7-channel recorder was used to put the data on magnetic tape for later playback at different filter settings and for record enhancement. The sparker ladders were trailed about 70 m behind the navigation antenna; the center of the hydrostreamer was at about 180 m.

Organization of profile records.--The subbottom acoustic profiles in this report are presented in numerical order at approximately 1/5th scale. Some have been printed in reverse in order to facilitate comparison of structural and sedimentary features from profile to profile. Profiles through Mona Passage are organized to be viewed generally westward (south on the left side), those along the Anegada Trough are viewed to the east and northeast except lines 23 and 25; those along the Puerto Rico Trench are viewed northwestward, as are lines 23, 25, 32, 34, and 50; the remainder are viewed generally northward. The start and end of each line are indicated. Days are numbered consecutively from day one of the year 1971; time marks are every hour. The records in this report were made between days 198 and 216 (July 17 to August 4). Hour marks shown on the profiles are GMT and correspond to those on the detailed track chart (plate 1) and on the location-depth printout (Table 1).

The subbottom profiles were made mainly at a 4-second firing rate and 4-second sweep with the exception of line 27, which was run at 1-second firing rate and 1-second sweep, and of line 9 and parts of lines 8, 10, and 47, which were run at 6-second firing rate and 6-second sweep. Only 19 of the 50 lines were run at a single power setting. Line 27 was run entirely at 40 kj, lines 2, 15, 16, 19, 30 and 31 at 80 kj, lines 11 and 34 at 120 kj, and lines 8, 9, 13, 38, 39, 45 and 47 to 50 at 160 kj. Parts of the remaining lines were run at power settings of 40, 80, 120, and 160 kj. The filter band pass was 76/16 and 76/20 for lines 1 - 46 and mainly 47/20 for lines 47 - 50 but with intervals of 76/20.

The vertical scale shown on the acoustic profiles is two-way travel time. The profiles range widely in vertical exaggeration but average about 10:1.

#### Depth Recorder

A 3.5 khz Edo acoustic-reflection system was used as an echosounder and shallow-penetration subbottom profiler. Twelve transducers were mounted into a well that was built into the ship's hull. These transducers emitted a pulse signal programmed by a Giff graphic recorder. The pulse was reflected at the ocean bottom and provided uncorrected

water depths in seconds (two-way travel time). These water depths, in seconds, were transcribed at quarter-hour intervals and, in conjunction with navigation fixes, were computer-processed using corrections from Matthew's tables. Computer output was printed at one-hour intervals and includes the position of each station, the observed depth in seconds (two-way travel time), and the corrected depth in meters (Table 1).



Table 1.--Positions and depths expressed in two-way travel time and corrected meters along lines of Leg 3, Greater Antilles, 1971

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
1	198	2000	18.5109	66.2777	0.110	83
1	198	2100	18.5168	66.3960	0.160	121
1	198	2200	18.5225	66.5283	0.289	219
1	198	2300	18.5264	66.6668	0.603	454
1	199	0000	18.5282	66.8111	0.430	325
1	199	0100	18.5706	66.7305	1.050	783
1	199	0200	18.5989	66.6417	1.482	1104
1	199	0300	18.5936	66.8025	1.282	955
2	199	0400	18.5874	66.9642	1.055	786
2	199	0500	18.5901	67.1249	0.335	253
2	199	0600	18.5965	67.2849	0.608	458
2	199	0700	18.6029	67.4450	3.720	2779
2	199	0800	18.6111	67.5582	3.120	2327
3	199	0900	18.5215	67.5961	2.640	1967
3	199	1000	18.3757	67.6004	1.010	753
3	199	1100	18.2212	67.6076	0.660	495
3	199	1200	18.0585	67.6084	1.270	946
3	199	1300	17.9059	67.6033	2.050	1527
4	199	1400	17.8344	67.6266	2.240	1669
4	199	1500	17.9674	67.6867	1.520	1132
4	199	1600	18.1075	67.7485	1.110	827
4	199	1700	18.2602	67.8229	0.653	490
4	199	1800	18.4109	67.8848	0.652	489
4	199	1900	18.5615	67.9468	0.381	288
4	199	2000	18.7077	67.9976	0.652	489
4	199	2100	18.8511	68.0471	1.105	824
5	199	2200	18.9833	68.0967	3.000	2238
5	199	2300	18.8465	68.0938	1.070	798
5	200	0000	18.7043	68.0895	0.570	430
5	200	0100	18.5633	68.0911	0.230	174
5	200	0200	18.4237	68.0946	0.430	325
5	200	0300	18.2854	68.1000	0.950	709
5	200	0400	18.1453	68.0999	2.110	1572
6	200	0500	18.0565	68.2002	2.962	2209
6	200	0600	17.9709	68.3128	3.000	2238
6	200	0700	17.8854	68.4255	2.389	1780
6	200	0800	17.7872	68.5343	2.700	2012
6	200	0900	17.6904	68.6482	2.945	2196
6	200	1000	17.5904	68.7609	4.010	2999

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
6	200	1100	17.4821	68.8674	4.930	3741
7	200	1200	17.3636	68.9462	6.030	4521
7	200	1300	17.2200	68.9658	7.325	5492
7	200	1400	17.0801	68.9898	6.910	5181
8	200	1500	17.0934	68.9097	6.950	5211
8	200	1600	17.1677	68.8061	7.290	5466
8	200	1700	17.2410	68.7066	7.250	5436
8	200	1800	17.2948	68.5797	6.790	5091
8	200	1900	17.3376	68.4789	6.700	5023
8	200	2000	17.3749	68.3981	5.300	3973
8	200	2100	17.4112	68.3166	5.190	3891
8	200	2200	17.4446	68.2328	5.085	3812
9	200	2300	17.3850	68.1680	5.170	3876
9	201	0000	17.3163	68.1053	5.700	4273
9	201	0100	17.2483	68.0404	6.490	4866
9	201	0200	17.1817	67.9713	7.220	5413
9	201	0300	17.1210	67.9019	6.800	5098
9	201	0400	17.0613	67.8324	6.550	4911
9	201	0500	17.0019	67.7622	6.580	4933
10	201	0600	16.9820	67.6871	6.620	4963
10	201	0700	17.0508	67.6039	6.680	5008
10	201	0800	17.1195	67.5206	6.760	5068
10	201	0900	17.1883	67.4354	6.790	5091
10	201	1000	17.2526	67.3601	6.805	5102
10	201	1100	17.3203	67.2981	6.450	4836
11	201	1200	17.3908	67.2383	5.650	4236
11	201	1300	17.3160	67.1923	6.790	5091
11	201	1400	17.2364	67.1475	6.730	5046
12	201	1500	17.2331	67.0783	6.740	5053
13	201	1600	17.2650	66.9919	6.740	5053
13	201	1700	17.2726	66.8960	6.735	5049
13	201	1800	17.2800	66.8002	6.710	5031
13	201	1900	17.2875	66.7045	6.670	5001
13	201	2000	17.2936	66.6011	6.700	5023
13	201	2100	17.2996	66.5014	6.700	5023
13	201	2200	17.3078	66.3942	6.680	5008

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
14	202	0000	17.5064	66.2443	4.750	3561
14	202	0100	17.6402	66.1710	2.600	1937
14	202	0200	17.7734	66.0960	1.020	760
15	202	0300	17.8729	66.0110	1.520	1132
15	202	0400	17.7852	65.8930	0.425	322
15	202	0500	17.6996	65.7772	2.170	1617
15	202	0600	17.6139	65.6615	1.700	1266
15	202	0700	17.5274	65.5518	3.210	2395
16	202	0800	17.6062	65.5609	2.320	1728
16	202	0900	17.7469	65.6075	2.910	2170
16	202	1000	17.8847	65.6190	1.840	1371
16	202	1100	18.0316	65.6418	1.150	857
17	202	1200	18.0074	65.6015	1.960	1460
17	202	1300	17.8892	65.5300	3.350	2500
17	202	1400	17.7605	65.4621	0.340	257
17	202	1500	17.6343	65.3964	2.280	1699
17	202	1600	17.5129	65.3319	3.050	2275
17	202	1700	17.3972	65.2595	5.100	3824
18	202	1800	17.3200	65.1922	5.780	4333
18	202	1900	17.4641	65.2256	4.200	3144
18	202	2000	17.6056	65.2584	2.360	1758
18	202	2100	17.7427	65.2793	2.630	1959
18	202	2200	17.8798	65.3003	5.280	3958
18	202	2300	18.0146	65.3188	2.900	2162
19	203	0000	18.0922	65.2432	0.890	664
20	203	0100	18.1063	65.1301	1.230	916
20	203	0200	17.9992	65.0770	4.920	3731
20	203	0300	17.8870	65.0289	5.950	4461
20	203	0400	17.7692	64.9869	1.210	901
21	203	0500	17.7494	64.9562	1.540	1147
21	203	0600	17.8689	64.9597	5.960	4468
21	203	0700	17.9894	64.9631	5.800	4348
21	203	0800	18.1099	64.9665	3.800	2839
22	204	0000	18.0824	64.7628	3.350	2500
22	204	0100	18.0211	64.6649	4.530	3396
22	204	0200	17.9554	64.5621	2.470	1840

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
22	204	0300	17.8897	64.4594	2.380	1773
22	204	0400	17.8284	64.3575	1.620	1207
22	204	0500	17.7683	64.2559	2.050	1527
22	204	0600	17.7083	64.1542	0.950	709
22	204	0700	17.6473	64.0523	0.790	590
22	204	0800	17.5840	63.9498	0.650	488
22	204	0900	17.5169	63.8484	0.520	393
22	204	1000	17.4707	63.7477	0.320	242
22	204	1100	17.5552	63.6563	0.420	318
22	204	1200	17.6420	63.5662	0.635	477
22	204	1300	17.7316	63.4775	0.550	415
22	204	1400	17.8205	63.3862	1.450	1080
22	204	1500	17.9084	63.2870	1.455	1084
24	204	1600	17.9963	63.1878	0.820	612
24	204	1700	18.0227	63.3085	1.350	1006
24	204	1800	18.0431	63.4252	1.380	1028
24	204	1900	18.0645	63.5445	1.210	901
25	204	2000	17.9721	63.6678	2.120	1579
25	204	2100	17.8758	63.7907	2.060	1535
25	204	2200	17.7783	63.9132	1.430	1065
25	204	2300	17.6807	64.0356	0.870	649
25	205	0000	17.5853	64.1548	2.650	1974
25	205	0100	17.4905	64.2730	4.255	3186
25	205	0200	17.3933	64.3863	4.595	3445
25	205	0300	17.2991	64.4994	4.775	3586
25	205	0400	17.2038	64.6075	5.230	3921
26	205	0500	17.3112	64.7056	4.980	3792
26	205	0600	17.4262	64.8034	3.750	2801
26	205	0700	17.5563	64.8796	1.470	1095
27	205	2000	18.2203	65.0297	0.055	41
27	205	2100	18.2265	64.8813	0.055	41
27	205	2200	18.2291	64.7303	0.065	49
28	205	2300	18.2065	64.6015	2.150	1602
28	206	0000	18.1449	64.4674	1.400	1043
28	206	0100	18.0891	64.3313	3.870	2892
28	206	0200	18.0315	64.1966	3.760	2809
28	206	0300	17.9679	64.0654	3.640	2719
28	206	0400	17.9042	63.9375	1.520	1132
28	206	0500	17.8438	63.7944	1.970	1468

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
28	206	0600	17.7835	63.6513	2.090	1557
28	206	0700	17.7238	63.5109	0.110	83
28	206	0800	17.6655	63.3751	0.110	83
29	206	0900	17.6762	63.3465	0.840	627
29	206	1000	17.7747	63.4745	1.220	909
29	206	1100	17.8727	63.5943	1.930	1438
29	206	1200	17.9698	63.7163	2.195	1635
29	206	1300	18.0653	63.8421	1.830	1363
29	206	1400	18.1610	63.9660	2.050	1527
29	206	1500	18.2584	64.0849	2.470	1840
29	206	1600	18.3626	64.2062	1.600	1192
30	206	1700	18.4376	64.2749	1.660	1237
30	206	1800	18.3759	64.1486	1.340	998
30	206	1900	18.3162	64.0199	2.050	1527
30	206	2000	18.2559	63.8908	1.200	894
30	206	2100	18.1936	63.7602	1.380	1028
30	206	2200	18.1360	63.6348	0.920	686
30	206	2300	18.0796	63.5107	1.010	753
30	207	0000	18.0252	63.3826	1.400	1043
30	207	0100	17.9721	63.2515	1.290	961
31	207	0200	18.0582	63.2625	1.020	760
31	207	0300	18.1990	63.3362	0.570	430
31	207	0400	18.3332	63.4096	1.000	746
31	207	0500	18.4675	63.4830	1.070	798
32	207	0600	18.5097	63.5629	1.640	1222
32	207	0700	18.3815	63.6538	1.390	1035
32	207	0800	18.2533	63.7447	1.460	1088
32	207	0900	18.1250	63.8244	1.990	1483
32	207	1000	18.0003	63.9077	2.700	2012
33	207	1100	17.9535	63.9951	2.000	1490
34	207	1200	18.0673	64.0406	2.770	2064
34	207	1300	18.1738	64.0055	1.680	1251
34	207	1400	18.2864	63.9559	1.880	1401
34	207	1500	18.3810	63.8925	1.750	1304
34	207	1600	18.4813	63.8291	1.980	1475
35	207	2000	18.6396	63.5877	2.300	1714
35	207	2100	18.7412	63.5198	4.850	3661

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
35	207	2200	18.8426	63.4518	8.050	6035
35	207	2300	18.9489	63.3746	7.460	5593
35	208	0000	19.0575	63.2907	7.870	5900
35	208	0100	19.1491	63.2031	7.390	5541
35	208	0200	19.2510	63.1156	8.400	6298
35	208	0300	19.3590	63.0144	8.310	6230
35	208	0400	19.4688	62.9164	8.800	6598
35	208	0500	19.5812	62.8232	9.680	7258
35	208	0600	19.6936	62.7301	8.980	6733
35	208	0700	19.8041	62.6316	8.500	6373
35	208	0800	19.9121	62.5261	6.950	5211
35	208	0900	20.0208	62.4245	7.460	5593
35	208	1000	20.1296	62.3236	7.350	5511
36	208	1100	20.0593	62.2997	7.380	5533
36	208	1200	19.9176	62.3133	7.500	5623
36	208	1300	19.7739	62.3323	7.820	5863
36	208	1400	19.6304	62.3546	8.150	6110
36	208	1500	19.4866	62.3712	9.630	7220
36	208	1600	19.3477	62.3943	9.390	7040
36	208	1700	19.2087	62.4174	8.500	6373
36	208	1800	19.0698	62.4405	8.900	6673
36	208	1900	18.9305	62.4566	8.100	6073
36	208	2000	18.7914	62.4727	7.450	5586
36	208	2100	18.6526	62.4946	7.090	5316
36	208	2200	18.5137	62.5164	5.000	3749
37	208	2300	18.4006	62.5230	1.340	998
37	209	0000	18.5227	62.4307	4.430	3320
37	209	0100	18.6447	62.3383	7.620	5713
37	209	0200	18.7574	62.2252	7.820	5863
37	209	0300	18.8592	62.1192	8.380	6283
37	209	0400	18.9539	62.0114	8.250	6185
37	209	0500	19.0486	61.9037	7.790	5840
37	209	0600	19.1406	61.7938	9.100	6823
37	209	0700	19.2273	61.6795	9.030	6770
37	209	0800	19.3215	61.5583	7.570	5676
37	209	0900	19.4267	61.4865	7.490	5616
38	209	1000	19.5345	61.4142	6.610	4956
38	209	1100	19.4032	61.4297	7.320	5488
38	209	1200	19.2517	61.4571	8.200	6148
38	209	1300	19.1047	61.4887	9.230	6920
38	209	1400	18.9606	61.5202	8.450	6335

## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
39	209	1500	18.9637	61.5529	8.200	6148
39	209	1600	19.0991	61.5788	9.380	7033
39	209	1700	19.2345	61.6047	8.380	6283
40	209	1800	19.2414	61.6308	8.550	6410
40	209	1900	19.0954	61.6489	9.100	6823
40	209	2000	18.9495	61.6669	7.600	5698
40	209	2100	18.8035	61.6850	7.820	5863
40	209	2200	18.6576	61.7030	7.950	5960
40	209	2300	18.5133	61.7231	7.660	5743
40	210	0000	18.3745	61.7500	7.000	5248
40	210	0100	18.2337	61.7808	6.230	4671
40	210	0200	18.0904	61.8170	5.210	3906
41	210	0300	18.1080	61.7680	5.000	3749
41	210	0400	18.1790	61.6549	5.430	4071
41	210	0500	18.2501	61.5418	6.920	5188
41	210	0600	18.3211	61.4287	7.250	5436
41	210	0700	18.3922	61.3157	7.100	5323
41	210	0800	18.4378	61.1873	7.500	5623
41	210	0900	18.4833	61.0590	7.470	5601
41	210	1000	18.5289	60.9307	7.980	5983
41	210	1100	18.5745	60.8024	8.570	6425
41	210	1200	18.6201	60.6741	9.250	6935
41	210	1300	18.6711	60.5467	8.720	6538
41	210	1400	18.7226	60.4192	8.280	6208
41	210	1500	18.7754	60.2932	7.950	5960
41	210	1600	18.8282	60.1672	8.000	5998
41	210	1700	18.7943	60.2078	8.000	5998
42	210	1800	18.7040	60.2953	8.200	6148
42	210	1900	18.5914	60.4011	8.600	6448
42	210	2000	18.4786	60.5057	8.910	6680
42	210	2100	18.3656	60.6080	8.140	6103
42	210	2200	18.2523	60.7121	7.870	5900
42	210	2300	18.1443	60.8216	7.730	5796
42	211	0000	18.0366	60.9319	7.090	5316
42	211	0100	17.9297	61.0447	6.270	4701
42	211	0200	17.8271	61.1669	6.080	4558
42	211	0300	17.7248	61.2900	5.370	4026
42	211	0400	17.6226	61.4131	5.360	4018
42	211	0500	17.5203	61.5361	3.900	2915
42	211	0600	17.4680	61.5614	3.000	2238



## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
43	211	0800	17.5273	61.3682	5.400	4048
43	211	0900	17.5692	61.2422	4.490	3366
43	211	1000	17.6112	61.1240	5.790	4341
43	211	1100	17.6531	61.0092	6.300	4723
43	211	1200	17.6953	60.8909	6.210	4656
43	211	1300	17.7319	60.7611	6.720	5038
43	211	1400	17.7612	60.6322	7.040	5278
43	211	1500	17.7917	60.5013	7.470	5601
43	211	1600	17.8267	60.3626	7.700	5773
43	211	1700	17.8617	60.2238	8.150	6110
43	211	1800	17.8967	60.0850	8.790	6590
43	211	1900	17.9317	59.9463	8.470	6350
43	211	2000	17.9616	59.8021	8.050	6035
43	211	2100	17.9916	59.6562	7.770	5826
43	211	2200	18.0224	59.5071	7.560	5668
43	211	2300	18.0532	59.3579	7.580	5683
44	212	0000	17.9892	59.3705	7.660	5743
44	212	0100	17.8637	59.4361	7.820	5863
44	212	0200	17.7341	59.5078	7.950	5960
44	212	0300	17.6045	59.5795	8.070	6050
44	212	0400	17.4749	59.6511	8.320	6238
44	212	0800	17.4510	59.6028	8.100	6073
44	212	0900	17.3255	59.6821	7.850	5885
44	212	1000	17.2000	59.7613	7.530	5646
44	212	1100	17.0772	59.8355	6.680	5008
45	212	1200	17.0262	59.7788	6.850	5136
45	212	1300	17.0221	59.6366	7.780	5833
45	212	1400	17.0164	59.4920	7.250	5436
45	212	1500	17.0117	59.3479	7.500	5623
45	212	1600	17.0049	59.2024	7.780	5833
45	212	1700	16.9972	59.0564	7.840	5878
45	212	1800	16.9897	58.9105	7.820	5863
45	212	1900	16.9829	58.7646	7.130	5346
45	212	2000	16.9749	58.6270	7.640	5728
46	212	2100	16.9216	58.6630	7.780	5833
46	212	2200	16.8495	58.8001	7.260	5443
46	212	2300	16.7803	58.9425	7.660	5743
46	213	0000	16.7118	59.0859	7.270	5451
46	213	0100	16.6470	59.2278	6.980	5233
46	213	0200	16.5821	59.3697	7.870	5900
46	213	0300	16.5173	59.5116	7.760	5818

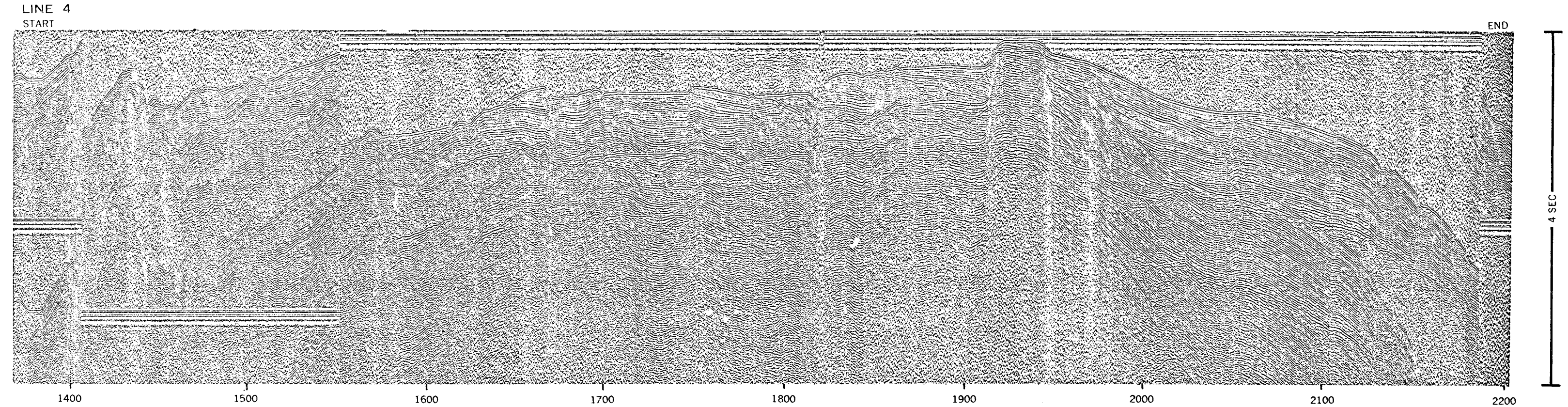
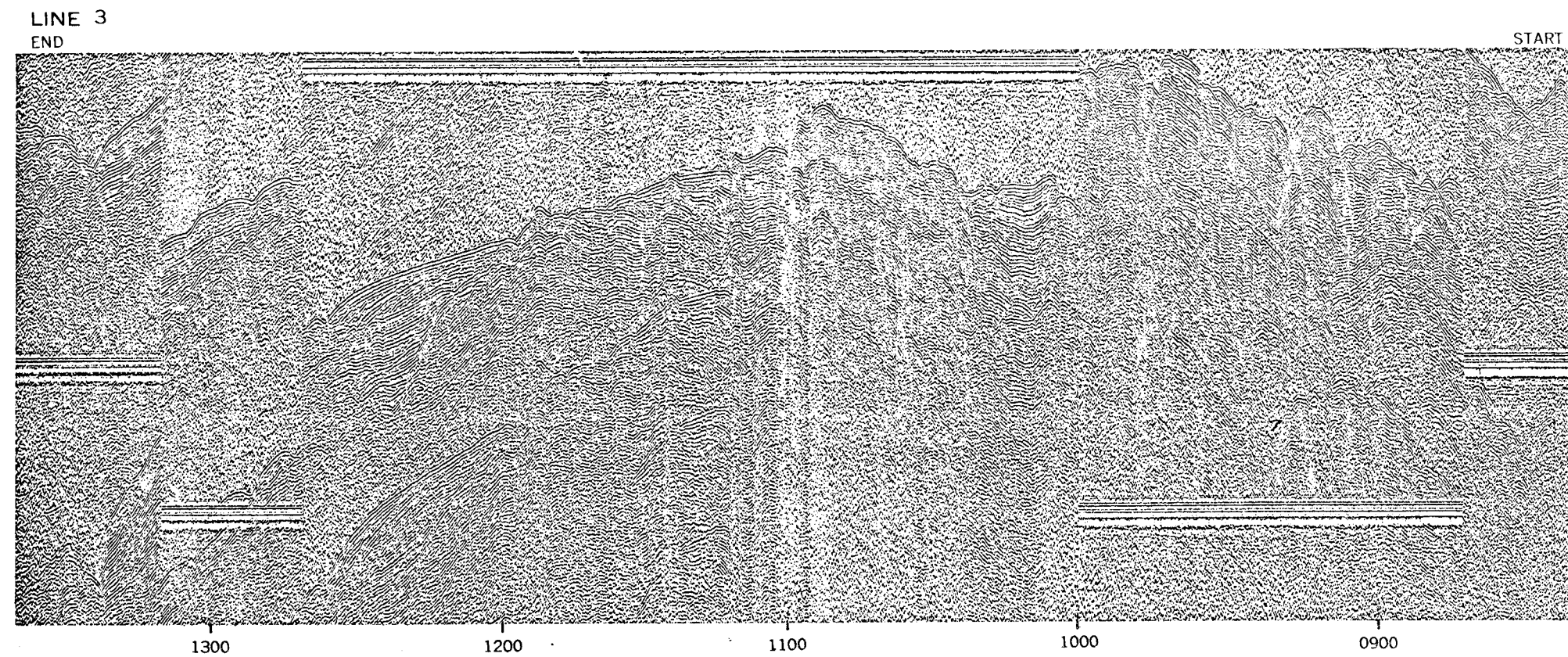
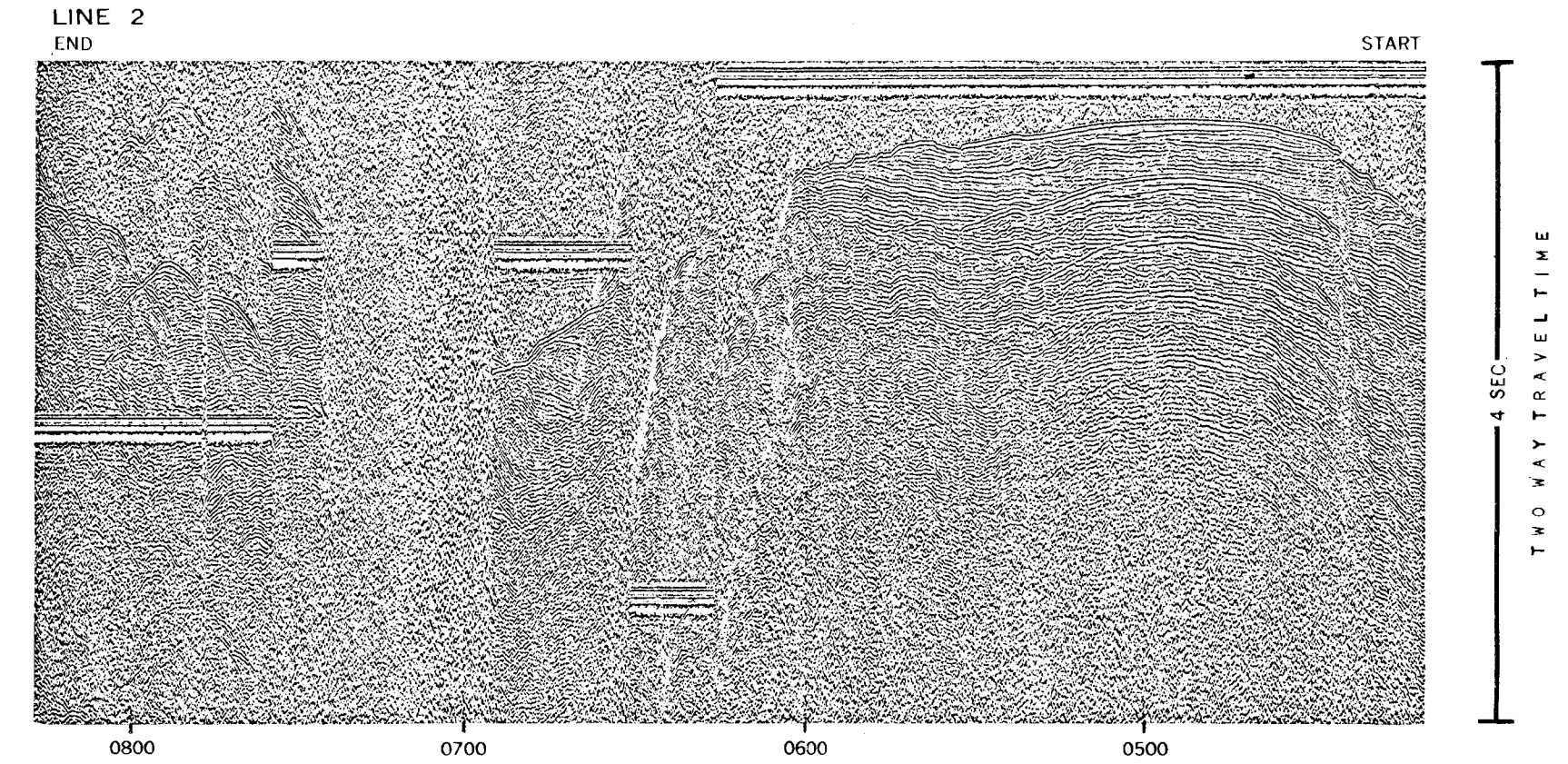
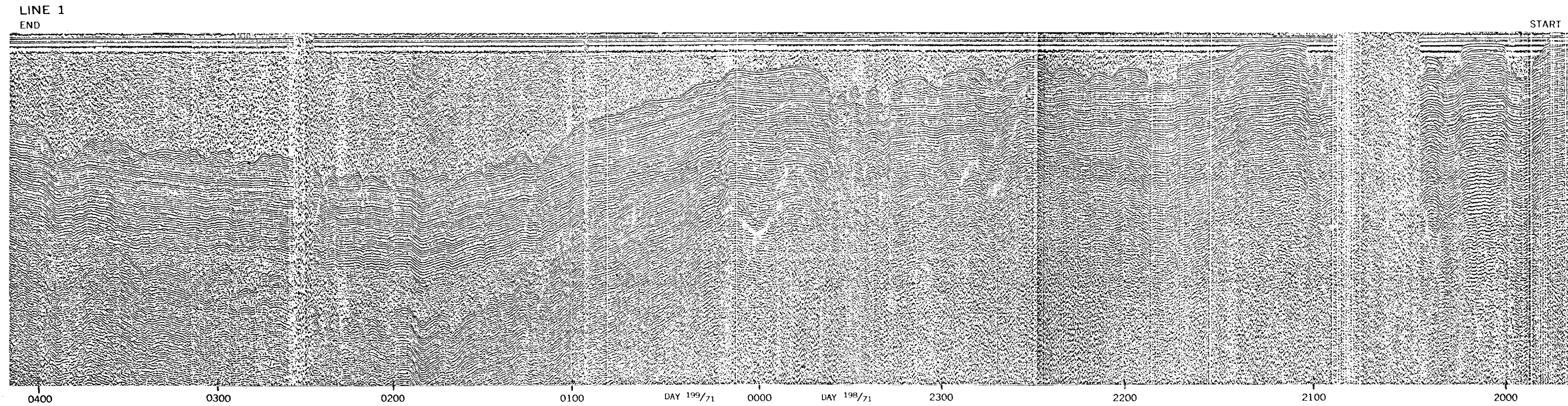
## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
46	213	0400	16.4585	59.6534	7.580	5683
46	213	0500	16.3997	59.7952	7.900	5923
46	213	0600	16.3365	59.9404	6.530	4896
46	213	0700	16.2800	60.0776	6.590	4941
46	213	0800	16.2205	60.2132	6.470	4851
46	213	0900	16.1542	60.3454	6.150	4611
46	213	1000	16.0844	60.4767	5.780	4333
46	213	1100	16.0114	60.6071	2.260	1684
46	213	1200	15.9398	60.7399	1.470	1095
46	213	1300	15.8692	60.8750	1.910	1423
46	213	1400	15.7989	61.0122	1.510	1125
46	213	1500	15.7562	61.1611	0.810	604
46	213	1600	15.7529	61.3313	0.930	694
46	213	1700	15.7496	61.5016	1.200	894
46	213	1800	15.7480	61.6126	1.550	1155
46	213	1900	15.7458	61.7350	2.340	1743
46	213	2000	15.7419	61.9127	1.710	1274
46	213	2100	15.7028	62.0936	2.170	1617
46	213	2200	15.6623	62.2693	2.610	1945
46	213	2300	15.6383	62.4273	2.690	2004
46	214	0000	15.6228	62.5687	3.280	2447
46	214	0100	15.6126	62.7106	2.820	2102
46	214	0200	15.6020	62.8530	2.840	2117
46	214	0300	15.5893	62.9925	2.700	2012
46	214	0400	15.5762	63.1314	3.130	2335
46	214	0500	15.5631	63.2702	2.640	1967
46	214	0600	15.5501	63.4091	2.610	1945
46	214	0700	15.5339	63.5499	1.700	1266
46	214	0800	15.5208	63.6950	1.930	1438
46	214	0900	15.5002	63.8370	2.690	2004
46	214	1000	15.4813	63.9774	2.180	1624
46	214	1100	15.4623	64.1178	4.370	3274
46	214	1200	15.4434	64.2583	4.800	3611
46	214	1300	15.4269	64.3989	5.060	3794
46	214	1400	15.4109	64.5413	5.200	3898
46	214	1500	15.3949	64.6837	5.200	3898
46	214	1600	15.3790	64.8261	5.500	4123
47	214	1700	15.4254	64.8064	5.480	4108
47	214	1800	15.4919	64.7191	5.400	4048
47	214	1900	15.5413	64.6227	5.310	3981
47	214	2000	15.6201	64.4954	5.110	3831
47	214	2100	15.6988	64.3681	4.810	3621
47	214	2200	15.7783	64.2411	4.620	3464

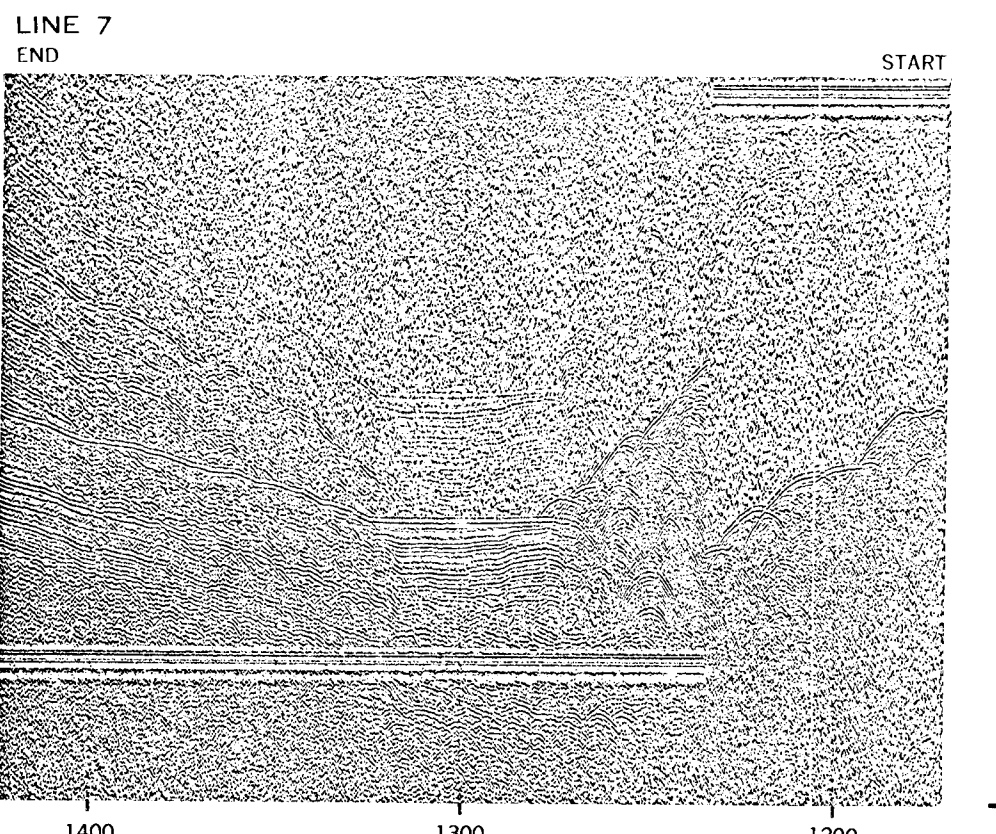
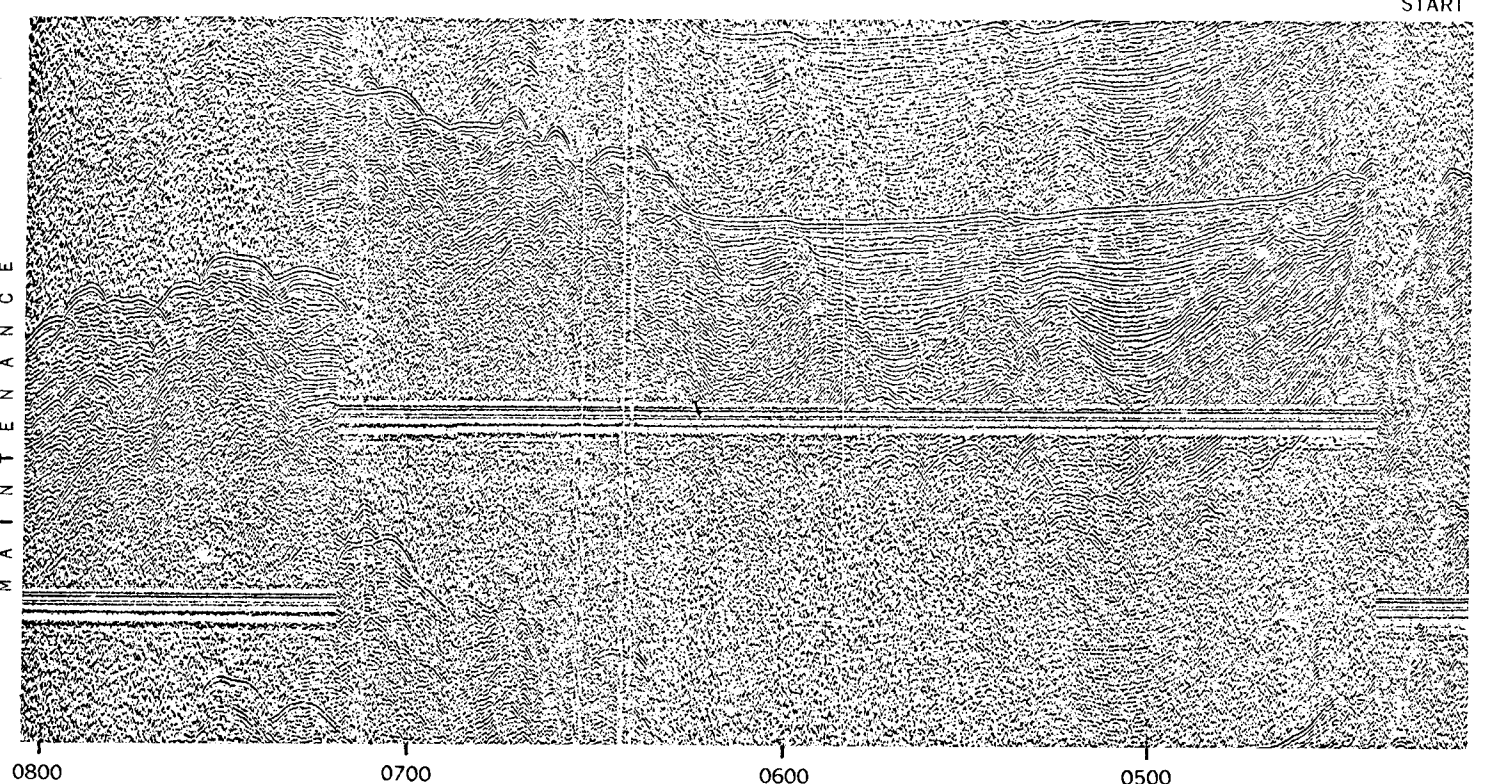
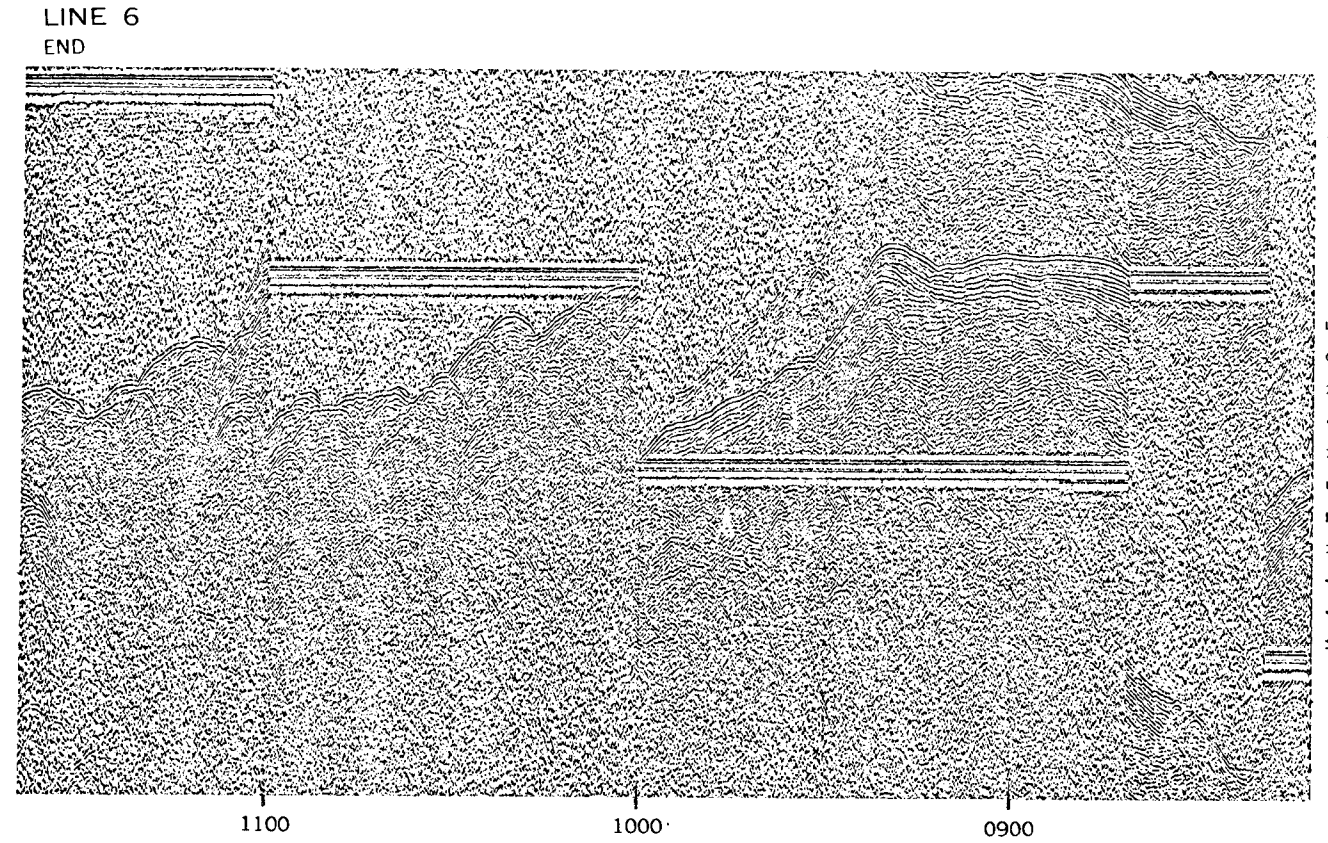
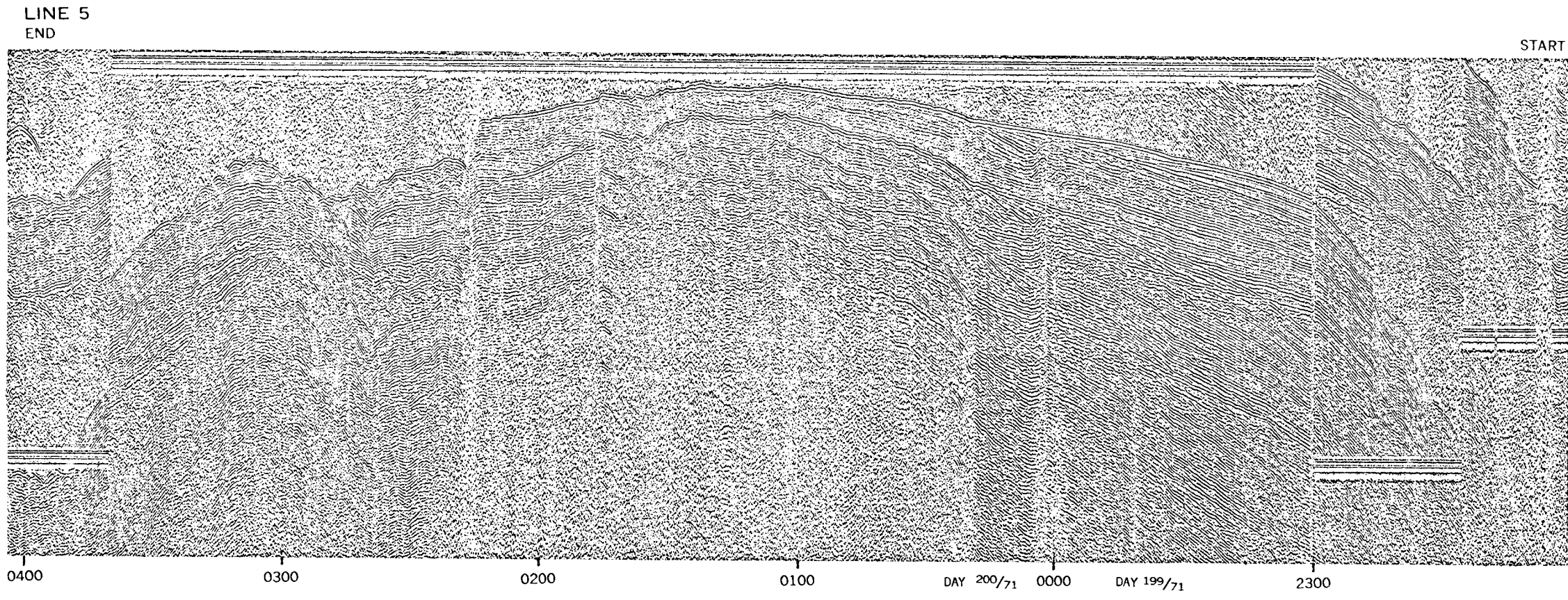
## I.D.O.E. '71 LEG 3 - ANTILLES

LINE	DAY	TIME (Z)	LATITUDE (NORTH)	LONGITUDE (WEST)	DEPTH (SEC)	DEPTH (M)
47	214	2300	15.8544	64.1165	4.180	3129
47	215	0000	15.9144	64.0144	3.170	2365
47	215	0100	15.9915	63.8848	2.440	1818
47	215	0200	16.0695	63.7538	2.430	1810
47	215	0300	16.1474	63.6229	2.400	1788
48	215	0400	16.2275	63.4958	2.300	1714
48	215	0500	16.3026	63.6234	2.220	1654
48	215	0600	16.3747	63.7602	2.050	1527
48	215	0700	16.4459	63.8947	1.310	976
48	215	0800	16.5197	64.0292	3.400	2538
48	215	0900	16.5933	64.1664	4.320	3236
48	215	1000	16.6679	64.3018	4.630	3471
48	215	1100	16.7439	64.4342	4.940	3752
49	215	1200	16.8185	64.5689	5.180	3884
49	215	1300	16.8558	64.7175	5.260	3943
49	215	1400	16.8571	64.8753	5.400	4048
49	215	1500	16.8584	65.0328	5.770	4326
49	215	1600	16.8598	65.1903	6.020	4513
49	215	1700	16.8612	65.3478	6.100	4573
49	215	1800	16.8625	65.5053	6.150	4611
49	215	1900	16.8639	65.6628	6.130	4596
49	215	2000	16.8664	65.8217	6.080	4558
50	215	2100	16.9944	65.7869	6.240	4678
50	215	2200	17.1267	65.7133	6.360	4768
50	215	2300	17.2586	65.6238	6.230	4671
50	216	0000	17.3906	65.5343	5.160	3869
50	216	0100	17.5175	65.4537	2.950	2200
50	216	0200	17.6405	65.3800	2.220	1654
50	216	0300	17.7636	65.3062	2.650	1974
50	216	0400	17.8866	65.2324	5.350	4011
50	216	0500	18.0096	65.1585	3.700	2764

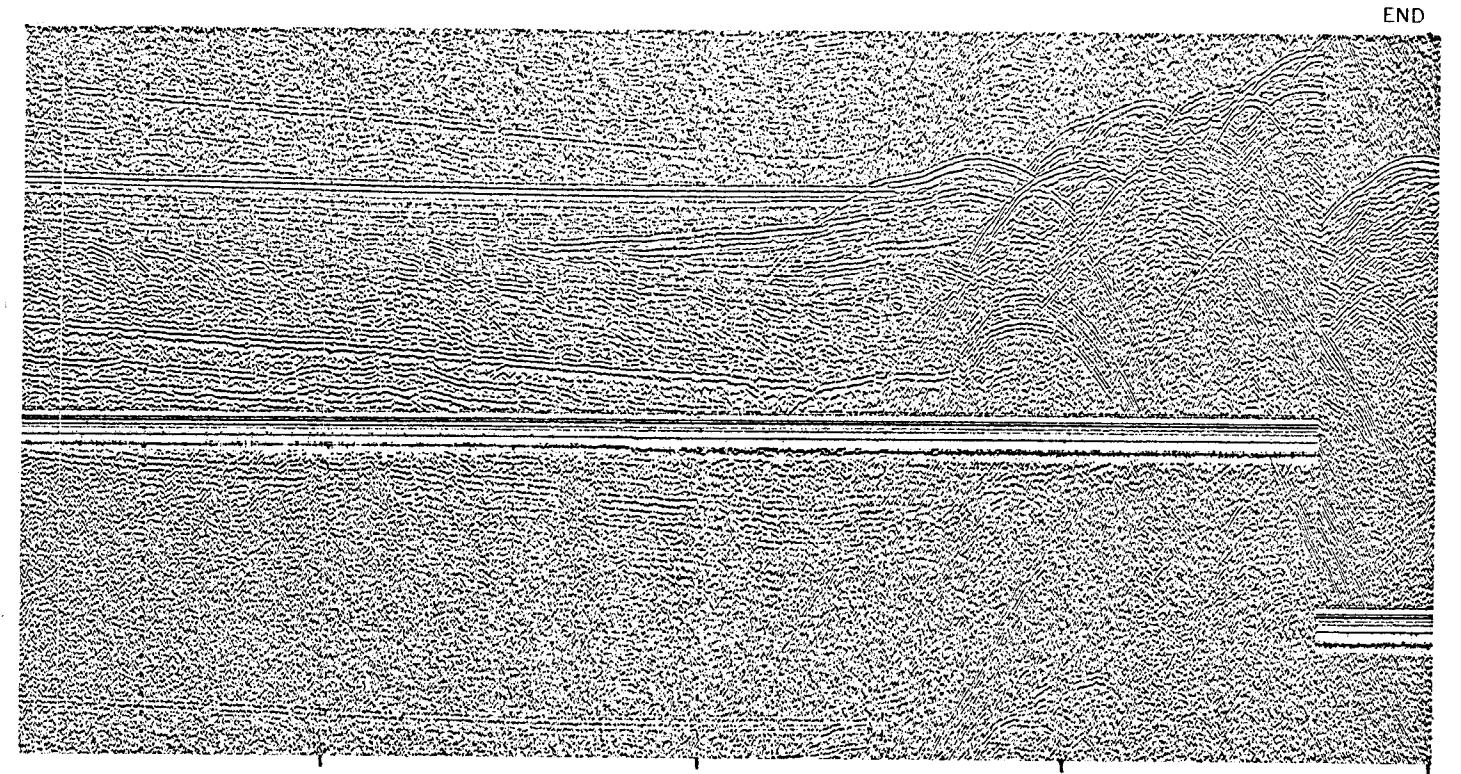
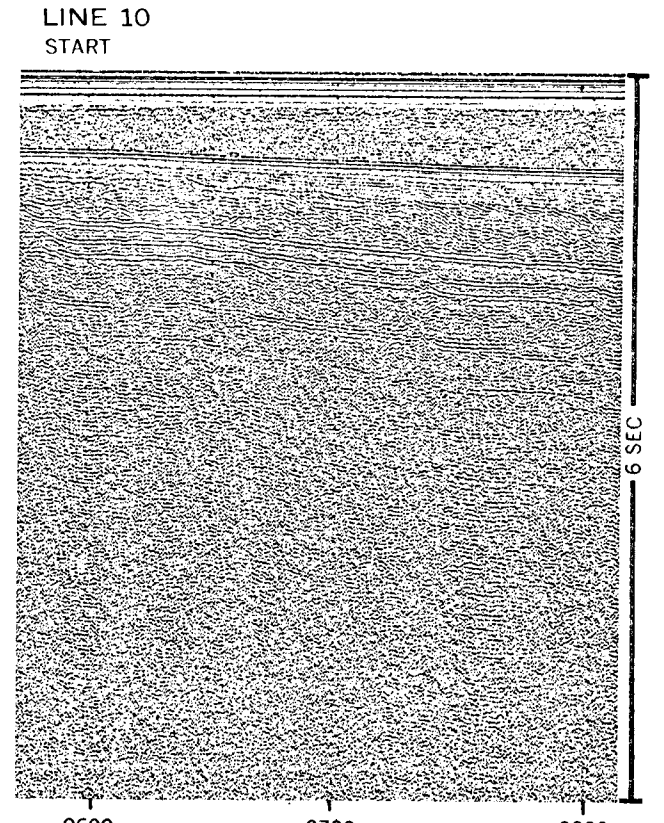
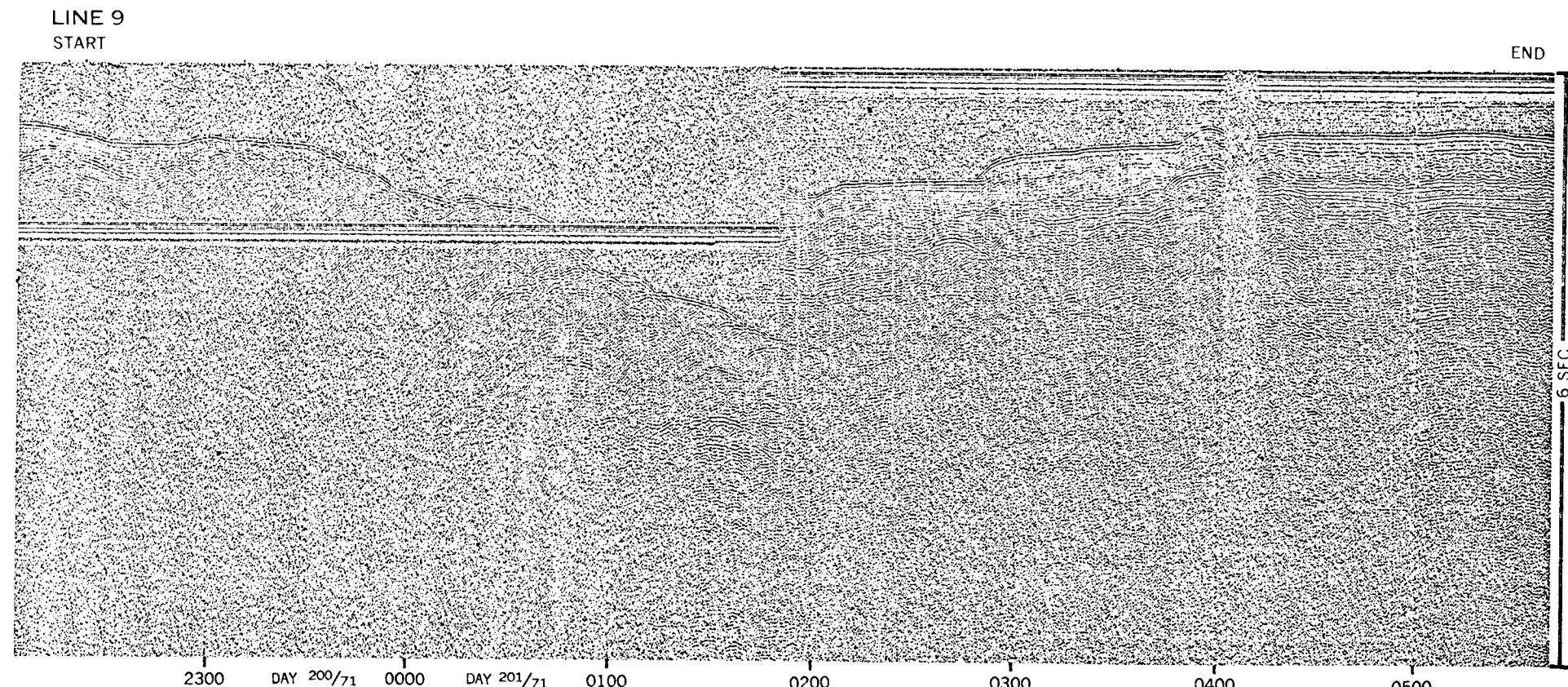
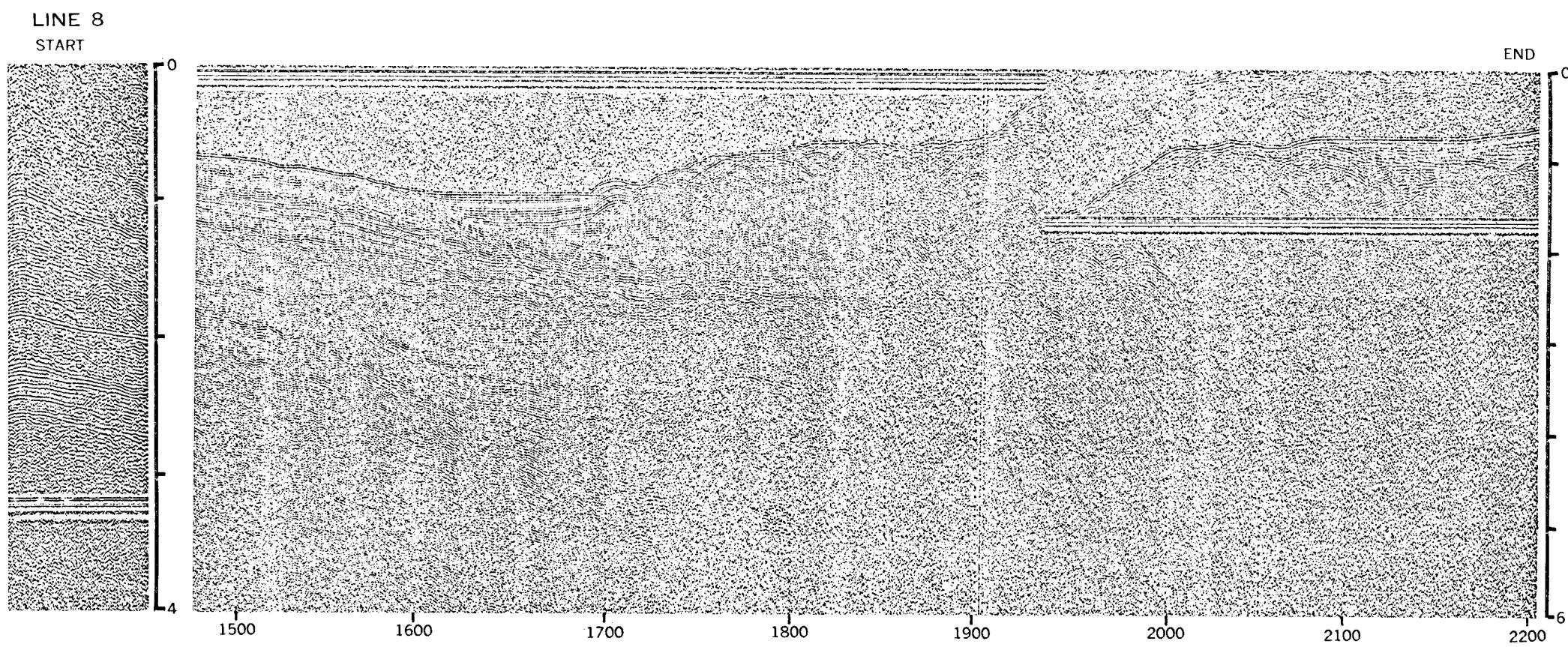






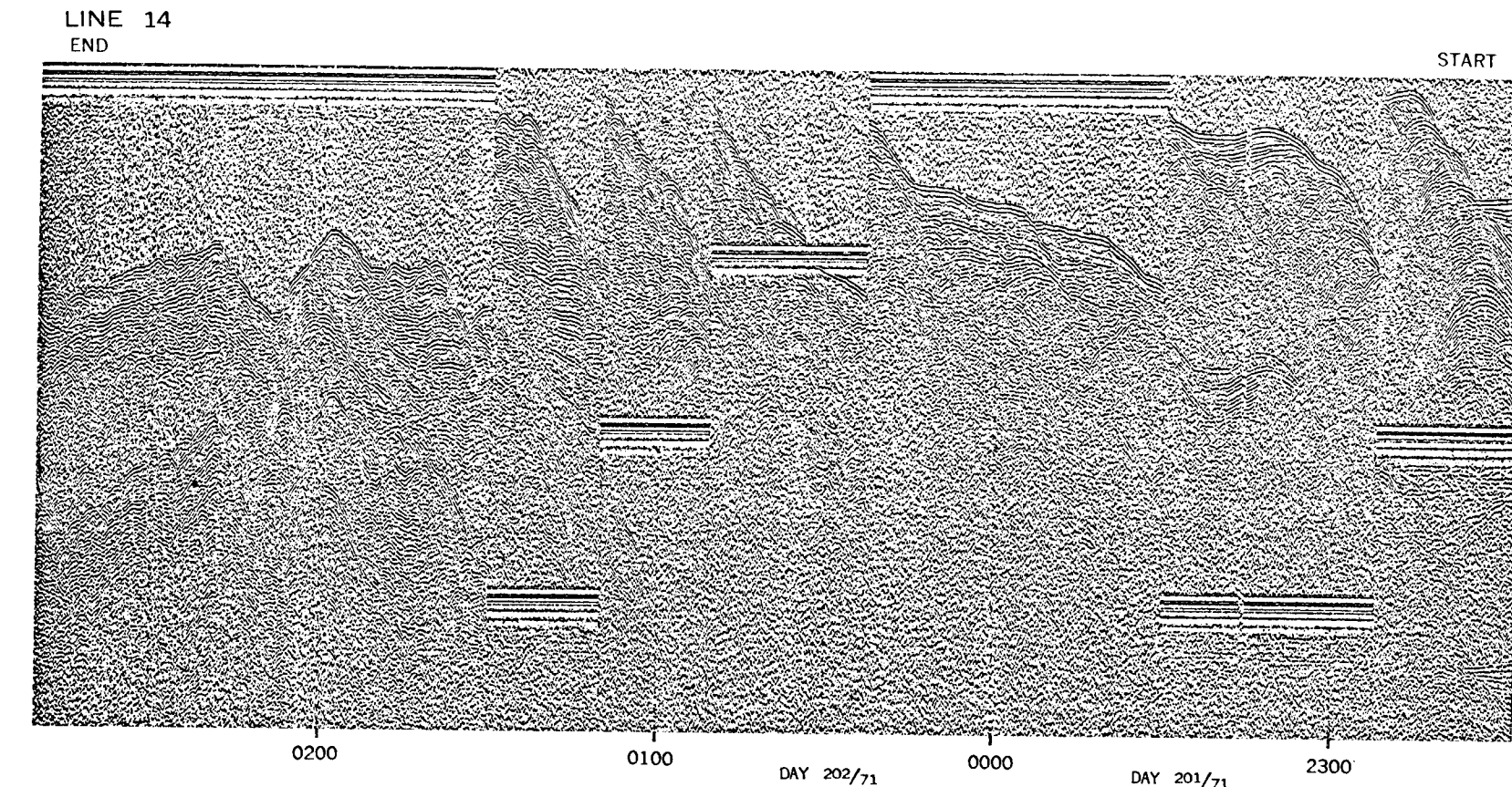
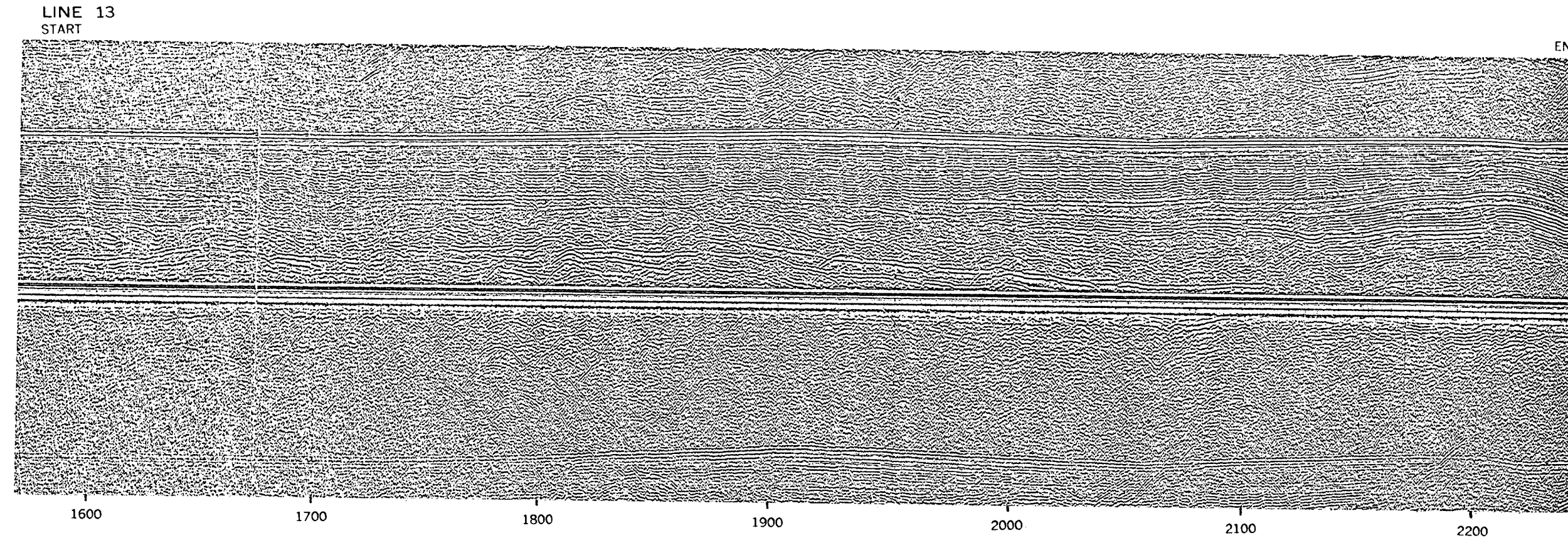
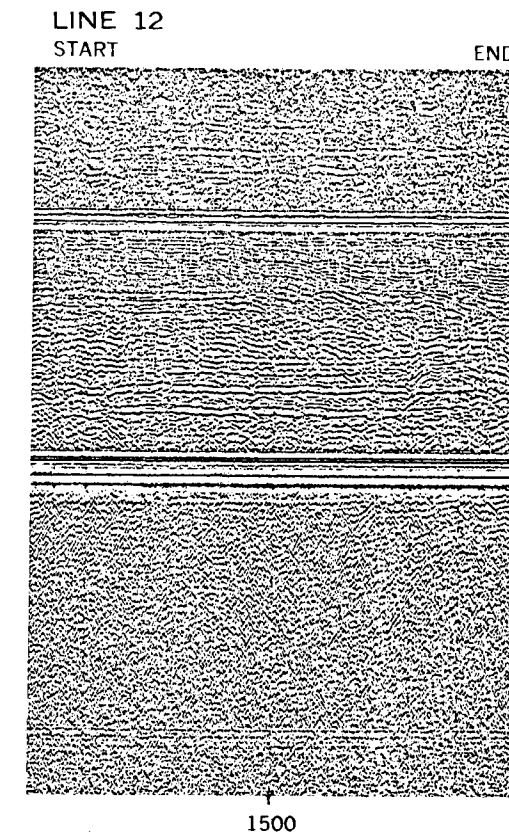
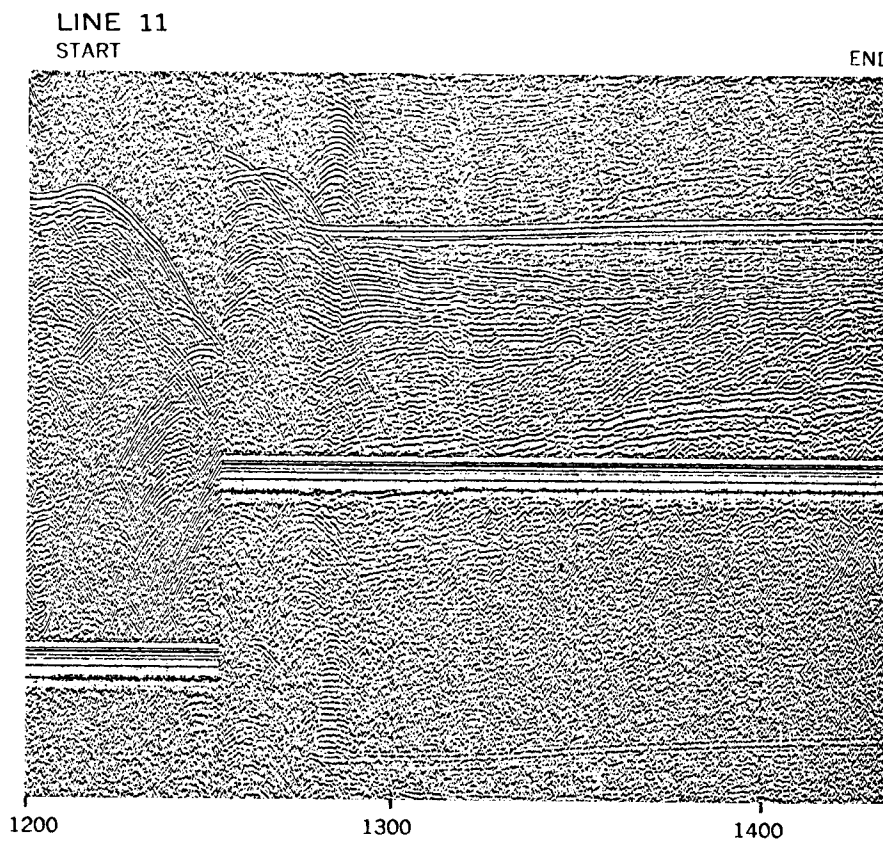


4 SEC  
TWO WAY TRAVEL TIME

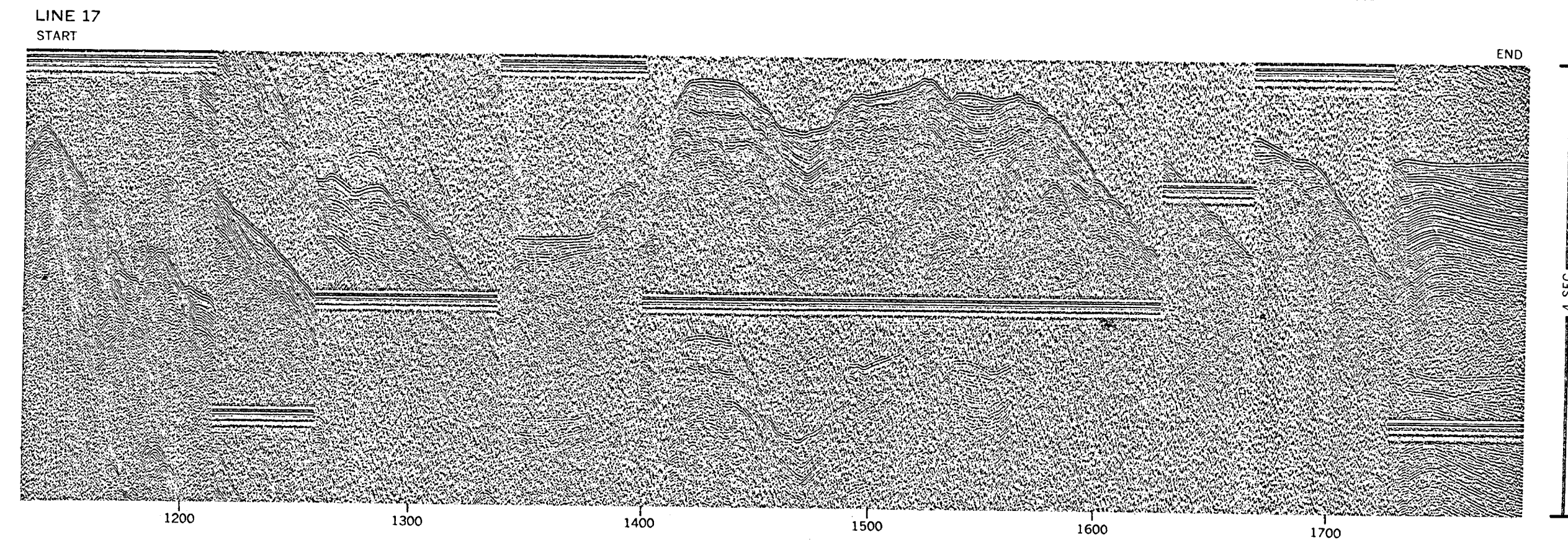
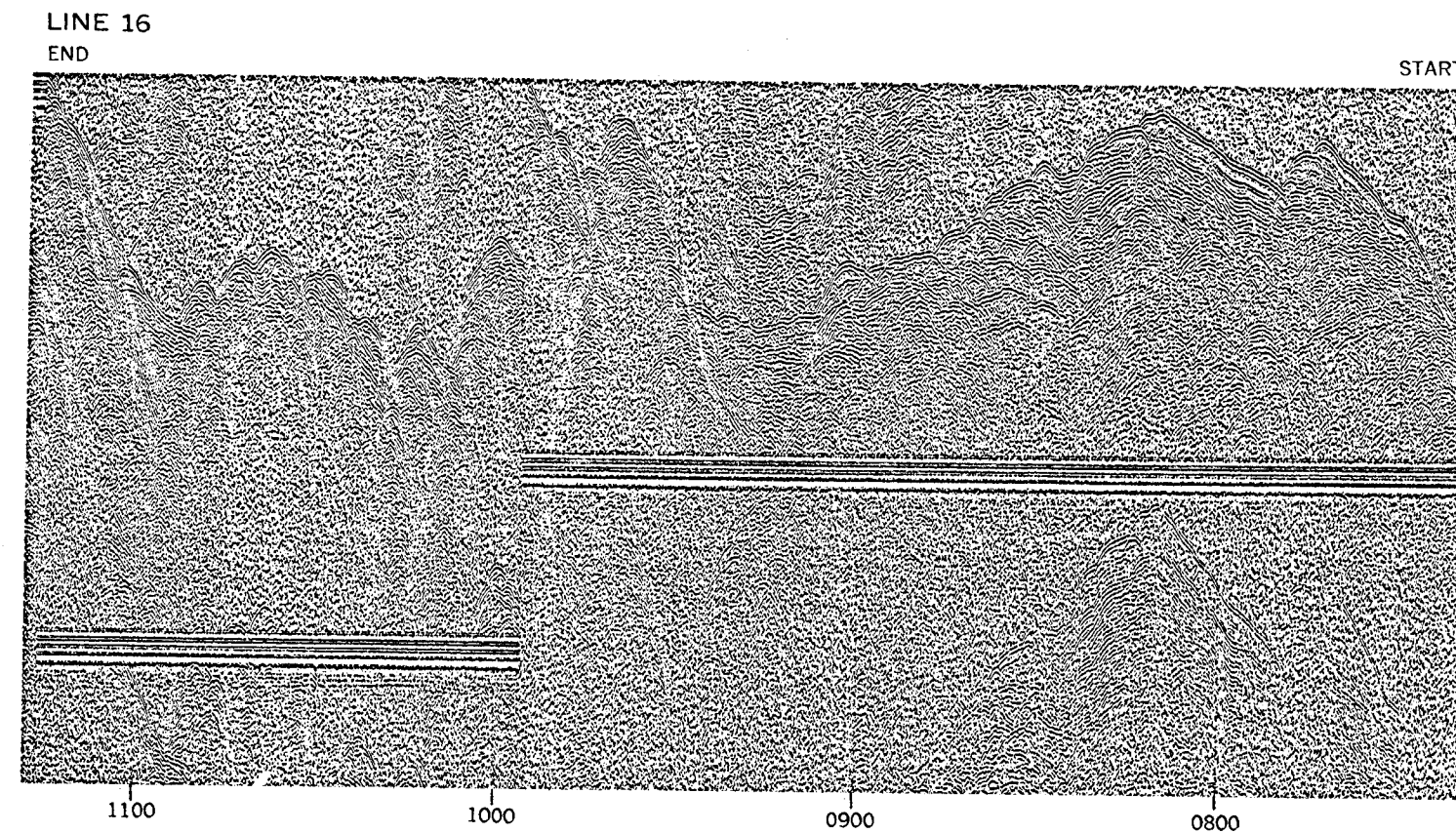
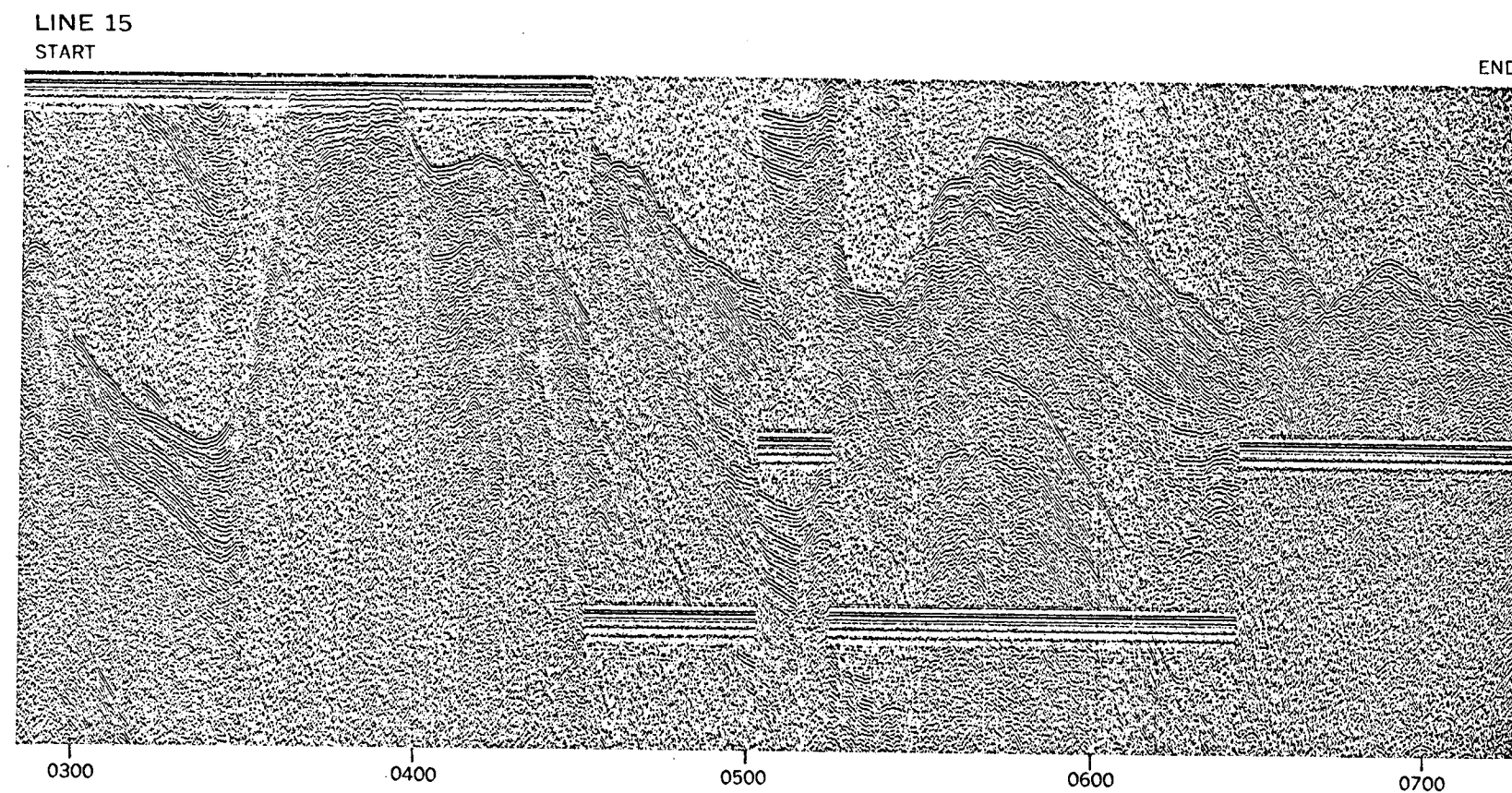


4 SEC  
TWO WAY TRAVEL TIME



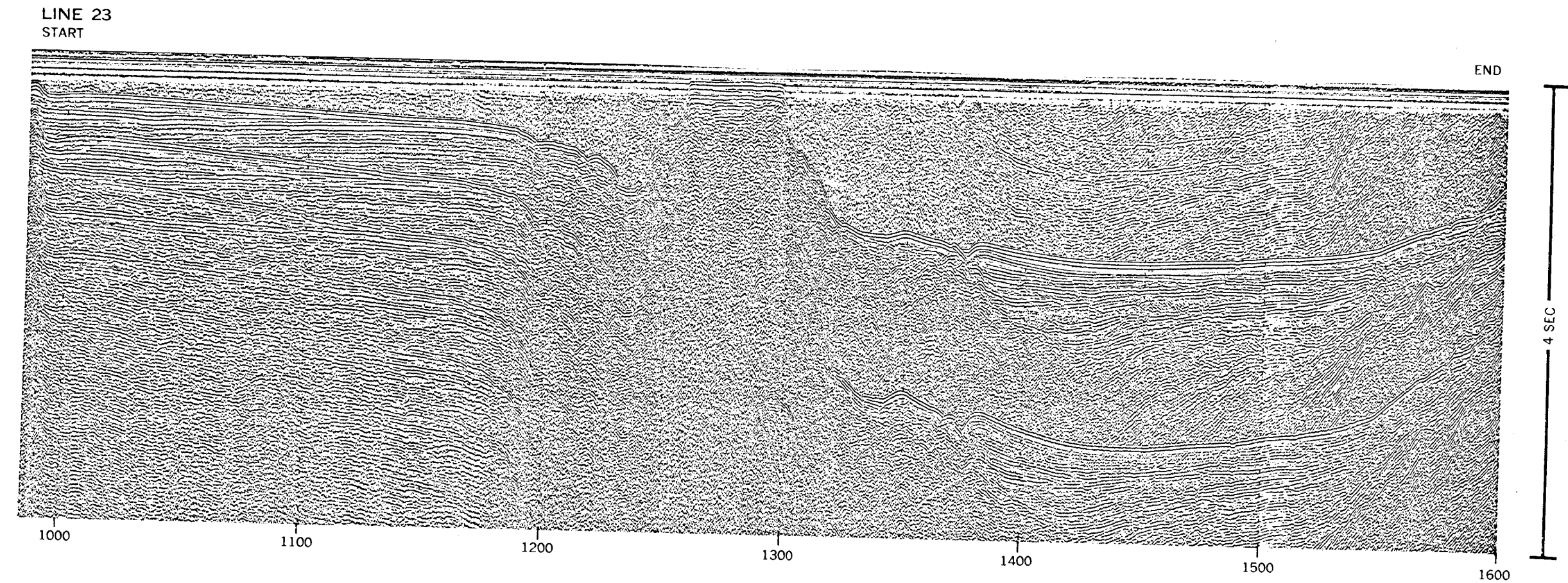
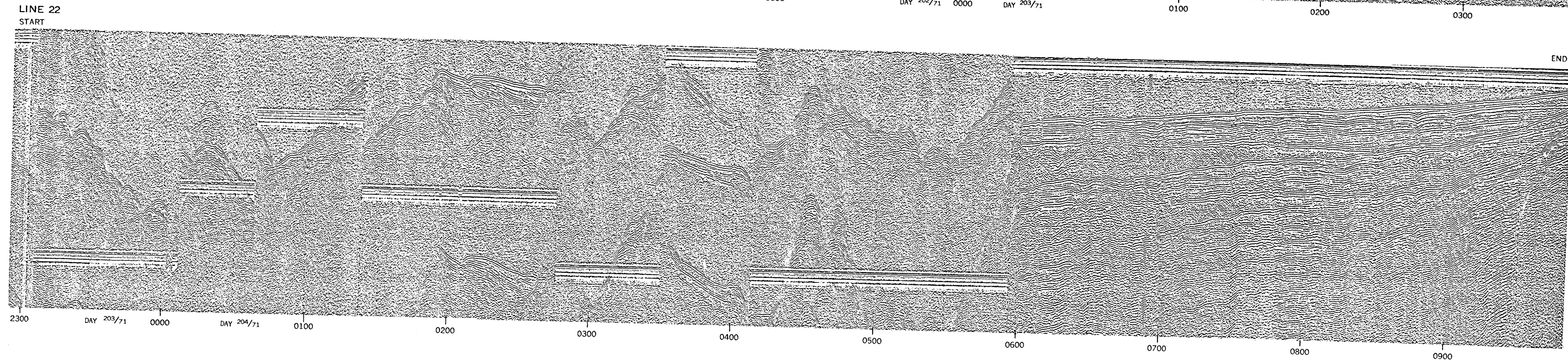
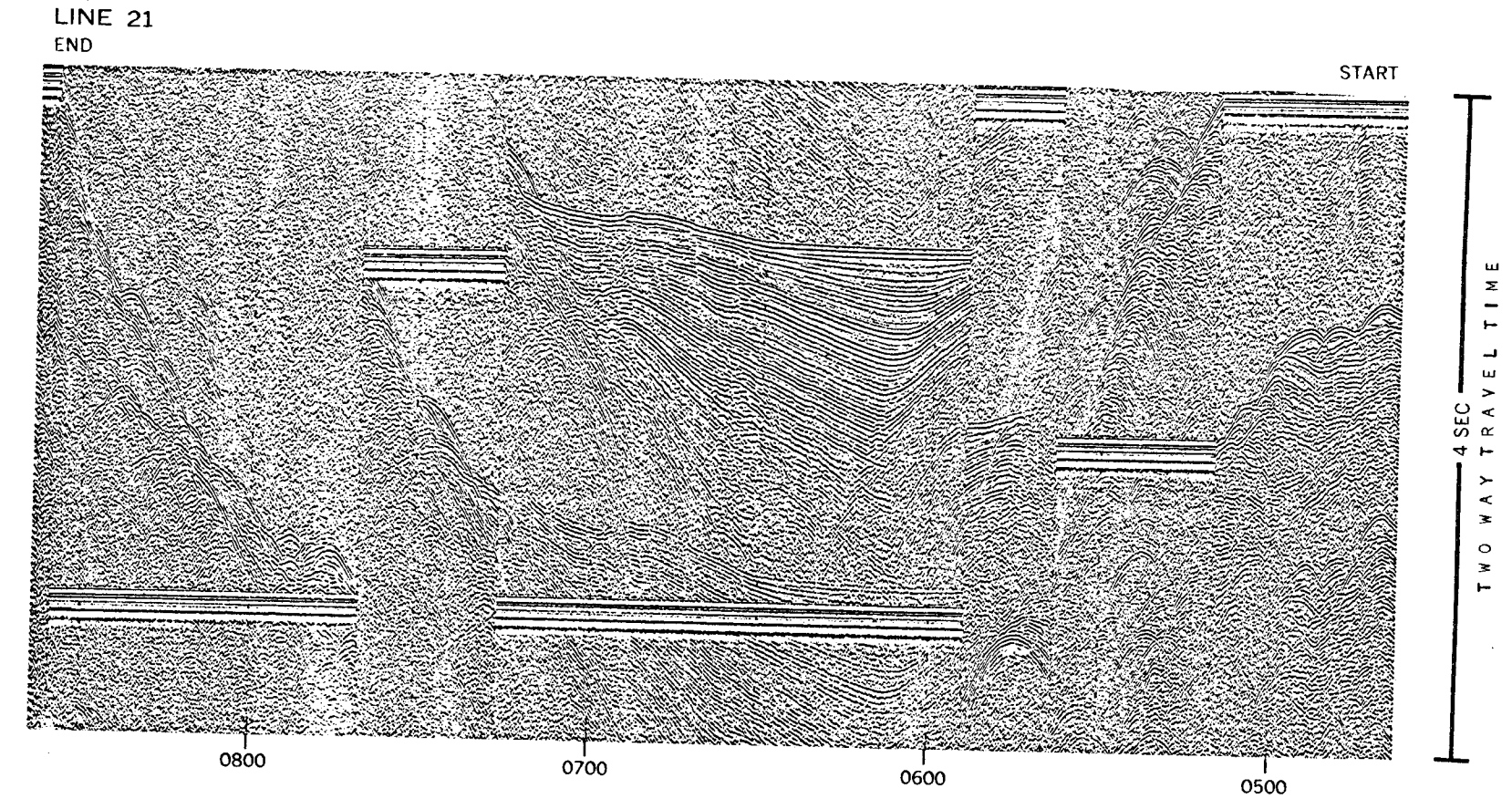
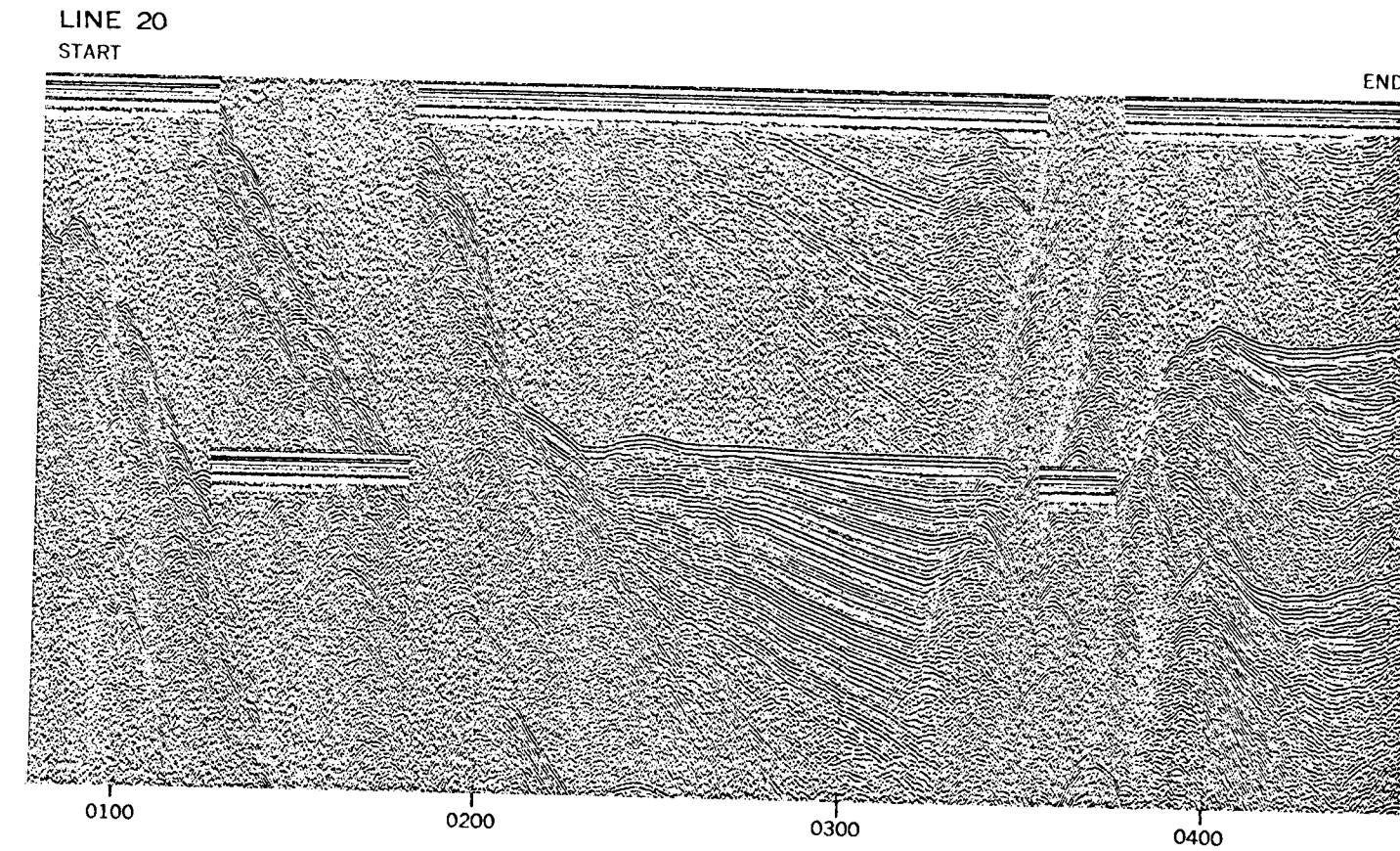
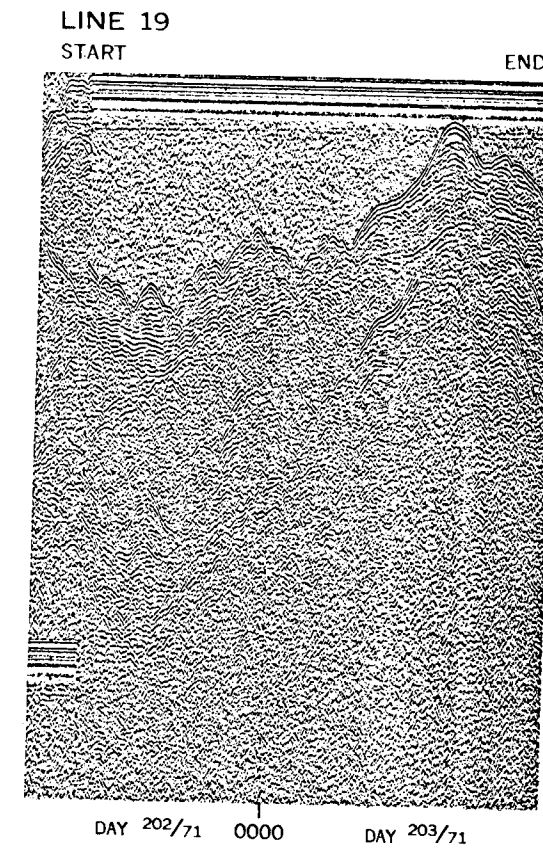
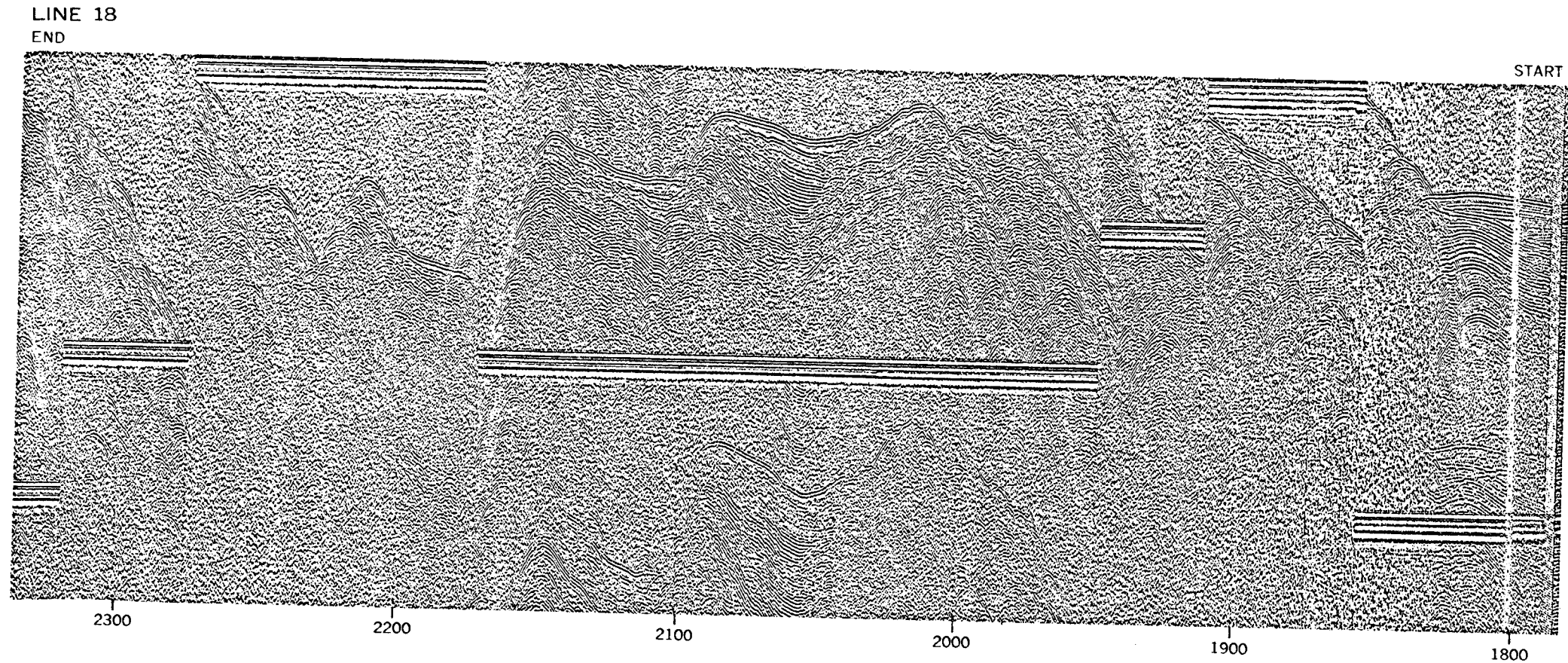


4 SEC  
TWO WAY TRAVEL TIME

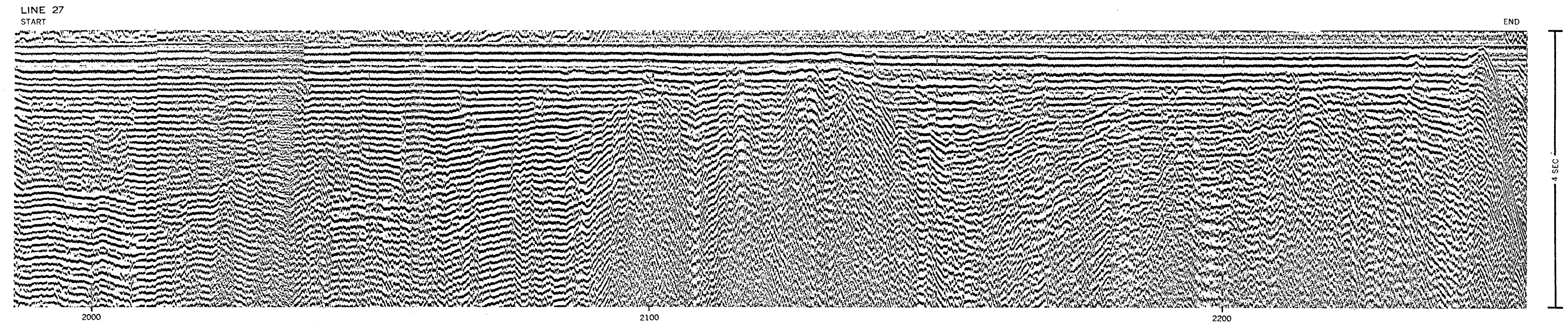
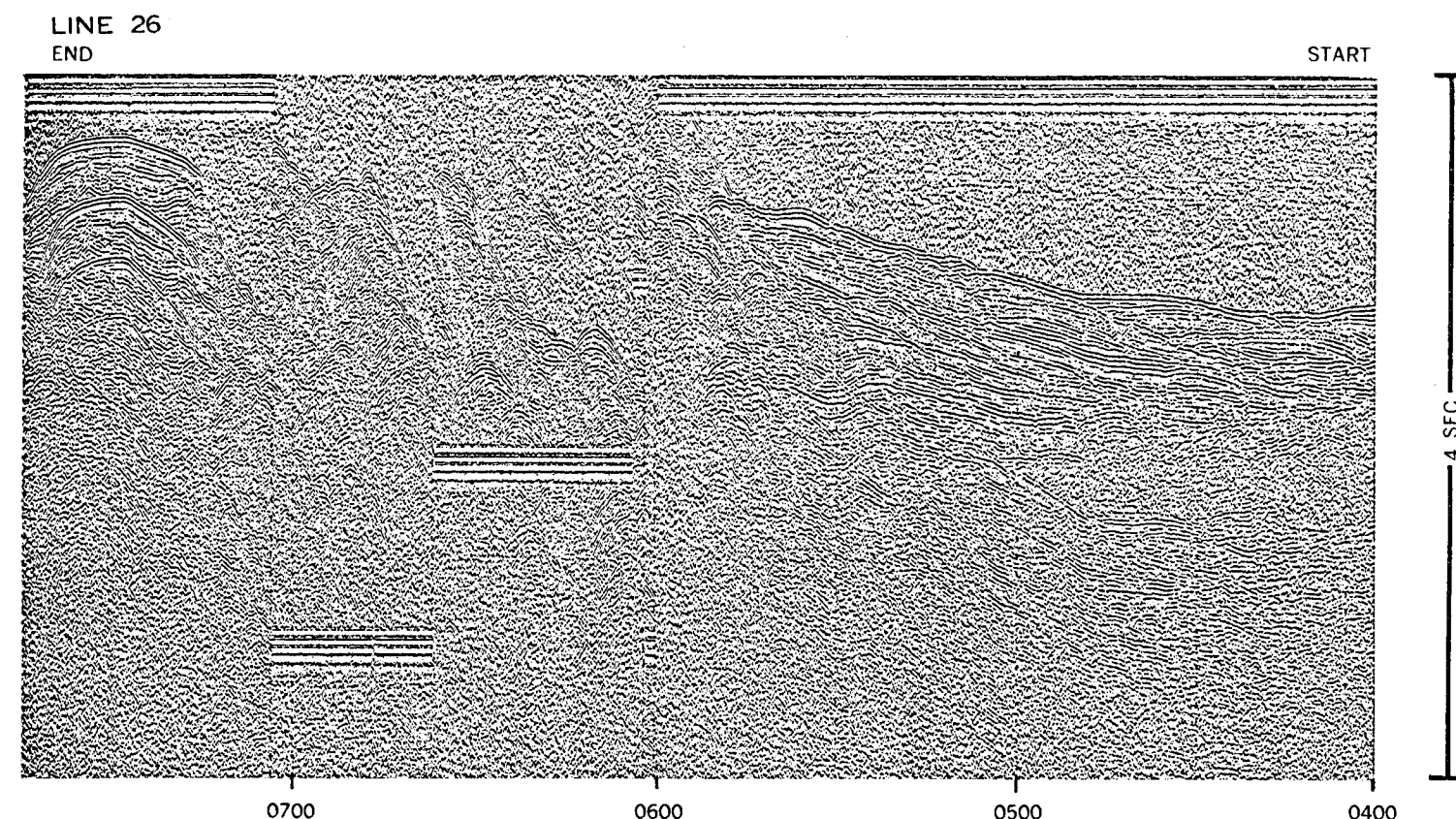
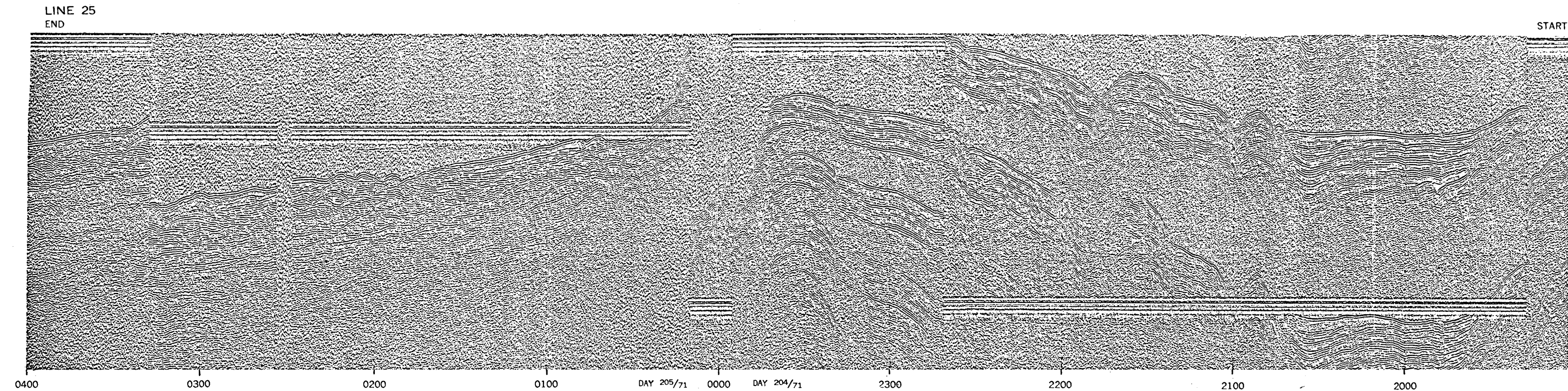
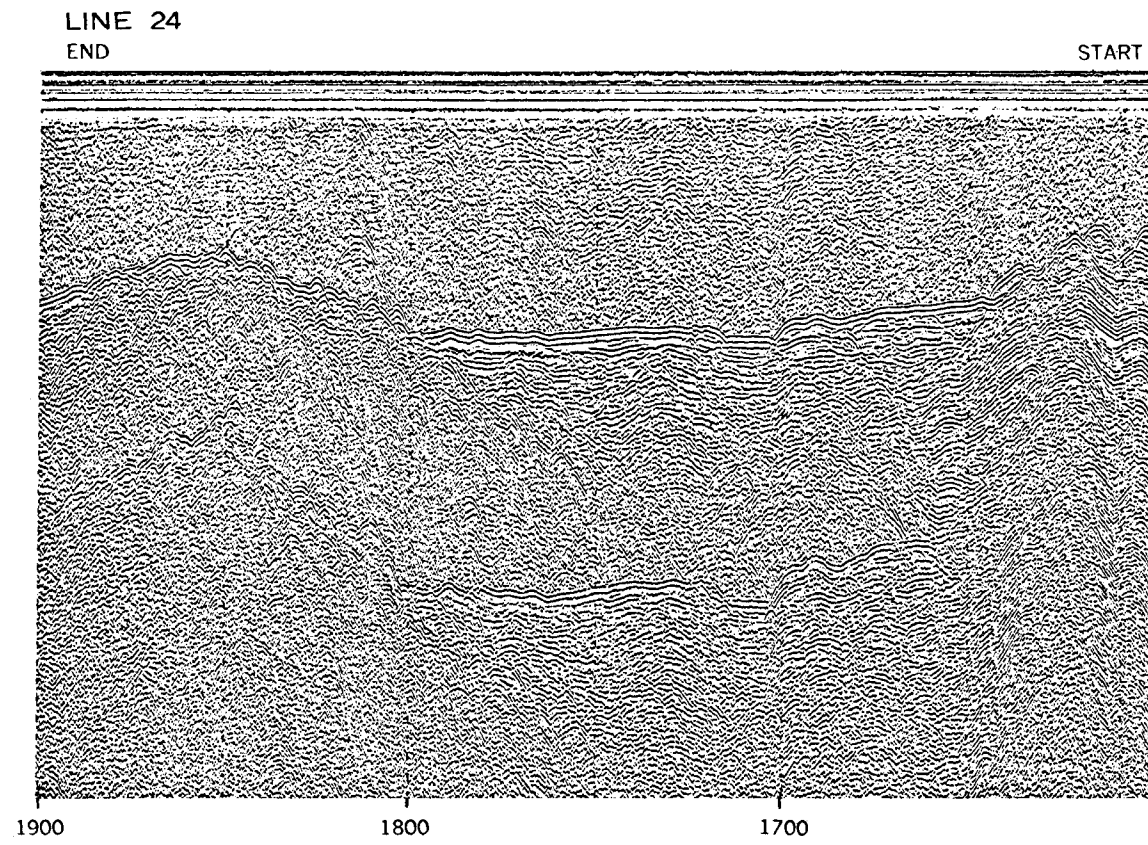


4 SEC





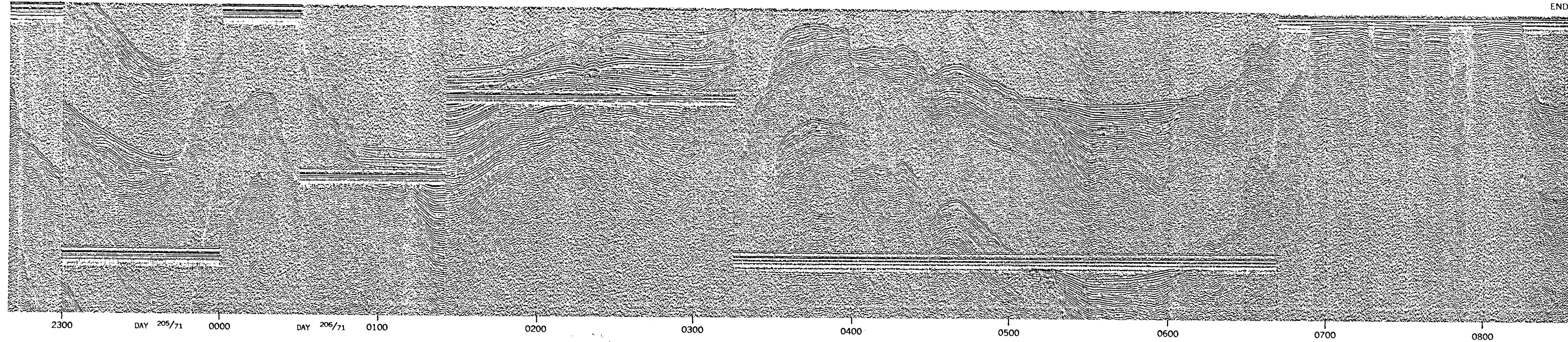






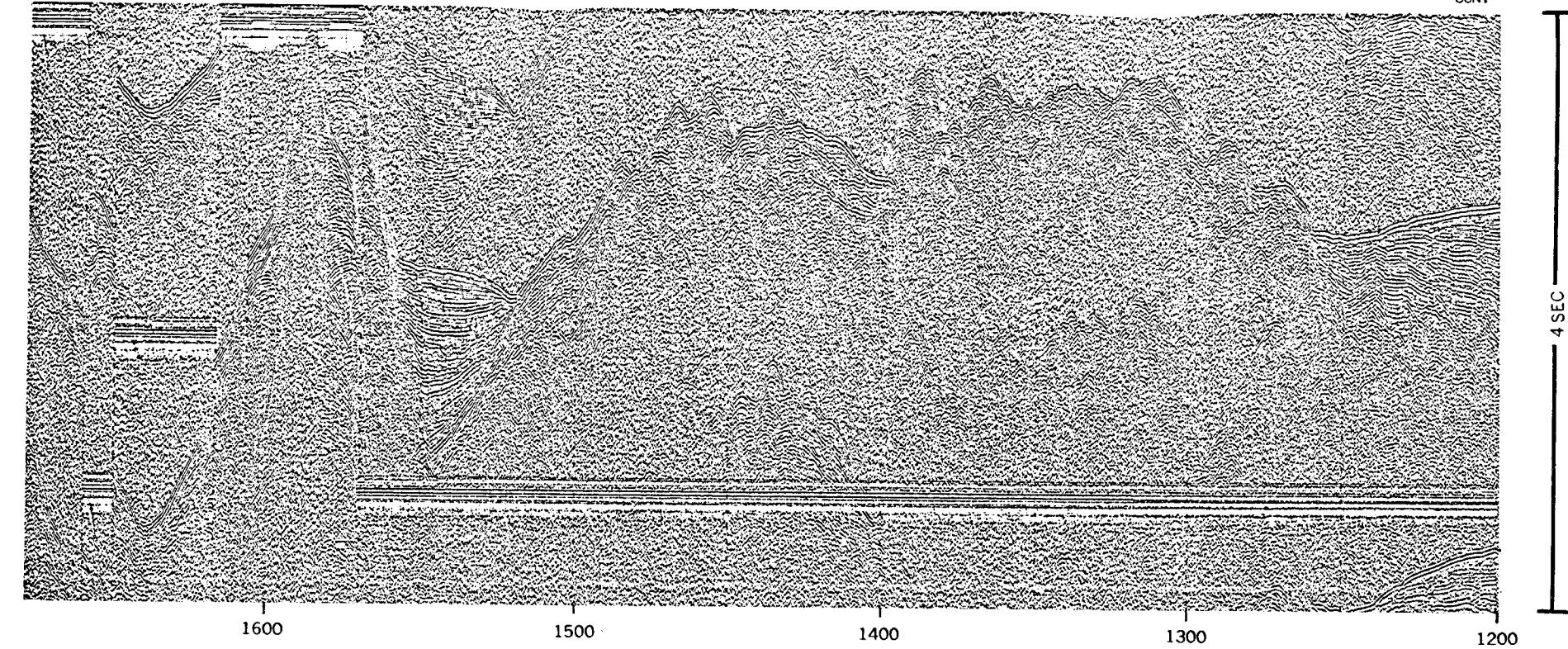
LINE 28

START



LINE 29

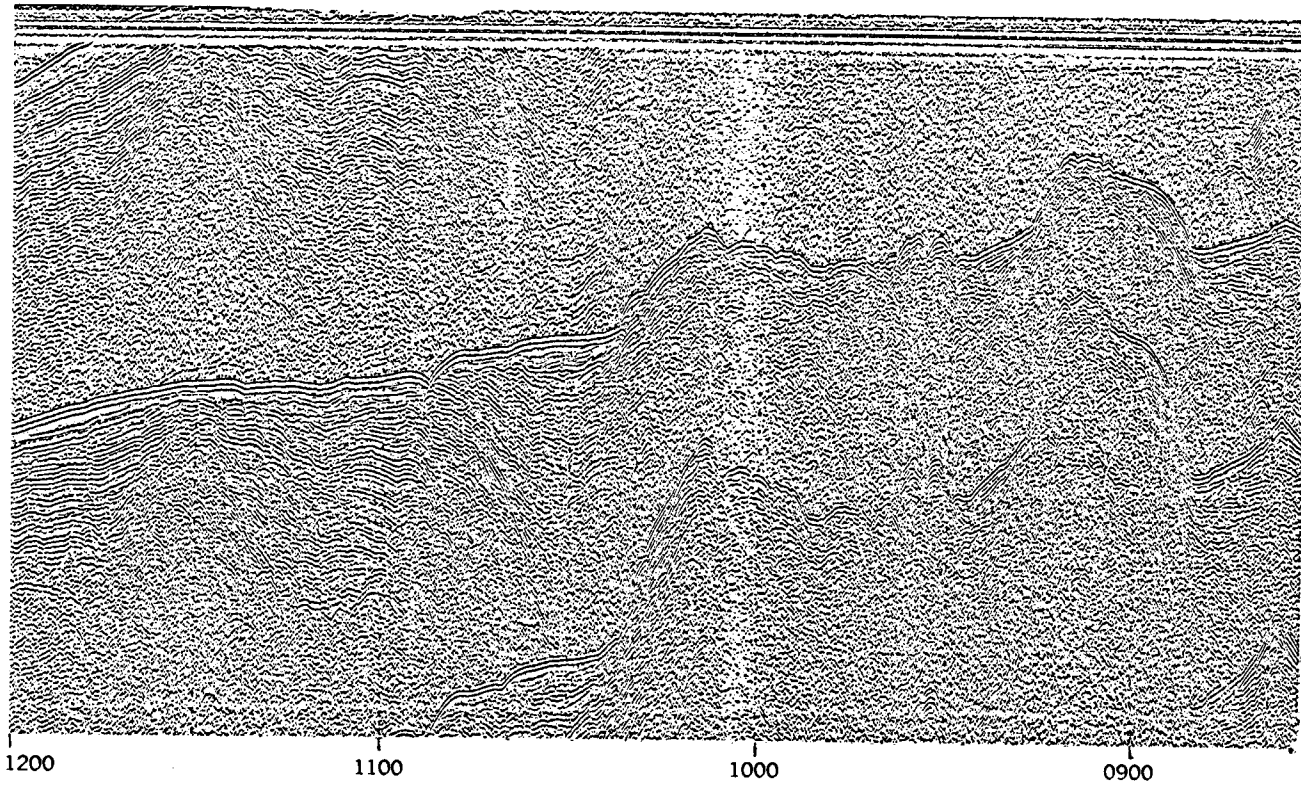
END



4 SEC  
TWO WAY TRAVEL TIME

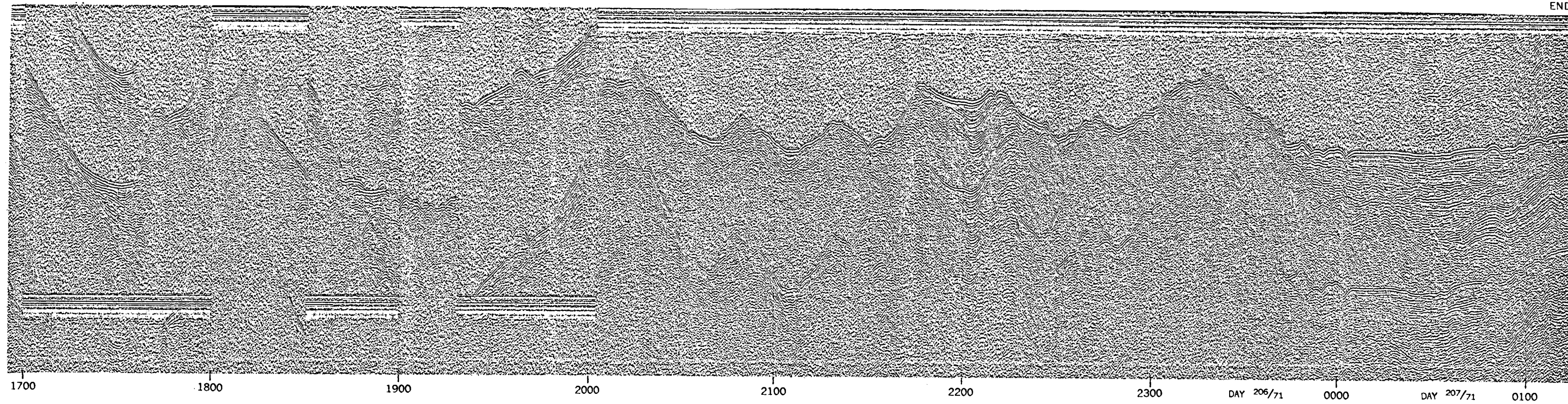
LINE 29

CONT



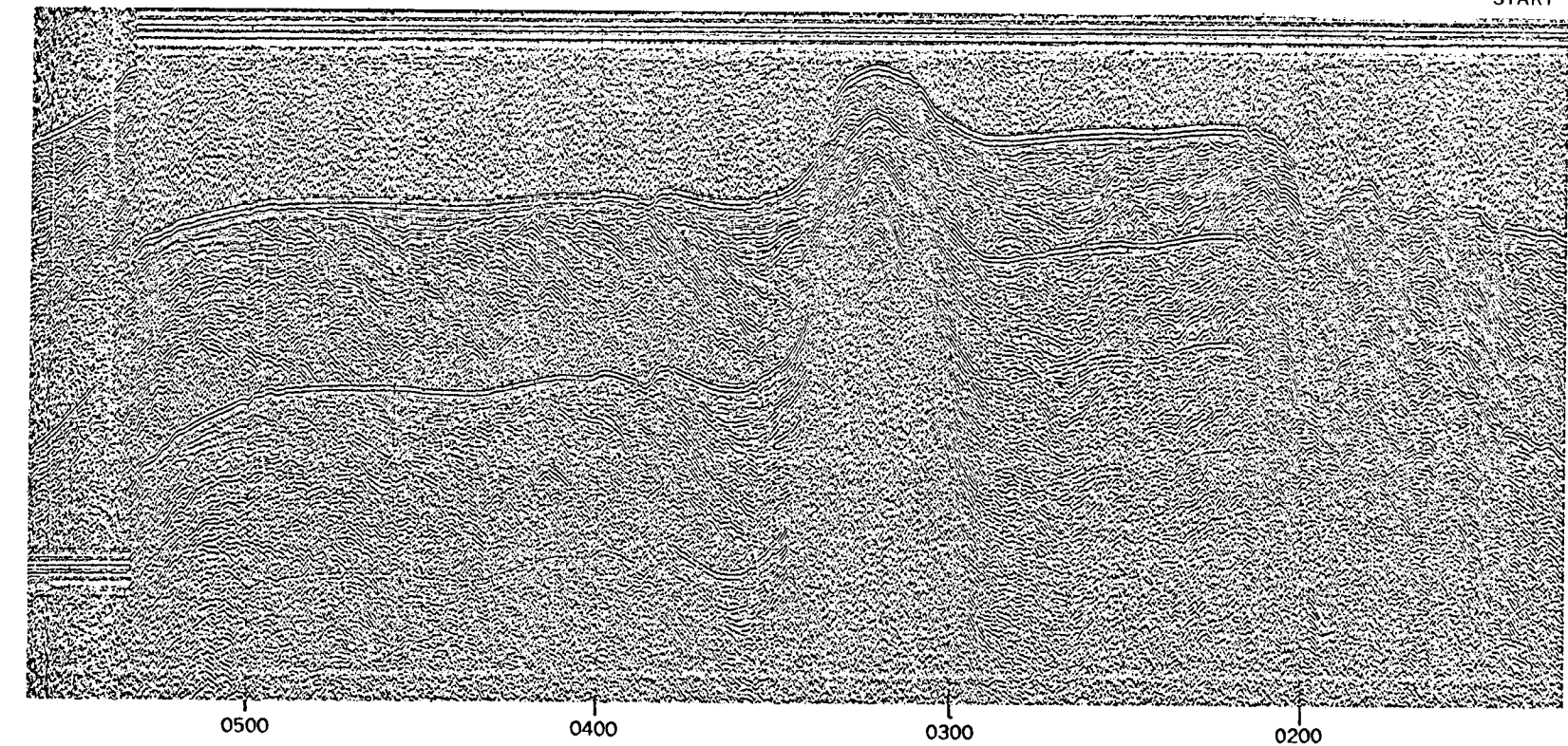
LINE 30

START



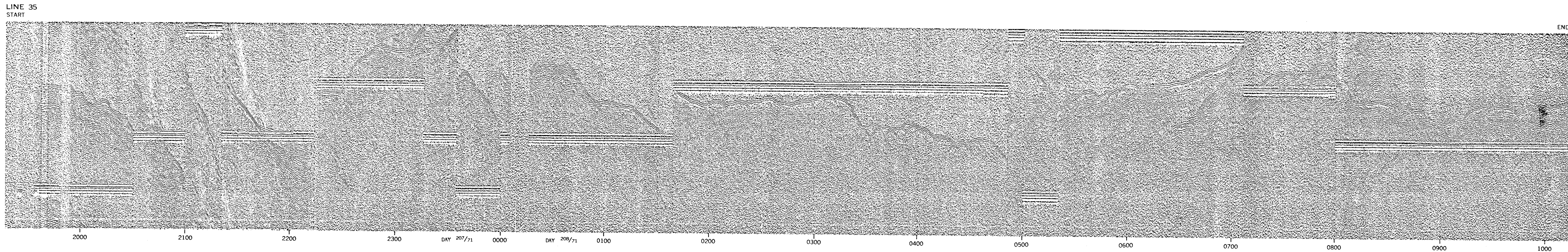
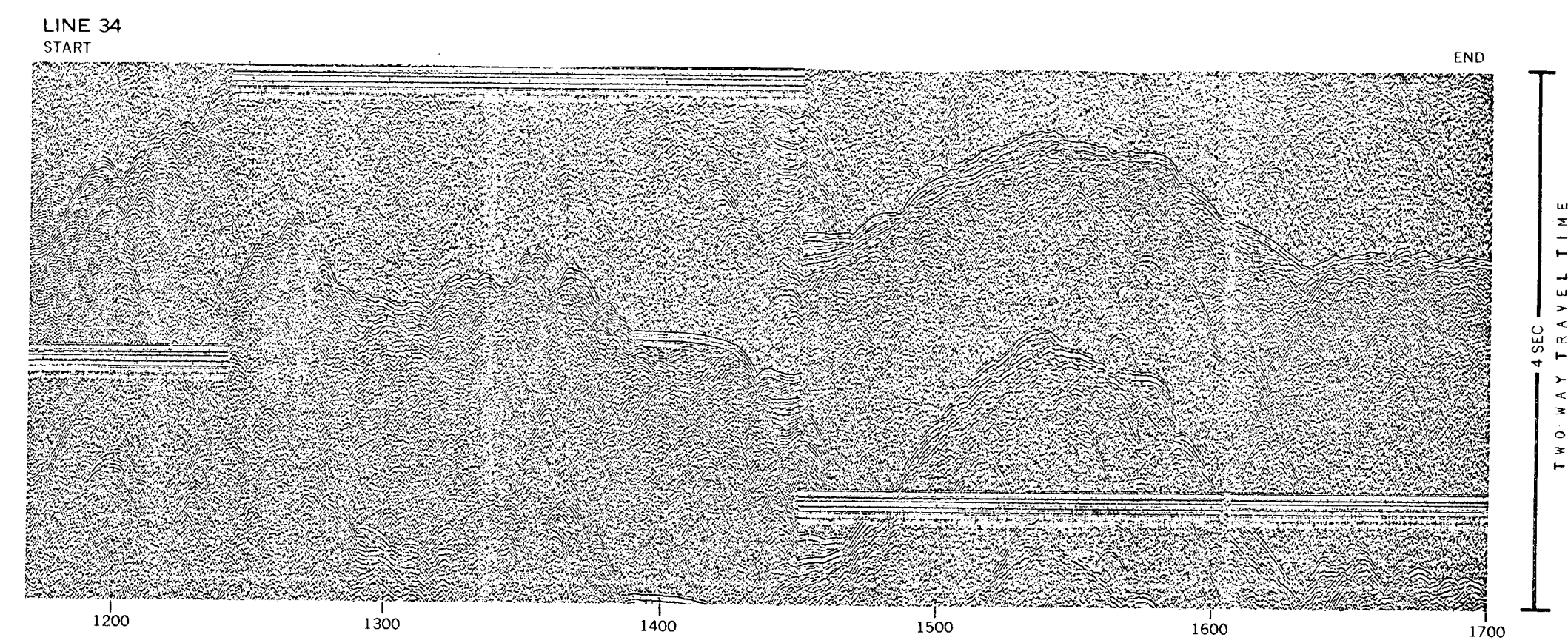
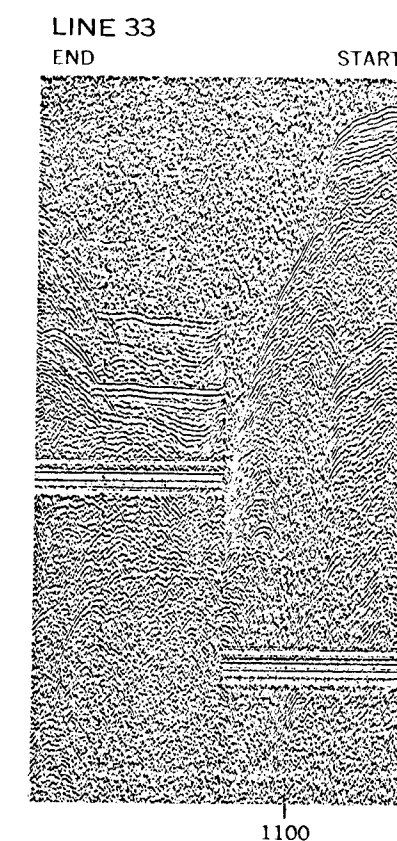
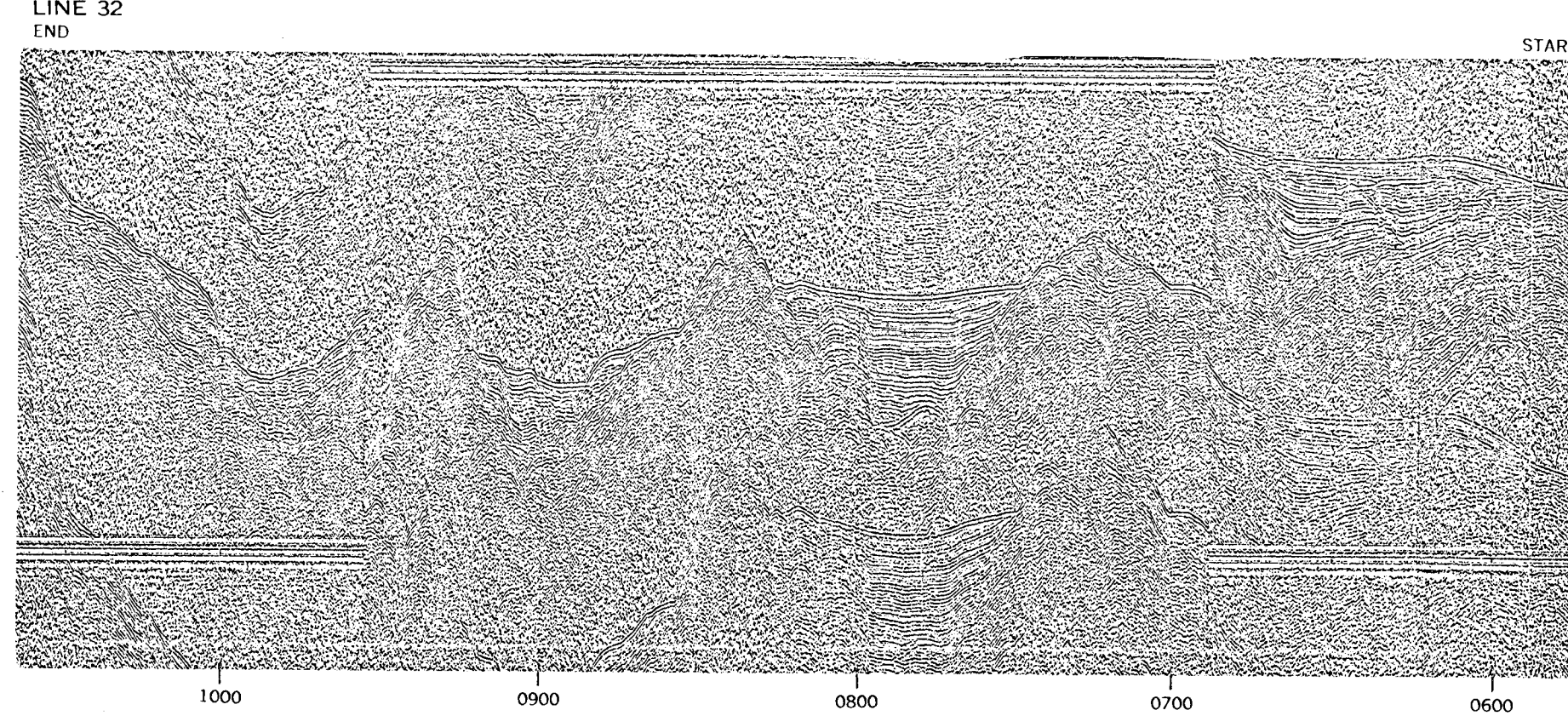
LINE 31

END



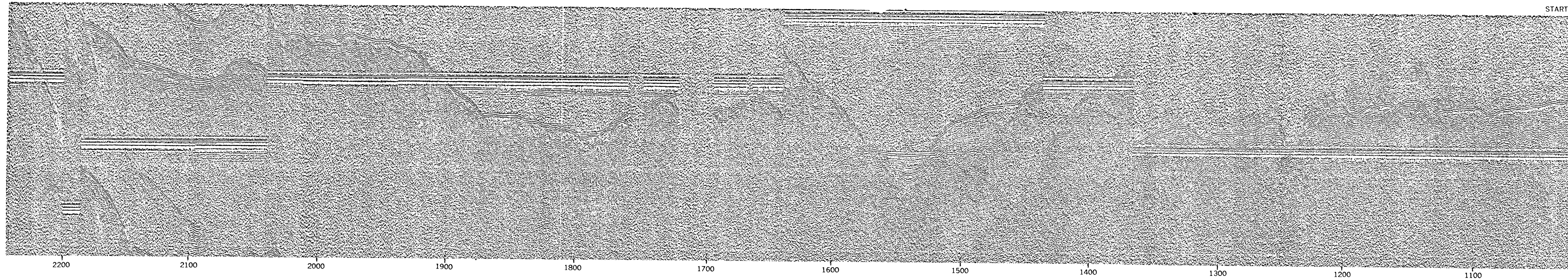
4 SEC  
TWO WAY TRAVEL TIME



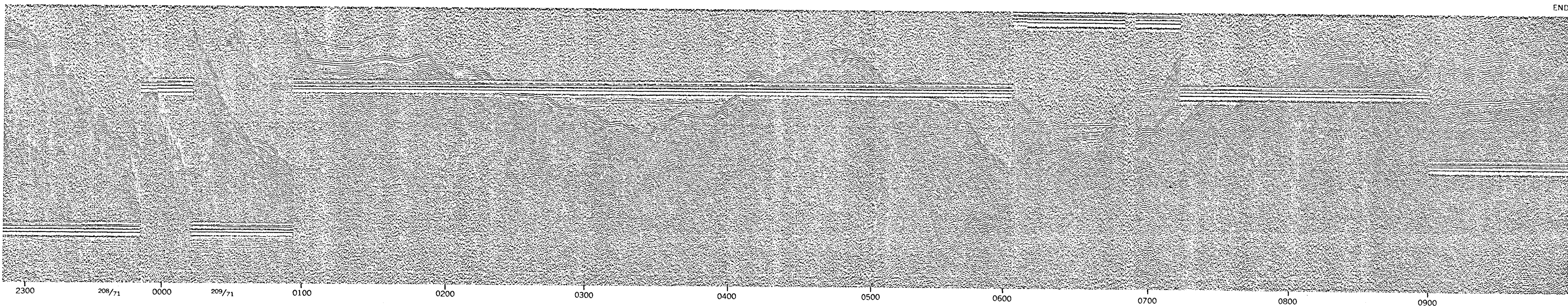




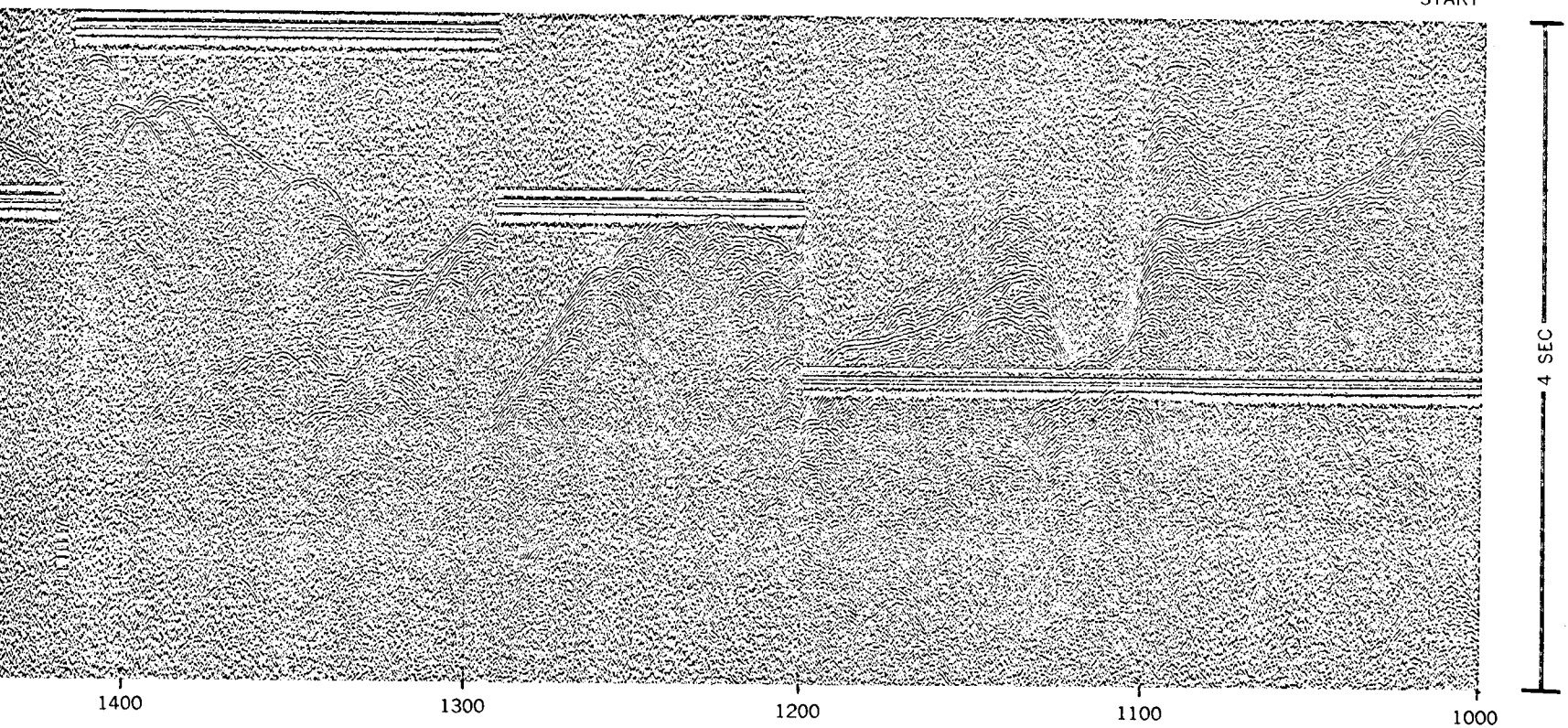
LINE 36  
END



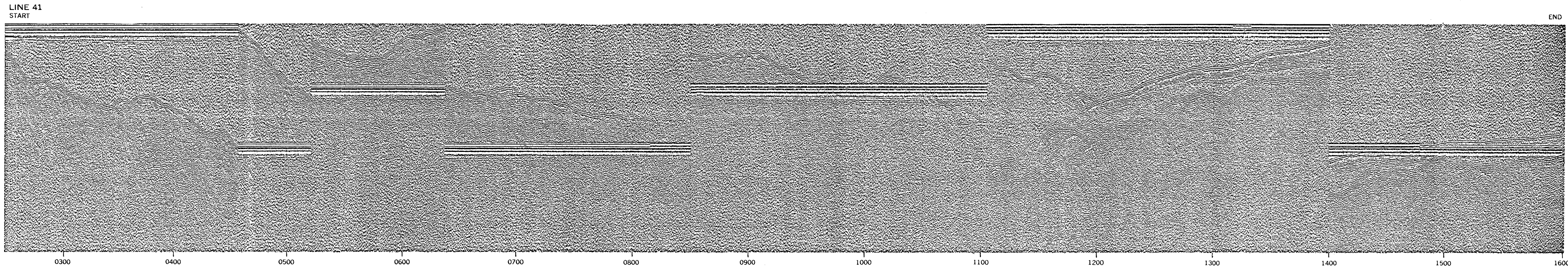
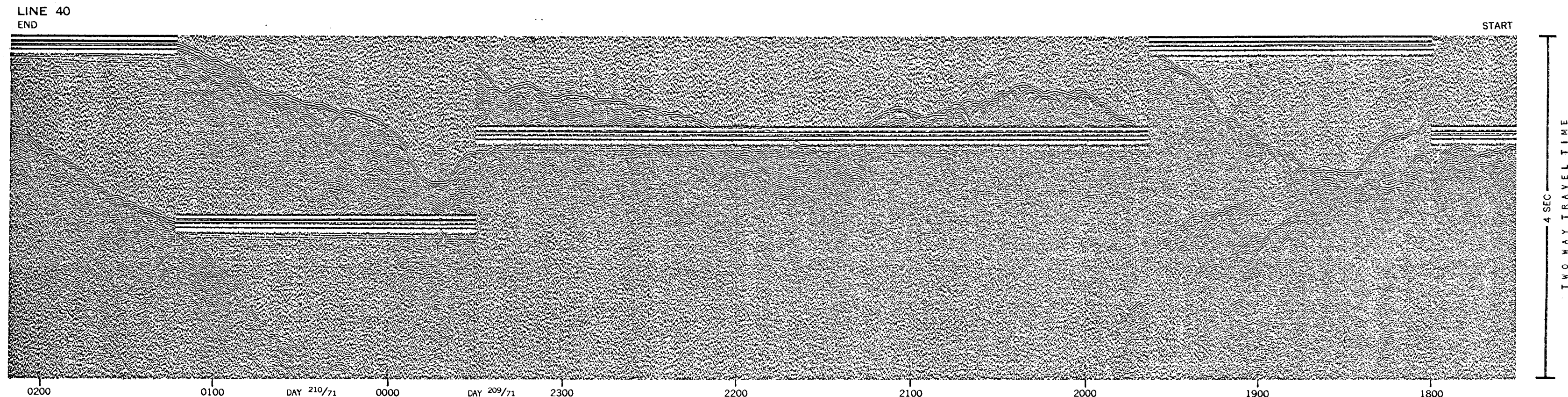
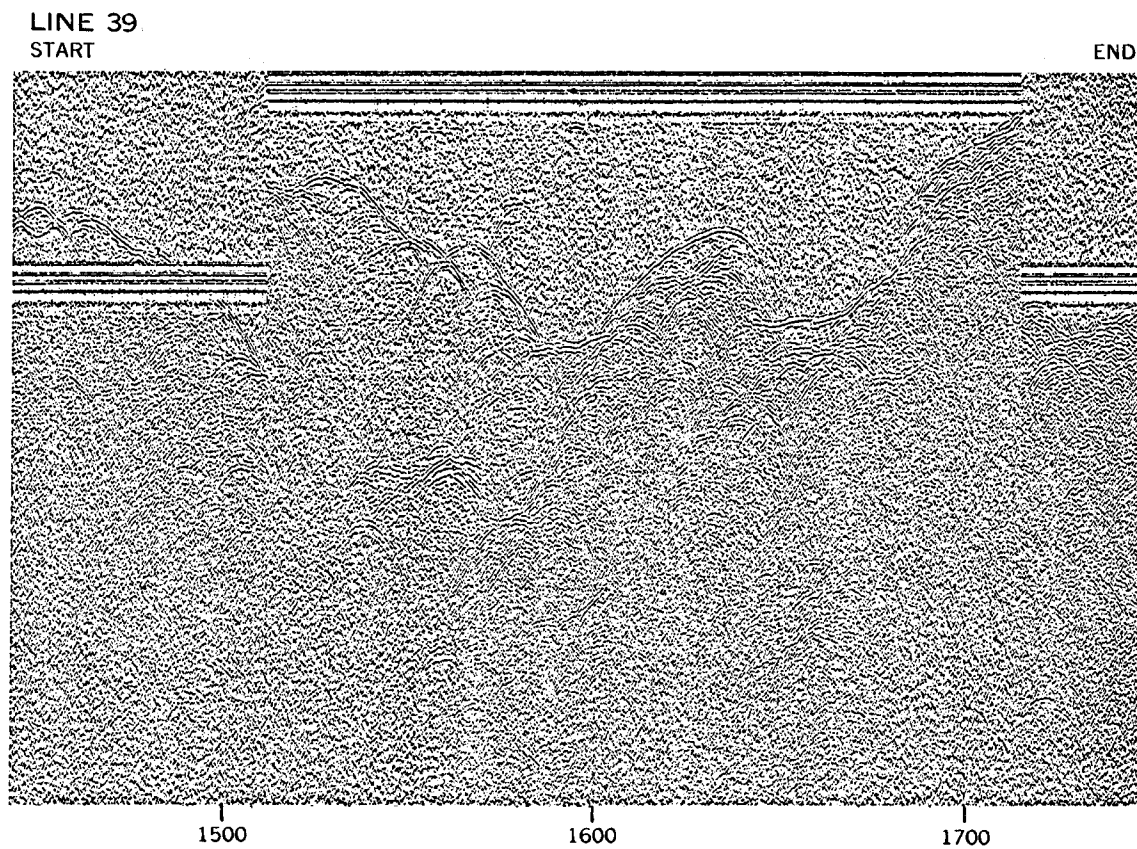
LINE 37  
START



LINE 38  
END



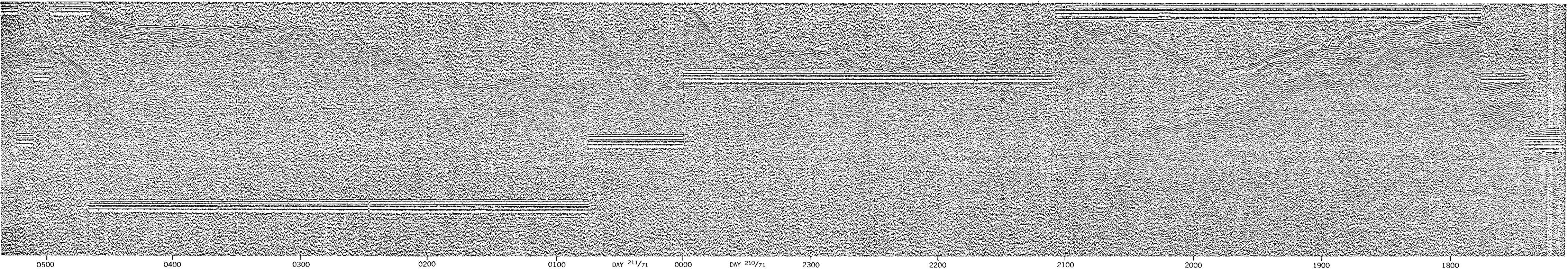






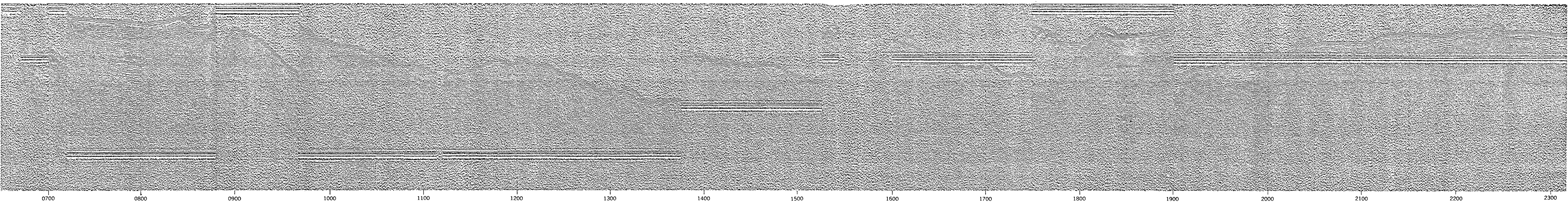
LINE 42

END



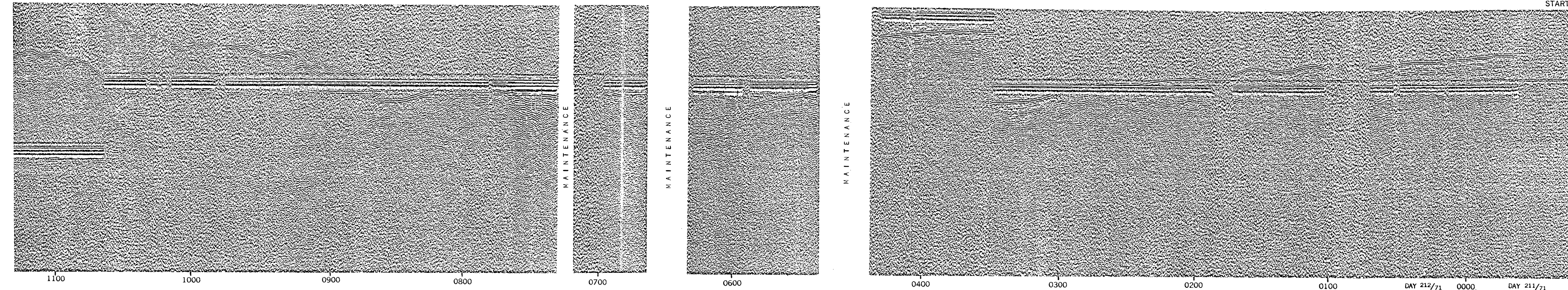
LINE 43

START

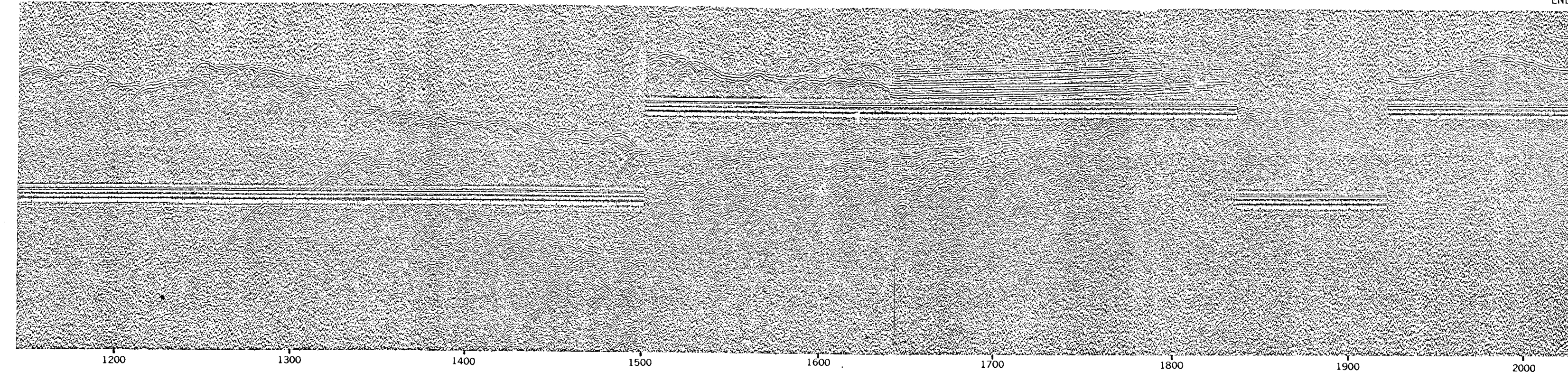




LINE 44  
END

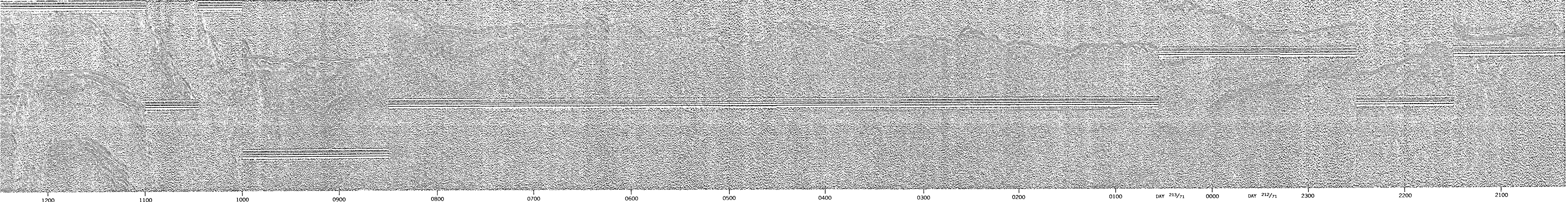


LINE 45  
START

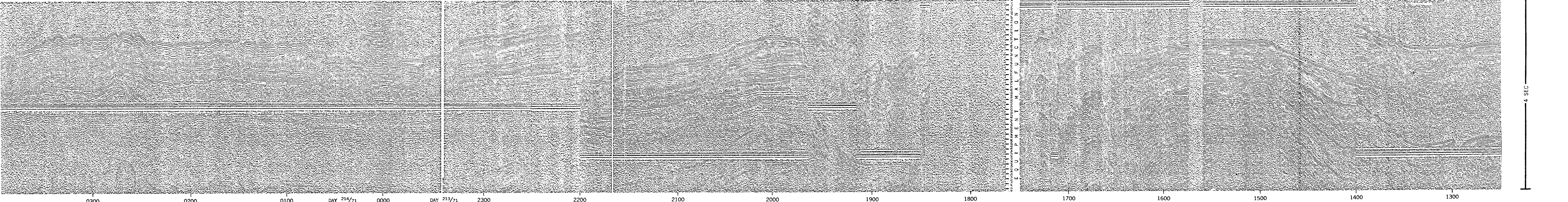




LINE 46  
CONT

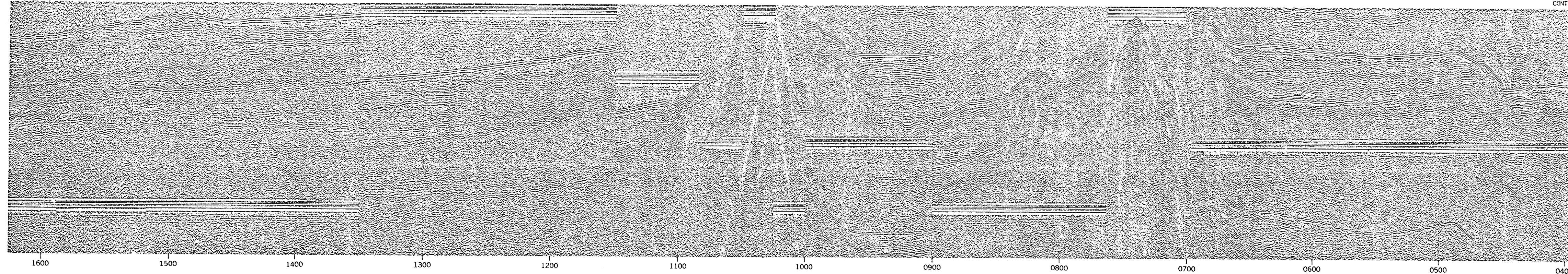


LINE 46  
CONT

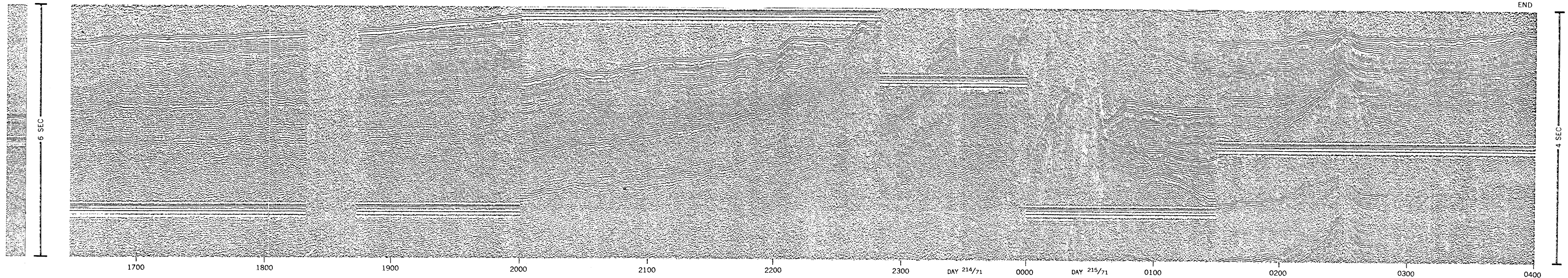




LINE 46  
END



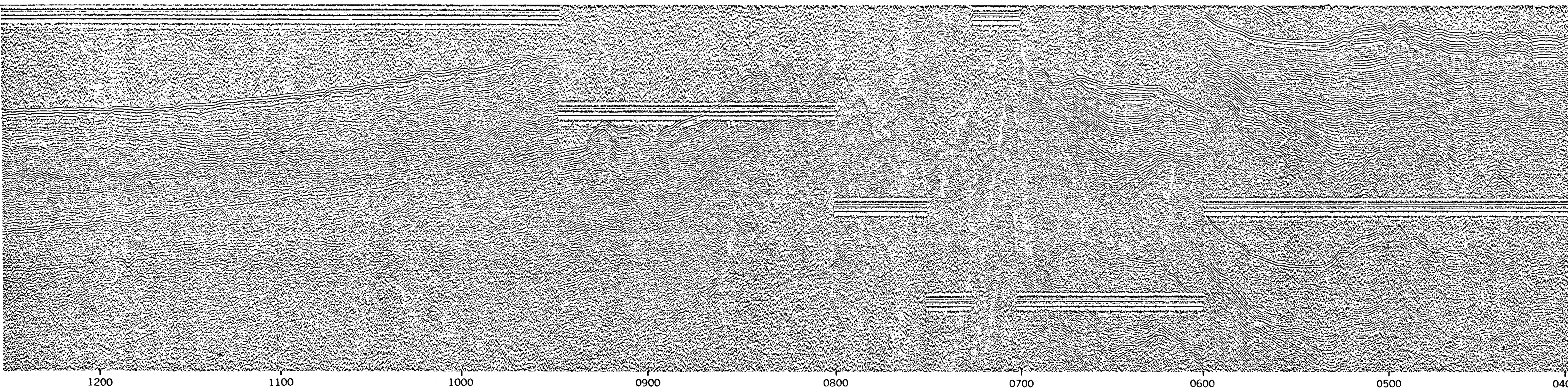
LINE 47  
START





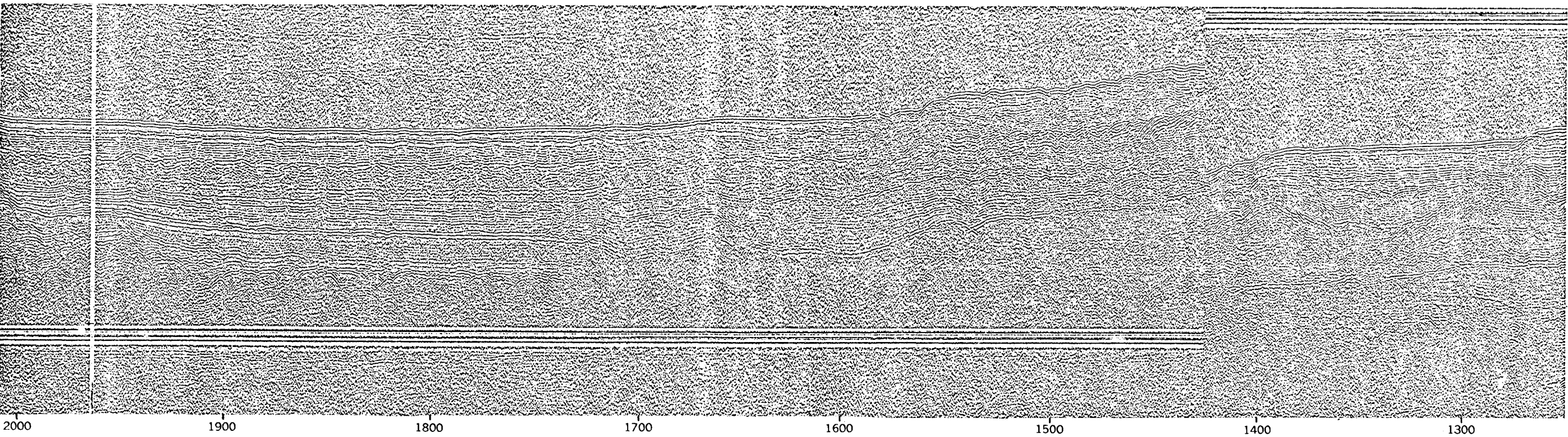
LINE 48  
END

START



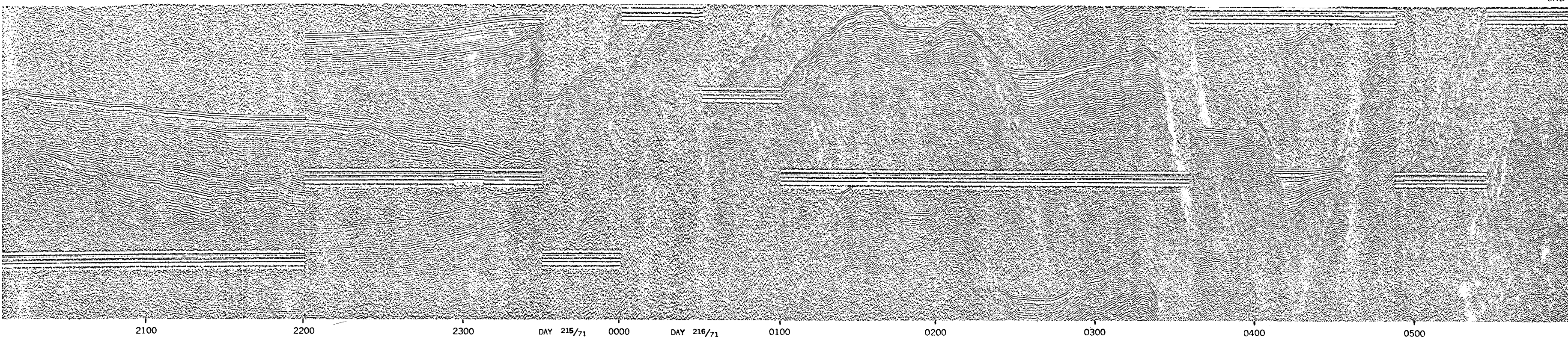
LINE 49  
END

START



LINE 50  
START

END





20°

18°

16°

