

15. UNDERWAY GEOPHYSICAL MEASUREMENTS OBTAINED ON THE *GLOMAR CHALLENGER* IN THE EASTERN NORTH ATLANTIC AND MEDITERRANEAN SEA

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INTRODUCTION

Routine geophysical measurements were obtained during Leg 13 of the Deep Sea Drilling Project while the *Glomar Challenger* steamed to and from the various drilling sites. The entire track from Lisbon, Portugal into the Mediterranean as far east as the Nile Cone, and then back again to Lisbon covered a distance of 4646 nautical miles. In fact, 38 per cent of the entire leg was spent underway, almost all of it in direct runs between the sites. Because of careful planning and excellent pre-site surveys, the drilling vessel was usually able to find the drilling targets with a minimum of time spent in surveys of her own.

The onboard instrumentation included a 12 kHz precision echo-sounder, magnetometer, seismic reflection profiler, and a satellite navigation system. The instruments were maintained and operated by a technical staff of the Scripps Institution of Oceanography, in cooperation with the scientific party and the officers and crew of Global Marine, Inc.

NAVIGATION

The prime navigation system on the *Glomar Challenger* consisted of an I.T.T. Model 4007AB Satellite Navigation Receiver utilizing a PDP 8 digital computer and teletype display. Positions were obtained with this system through the entire 54-day leg, except for an occasional few hours of down time. Approximately 15 fixes were available each day when underway, and these were supplemented by celestial fixes and radar ranges and bearings when available or needed.

The ship's track¹ was generated by interpolating dead-reckoning readouts of course (gyro-compass headings) and speed (electromagnetic log) between the satellite "benchmarks" so as to position the location of all course and speed changes. The smoothed track was digitized, interval speeds and courses-made-good have been calculated, and the output is listed in Table 1. The track is displayed in a mosaic of sixteen mercator charts (Figure 1, A, B, C, etc.) at one half standard plotting sheet scale.

Not all sections of the track can be constructed with the same degree of accuracy. Whereas the positions of the satellite fixes themselves are generally good to ± 0.2 mile, the intermediate positions between fixes can degrade to ± 3 miles depending upon the length of time between fixes, and the amount of maneuvering of the vessel.

¹The preliminary track was made by the bridge officers during the cruise. This track was subsequently edited and smoothed by the senior author, who assumes responsibility for any errors or omissions.

Details of the track in the vicinity of the individual sites are shown in maps appearing in the Site Chapters.

The dead-reckoning while locating the drilling target was facilitated with the deployment of surface buoys, and is presented in terms of relative positions without an implied absolute accuracy. The navigational control in the area of Site 121 in the Alboran Sea is particularly poor owing to strong and variable currents.

Bathymetry

Bathymetric profiles were obtained with a 12 kHz echo-sounder using a Giffit Recorder and displaying on wet Mufax paper. Sweep rates were maintained at 1 second (400 tau) with a pulse width of ≈ 1 millisecond. The echo-grams were digitized at all inflection points and the depth data have been corrected for the vessel's draft. Because the 12 kHz system was inoperable from Lisbon to Site 121, the depth data for this interval were obtained by digitizing the seismic reflection profiles with a consequent degradation in accuracy to ± 5 tau.

Magnetics

Total intensity measurements of the earth's magnetic field were obtained with a Varian Proton Precession Magnetometer. The sensor unit was towed approximately 250 meters astern. The direct analog readings in gammas have been digitized and converted to residual anomalies using a spherical harmonic expression of the earth's regional magnetic field (Talwani, 1969).

Topographic and Magnetic Profiles

The digitized bathymetric, magnetic, and navigation data are graphically presented in Figure 2. The navigation positions are annotated along the base of the plot (distance axis: one cm equal to twenty miles). Where the distance between fixes is large enough, interpolated headings and speeds are also shown. Date and time of day² appear at the top of the plot along with annotations for even degree crossings of longitude and latitude. The depth units are in terms of two-way travel time (1 tau = 1/400th second), and the topographic profile has a uniform exaggeration of 100 to 1.

Seismic Reflecting Profiling

The reflection profiling system aboard the *Challenger* included: (1) a sound source of two Bolt 600A pneumatic airguns (one 10 cubic inches, the other 30); (2) a listening array of twenty EVP 23 hydrophones, evenly spaced over

²Time-zone-1 was used throughout the leg.

TABLE 1
Navigation Leg 13^a

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
DEPART LISBON (August 14, 1970)					
300	38° 43.1'N	-9° 28.2'W	0.0	10.6	216
800	38 00.0	-10 07.5	53.0	11.1	215
1250	37 16.1	-10 46.1	106.5	10.0	220
1330	37 11.0	-10 51.5	113.2	11.5	228
1358	37 07.4	-10 56.5	118.5	10.9	224
1635	36 46.8	-11 21.3	147.1	7.4	261
1646	36 46.6	-11 23.0	148.5	8.1	257
1705	36 46.0	-11 26.1	151.0	7.4	171
1738	36 42.0	-11 25.3	155.1	4.5	175
1750	36 41.1	-11 25.2	156.0	2.8	329
1800	36 41.5	-11 25.5	156.5	1.1	253
1820	36 41.4	-11 25.9	156.8	0.0	270
SITE 120 (August 17, 1970)					
312	36 41.4	-11 25.9	156.8	3.5	286
338	36 41.8	-11 27.7	158.3	6.6	122
344	36 41.4	-11 27.0	159.0	5.9	94
353	36 41.4	-11 25.9	159.9	10.5	102
714	36 33.9	-10 43.2	195.0	10.4	101
1004	36 28.5	-10 07.2	224.5	10.1	100
1152	36 25.4	-9 44.9	242.7	10.1	100
1406	36 21.5	-9 17.4	265.1	10.4	101
1552	36 18.0	-8 55.0	283.5	10.8	103
1756	36 13.0	-8 28.0	305.8	10.8	101
2202	36 04.6	-7 34.3	350.0	10.7	101
(August 18, 1970)					
102	35 58.7	-6 55.4	382.0	10.5	101
202	35 56.7	-6 42.6	392.6	11.1	97
348	35 54.2	-6 18.6	412.1	10.7	87
436	35 54.7	-6 08.1	420.7	11.7	95
521	35 53.9	-5 57.3	429.5	12.4	86
541	35 54.2	-5 52.2	433.6	12.9	90
601	35 54.2	-5 46.9	437.9	13.3	89
627	35 54.3	-5 39.8	443.6	13.1	76
655	35 55.8	-5 32.5	449.7	12.7	73
729	35 57.9	-5 24.0	456.9	13.4	76
800	35 59.6	-5 15.7	463.9	13.8	85
914	36 01.1	-4 54.7	480.9	12.5	79
1100	36 05.4	-4 27.9	503.0	12.6	85
1136	36 06.0	-4 18.6	510.5	6.9	346
1228	36 11.8	-4 20.4	516.5	6.4	347
1252	36 14.3	-4 21.1	519.1	5.9	155
1310	36 12.7	-4 20.2	520.8	6.1	152
1320	36 11.8	-4 19.6	521.9	2.6	252
1420	36 11.0	-4 22.7	524.5	2.9	102
1456	36 10.6	-4 20.6	526.2	2.6	101
1520	36 10.4	-4 19.3	527.3	3.7	254
1610	36 09.6	-4 23.0	530.3	1.4	86
1630	36 09.6	-4 22.4	530.8	0.0	90
SITE 121 (August 21, 1970)					
1106	36 09.6	-4 22.4	530.8	8.2	66
1200	36 12.6	-4 14.0	538.2	12.0	78
1402	36 17.6	-3 44.4	562.6	11.2	76
1548	36 22.4	-3 20.6	582.4	10.5	79
1816	36 27.3	-2 48.9	608.3	11.3	80
2128	36 33.9	-2 04.7	644.5	11.4	55
2136	36 34.8	-2 03.2	646.0	11.8	57
2222	36 39.7	-1 53.8	655.0	10.7	50
2322	36 46.6	-1 43.6	665.7	9.7	44

^aWest longitudes are negative, speed in knots, cumulative distance in nautical miles.

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
(August 22, 1970)					
014	36 52.7	-1 36.3	674.1	10.2	53
243	37 08.1	-1 11.0	699.5	11.1	52
612	37 31.8	-0 32.6	738.2	11.1	51
623	37 33.1	-0 30.6	740.2	11.5	38
940	38 02.7	-0 00.9	778.0	10.9	41
1304	38 30.4	0 30.2 E	814.9	10.7	43
1450	38 44.2	0 46.8	833.8	10.3	41
1724	39 04.3	1 08.9	860.4	10.2	43
1746	39 07.1	1 12.2	864.1	10.5	39
2254	39 49.3	1 56.0	918.2	10.3	39
(August 23, 1970)					
248	40 20.6	2 28.6	958.2	9.2	39
309	40 23.1	2 31.2	961.4	9.8	46
336	40 26.2	2 35.4	965.8	9.7	59
340	40 26.5	2 36.1	966.5	9.7	62
357	40 27.8	2 39.3	969.2	3.9	64
412	40 28.2	2 40.4	970.2	3.0	171
417	40 28.0	2 40.5	970.4	9.0	244
433	40 26.9	2 37.6	972.8	1.0	235
510	40 26.6	2 37.0	973.5	1.4	105
532	40 26.5	2 37.6	974.0	0.4	341
630	40 26.9	2 37.5	974.4	0.0	46
SITE 122 (August 24, 1970)					
620	40 26.9	2 37.5	974.4	6.0	37
625	40 27.3	2 37.9	974.9	10.5	39
715	40 34.1	2 45.2	983.7	10.1	44
751	40 38.5	2 50.7	989.8	3.0	90
754	40 38.5	2 50.9	989.9	4.6	210
800	40 38.1	2 50.6	990.4	3.4	250
813	40 37.8	2 49.7	991.1	1.2	102
825	40 37.8	2 50.0	991.3	0.8	82
840	40 37.8	2 50.3	991.5	0.0	270
SITE 123 (August 25, 1970)					
2230	40 37.8	2 50.3	991.6	4.0	320
2249	40 38.8	2 49.2	992.8	4.6	30
2252	40 39.0	2 49.3	993.0	7.9	140
2256	40 38.6	2 49.8	993.6	7.3	155
2303	40 37.8	2 50.3	994.4	11.3	132
(August 26, 1970)					
010	40 29.3	3 02.6	1007.1	9.5	146
150	40 16.1	3 14.2	1022.9	10.8	137
302	40 06.6	3 25.8	1036.0	10.2	139
448	39 53.0	3 41.1	1053.9	10.0	135
802	39 30.2	4 10.7	1086.1	9.3	136
851	39 24.8	4 17.6	1093.7	9.1	143
946	39 18.1	4 24.1	1102.1	10.2	139
1116	39 06.6	4 37.0	1117.3	8.1	142
1132	39 04.9	4 38.7	1119.5	10.9	137
1138	39 04.1	4 39.7	1120.6	9.4	111
1300	38 59.6	4 55.1	1133.4	10.6	109
1310	38 59.0	4 57.3	1135.2	3.9	111
1349	38 58.1	5 00.3	1137.7	5.7	156
1410	38 56.3	5 01.4	1139.7	6.1	159
1424	38 54.9	5 02.0	1141.1	5.2	151
1436	38 54.0	5 02.7	1142.2	5.7	142
1446	38 53.3	5 03.4	1143.1	5.5	143
1505	38 51.9	5 04.8	1144.9	5.3	257
1510	38 51.8	5 04.2	1145.3	8.6	276
1524	38 52.0	5 01.7	1147.3	8.1	284

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
1530	38 52.2	5 00.7	1148.1	3.8	279
1545	38 52.3	4 59.5	1149.1	0.9	237
1551	38 52.3	4 59.4	1149.2	3.0	98
1605	38 52.2	5 00.3	1149.9	0.6	291
1700	38 52.4	4 59.7	1150.4	0.0	21
SITE 124 (August 29, 1970)					
1820	38 52.4	4 59.7	1150.4	4.0	90
1835	38 52.4	5 01.0	1151.4	10.4	93
1926	38 51.9	5 12.3	1160.2	10.4	98
2112	38 49.5	5 35.7	1178.6	10.9	100
2154	38 48.2	5 45.3	1186.2	9.2	96
2218	38 47.8	5 50.0	1189.9	10.5	90
(August 30, 1970)					
136	38 47.5	6 34.5	1224.6	12.6	90
200	38 47.5	6 41.0	1229.6	11.4	90
508	38 47.3	7 27.0	1265.5	10.8	91
804	38 46.6	8 07.6	1297.1	10.9	91
918	38 46.3	8 24.8	1310.6	10.0	92
1117	38 45.5	8 50.1	1330.3	10.6	111
1620	38 25.9	9 53.9	1383.9	10.7	107
2100	38 11.5	10 54.8	1433.8	11.0	109
2208	38 07.6	11 09.8	1446.2	11.2	113
(August 31, 1970)					
048	37 56.1	11 44.6	1476.0	11.1	123
230	37 45.9	12 04.8	1494.9	11.0	125
416	37 34.6	12 24.8	1514.3	9.9	121
554	37 26.4	12 42.5	1530.6	9.9	122
730	37 18.1	12 59.4	1546.4	10.3	123
858	37 09.9	13 15.3	1561.5	10.4	123
1156	36 53.2	13 47.9	1592.4	10.1	116
1217	36 51.7	13 51.9	1595.9	12.8	116
1342	36 43.7	14 12.2	1614.0	11.5	117
1530	36 34.2	14 35.0	1634.7	10.9	115
1715	36 26.0	14 56.5	1653.8	10.7	115
2118	36 07.3	15 45.2	1697.2	10.0	115
2352	35 56.4	16 14.0	1723.0	9.7	113
(September 1, 1970)					
138	35 49.8	16 33.5	1740.1	11.9	129
146	35 48.8	16 35.0	1741.6	10.8	112
326	35 41.9	16 55.6	1759.7	10.6	111
806	35 24.4	17 52.4	1809.1	11.3	110
956	35 17.4	18 16.2	1829.8	11.1	115
1102	35 12.2	18 29.8	1842.1	11.4	115
1250	35 03.6	18 52.5	1862.5	11.3	112
1442	34 55.8	19 16.4	1883.6	11.0	113
1525	34 52.7	19 25.3	1891.5	10.1	105
1700	34 48.7	19 44.1	1907.5	10.4	105
1848	34 43.9	20 06.2	1926.2	11.8	102
1920	34 42.6	20 13.7	1932.5	10.8	103
1959	34 41.1	20 22.0	1939.5	10.9	137
2012	34 39.4	20 23.9	1941.9	4.1	137
2028	34 38.6	20 24.9	1943.0	6.8	137
2040	34 37.6	20 26.0	1944.3	2.6	220
2043	34 37.5	20 25.9	1944.4	2.5	307
2053	34 37.7	20 25.5	1944.9	1.6	141
2058	34 37.6	20 25.6	1945.0	1.0	141
2102	34 37.6	20 25.6	1945.1	0.1	140
2200	34 37.5	20 25.8	1945.2	0.0	321
SITE 125 (September 4, 1970)					
445	34 37.5	20 25.7	1945.2	6.2	84
455	34 37.6	20 27.0	1946.2	10.6	89

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
550	34 37.8	20 38.8	1956.0	10.8	56
602	34 39.0	20 41.0	1958.1	9.7	50
718	34 46.9	20 52.4	1970.4	10.1	47
750	34 50.6	20 57.2	1975.8	10.6	48
910	34 60.0	21 10.2	1990.0	10.2	51
949	35 04.1	21 16.5	1996.6	10.4	55
953	35 04.5	21 17.2	1997.3	10.3	53
1043	35 09.7	21 25.6	2005.9	5.0	56
1057	35 10.3	21 26.8	2007.1	1.9	121
1100	35 10.3	21 26.9	2007.2	4.9	235
1117	35 09.5	21 25.5	2008.6	1.2	22
1128	35 09.7	21 25.6	2008.8	0.0	39
1200	35 09.7	21 25.6	2008.8	0.0	219
SITE 126 (September 6, 1972)					
445	35 09.5	21 25.4	2009.1	4.2	90
452	35 09.5	21 26.0	2009.6	9.7	87
553	35 10.0	21 38.0	2019.4	10.6	55
612	35 11.9	21 41.4	2022.8	9.9	49
724	35 19.8	21 52.4	2034.7	9.6	51
758	35 23.2	21 57.6	2040.2	10.4	48
836	35 27.6	22 03.6	2046.7	10.1	51
910	35 31.2	22 09.1	2052.5	10.1	54
1002	35 36.3	22 17.8	2061.2	10.3	54
1050	35 41.1	22 26.0	2069.4	9.3	48
1117	35 43.9	22 29.8	2073.6	5.2	50
1133	35 44.8	22 31.1	2075.0	6.9	152
1136	35 44.5	22 31.3	2075.3	8.0	244
1146	35 43.9	22 29.8	2076.6	0.0	240
1209	35 43.9	22 29.8	2076.7	0.0	227
SITES 127 AND 128 (September 12, 1970)					
1327	35 42.6	22 28.1	2078.6	5.9	121
1353	35 41.3	22 30.8	2081.1	11.0	121
1411	35 39.6	22 34.3	2084.4	7.0	119
1440	35 38.0	22 38.0	2087.8	6.2	127
1500	35 36.7	22 40.0	2089.9	8.6	122
1710	35 26.7	22 59.4	2108.6	10.6	126
1848	35 16.6	23 16.7	2125.9	9.6	115
2018	35 10.5	23 32.6	2140.3	9.6	110
2152	35 05.4	23 49.8	2155.3	10.8	110
2215	35 04.0	23 54.6	2159.4	10.1	108
2334	35 00.0	24 10.0	2172.7	10.4	105
(September 13, 1970)					
052	34 56.4	24 26.0	2186.3	11.2	109
105	34 55.6	24 28.8	2188.7	11.4	112
119	34 54.6	24 31.8	2191.3	10.2	117
240	34 48.4	24 46.8	2205.1	10.1	117
314	34 45.8	24 53.0	2210.8	10.1	103
550	34 39.9	25 24.0	2237.0	9.8	101
644	34 38.2	25 34.6	2245.8	11.2	91
738	34 38.1	25 46.8	2255.9	10.1	90
832	34 38.1	25 57.9	2265.0	10.3	87
858	34 38.4	26 03.3	2269.5	11.0	92
1044	34 37.8	26 27.0	2289.0	11.2	88
1115	34 38.0	26 34.0	2294.8	11.8	123
1204	34 32.7	26 43.8	2304.4	11.7	124
1350	34 21.1	27 04.6	2325.1	11.1	131
1352	34 20.9	27 04.9	2325.4	8.8	145
1355	34 20.5	27 05.2	2325.9	6.7	144
1403	34 19.8	27 05.8	2326.8	4.7	190
1406	34 19.6	27 05.8	2327.0	5.6	278
1415	34 19.7	27 04.8	2327.8	2.4	21
1419	34 19.8	27 04.9	2328.0	5.3	44
1437	34 21.0	27 06.2	2329.6	4.3	357
1447	34 21.7	27 06.2	2330.3	1.6	348
1502	34 22.1	27 06.1	2330.7	3.0	300

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
1506	34 22.2	27 05.9	2330.9	3.3	216
1510	34 22.0	27 05.7	2331.2	3.9	187
1520	34 21.4	27 05.6	2331.8	2.9	205
1528	34 21.0	27 05.4	2332.2	3.1	278
1532	34 21.1	27 05.1	2332.4	1.0	260
1543	34 21.0	27 04.9	2332.6	0.3	190
1600	34 21.0	27 04.9	2332.7	0.0	245
SITE 129 (September 16, 1970)					
345	34 20.8	27 04.5	2333.0	5.4	153
355	34 20.0	27 05.0	2333.9	11.2	131
556	34 05.1	27 25.4	2356.5	11.0	132
633	34 00.6	27 31.5	2363.2	10.8	99
640	34 00.4	27 33.0	2364.5	10.9	137
717	33 55.5	27 38.6	2371.2	11.0	136
742	33 52.2	27 42.4	2375.8	11.2	140
821	33 46.6	27 48.1	2383.1	11.8	166
912	33 36.9	27 51.1	2393.1	6.2	167
926	33 35.5	27 51.5	2394.6	4.1	68
930	33 35.6	27 51.8	2394.9	2.8	0
945	33 36.3	27 51.8	2395.6	0.6	86
1000	33 36.3	27 52.0	2395.7	0.0	90
SITE 130 (September 18, 1970)					
710	33 36.3	27 52.0	2395.7	4.2	152
728	33 35.2	27 52.7	2397.0	10.7	131
748	33 32.8	27 55.9	2400.6	11.0	131
946	33 18.8	28 15.6	2422.2	11.2	132
1016	33 15.0	28 20.6	2427.8	10.5	138
1128	33 05.6	28 30.6	2440.3	10.7	142
1129	33 05.5	28 30.7	2440.5	4.2	140
1142	33 04.8	28 31.4	2441.4	4.8	141
1147	33 04.5	28 31.7	2441.8	3.1	40
1152	33 04.7	28 31.9	2442.1	5.7	328
1210	33 06.1	28 30.8	2443.8	0.8	339
1230	33 06.4	28 30.7	2444.1	0.0	40
SITE 131 (September 20, 1970)					
001	33 06.4	28 30.7	2444.1	5.8	294
032	33 07.6	28 27.4	2447.1	10.0	293
344	33 20.0	27 52.2	2479.0	8.4	282
424	33 21.1	27 45.6	2484.6	8.9	291
440	33 22.0	27 43.0	2487.0	10.8	285
526	33 24.1	27 33.4	2495.3	8.8	290
604	33 26.0	27 27.2	2500.8	9.2	289
714	33 29.5	27 15.0	2511.6	10.0	281
738	33 30.3	27 10.3	2515.5	9.8	301
752	33 31.5	27 07.9	2517.8	9.4	282
838	33 33.0	26 59.5	2525.0	9.5	297
938	33 37.3	26 49.3	2534.6	8.6	291
944	33 37.6	26 48.3	2535.4	4.7	301
949	33 37.8	26 47.9	2535.8	8.5	296
1126	33 43.9	26 33.0	2549.6	9.5	297
1146	33 45.3	26 29.6	2552.8	9.7	294
1334	33 52.4	26 10.3	2570.3	9.7	294
1400	33 54.1	26 05.7	2574.5	10.9	286
1718	34 04.3	25 24.0	2610.6	10.4	286
1804	34 06.5	25 14.8	2618.5	10.2	292
1908	34 10.7	25 02.6	2629.4	10.8	289
2134	34 19.2	24 32.4	2655.8	11.4	290
2320	34 26.1	24 09.5	2675.9	12.1	291
2348	34 28.1	24 03.1	2681.5	9.0	288
(September 21, 1970)					
001	34 28.7	24 00.9	2683.5	11.3	299
128	34 36.8	23 43.5	2699.9	10.6	302

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
215	34 41.2	23 35.0	2708.2	6.1	295
414	34 46.4	23 21.6	2720.4	10.0	282
438	34 47.2	23 16.8	2724.4	9.6	290
516	34 49.3	23 09.9	2730.5	9.3	288
624	34 52.6	22 57.6	2741.0	11.4	284
700	34 54.2	22 49.5	2747.8	9.3	283
730	34 55.2	22 44.0	2752.5	10.5	291
844	34 59.8	22 29.2	2765.5	10.5	288
1024	35 05.1	22 08.9	2782.9	9.2	300
1058	35 07.7	22 03.3	2788.2	10.1	297
1143	35 11.1	21 55.1	2795.7	9.6	300
1242	35 15.9	21 45.1	2805.2	9.7	292
1430	35 22.5	21 25.4	2822.6	9.9	291
1510	35 24.9	21 17.8	2829.2	8.9	288
1816	35 33.5	20 45.5	2856.9	10.2	283
2014	35 37.9	20 21.4	2877.0	8.7	293
2258	35 47.3	19 54.6	2900.7	9.1	290
(September 22, 1970)					
042	35 52.8	19 36.4	2916.4	9.0	290
125	35 55.0	19 28.9	2922.9	10.0	296
224	35 59.3	19 18.0	2932.7	9.4	293
303	36 01.7	19 11.1	2938.8	9.1	297
418	36 06.9	18 58.5	2950.2	9.3	287
438	36 07.8	18 54.9	2953.2	8.7	283
538	36 09.8	18 44.5	2961.9	6.9	288
602	36 10.6	18 41.2	2964.7	9.5	288
610	36 11.0	18 39.7	2965.9	9.8	286
700	36 13.3	18 30.0	2974.1	9.3	292
722	36 14.6	18 26.1	2977.5	9.0	299
750	36 16.6	18 21.5	2981.7	7.1	308
950	36 25.4	18 07.7	2995.9	4.1	314
1021	36 26.9	18 05.8	2998.0	0.2	305
1120	36 27.0	18 05.5	2998.3	2.2	290
1156	36 27.5	18 04.0	2999.6	1.5	5
1310	36 29.3	18 04.2	3001.4	2.7	346
1333	36 30.3	18 03.9	3002.5	7.5	300
1340	36 30.7	18 03.0	3003.3	7.2	308
1608	36 41.7	17 45.7	3021.0	8.4	305
1926	36 57.5	17 17.2	3048.7	9.4	305
2130	37 08.5	16 57.3	3068.1	9.4	306
2318	37 18.5	16 40.2	3085.0	9.4	308
2354	37 21.9	16 34.6	3090.6	9.8	303
(September 23, 1970)					
030	37 25.1	16 28.4	3096.4	9.5	312
140	37 32.4	16 18.0	3107.5	9.7	309
209	37 35.4	16 13.4	3112.2	11.1	298
244	37 38.4	16 06.2	3118.6	10.0	292
322	37 40.7	15 58.8	3124.9	11.1	292
346	37 42.4	15 53.6	3129.4	9.4	302
415	37 44.8	15 48.7	3133.9	9.5	299
436	37 46.4	15 45.0	3137.3	10.9	300
447	37 47.4	15 42.8	3139.3	10.4	319
507	37 50.0	15 39.9	3142.7	10.5	329
537	37 54.5	15 36.5	3148.0	9.2	349
610	37 59.5	15 35.3	3153.1	10.4	2
621	38 01.4	15 35.4	3155.0	11.7	2
640	38 05.1	15 35.6	3158.7	5.4	5
700	38 06.9	15 35.8	3160.5	6.4	4
735	38 10.6	15 36.1	3164.2	5.5	12
805	38 13.3	15 36.8	3166.9	6.9	38
815	38 14.2	15 37.7	3168.1	10.5	83
824	38 14.4	15 39.7	3169.7	9.7	47
834	38 15.5	15 41.2	3171.3	6.4	21
842	38 16.3	15 41.6	3172.1	9.1	351
852	38 17.8	15 41.3	3173.6	10.0	318
942	38 24.0	15 34.2	3182.0	9.3	306

15. UNDERWAY GEOPHYSICAL MEASUREMENTS, EASTERN NORTH ATLANTIC AND MEDITERRANEAN

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
1026	38 28.0	15 27.2	3188.8	9.5	319
1250	38 45.3	15 08.3	3211.5	10.1	296
1442	38 53.5	14 46.6	3230.3	10.6	298
1528	38 57.4	14 37.4	3238.5	10.0	299
1648	39 03.9	14 22.4	3251.8	12.4	293
1712	39 05.8	14 16.5	3256.7	10.2	296
1818	39 10.7	14 03.5	3268.0	10.3	299
2008	39 20.0	13 42.3	3286.8	11.3	302
2042	39 23.4	13 35.3	3293.2	10.3	301
2226	39 32.5	13 15.4	3311.0	10.5	304
2248	39 34.6	13 11.3	3314.9	10.5	297

(September 24, 1970)

010	39 41.1	12 54.7	3329.2	10.4	298
052	39 44.5	12 46.3	3336.5	9.1	296
225	39 50.8	12 29.9	3350.6	4.7	303
232	39 51.1	12 29.3	3351.1	9.2	303
244	39 52.1	12 27.3	3353.0	8.8	296
410	39 57.6	12 12.5	3365.6	9.7	299
544	40 05.0	11 55.1	3380.8	9.0	300
616	40 07.4	11 49.7	3385.6	9.6	296
730	40 12.7	11 35.8	3397.5	10.4	293
800	40 14.7	11 29.5	3402.7	10.3	293
816	40 15.8	11 26.2	3405.4	5.3	294
837	40 16.5	11 23.9	3407.3	2.8	14
841	40 16.7	11 24.0	3407.5	8.8	119
855	40 15.7	11 26.3	3409.5	0.2	102
930	40 15.7	11 26.5	3409.6	0.0	90

SITE 132 (September 26, 1970)

1015	40 15.7	11 26.5	3409.6	6.0	230
1040	40 14.1	11 24.0	3412.1	10.0	227
1112	40 10.5	11 18.9	3417.4	10.3	231
1149	40 06.5	11 12.4	3423.8	4.8	224
1208	40 05.4	11 11.0	3425.4	10.7	230
1400	39 52.5	10 51.2	3445.3	10.9	230
1730	39 27.9	10 13.0	3483.6	10.8	225
1754	39 24.9	10 09.1	3487.9	12.4	231
1825	39 20.9	10 02.6	3494.3	11.6	231
1916	39 14.7	9 52.6	3504.2	10.3	221
2053	39 02.2	9 38.5	3520.8	10.9	247
2128	38 59.8	9 31.0	3527.1	10.9	246
2312	38 52.0	9 08.8	3546.1	11.4	252

(September 27, 1970)

014	38 48.4	8 54.4	3557.8	10.8	241
021	38 47.8	8 53.0	3559.1	11.2	264
037	38 47.5	8 49.2	3562.1	11.3	267
225	38 46.6	8 23.1	3582.4	10.6	300
315	38 51.0	8 13.3	3591.2	11.4	298
400	38 55.0	8 03.6	3599.8	10.8	299
504	39 00.5	7 50.6	3611.3	10.4	297
650	39 08.9	7 29.5	3629.7	10.4	297
734	39 12.4	7 20.7	3637.4	5.2	297
802	39 13.5	7 17.9	3639.8	3.7	216
806	39 13.3	7 17.7	3640.0	7.1	121
822	39 12.3	7 19.8	3641.9	5.4	121
827	39 12.1	7 20.3	3642.4	0.3	230
900	39 12.0	7 20.1	3642.6	0.0	257

SITES 133 AND 134 (October 1, 1970)

1800	39 11.6	7 17.9	3644.3	2.5	146
2000	39 07.5	7 21.5	3649.3	4.6	153
2040	39 04.8	7 23.3	3652.3	8.7	257
2212	39 01.8	7 06.6	3665.7	8.4	257
2348	38 58.7	6 49.7	3679.1	8.8	257

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
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(October 2, 1970)

114	38 55.8	6 34.0	3691.7	10.0	176
120	38 54.8	6 34.1	3692.7	7.4	246
130	38 54.3	6 32.6	3693.9	6.5	247
307	38 50.2	6 20.2	3704.4	3.2	171
316	38 49.7	6 20.3	3704.9	5.7	175
347	38 46.8	6 20.6	3707.9	8.1	256
350	38 46.7	6 20.1	3708.3	10.1	146
355	38 46.0	6 20.7	3709.1	9.1	255
434	38 44.4	6 13.4	3715.0	6.7	256
632	38 41.1	5 57.1	3728.2	10.1	169
645	38 39.0	5 57.6	3730.4	8.6	263
822	38 37.3	5 39.9	3744.3	9.4	264
918	38 36.4	5 28.7	3753.1	8.9	264
1106	38 34.6	5 08.3	3769.1	10.0	257
1117	38 34.2	5 06.0	3771.0	9.2	250
1244	38 29.6	4 49.9	3784.4	9.2	250
1434	38 23.8	4 29.7	3801.2	9.2	253
1702	38 17.3	4 02.2	3823.8	10.5	257
1746	38 15.5	3 52.7	3831.5	10.0	244
1822	38 12.9	3 45.8	3837.5	9.9	252
1855	38 11.2	3 39.2	3842.9	9.7	241
1928	38 08.6	3 33.2	3848.3	10.8	248
2006	38 06.1	3 25.2	3855.1	10.3	246
2118	38 01.2	3 10.9	3867.4	10.3	248

(October 3, 1970)

042	37 47.8	2 29.9	3902.4	10.6	247
116	37 45.5	2 22.9	3908.4	10.5	242
234	37 39.0	2 07.8	3922.0	10.2	247
305	37 37.0	2 01.6	3927.3	9.9	255
449	37 32.5	1 40.8	3944.3	9.4	247
530	37 30.0	1 33.3	3950.8	10.3	252
608	37 28.0	1 25.5	3957.3	11.1	254
718	37 24.4	1 9.9	3970.2	10.2	251
911	37 18.0	0 47.0	3989.5	11.5	259
922	37 17.6	0 44.4	3991.6	11.1	249
940	37 16.4	0 40.5	3994.9	10.8	250
1200	37 07.7	0 10.9	4020.1	10.5	247
1342	37 00.8	-0 9.8 W	4038.0	9.7	253
1528	36 55.8	-0 30.5	4055.2	10.9	254
1738	36 49.2	-0 58.7	4078.7	10.8	250
1840	36 45.4	-1 11.8	4089.9	10.7	250
1920	36 43.0	-1 20.2	4097.0	11.1	246
2026	36 38.1	-1 34.1	4109.2	10.7	248
2118	36 34.6	-1 44.8	4118.5	10.2	226
2208	36 28.7	-1 52.4	4127.0	9.8	225
2240	36 25.0	-1 57.0	4132.2	10.2	260
2354	36 22.8	-2 12.4	4144.8	10.6	264

(October 4, 1970)

138	36 20.7	-2 35.1	4163.2	10.1	264
330	36 18.8	-2 58.5	4182.1	11.4	263
444	36 17.2	-3 15.8	4196.2	11.2	259
533	36 15.4	-3 27.0	4205.4	10.6	228
549	36 13.5	-3 29.6	4208.2	10.7	250
632	36 10.9	-3 38.5	4215.9	9.8	263
816	36 08.9	-3 59.4	4232.9	11.4	256
855	36 07.1	-4 08.3	4240.3	11.3	248
918	36 05.5	-4 13.3	4244.6	10.7	344
920	36 05.8	-4 13.4	4245.0	5.3	347
1058	36 14.3	-4 15.8	4253.6	3.0	258
1144	36 13.8	-4 18.6	4255.9	10.0	257
1254	36 11.1	-4 32.7	4267.6	10.5	257
1330	36 09.7	-4 40.3	4273.9	11.1	258
1442	36 07.0	-4 56.4	4287.2	10.5	259
1535	36 05.2	-5 07.7	4296.5	11.2	249

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
1550	36 04.2	-5 11.0	4299.4	9.7	251
1627	36 02.2	-5 18.0	4305.4	10.4	250
1720	35 59.1	-5 28.7	4314.6	9.2	259
1812	35 57.6	-5 38.4	4322.5	9.5	285
1855	35 59.4	-5 46.5	4329.3	9.9	291
1937	36 01.9	-5 54.5	4336.3	9.3	289
2035	36 04.9	-6 05.0	4345.3	9.8	282
2108	36 06.0	-6 11.5	4350.6	10.6	296
2122	36 07.1	-6 14.2	4353.1	8.9	298
2144	36 08.6	-6 17.8	4356.4	10.7	292
2300	36 13.6	-6 33.4	4369.9	9.7	291

(October 5, 1970)

044	36 19.5	-6 52.8	4386.7	10.2	288
054	36 20.1	-6 54.9	4388.4	10.0	290
236	36 25.9	-7 14.7	4405.4	10.7	289
426	36 32.3	-7 37.7	4425.0	9.3	290
524	36 35.4	-7 48.2	4433.0	9.7	327
535	36 36.9	-7 49.4	4435.7	8.9	295
542	36 37.3	-7 50.6	4436.8	10.1	290
726	36 43.3	-8 11.0	4454.2	9.5	288
922	36 48.8	-8 33.0	4472.6	9.6	292
1042	36 53.7	-8 47.8	4485.5	9.4	291
1132	36 56.5	-8 57.0	4493.3	9.9	310
1158	36 59.3	-9 01.1	4497.6	8.7	325
1215	37 01.3	-9 02.9	4500.1	9.5	354
1234	37 04.3	-9 03.3	4503.1	9.6	345
1354	37 16.7	-9 07.4	4515.9	9.1	348
1436	37 22.9	-9 09.0	4522.3	8.8	346
1536	37 31.5	-9 11.6	4531.1	9.1	349
1628	37 39.3	-9 13.5	4539.0	8.8	351
1744	37 50.3	-9 15.6	4550.2	10.0	343
1814	37 55.1	-9 17.4	4555.2	9.0	345
1928	38 05.8	-9 21.0	4566.3	8.7	349
2028	38 14.4	-9 23.0	4575.0	9.2	350
2045	38 17.0	-9 23.6	4577.6	9.5	321
2142	38 24.0	-9 30.9	4586.7	9.7	236
2206	38 21.8	-9 35.0	4590.6	9.8	225
2216	38 20.7	-9 36.5	4592.2	8.9	140
2304	38 15.2	-9 30.7	4599.3	9.8	145
2328	38 12.0	-9 27.8	4603.3	11.3	225
2348	38 09.3	-9 31.2	4607.0	9.5	233

TABLE 1 - Continued

Time	Latitude	Longitude	Distance (miles)	Speed (knots)	Course (degrees)
(October 6, 1970)					
003	38 07.9	-9 33.6	4609.4	8.9	63
006	38 08.1	-9 33.1	4609.8	6.4	339
010	38 08.5	-9 33.3	4610.3	9.0	312
015	38 09.0	-9 34.0	4611.0	9.3	321
103	38 14.8	-9 39.9	4618.4	7.3	21
150	38 20.2	-9 37.2	4624.2	12.0	22
250	38 31.3	-9 31.5	4636.2	11.4	33
345	38 40.0	-9 24.2	4646.6		

ARRIVE LISBON

50 feet, towed \approx 300 meters behind the vessel; (3) a Bolt PA6 amplifier and filter module; (4) two Edo Western Model 333 Precision Bathymetric Recorders displaying on dry Timefax paper. One recorder was set on a 10-second sweep, the other on a 5-second sweep. The 10-second sweep records are annotated and shown in Figures 3, A, B, C, etc.

ACKNOWLEDGMENTS

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REFERENCE

Talwani, M., 1969. A computer system for the reduction, storage and display of underway data acquired at sea. *Technical Report 1*, Contract CU-1-69 N0014-67-A-0108-0004, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York, 1.

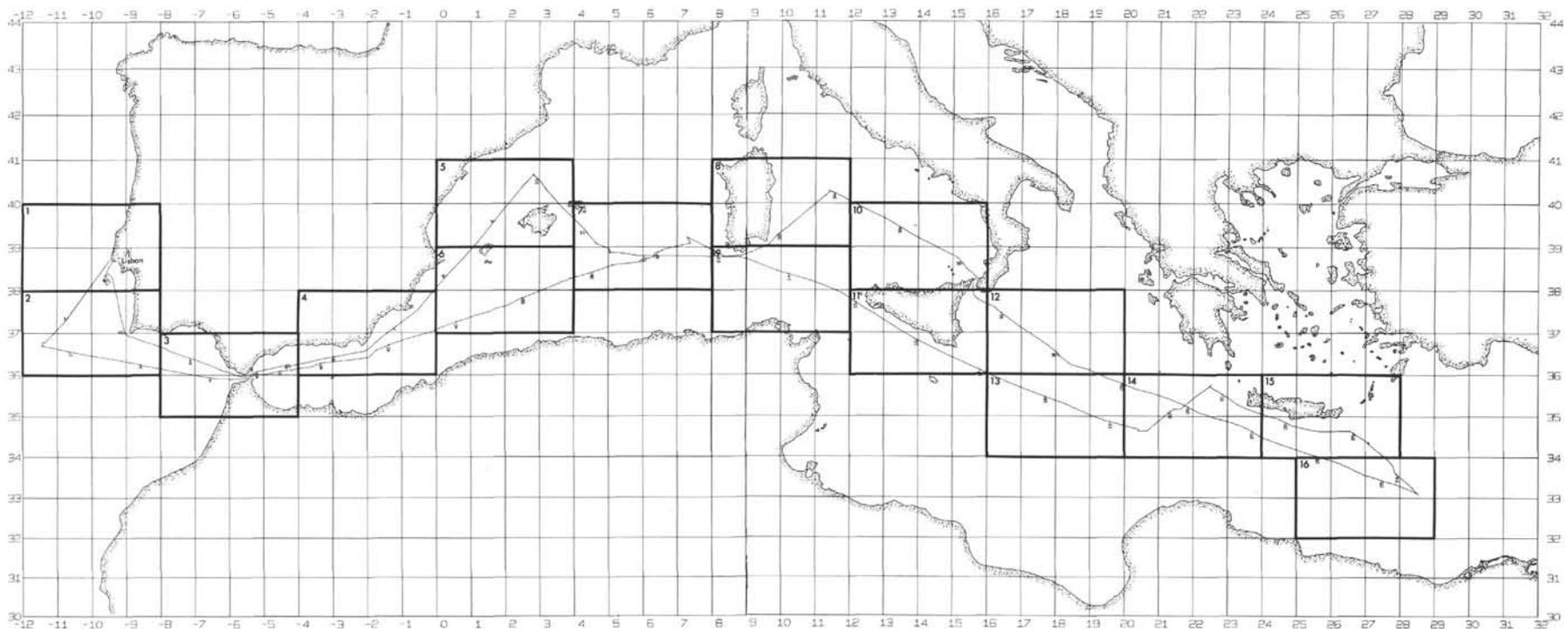


Figure 1A. Navigation and bathymetry, mercator projection.

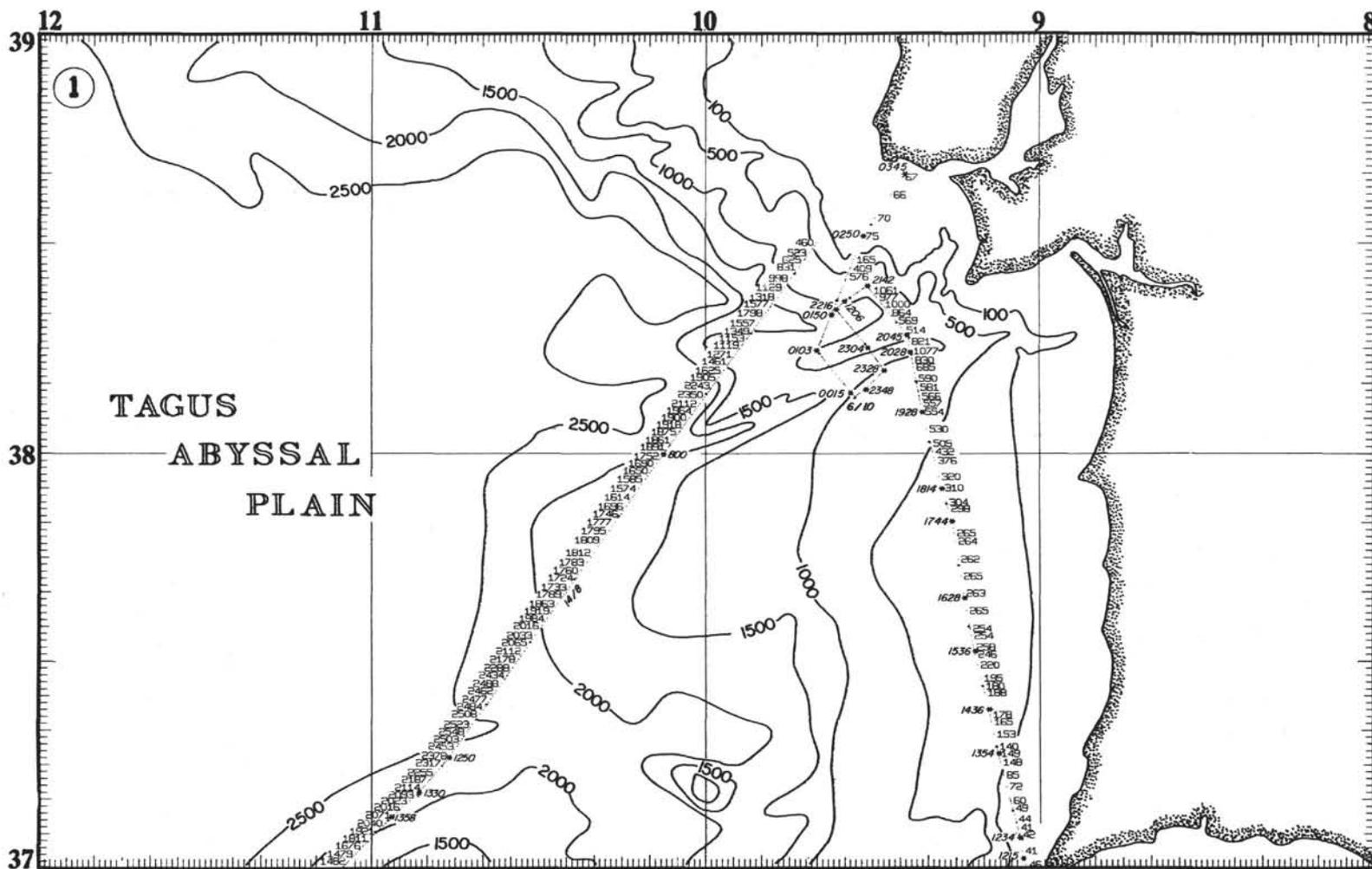


Figure 1B.

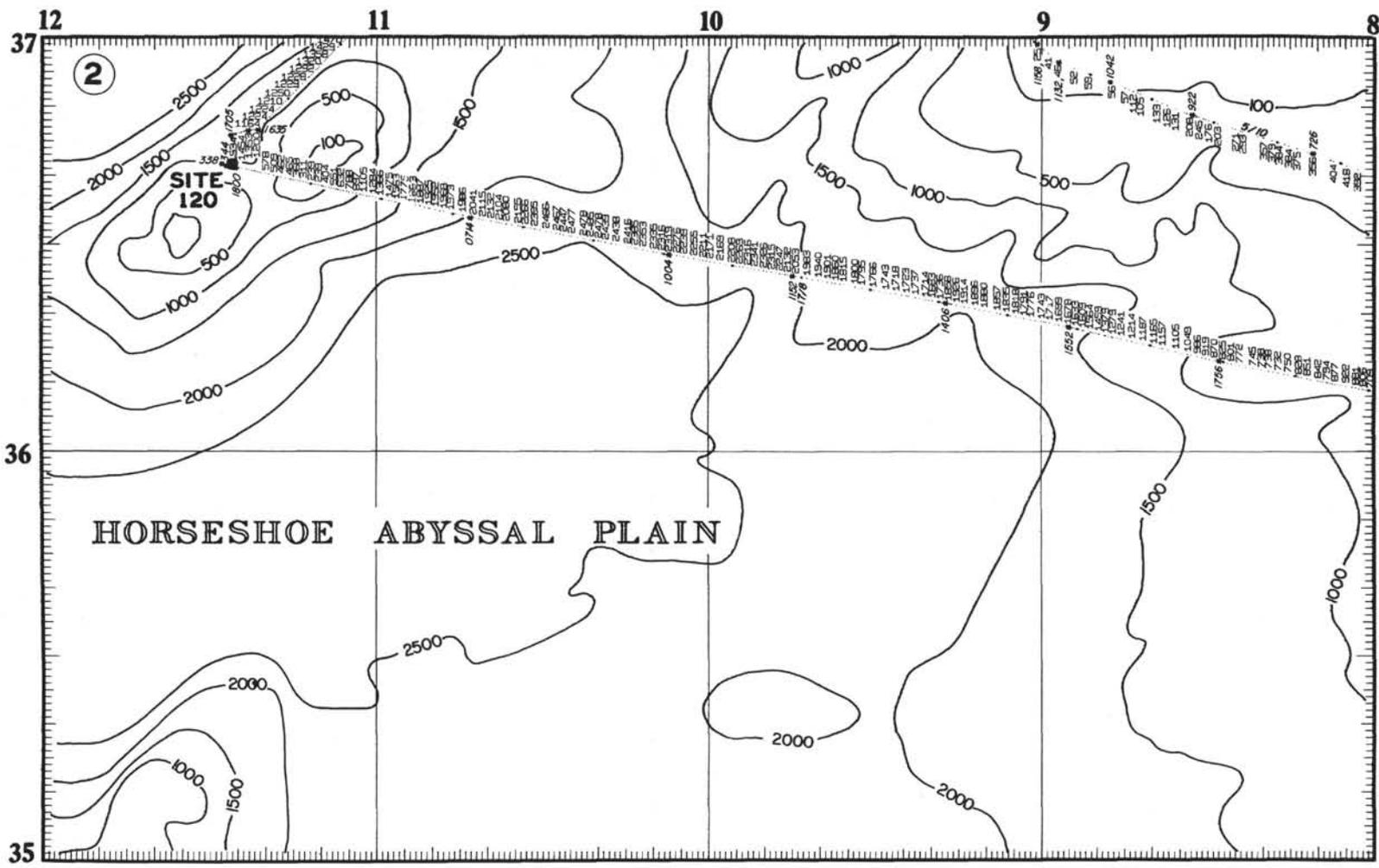


Figure 1C.

Depths in units of travel time (1 tau = 1/400th sec).

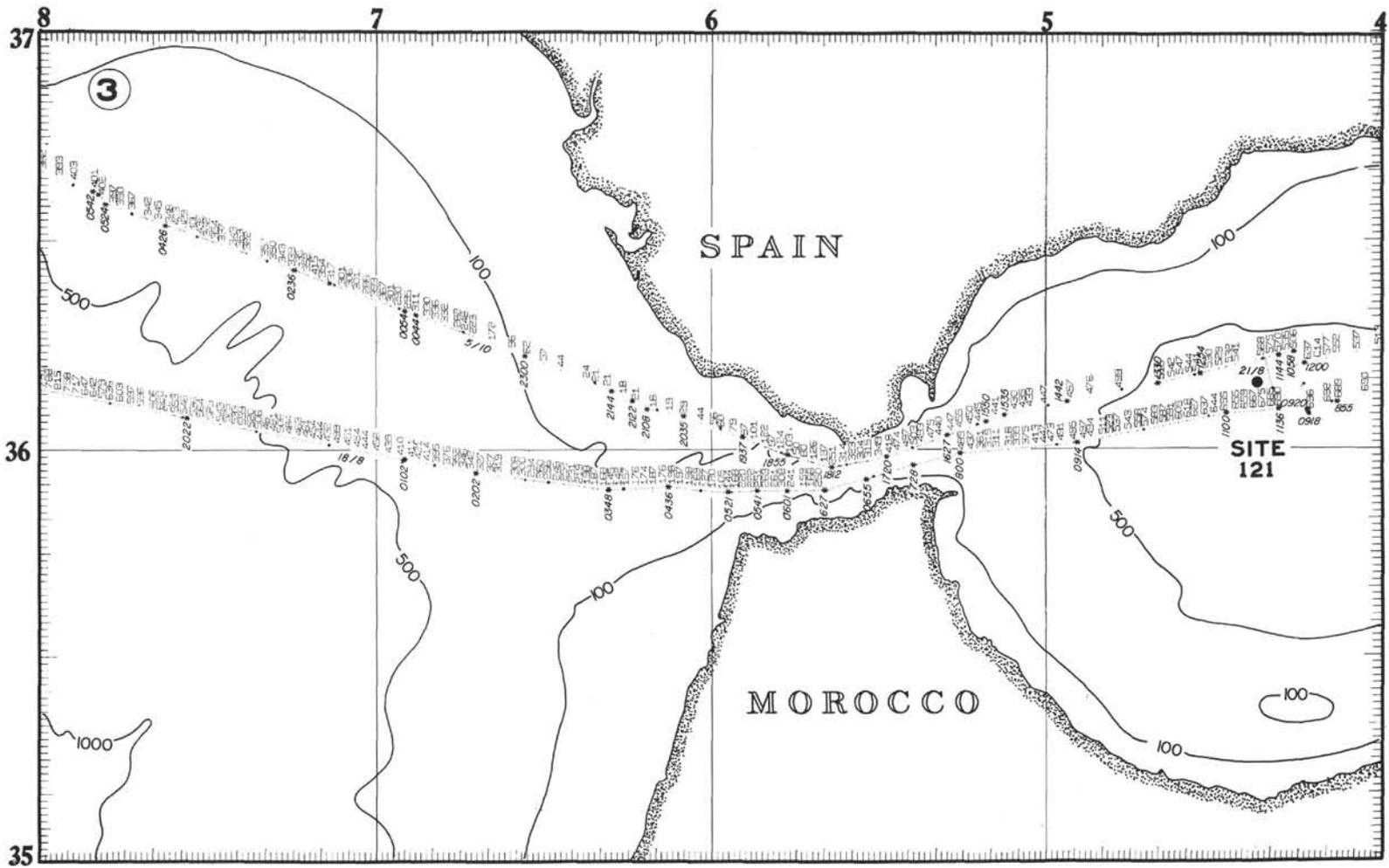


Figure 1D.

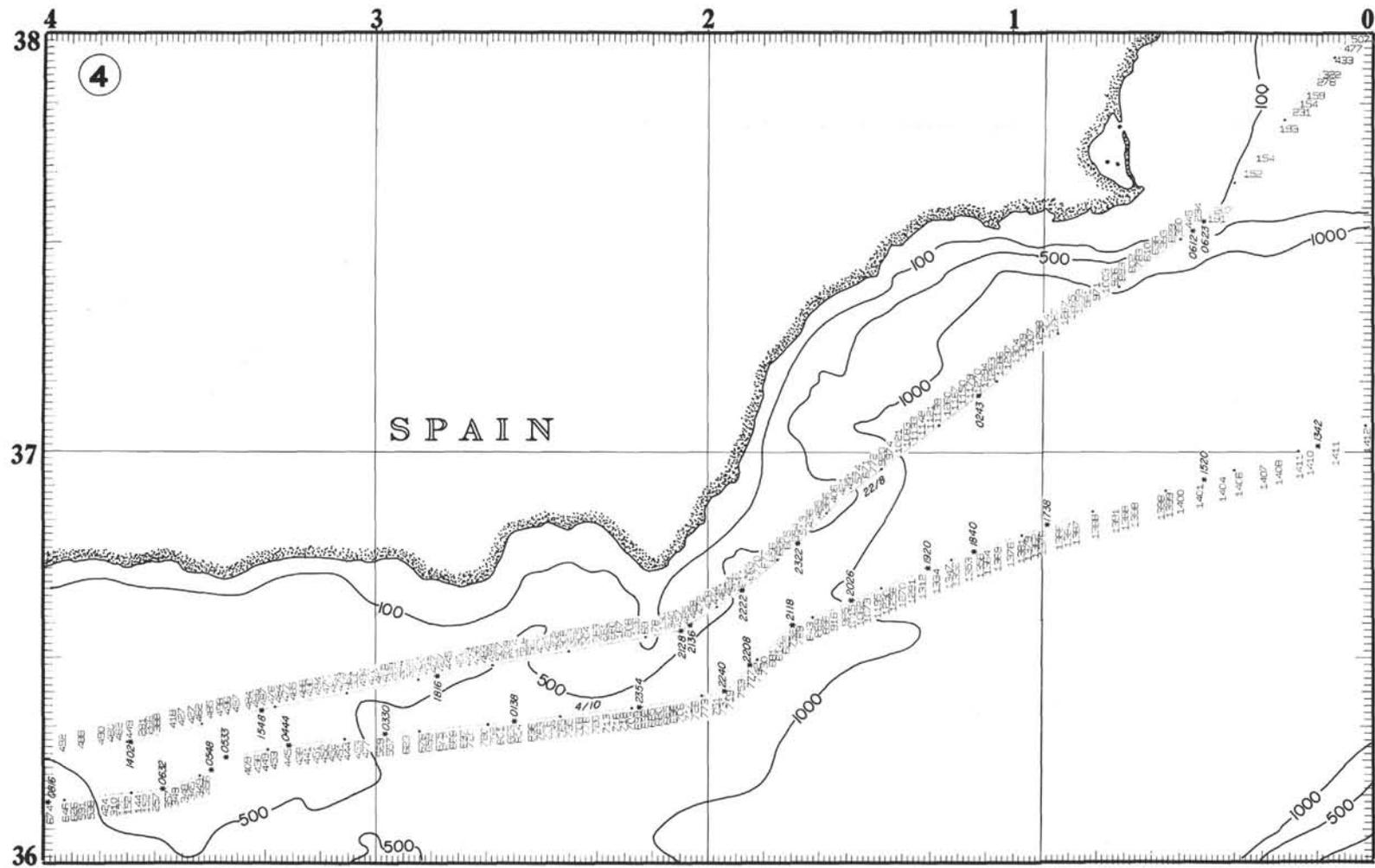
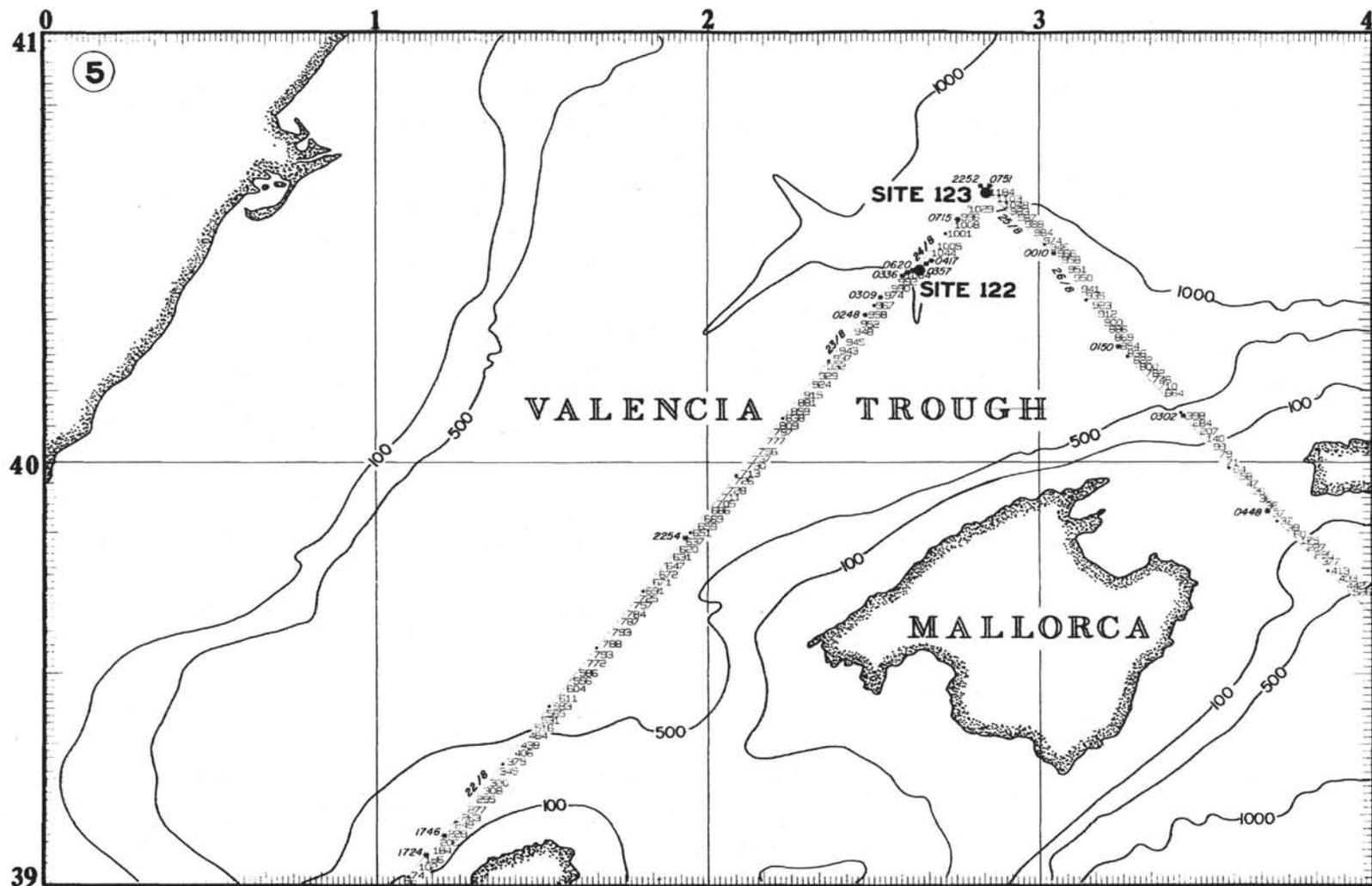


Figure 1E.

Depths in units of travel time (1 tau = 1/400th sec).



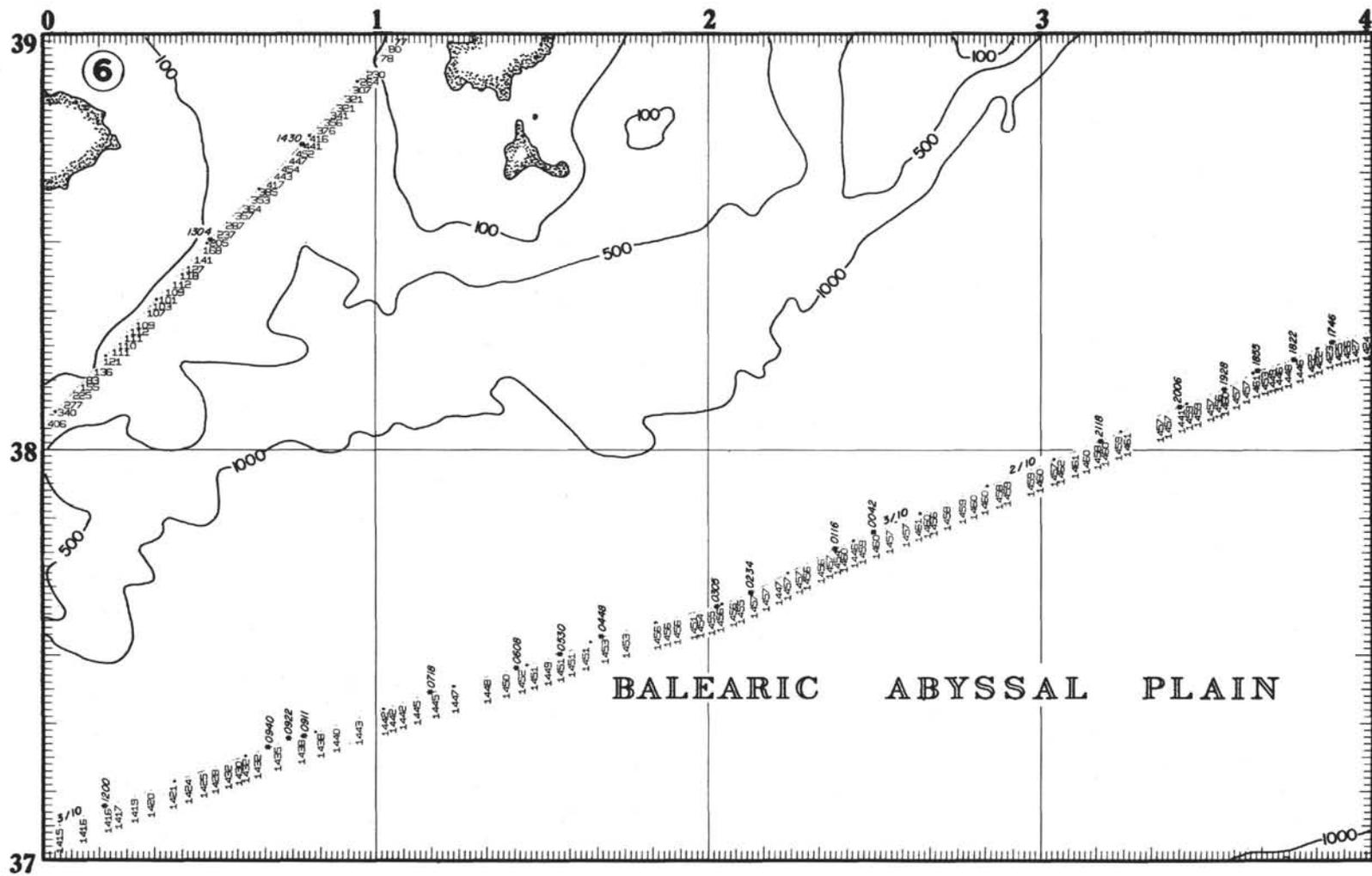


Figure 1G.

Depths in units of travel time (1 tau = 1/400th sec).

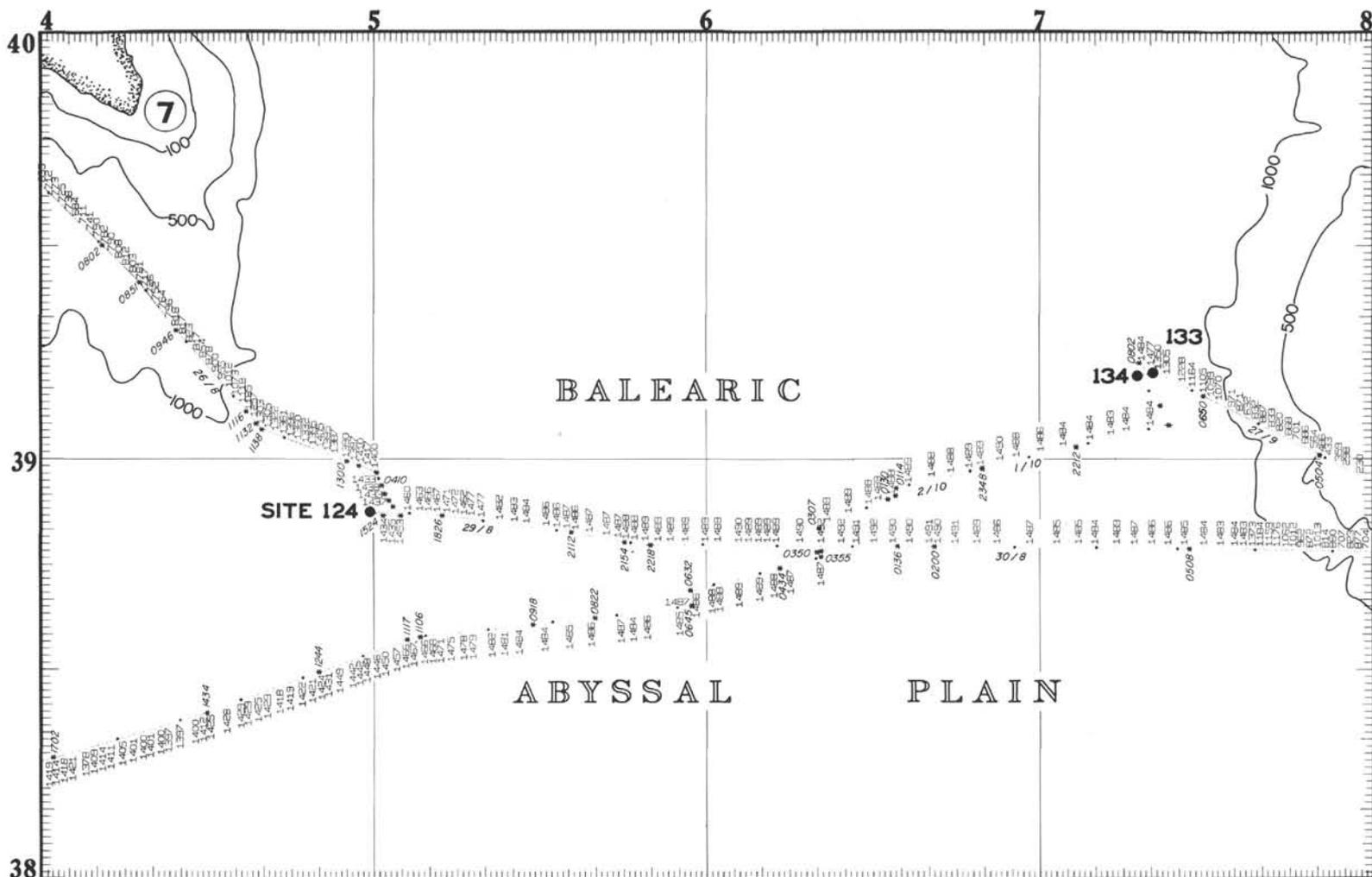


Figure 1H.

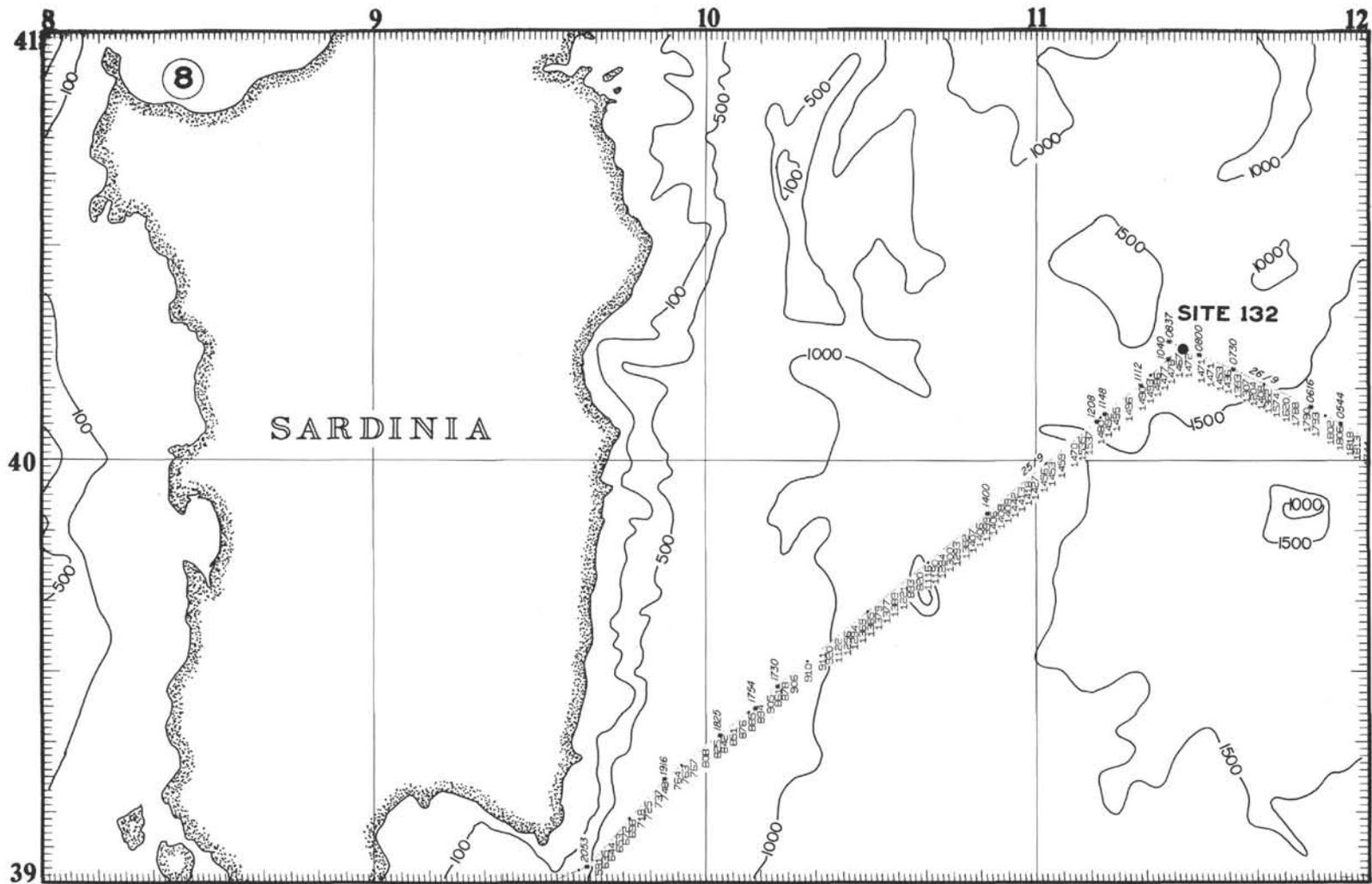


Figure 11.

Depths in units of travel time (1 tau = 1/400th sec).

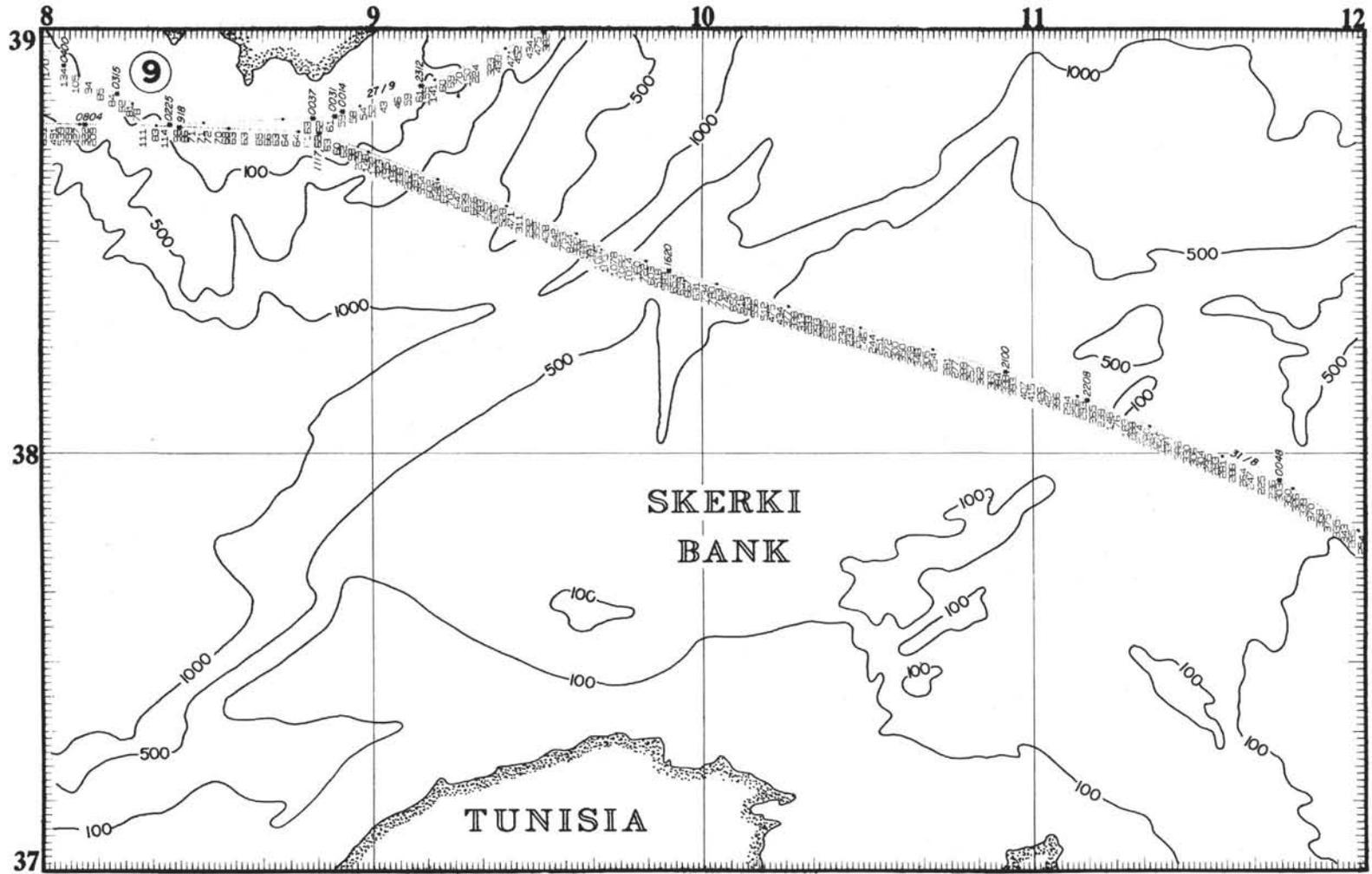


Figure 1J.

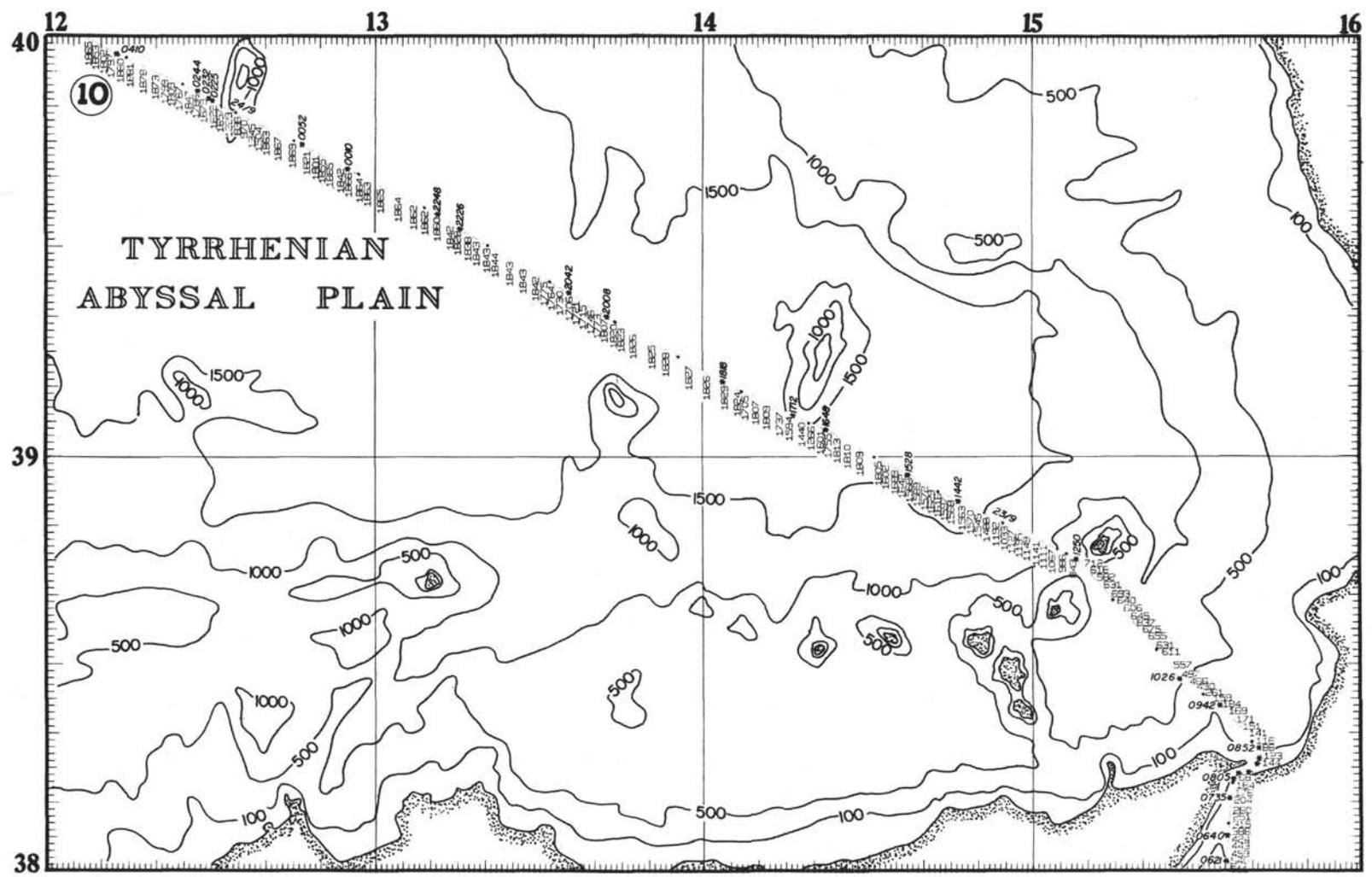


Figure 1K.

Depths in units of travel time (1 tau = 1/400th sec).

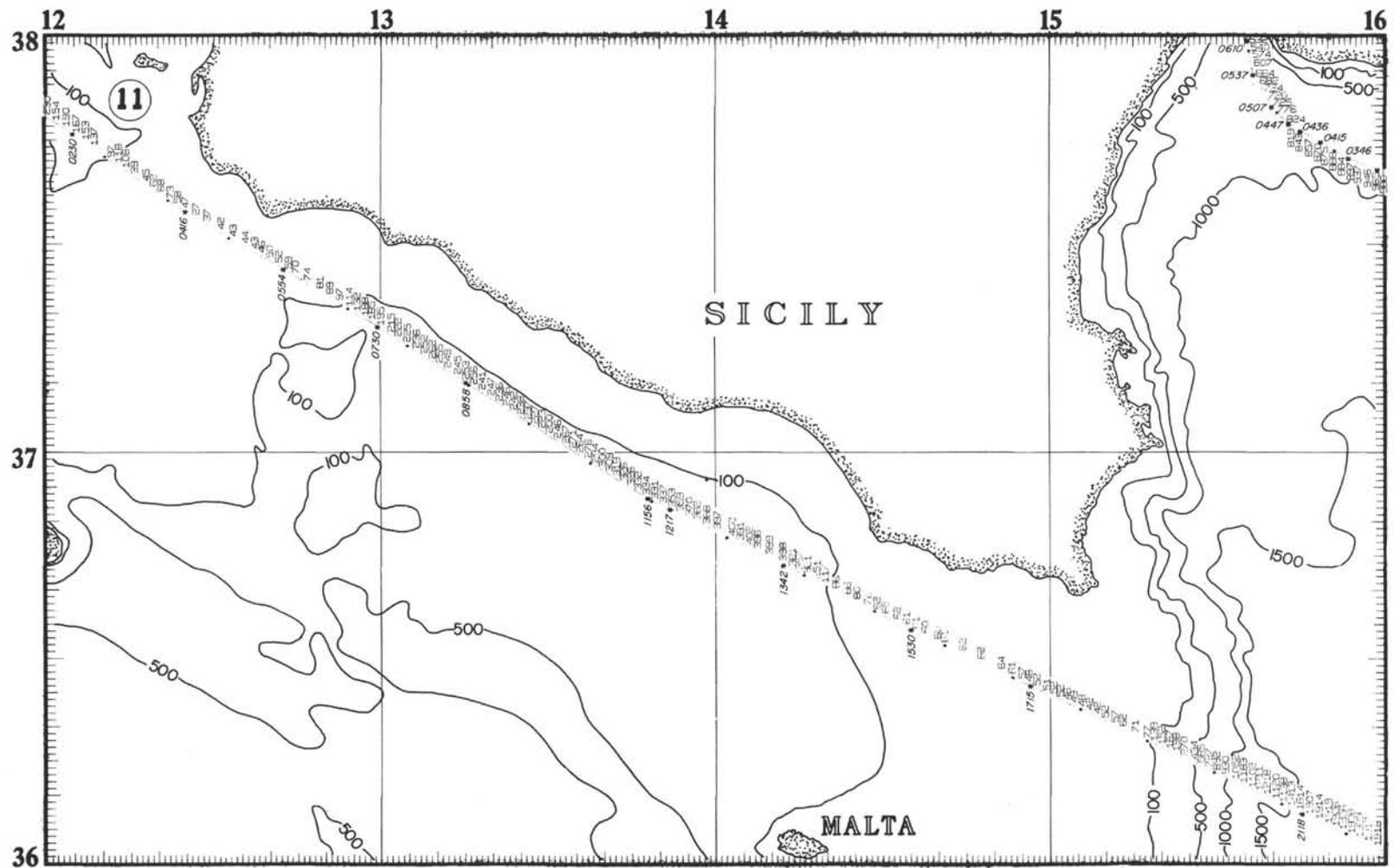


Figure 1L.

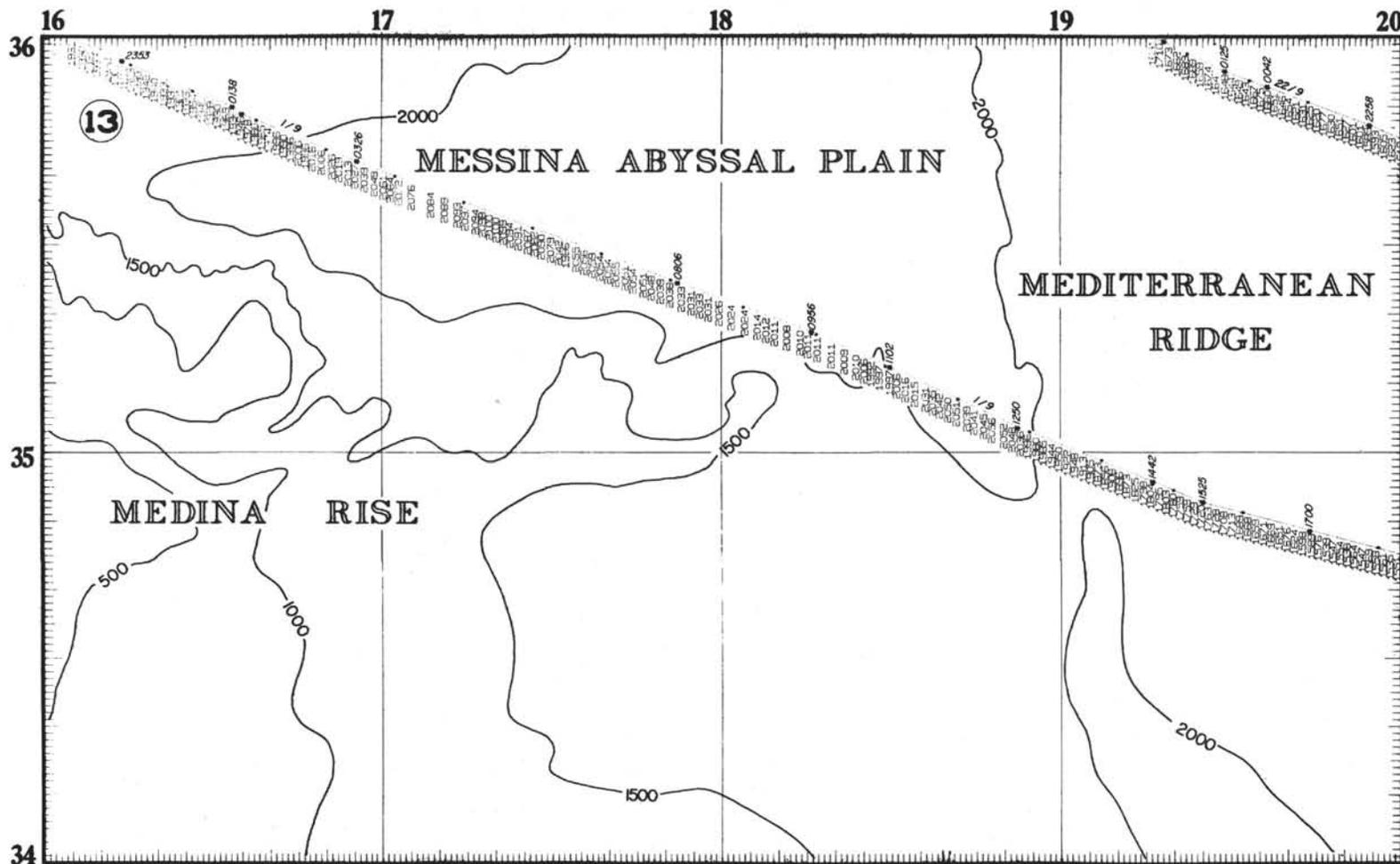


Figure 1N.

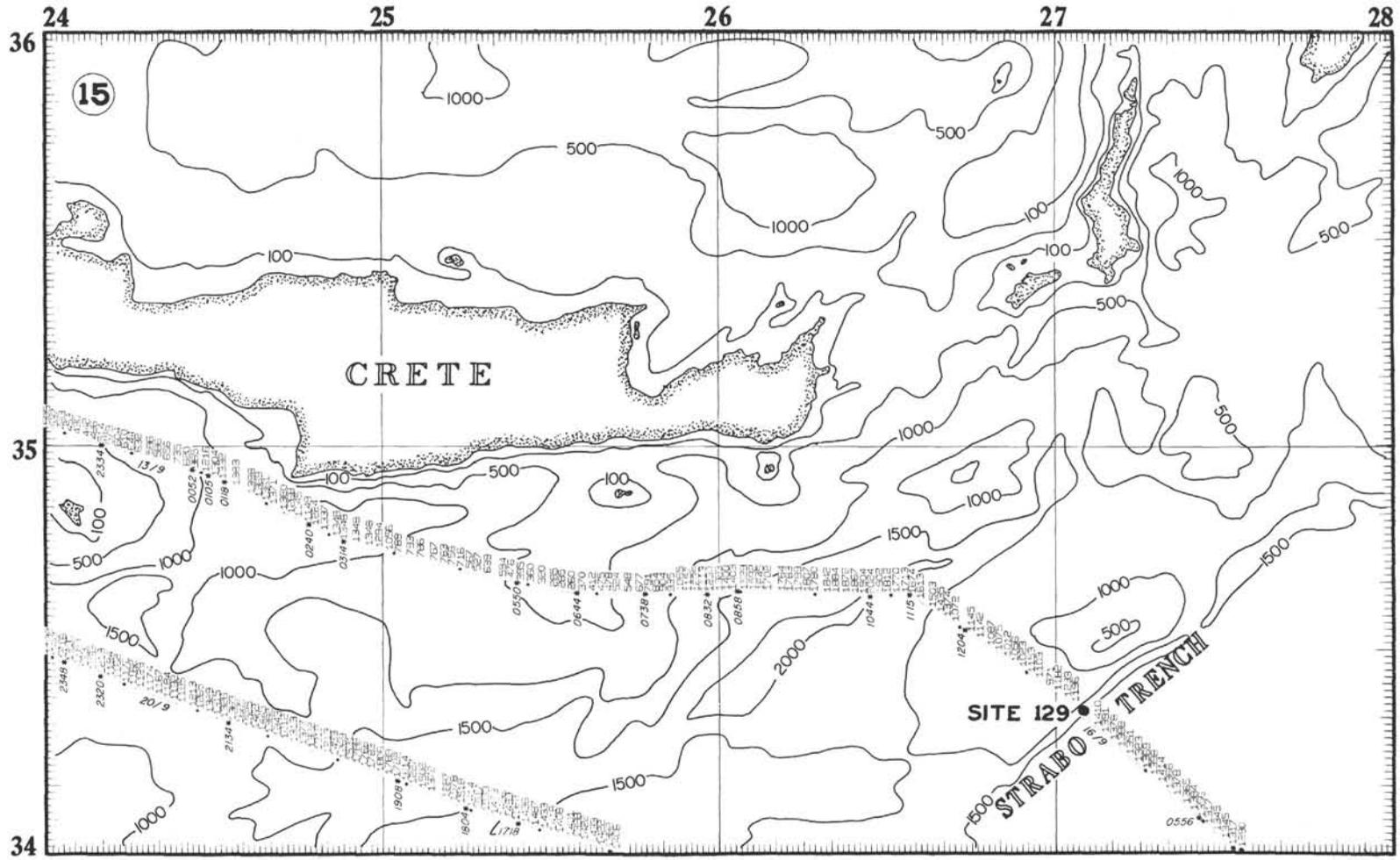


Figure 1P.

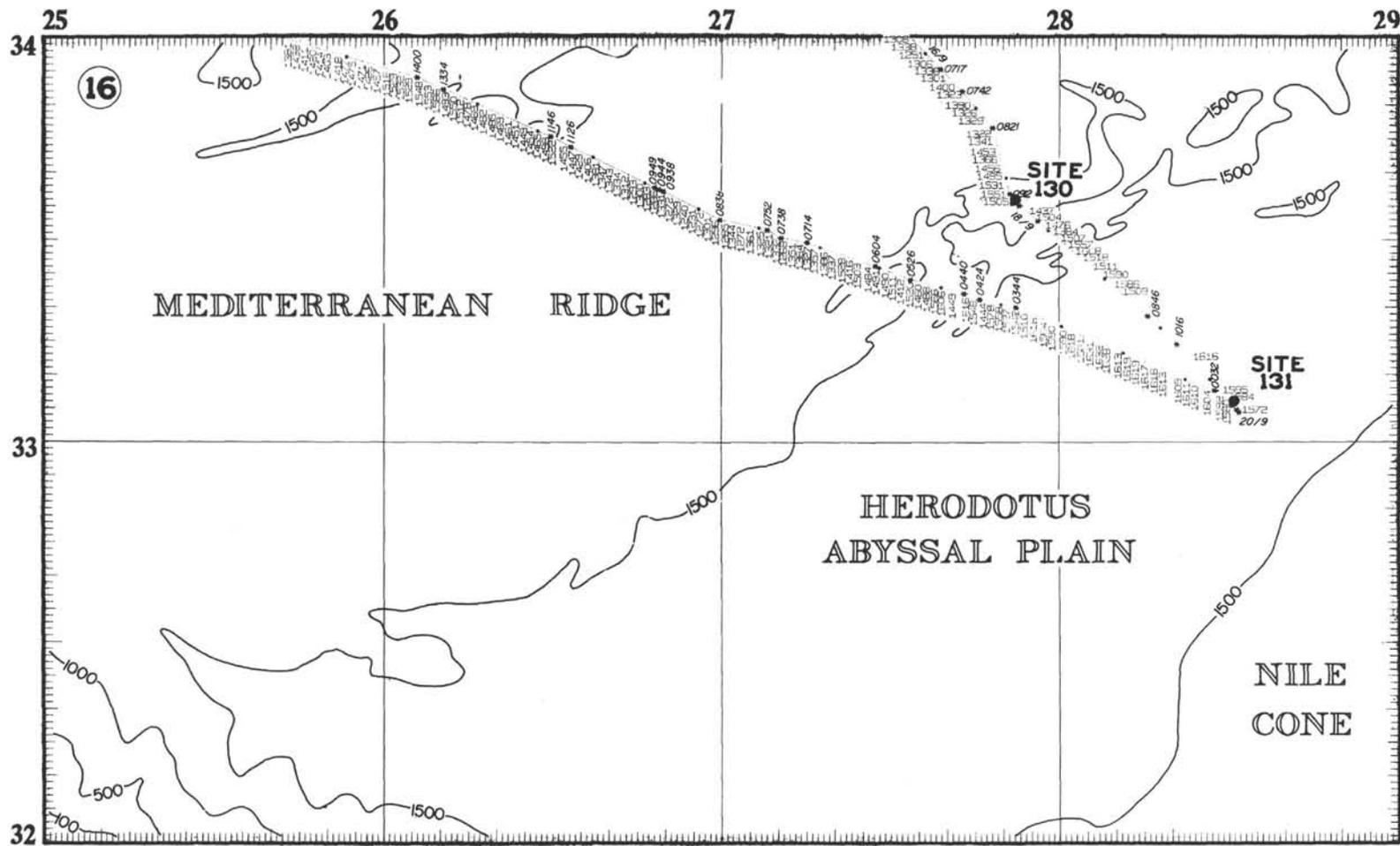


Figure 1Q.

Depths in units of travel time (1 tau = 1/400th sec).

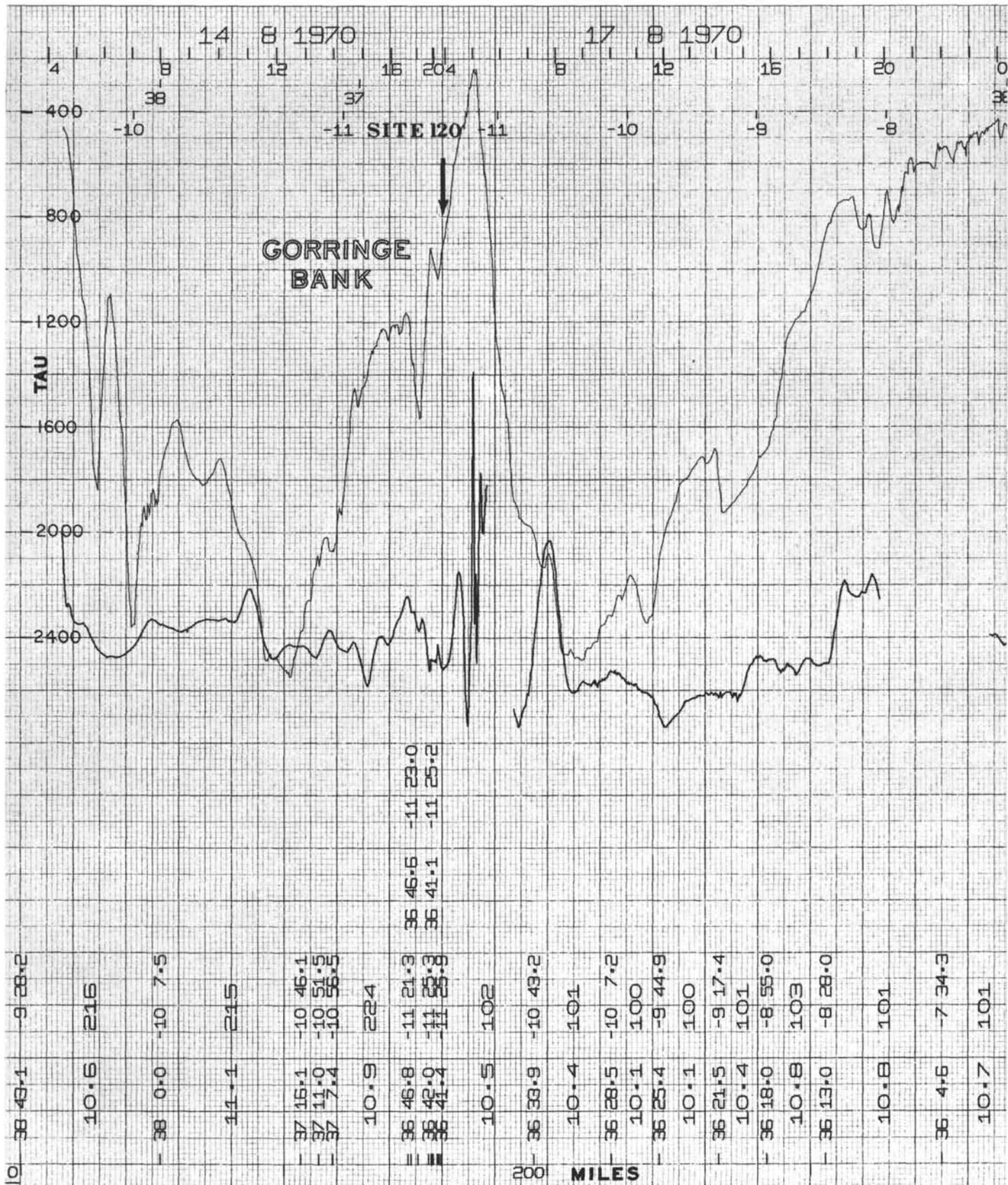


Figure 2A. Topographic and magnetic profiles.

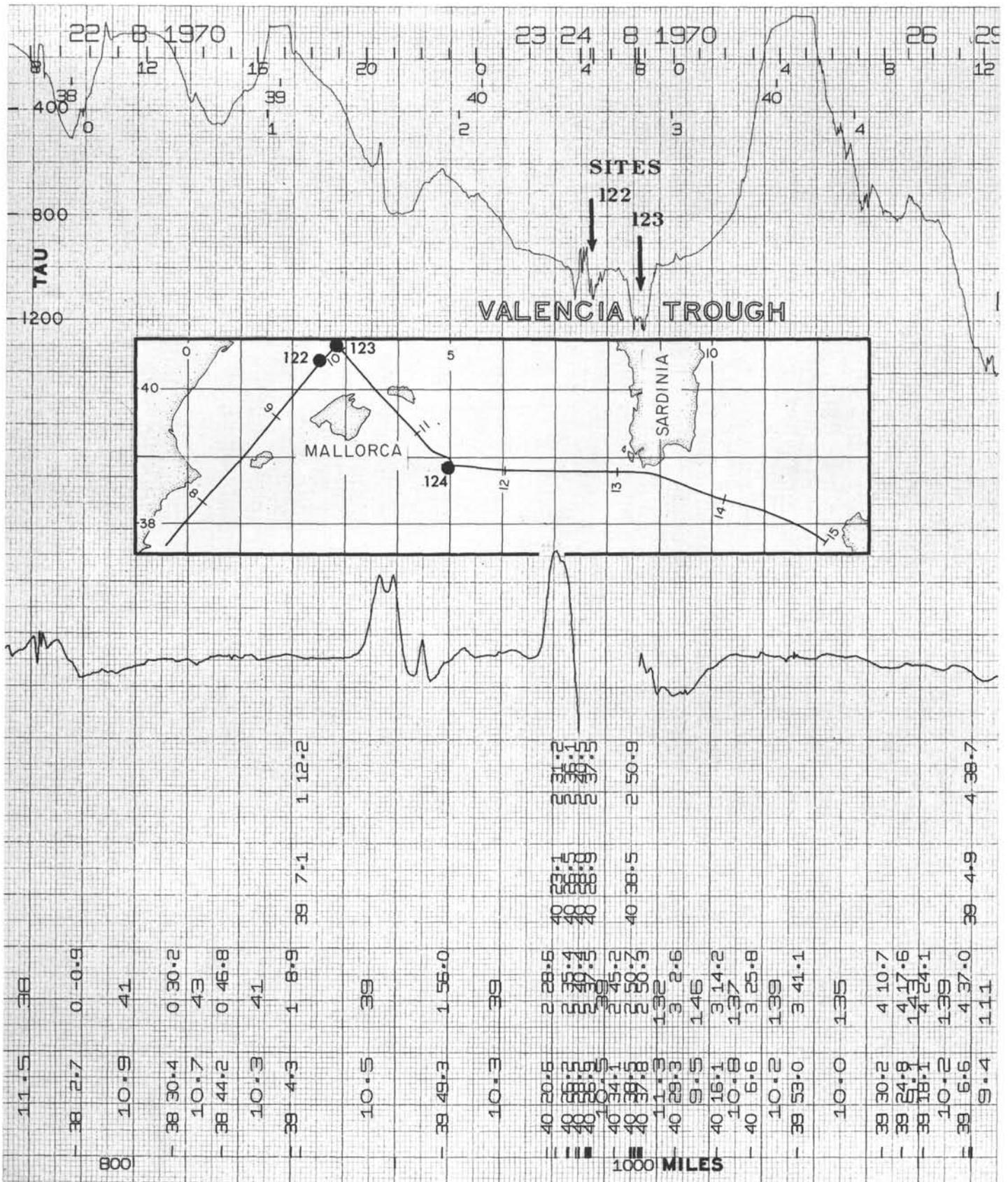


Figure 2C.

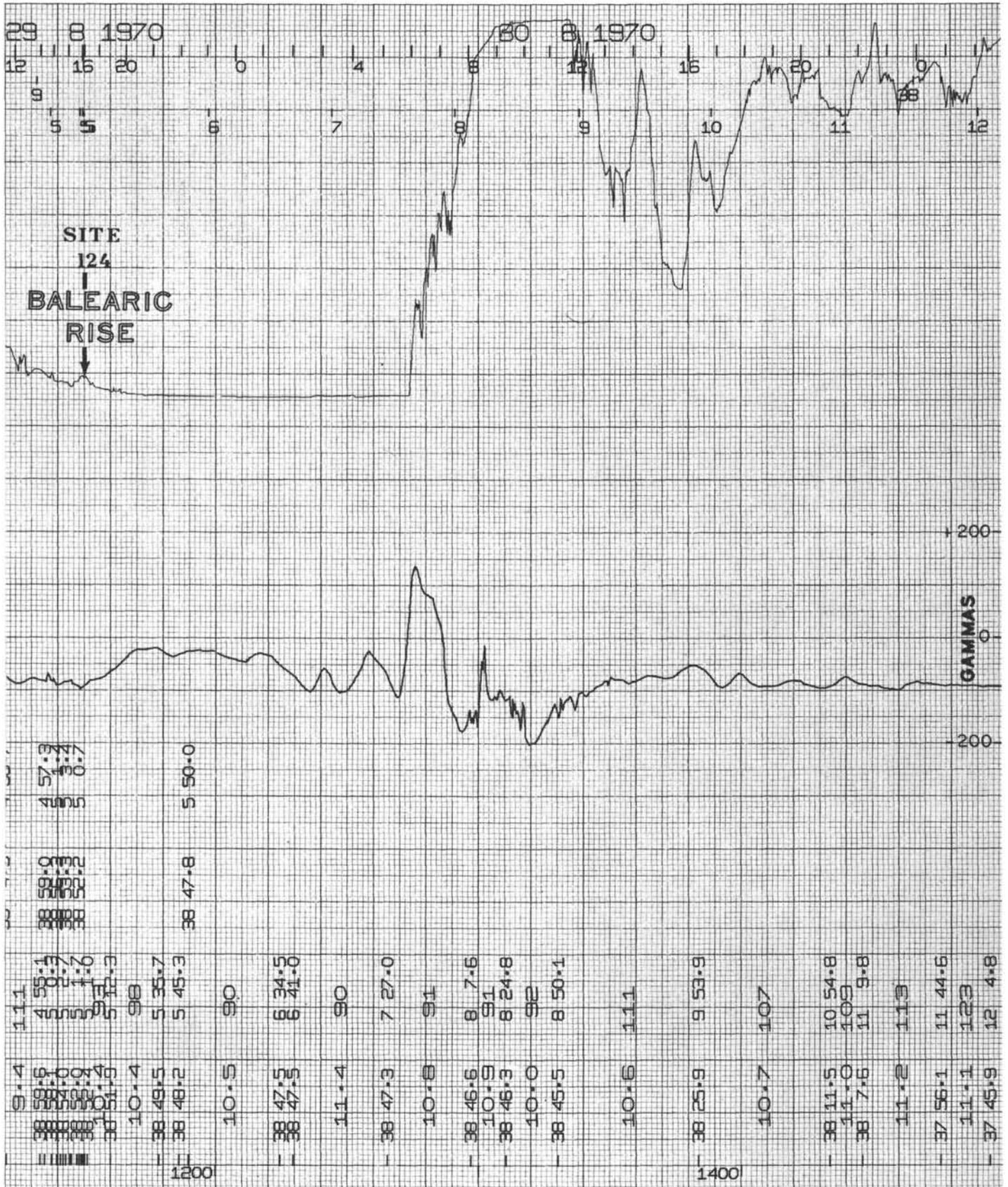


Figure 2D.

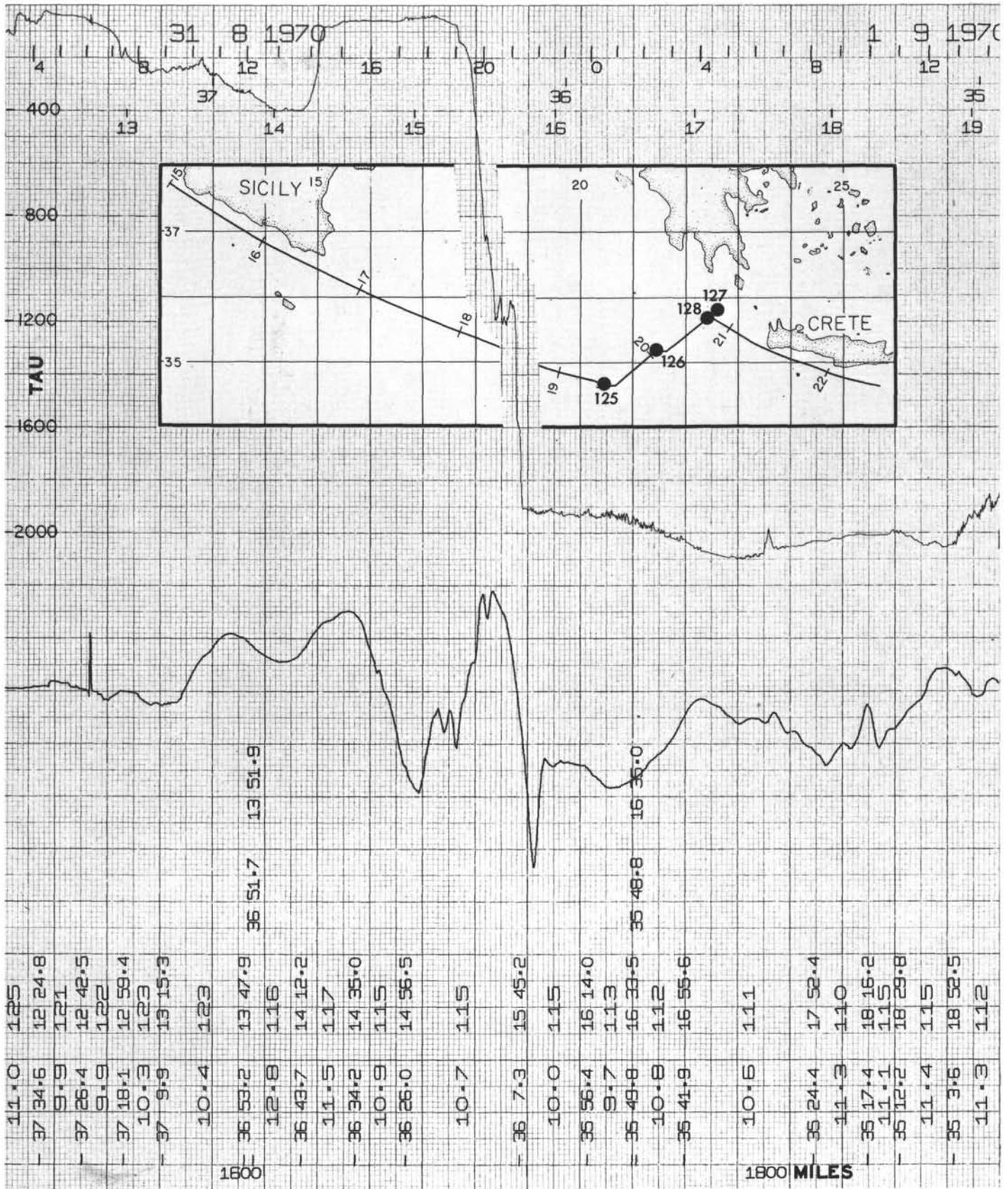


Figure 2E.

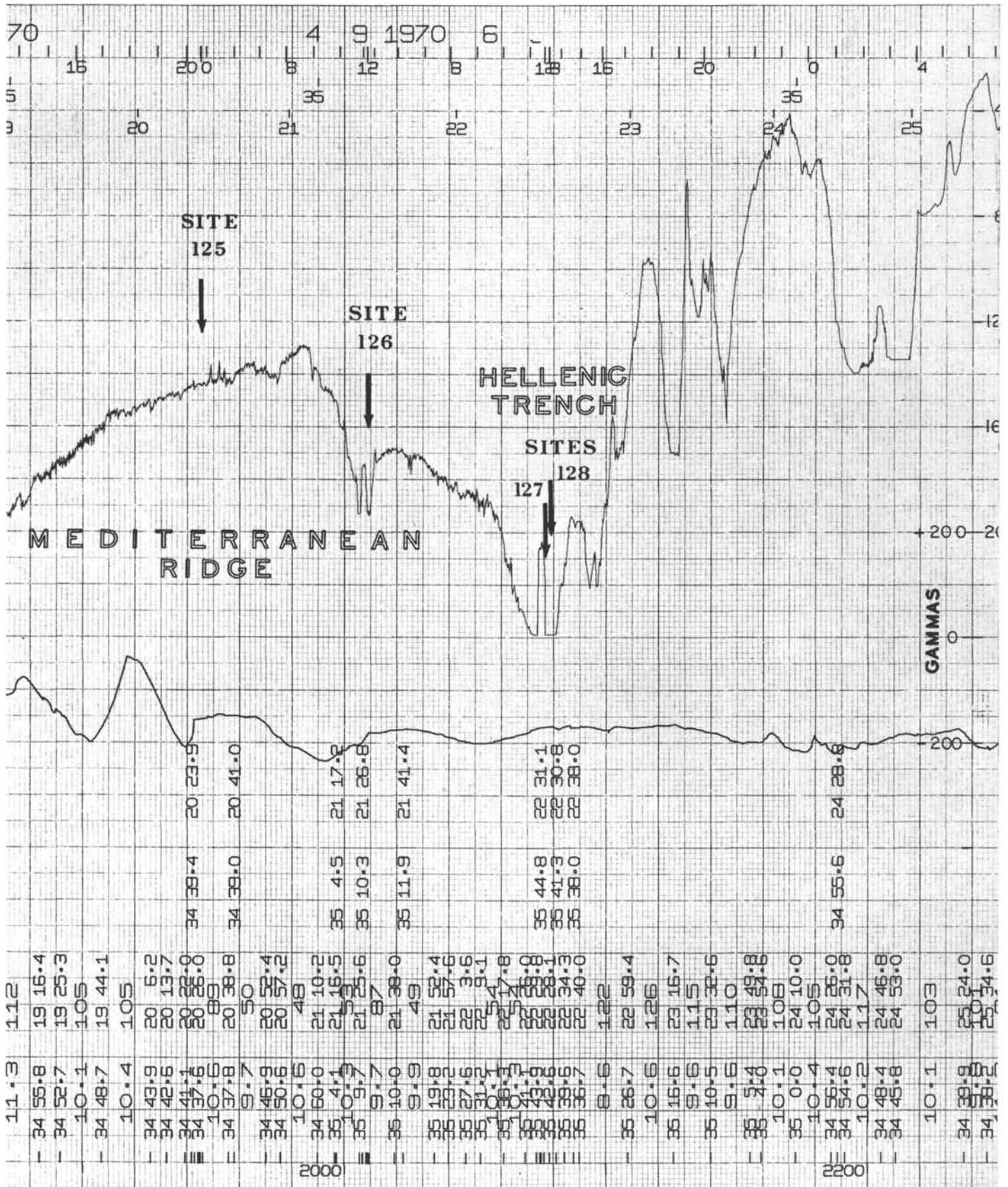


Figure 2F.

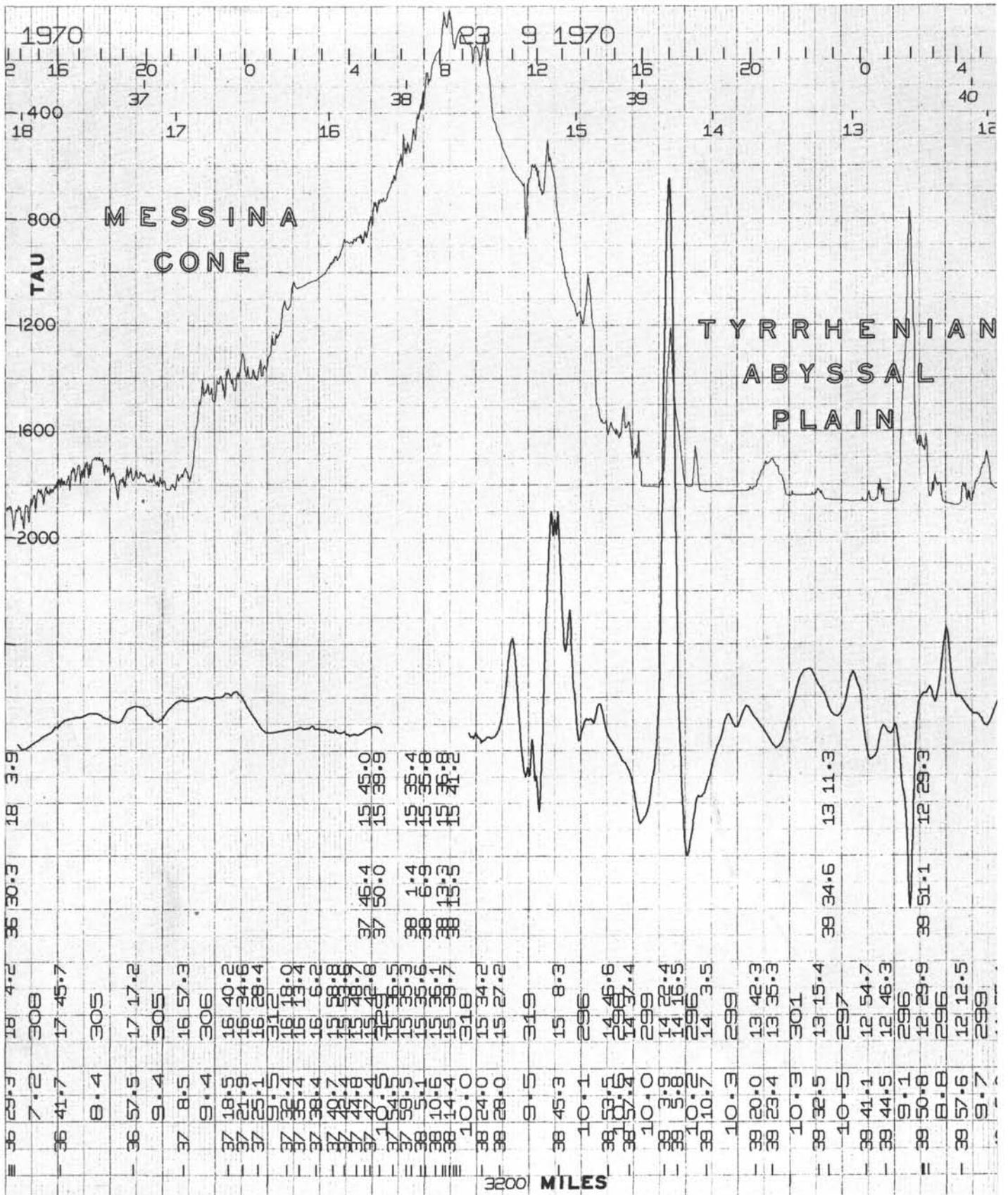


Figure 21.

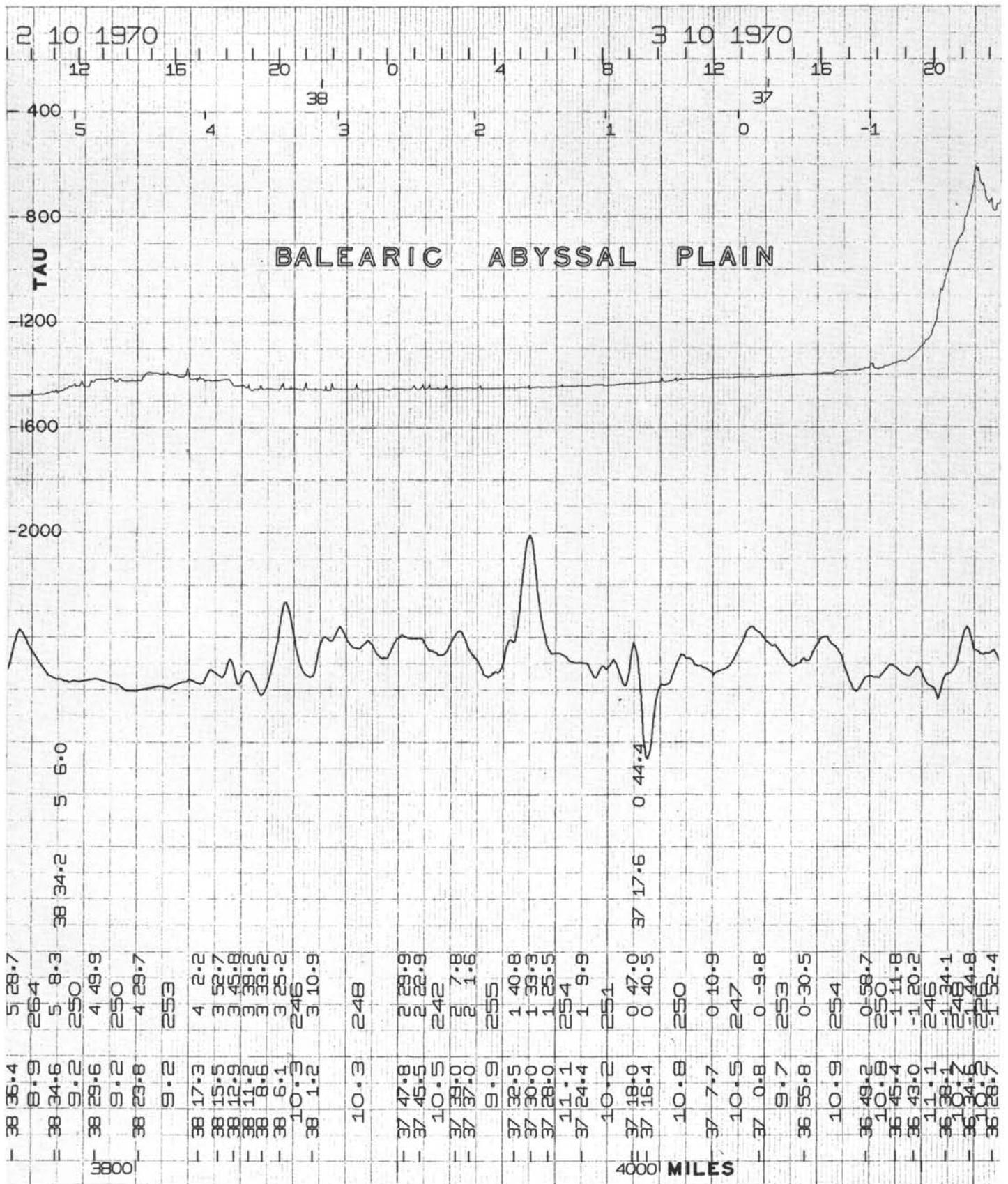


Figure 2K.

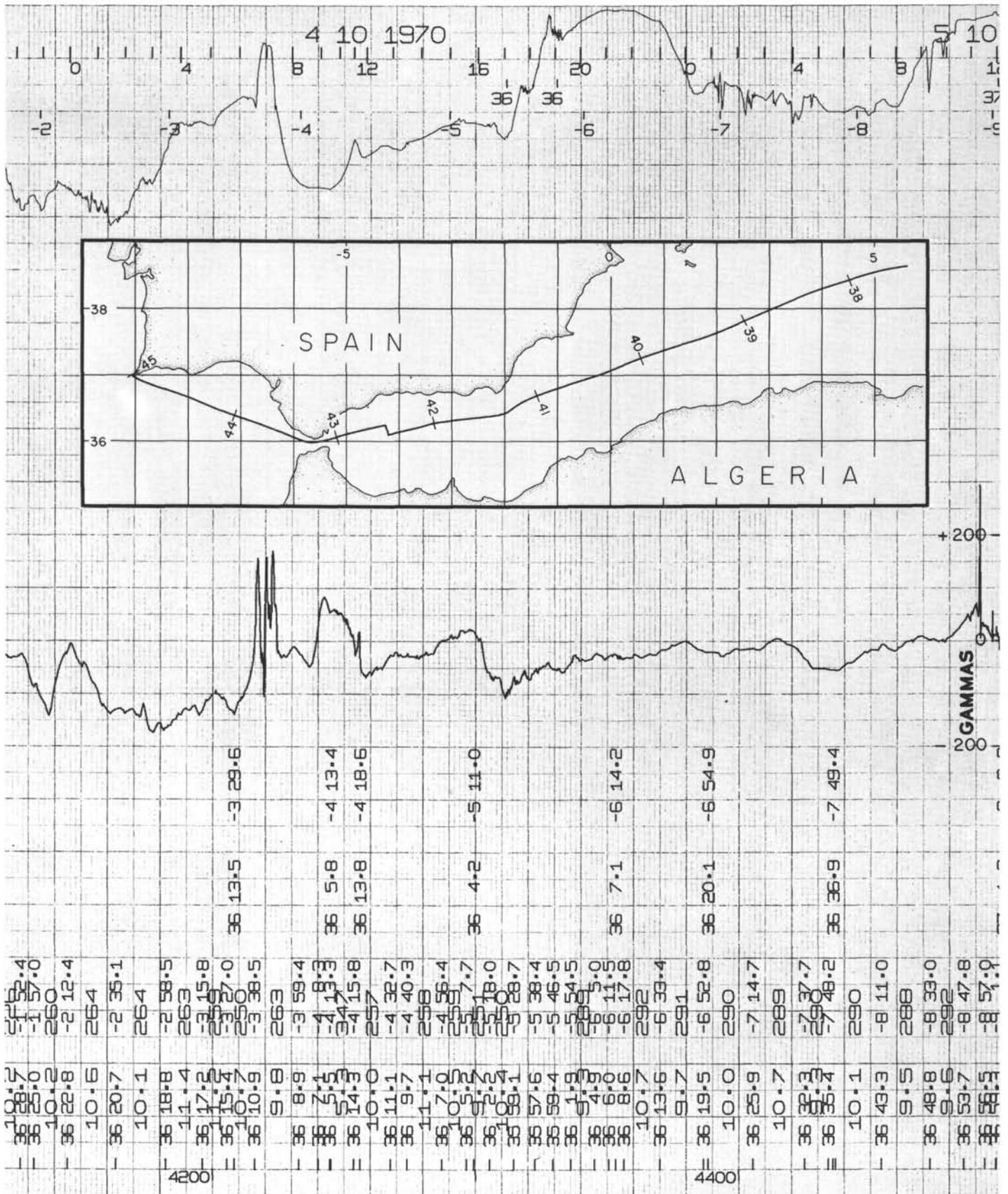


Figure 2L.

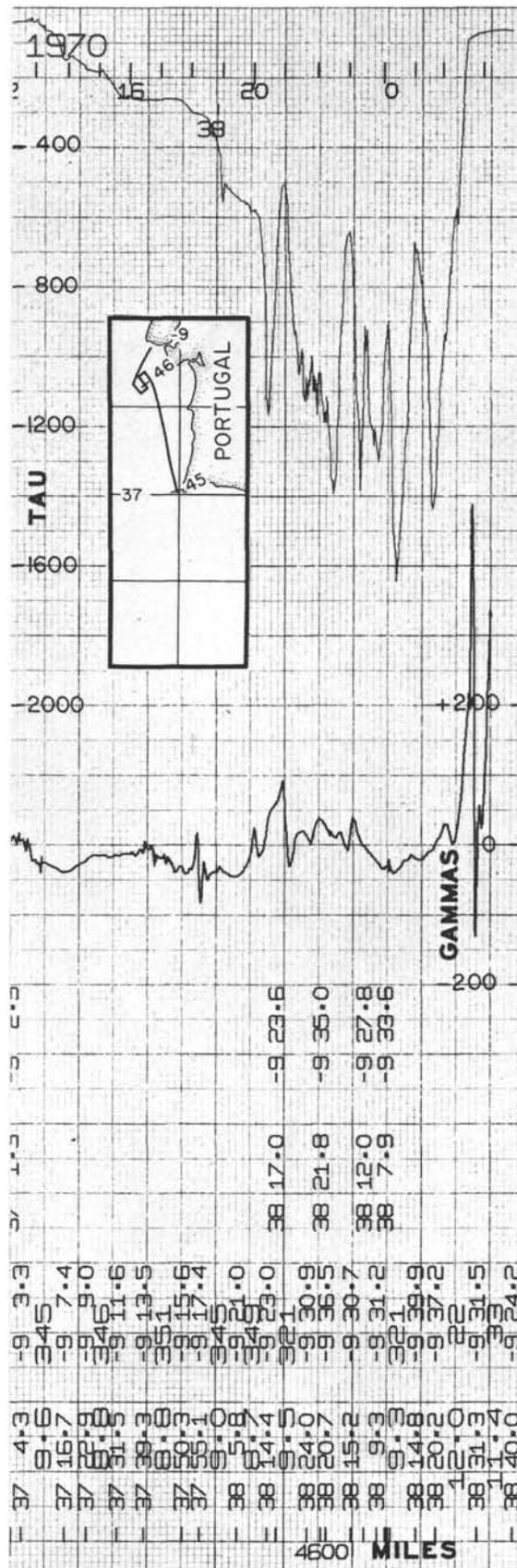


Figure 2M.

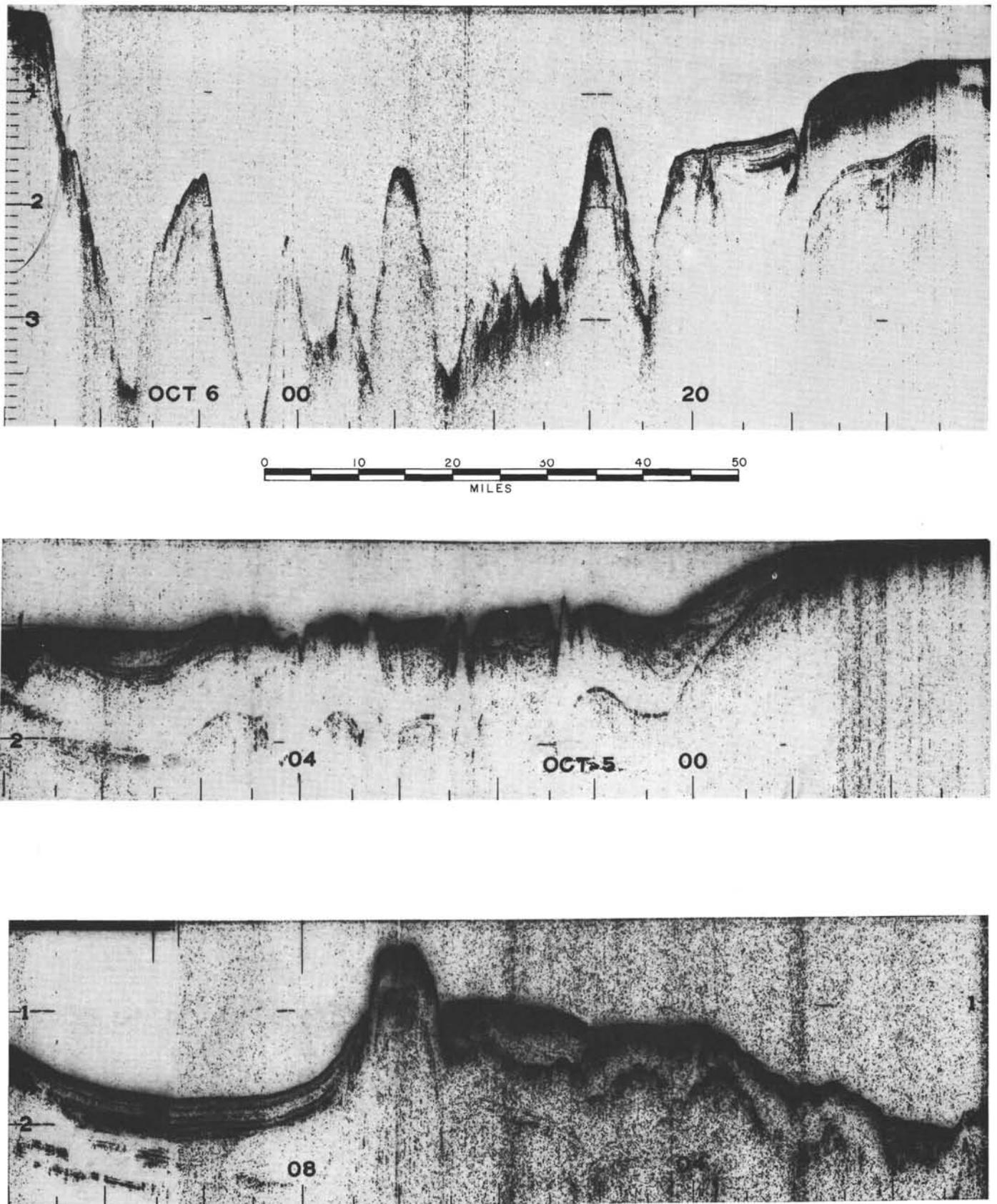


Figure 3A. Seismic reflection profiles.

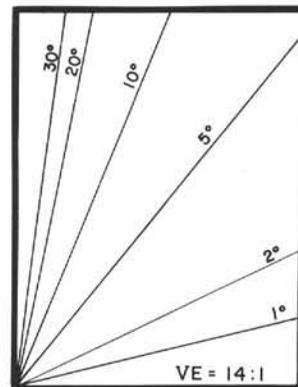
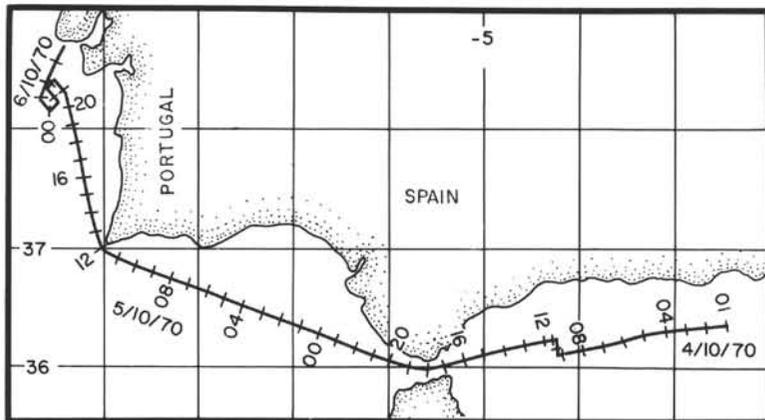
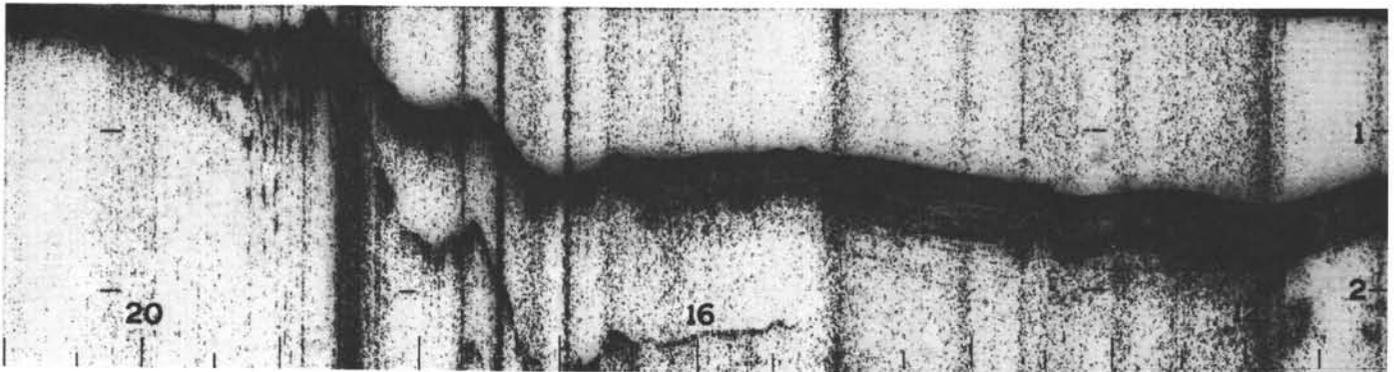
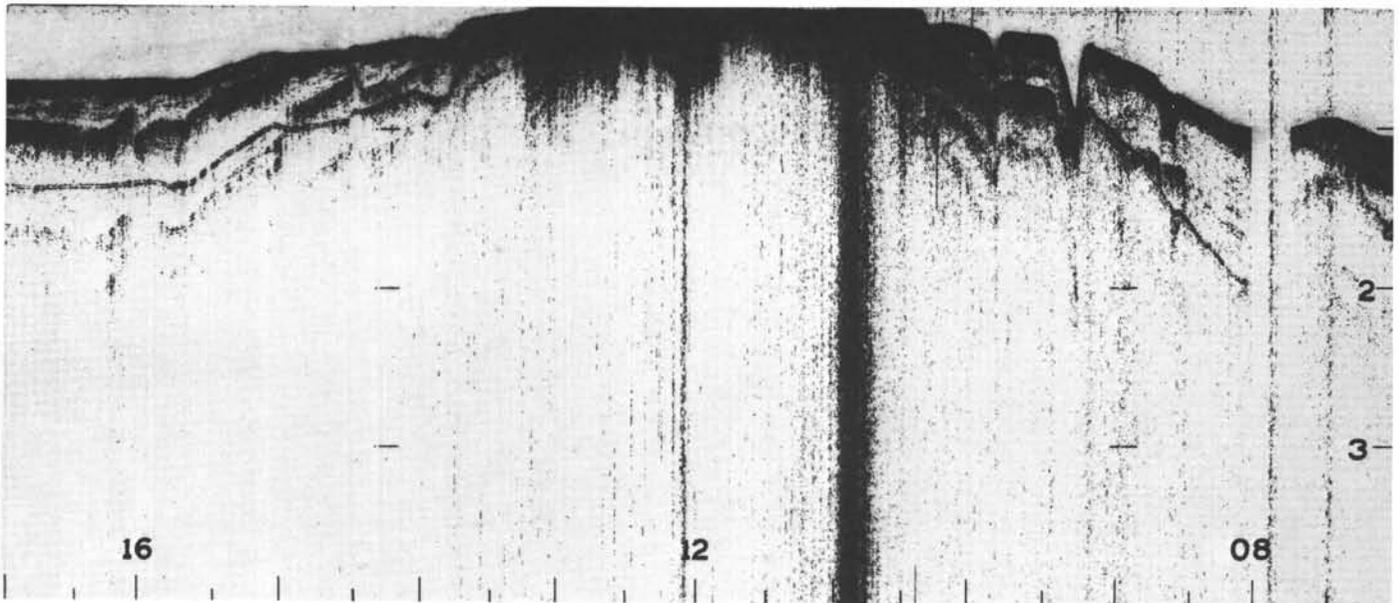


Figure 3B.

Vertical scale in seconds of two-way travel time.

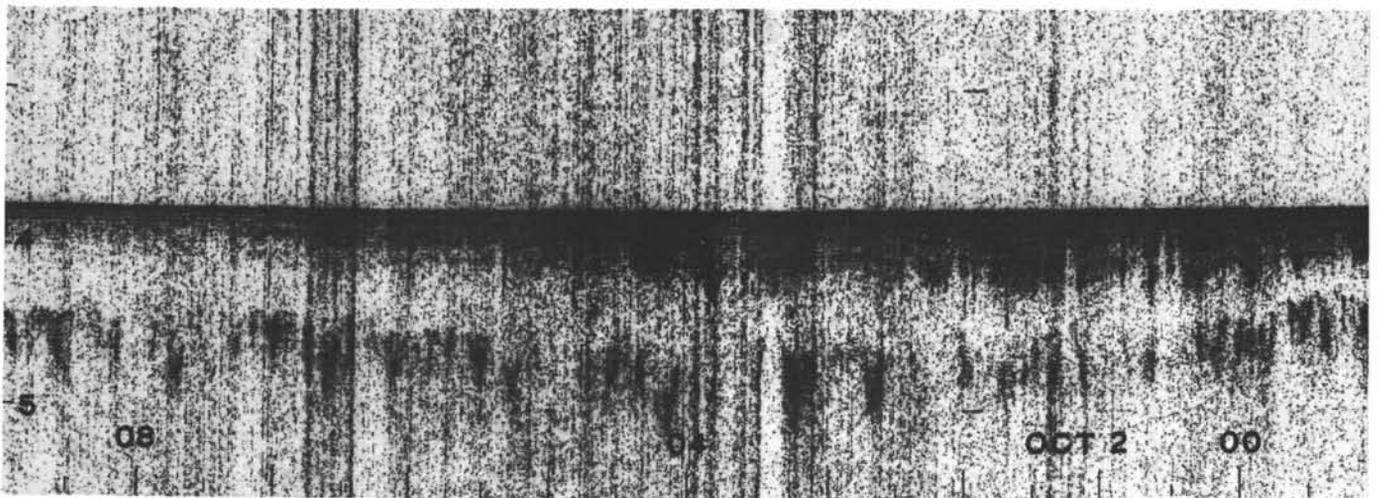
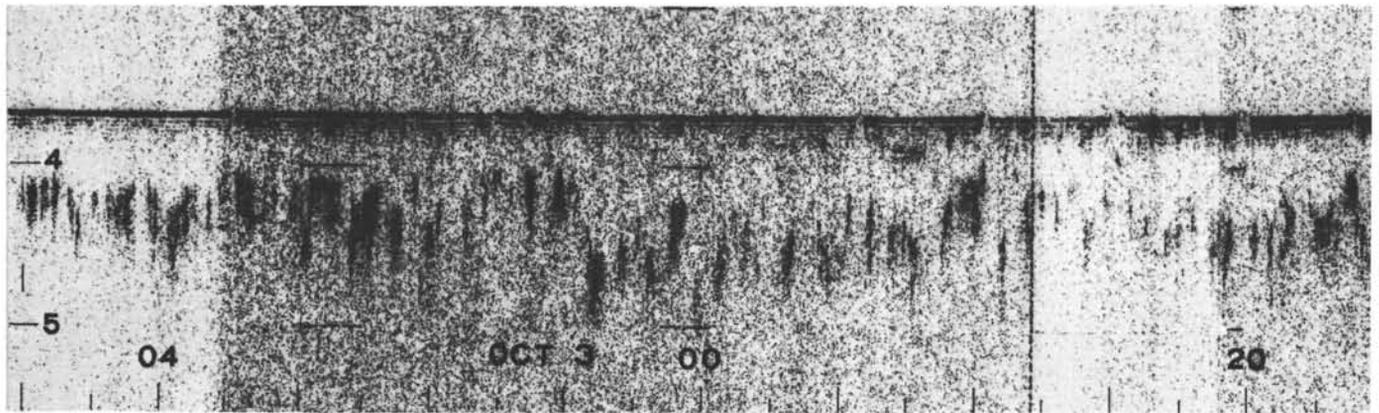
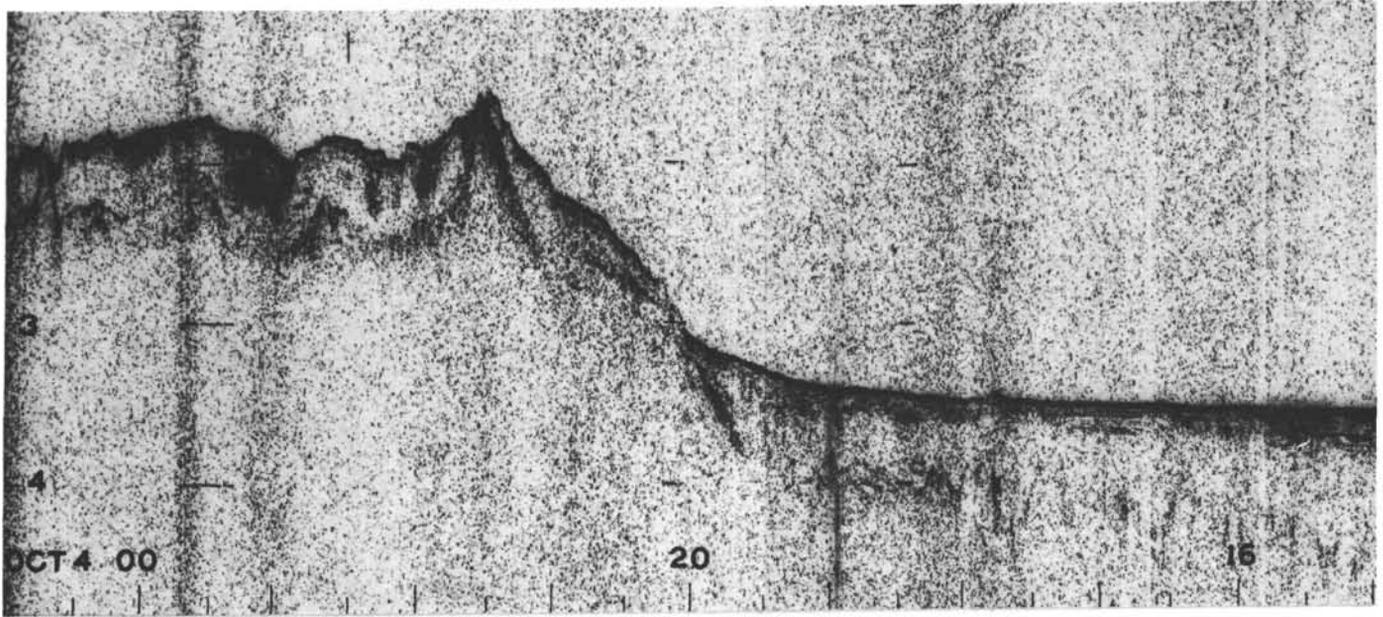


Figure 3C.

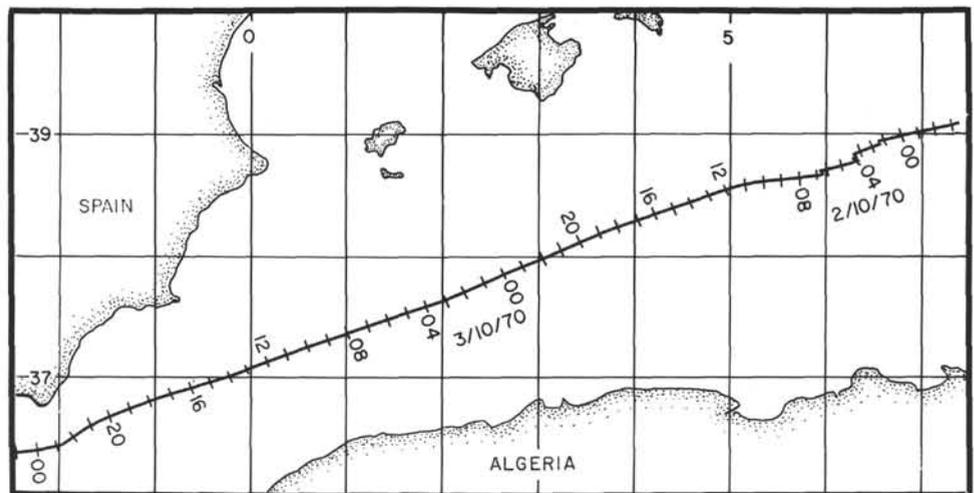
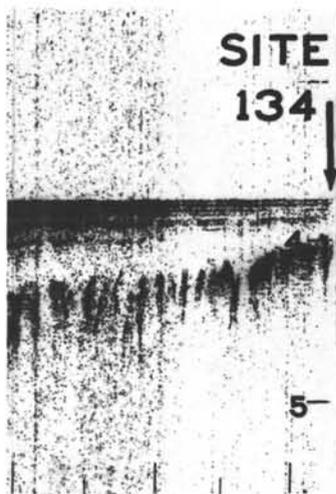
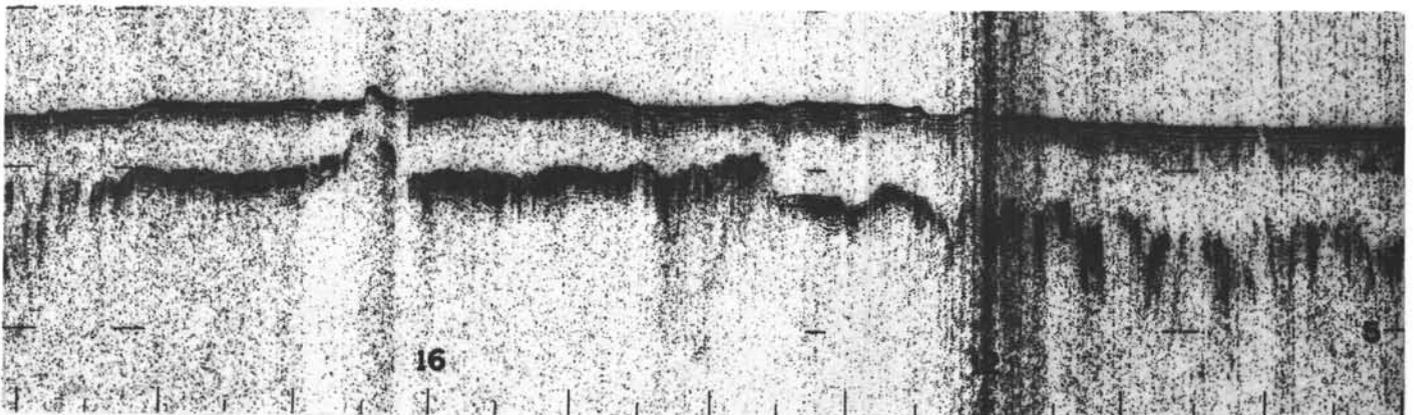
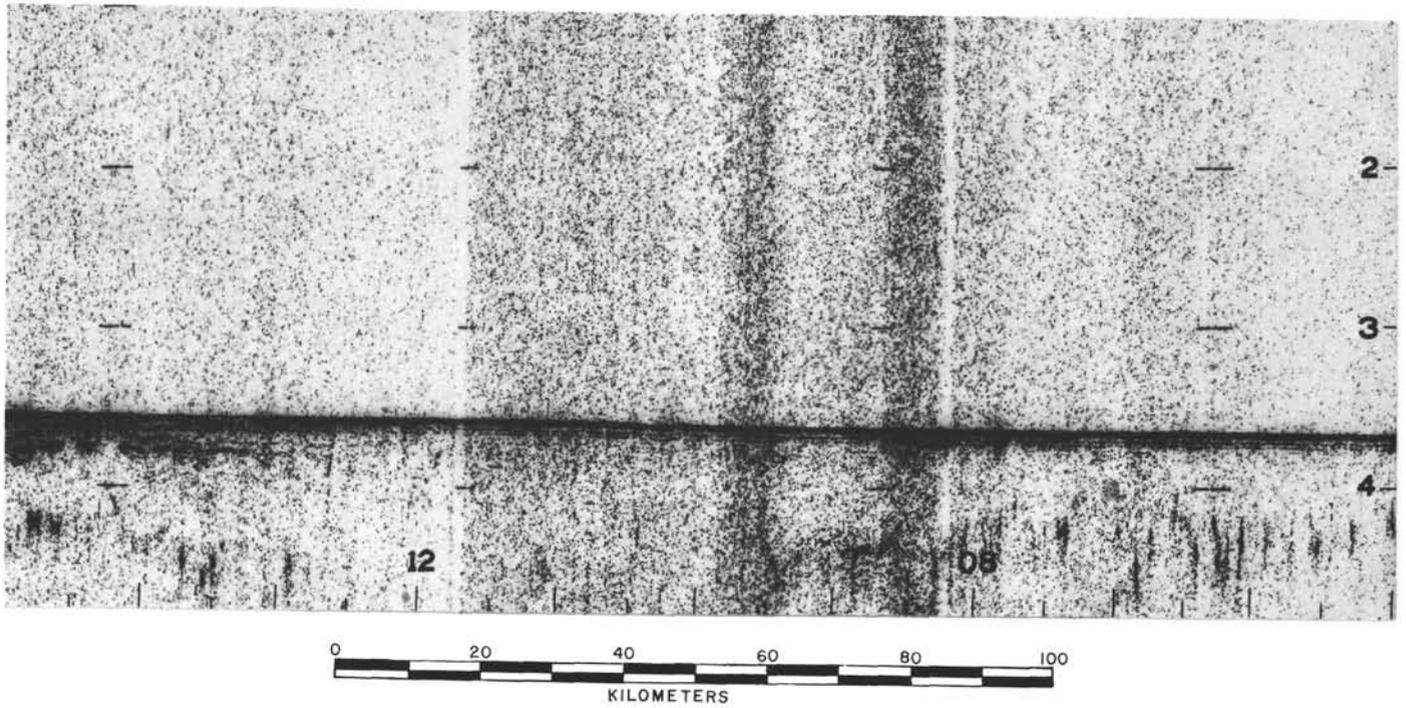


Figure 3D.

Vertical scale in seconds of two-way travel time.

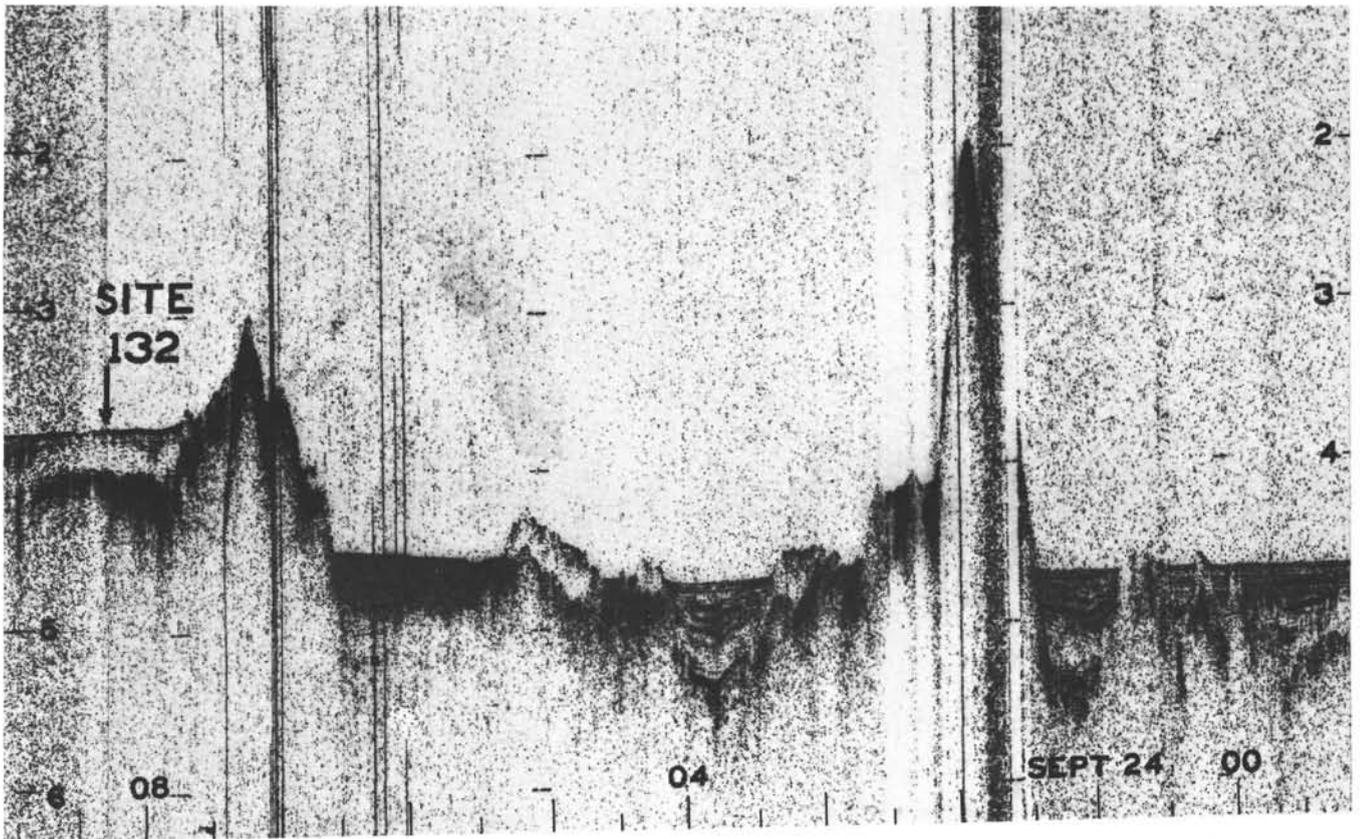
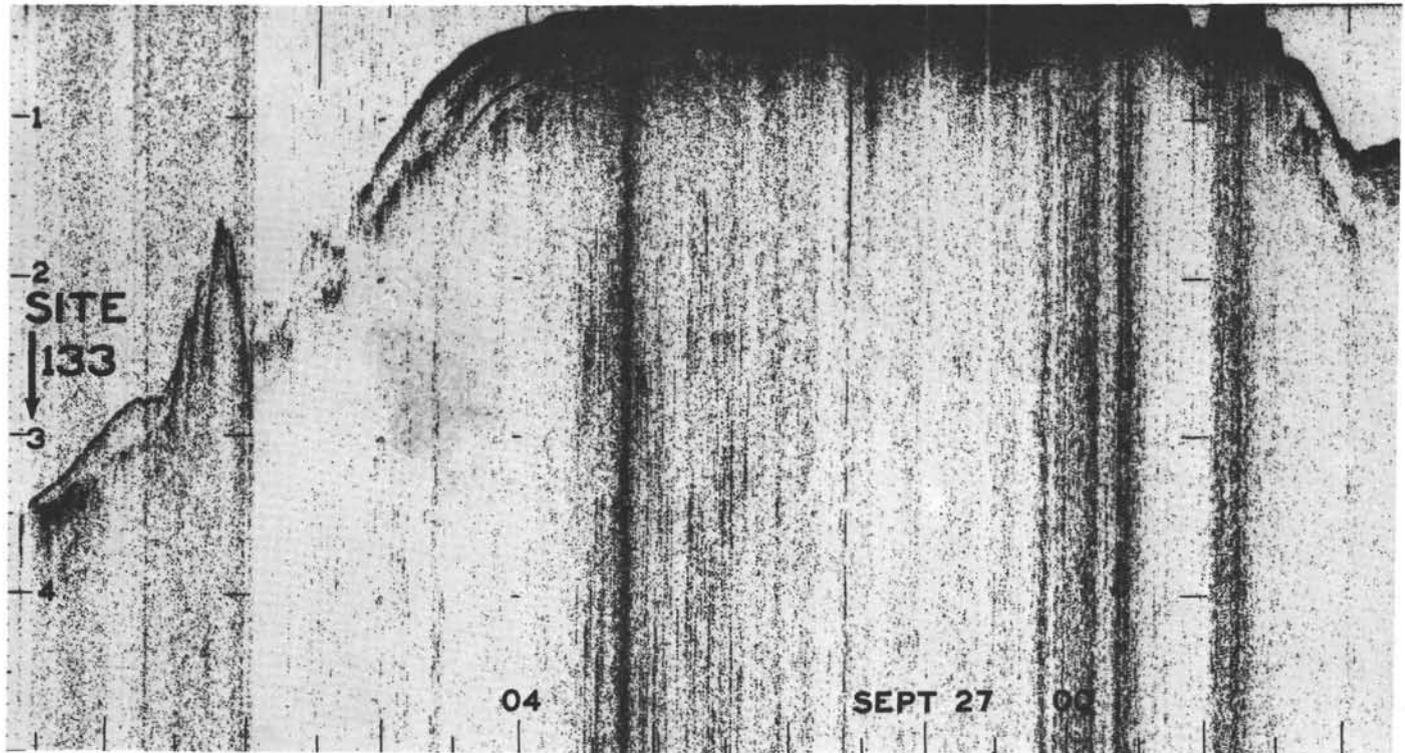


Figure 3E.

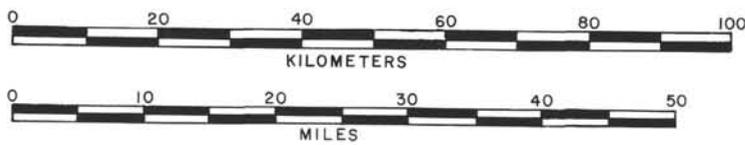
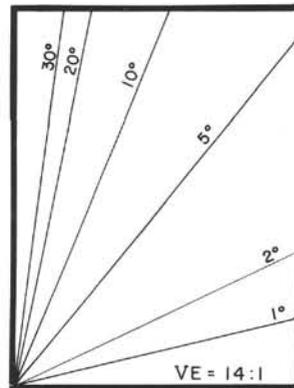
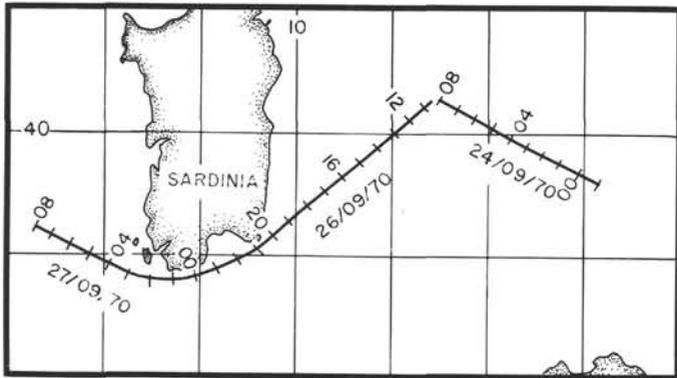
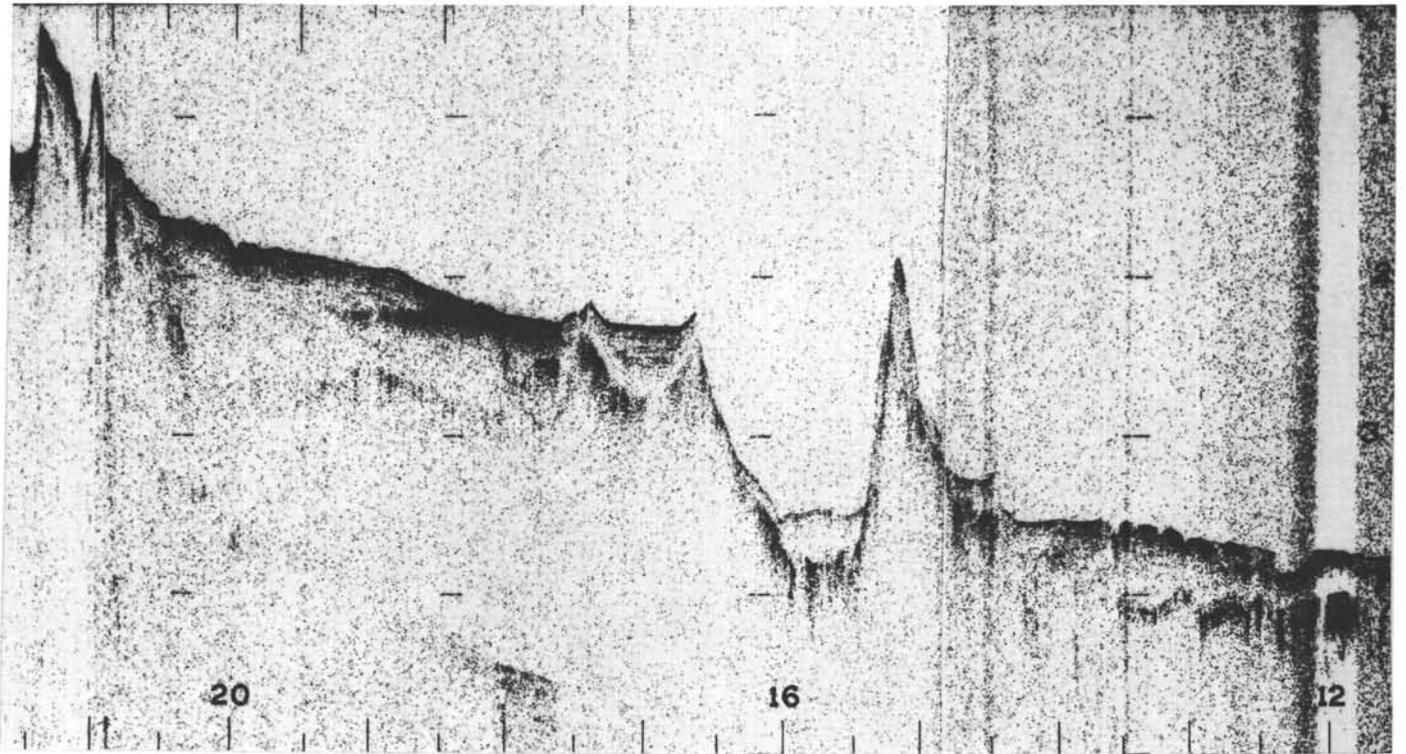


Figure 3F.

Vertical scale in seconds of two-way travel time.

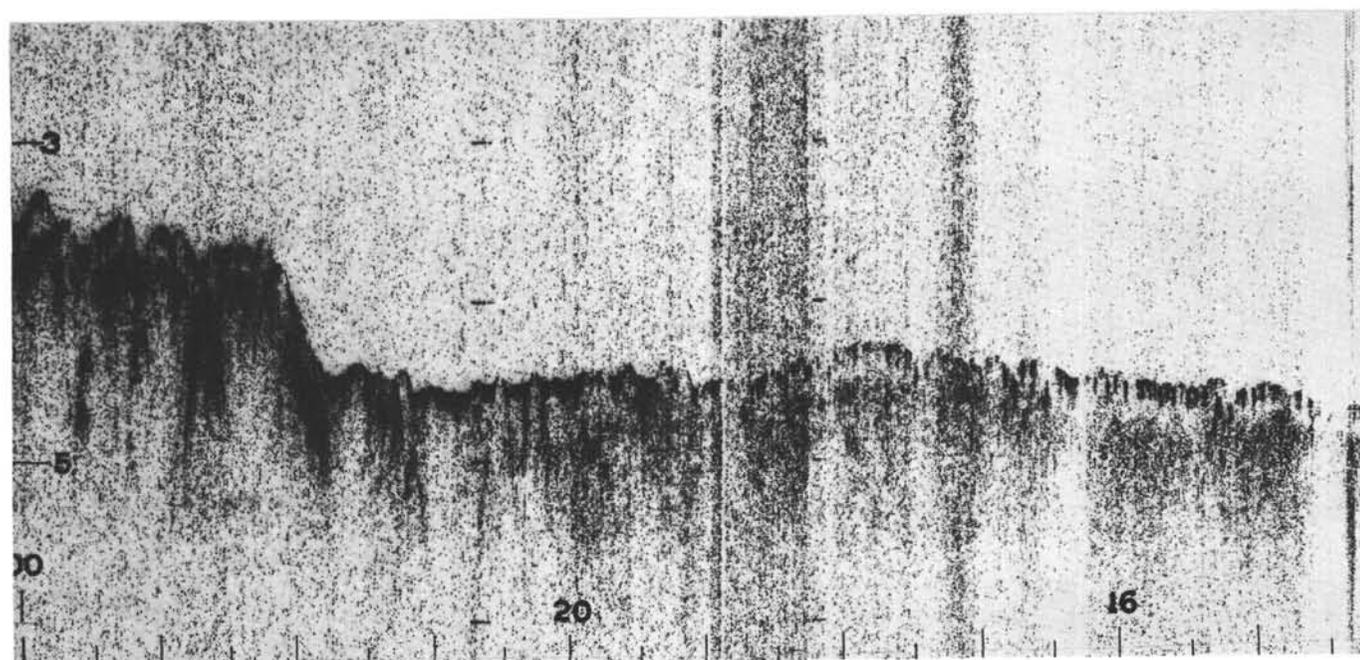
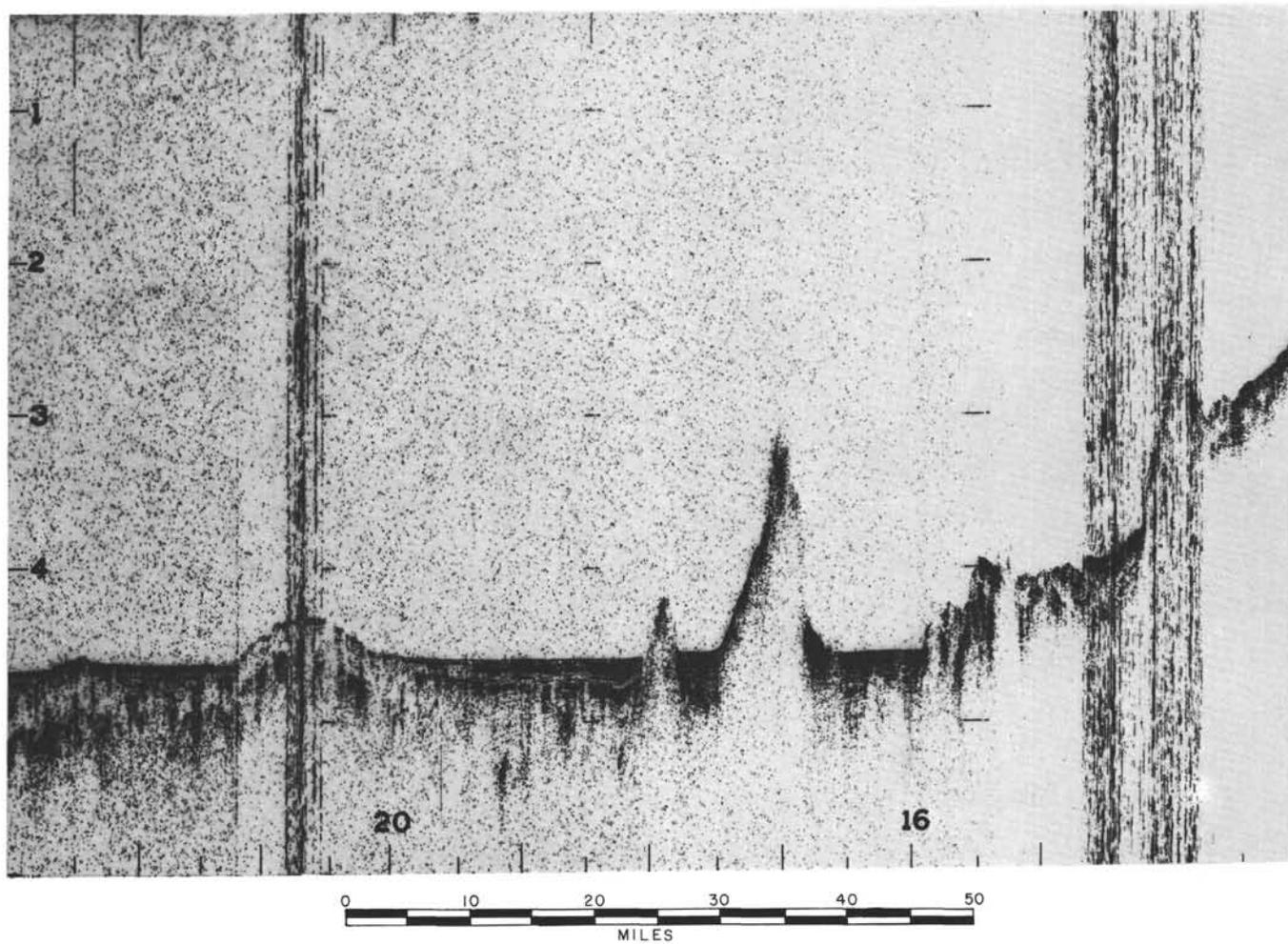


Figure 3G.

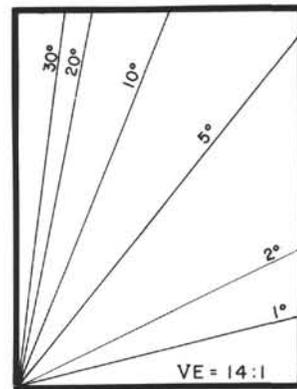
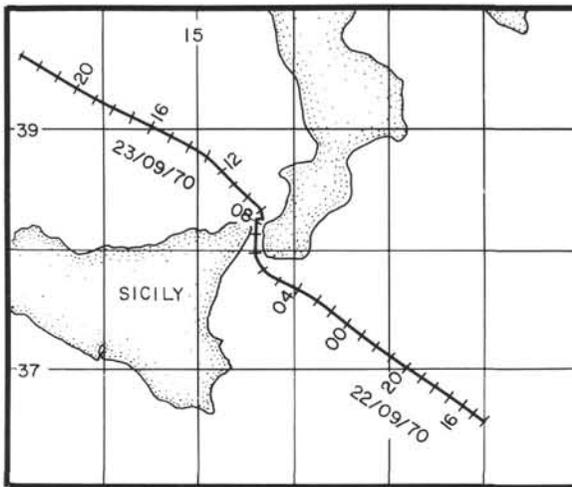
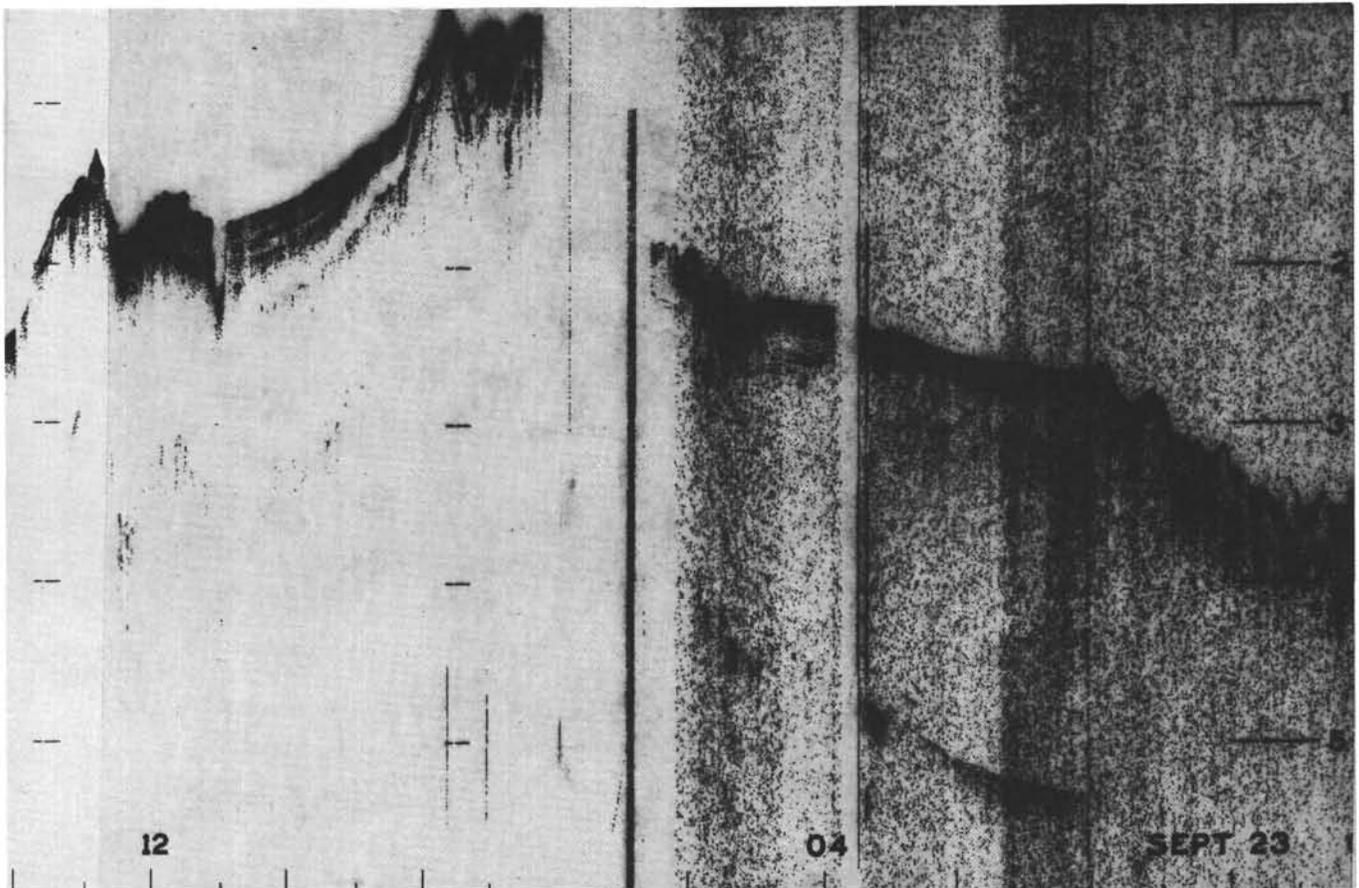


Figure 3H.

Vertical scale in seconds of two-way travel time.

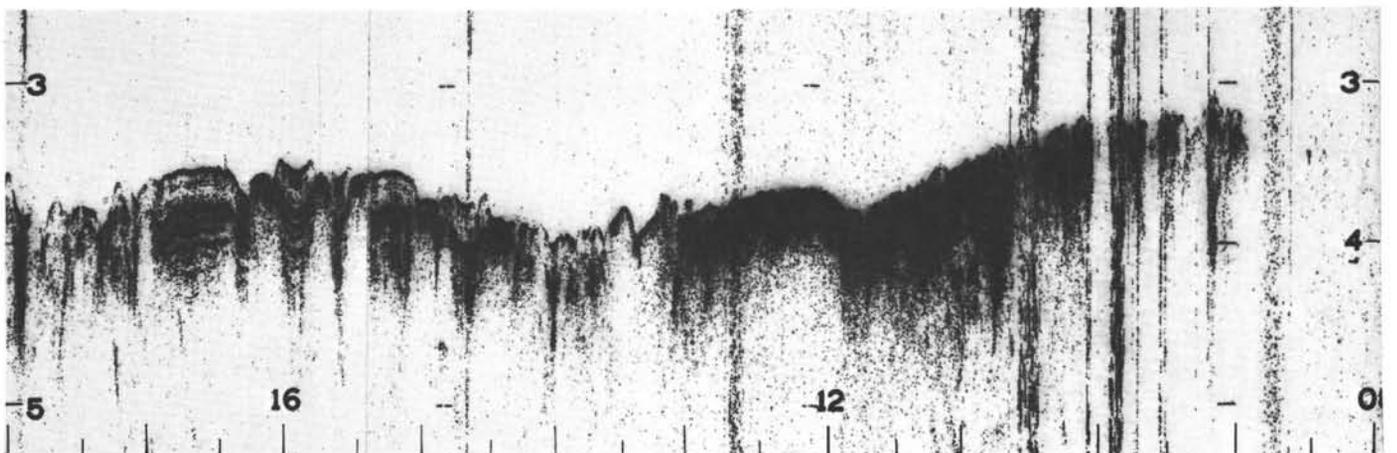
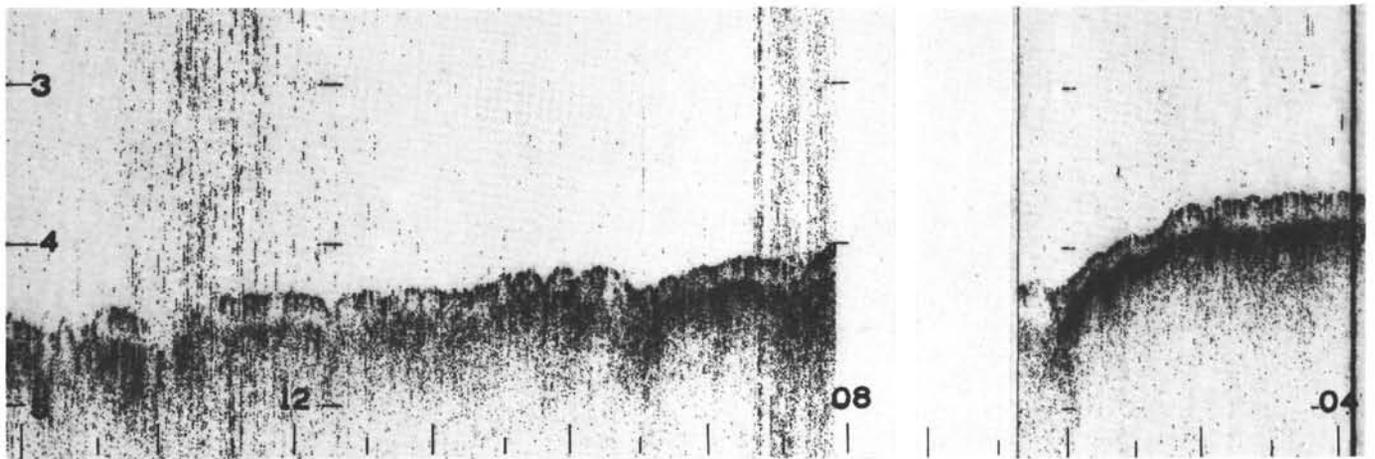
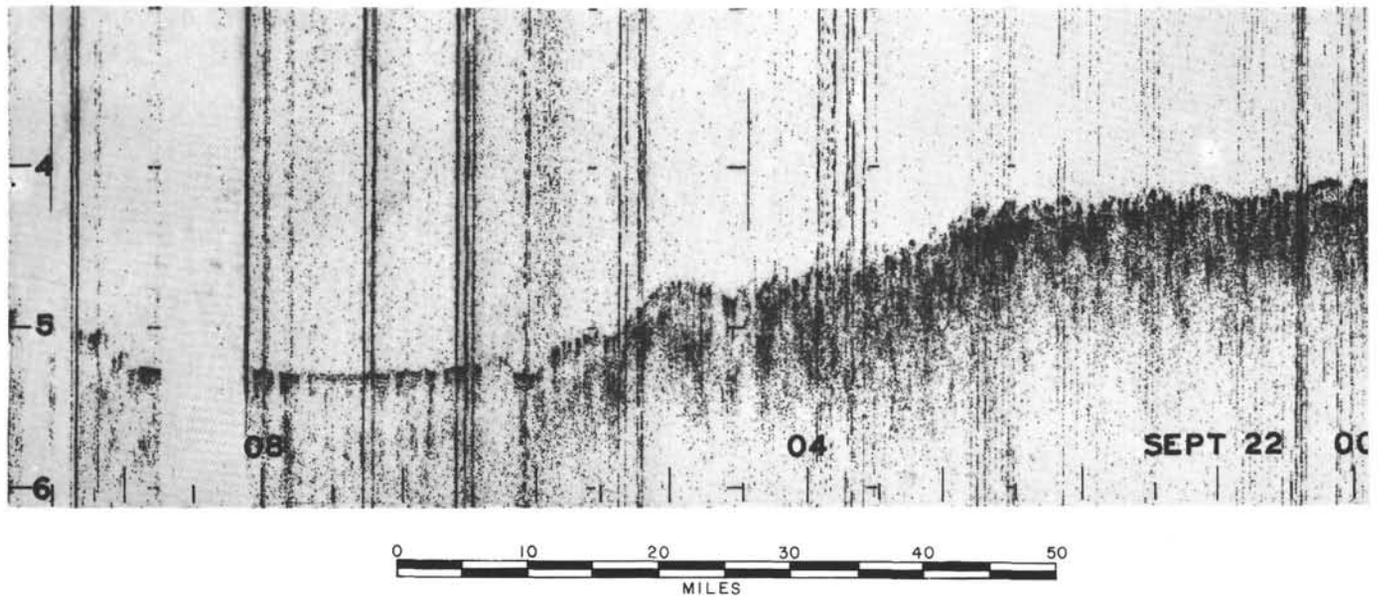


Figure 3I.

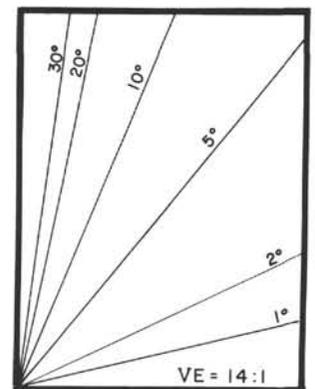
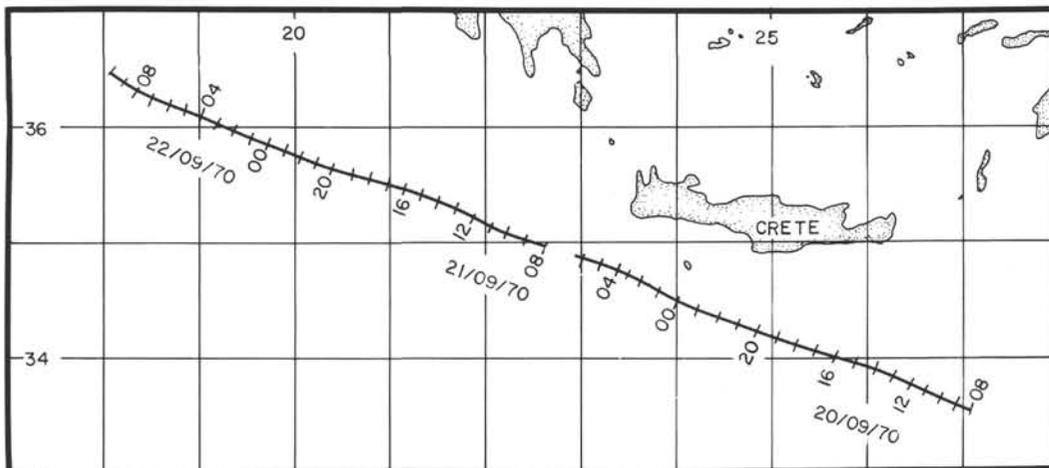
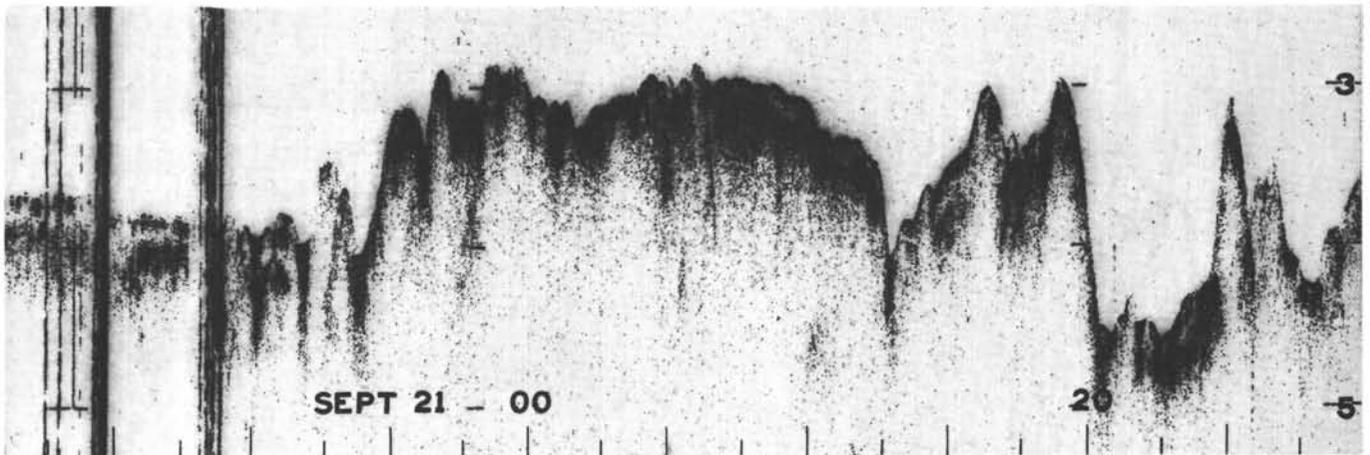
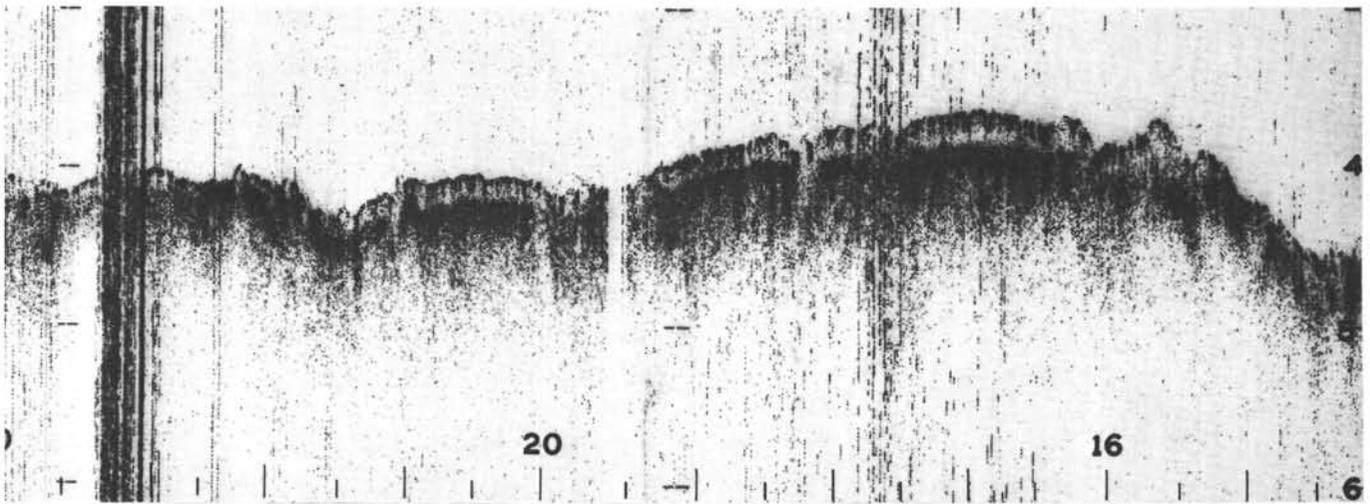


Figure 3J.

Vertical scale in seconds of two-way travel time.

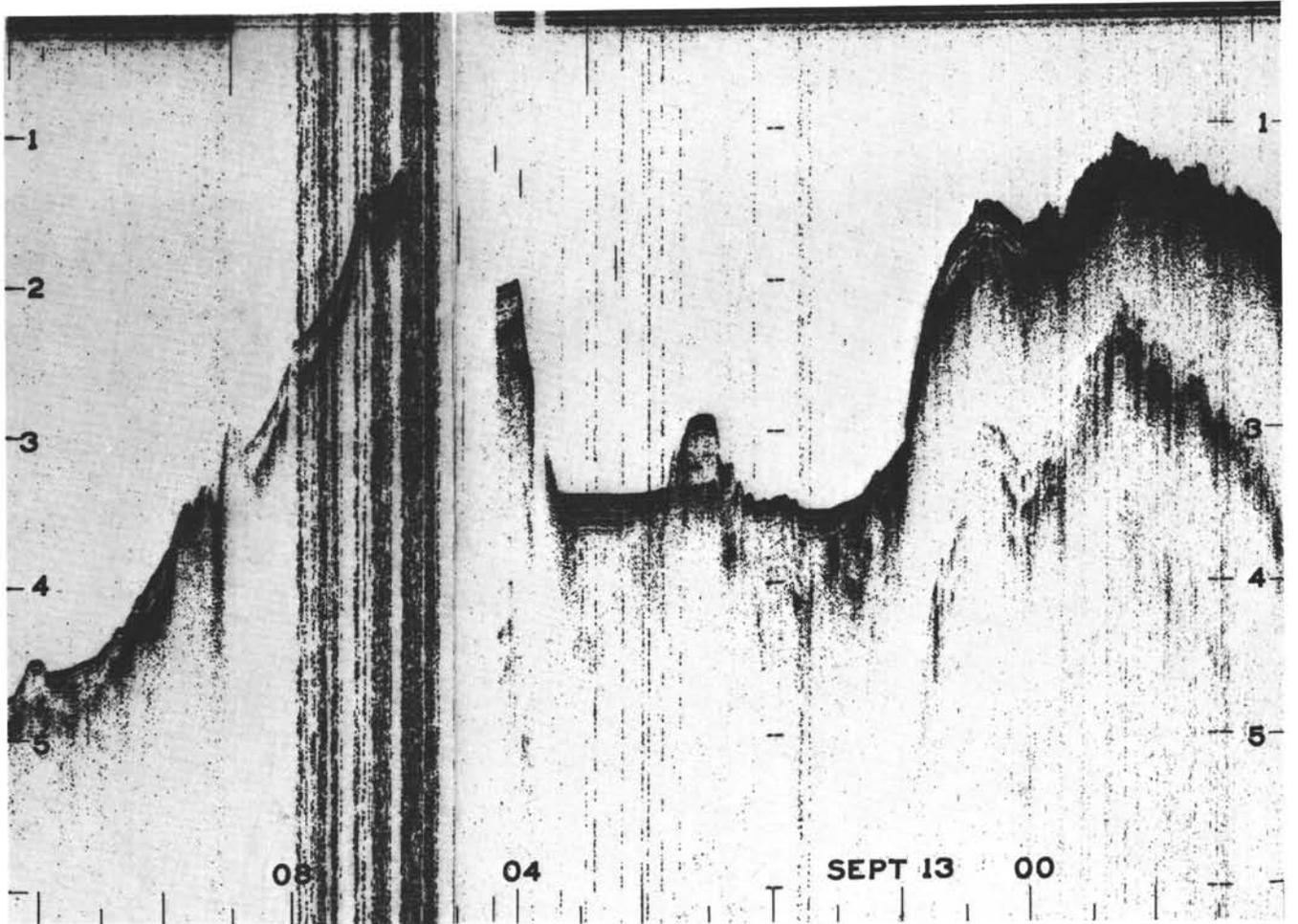
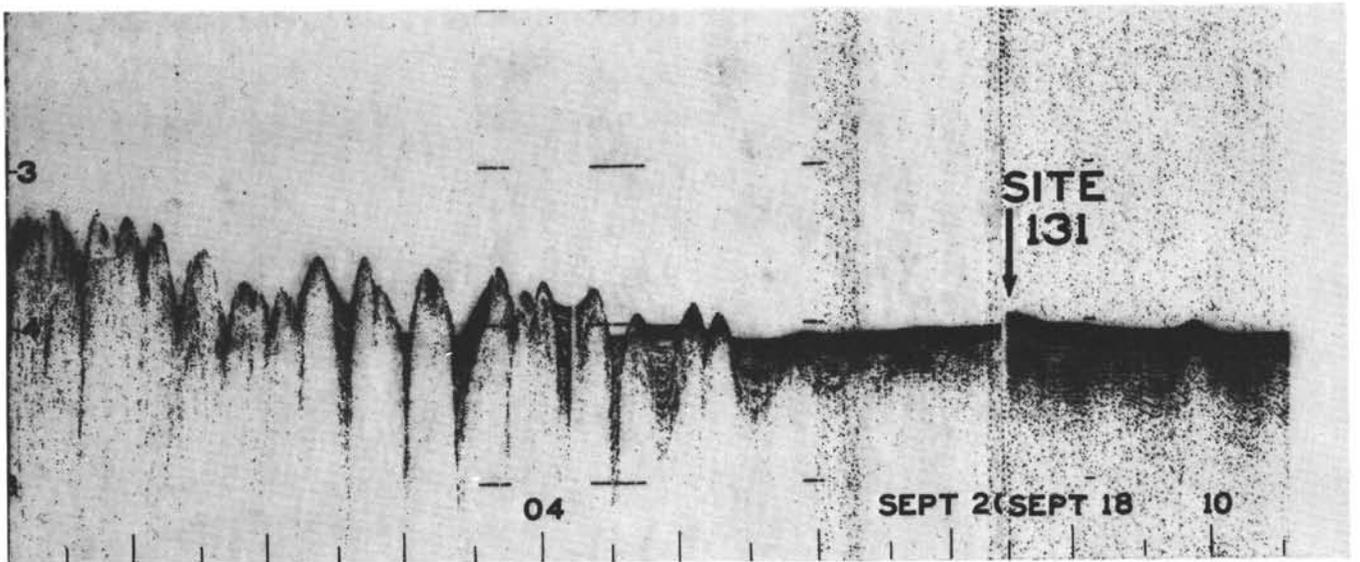


Figure 3K.

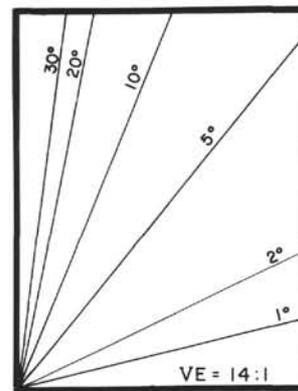
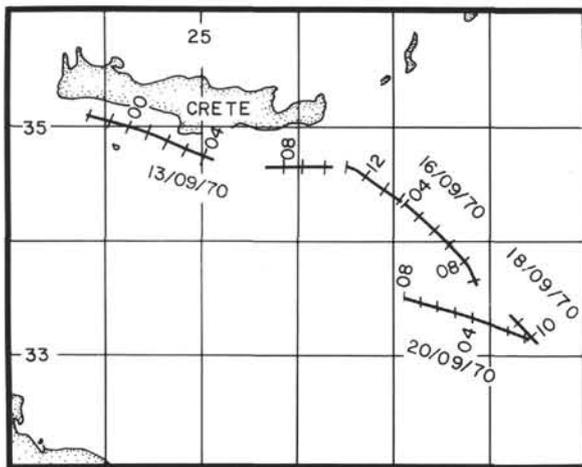
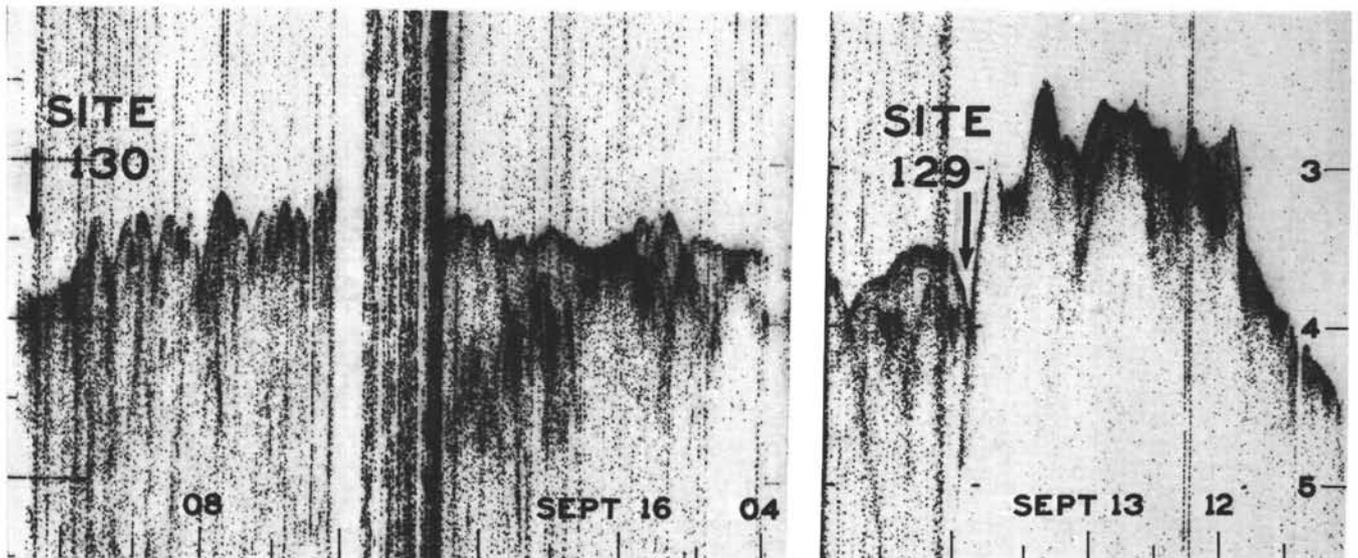


Figure 3L.

Vertical scale in seconds of two-way travel time.

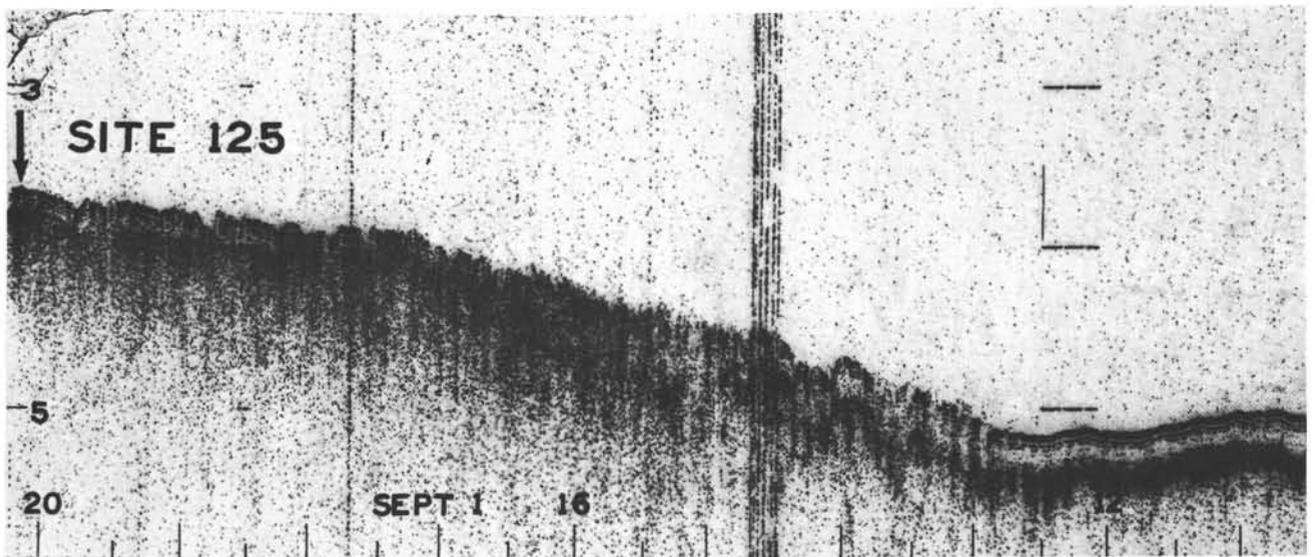
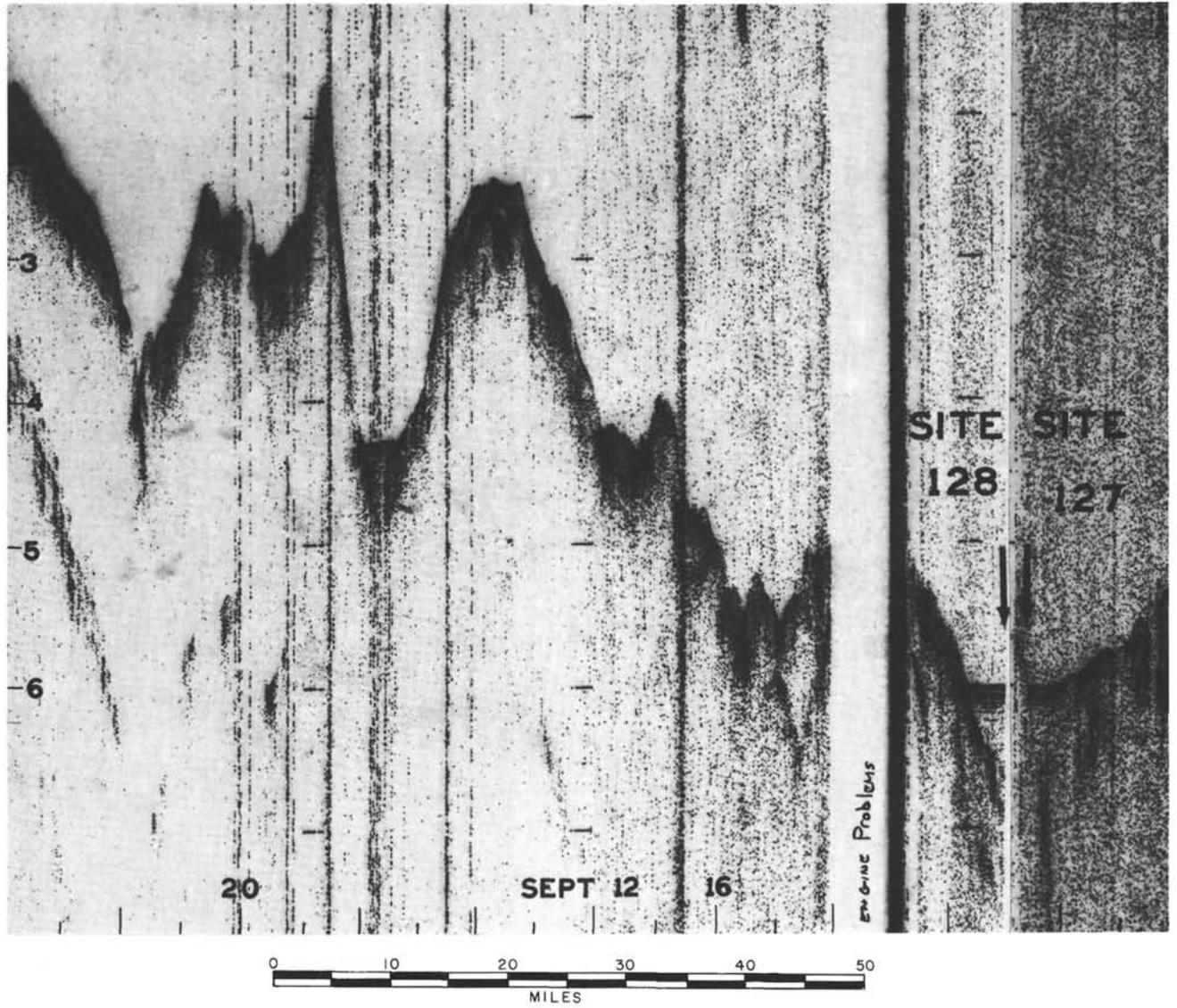


Figure 3M.

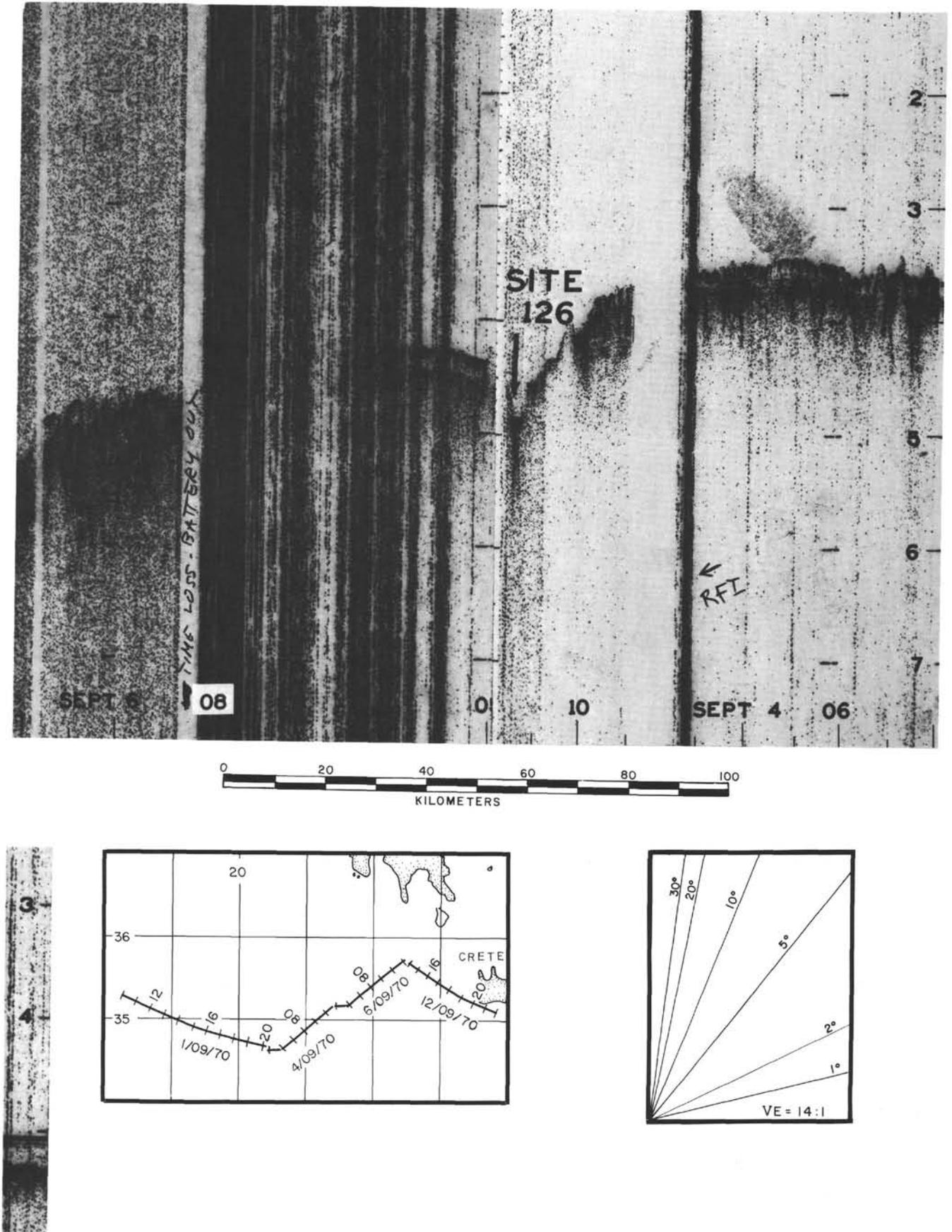


Figure 3N.

Vertical scale in seconds of two-way travel time.

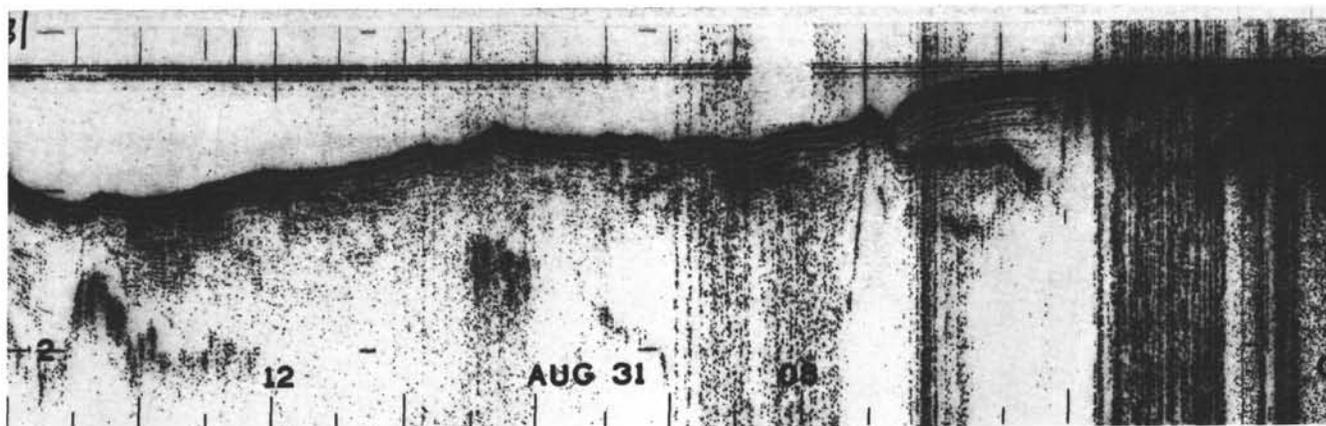
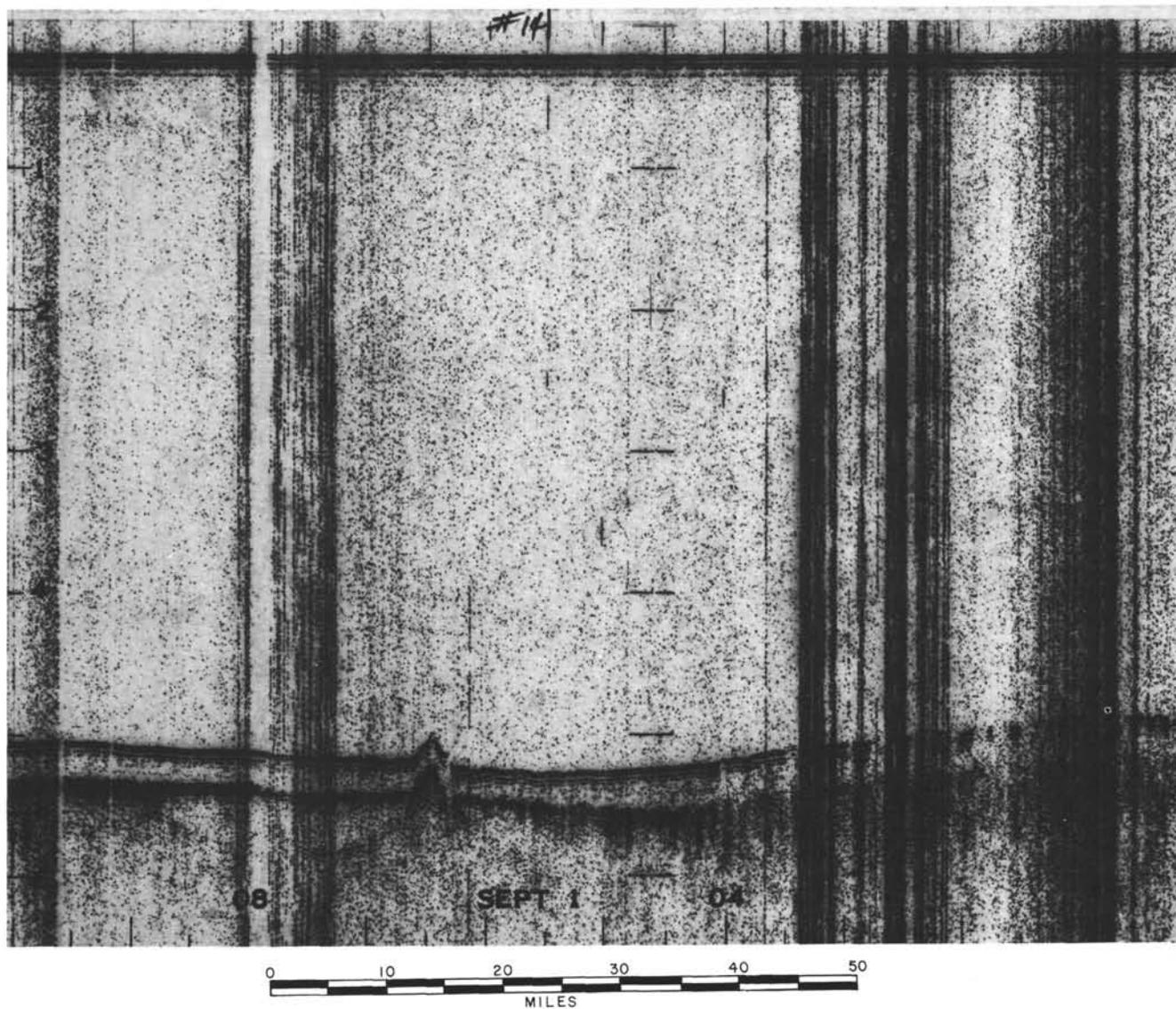


Figure 30.

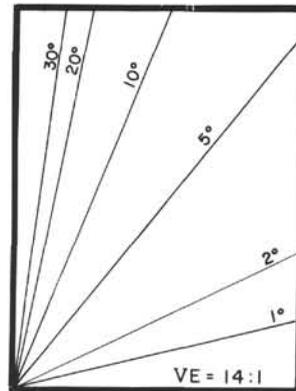
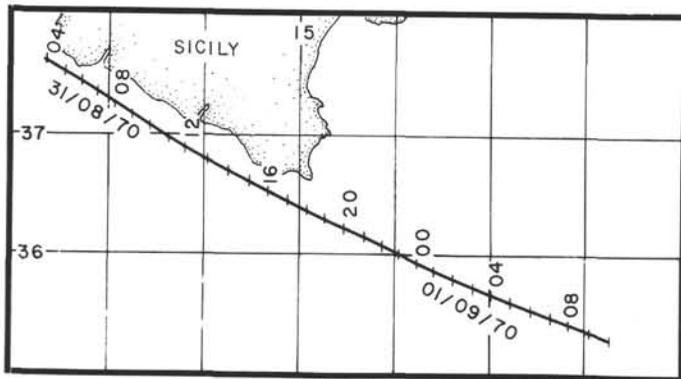
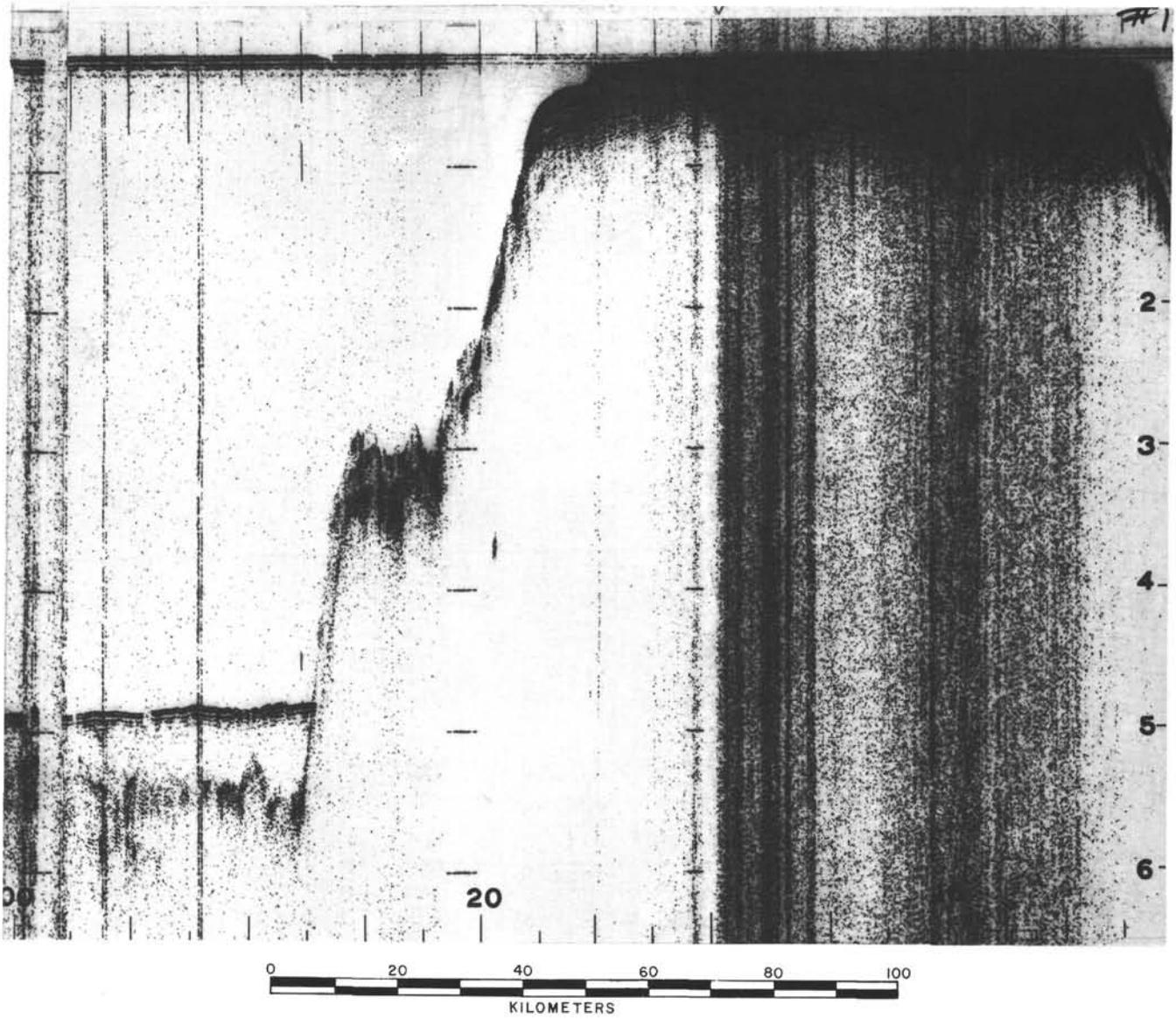


Figure 3P.

Vertical scale in seconds of two-way travel time.

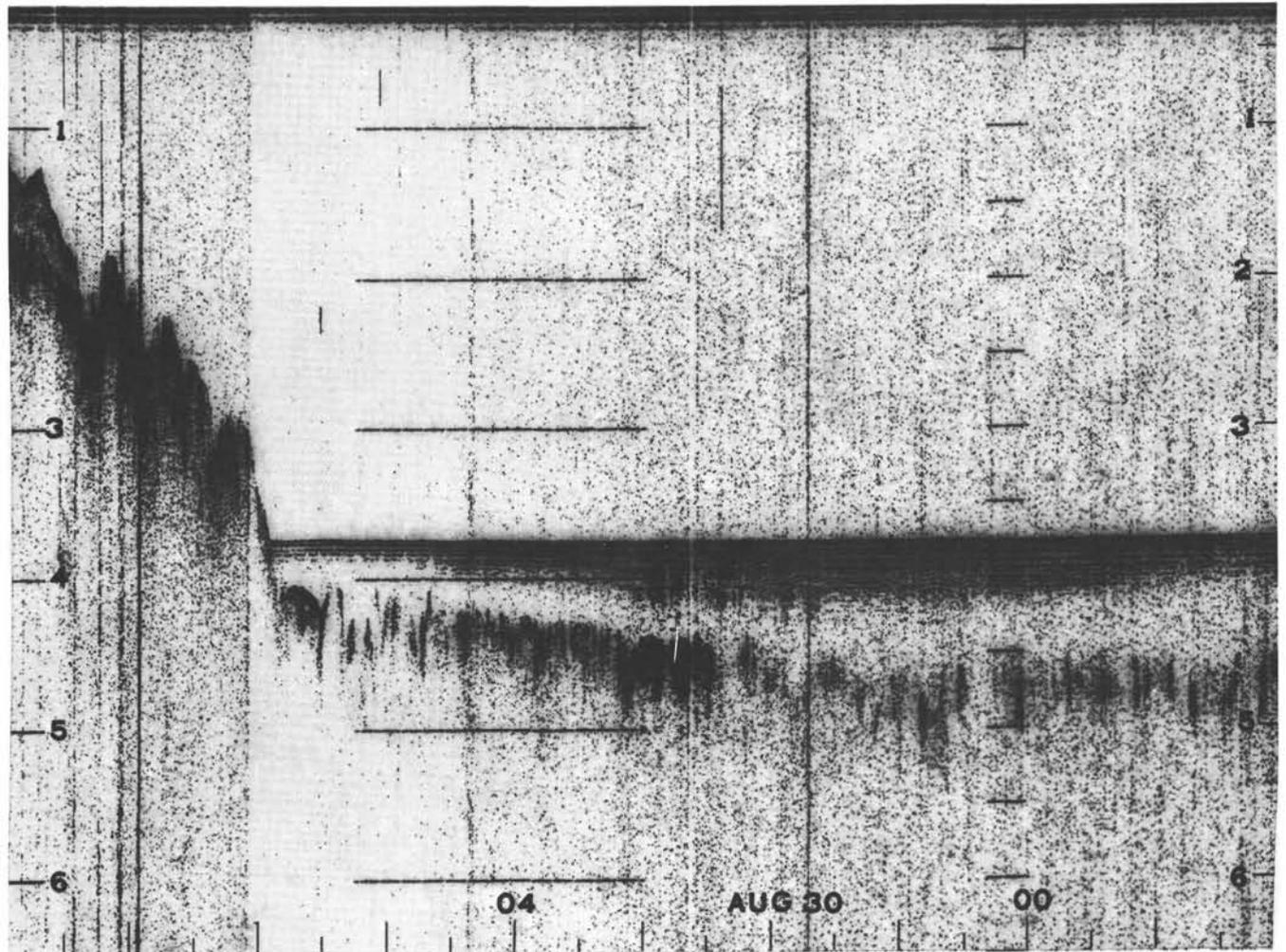
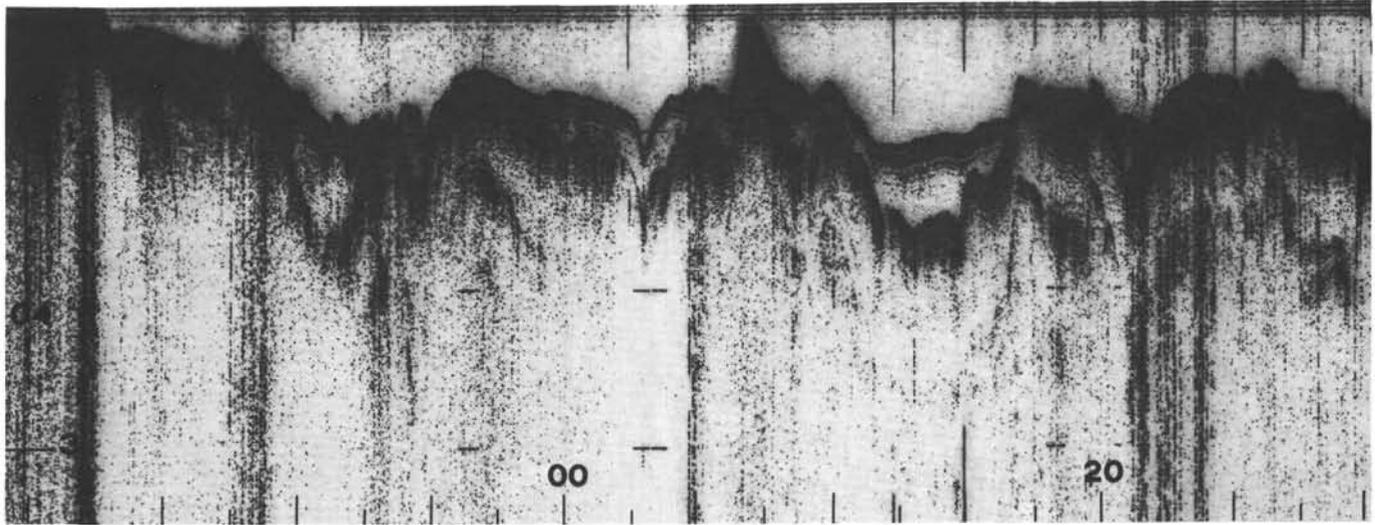


Figure 3Q.

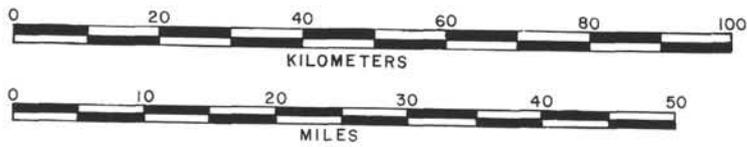
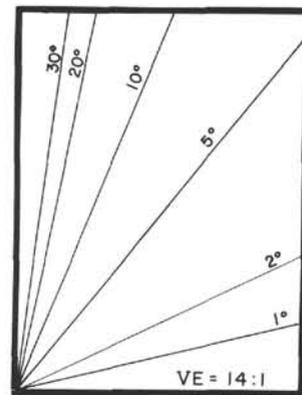
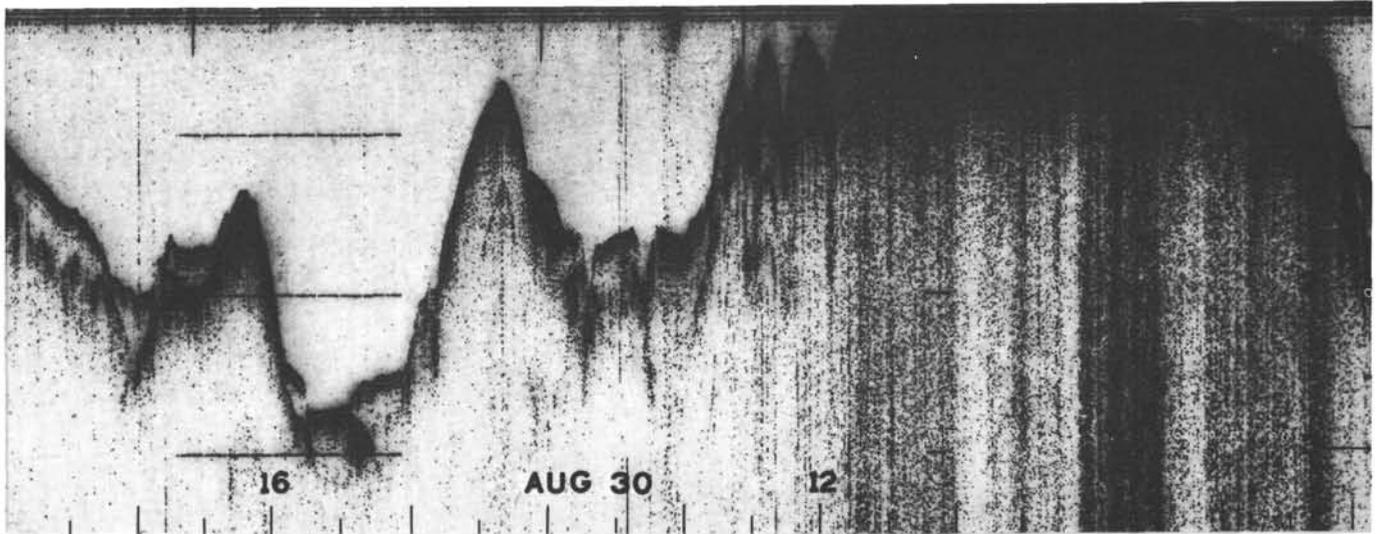


Figure 3R.

Vertical scale in seconds of two-way travel time.

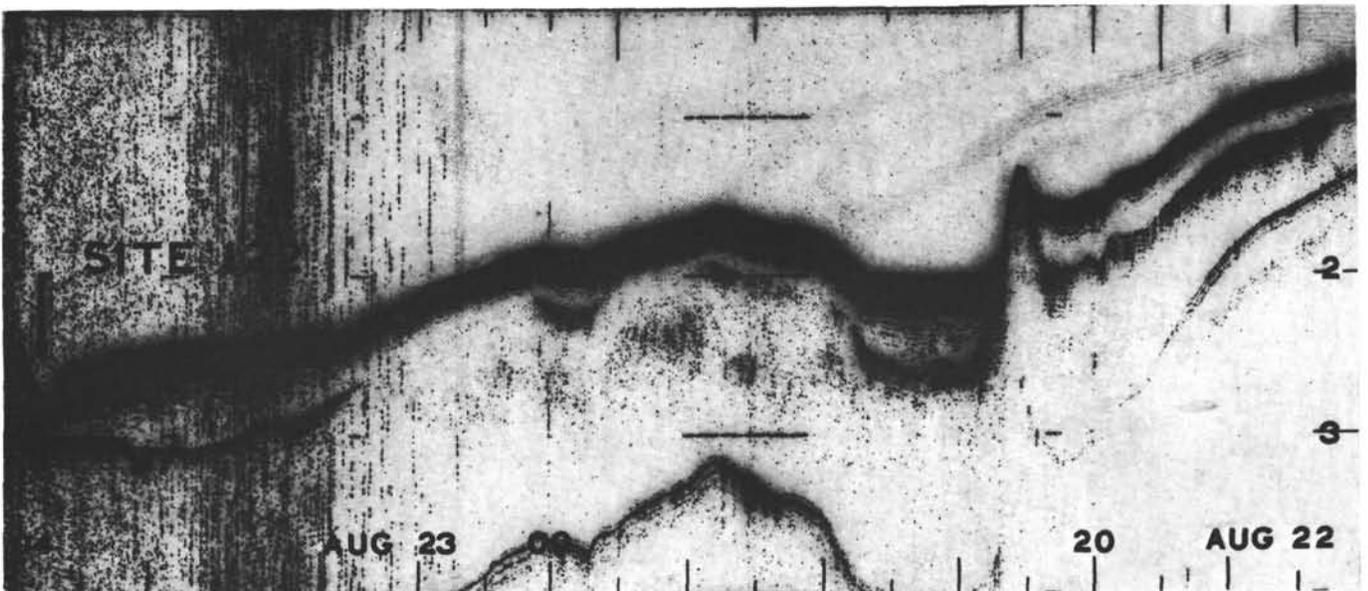
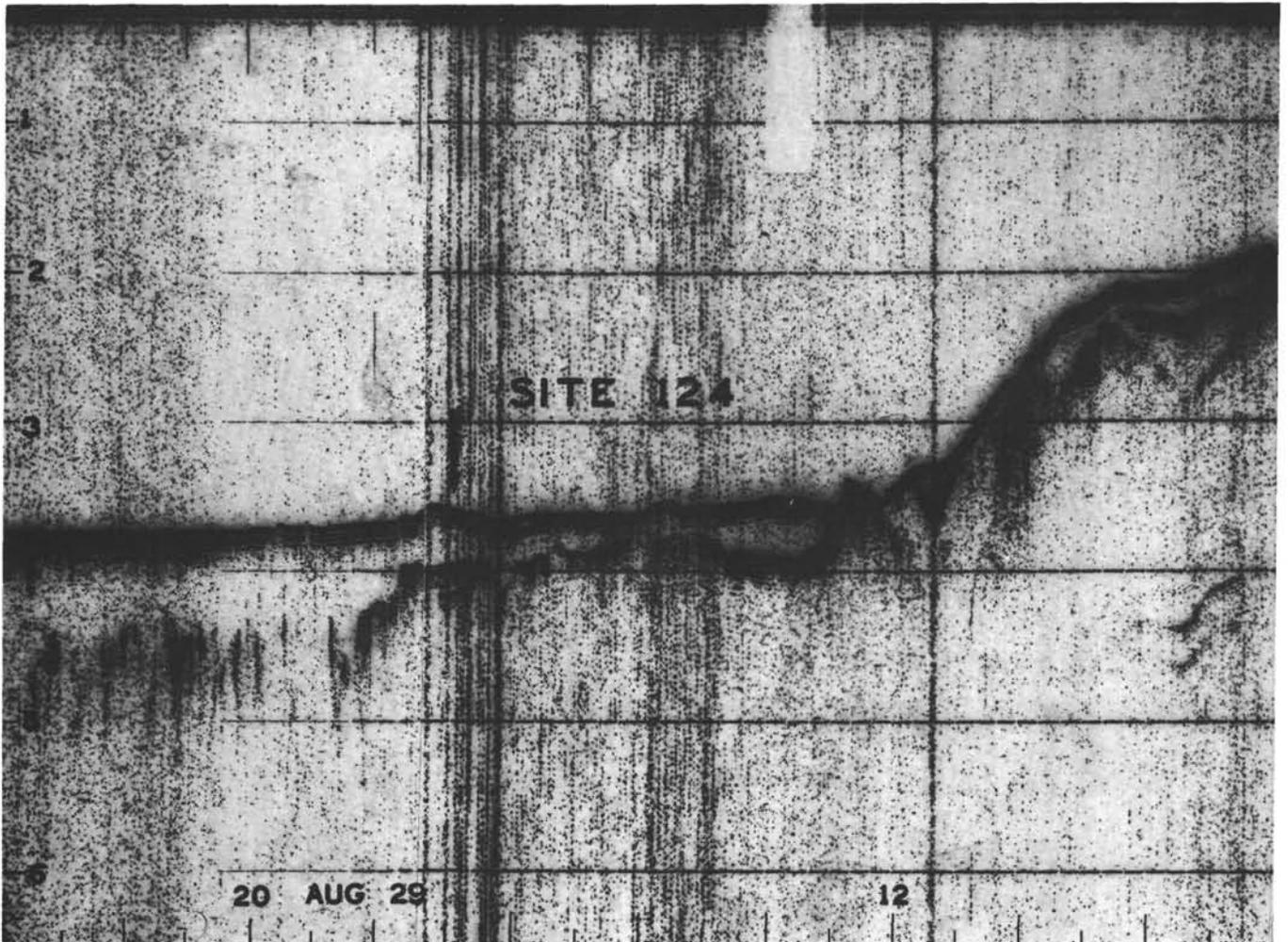


Figure 3S.

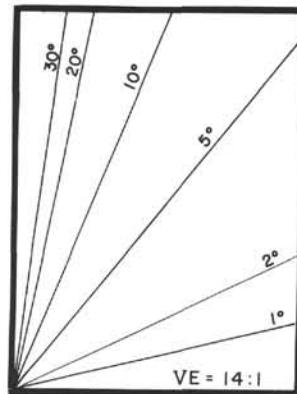
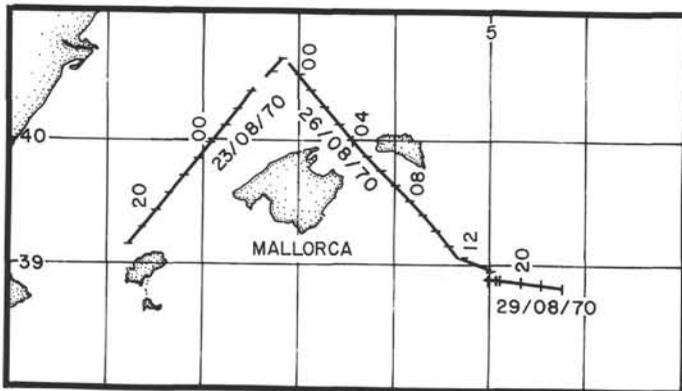
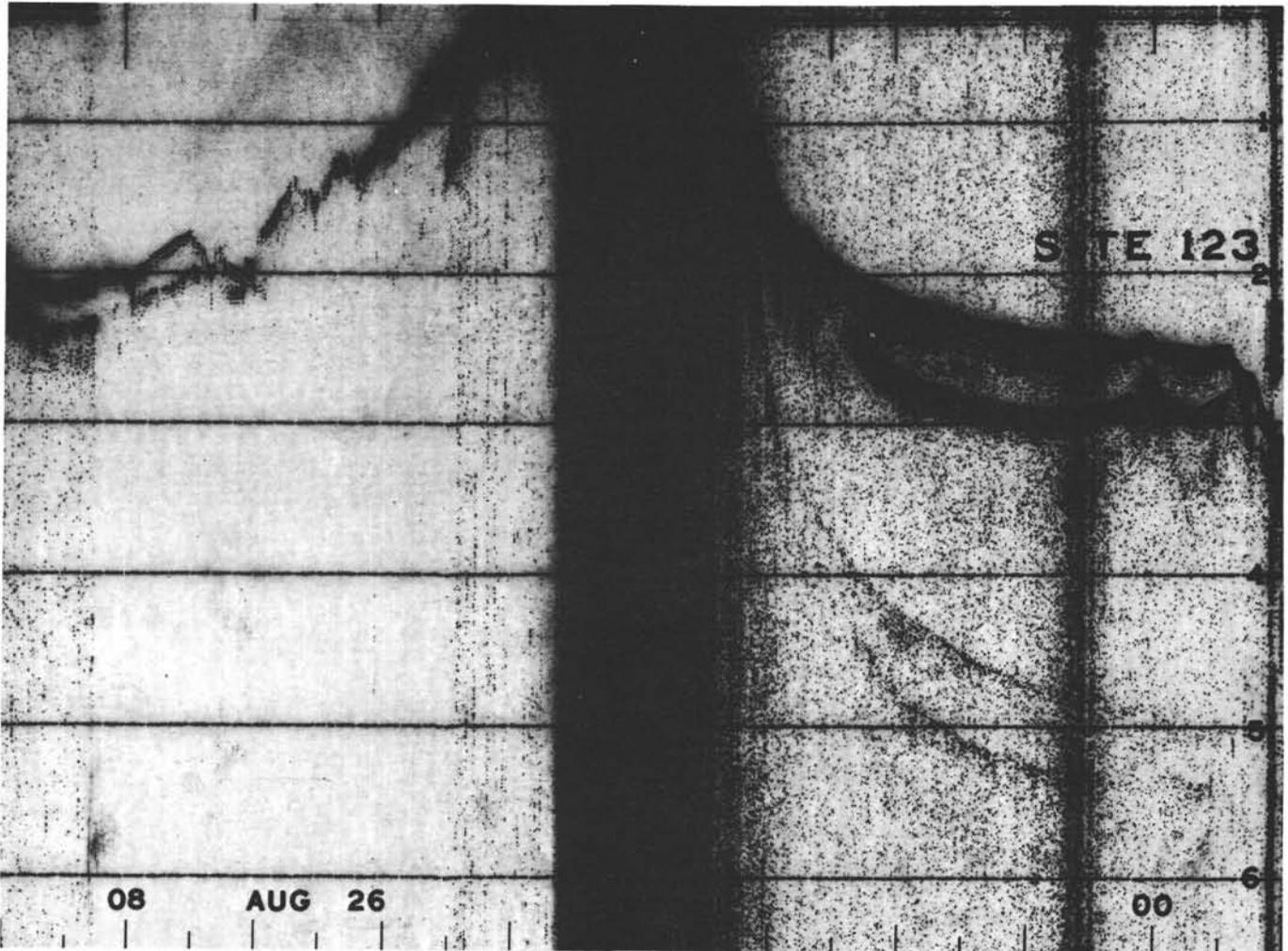


Figure 3T.

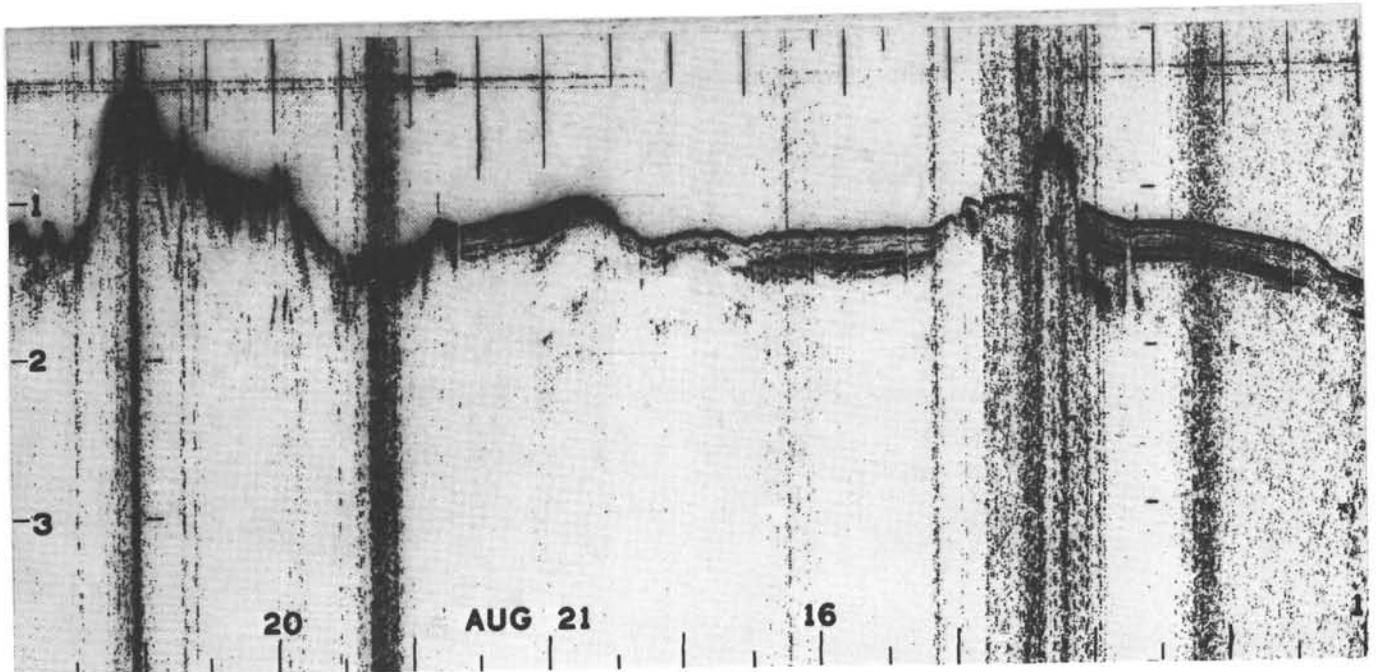
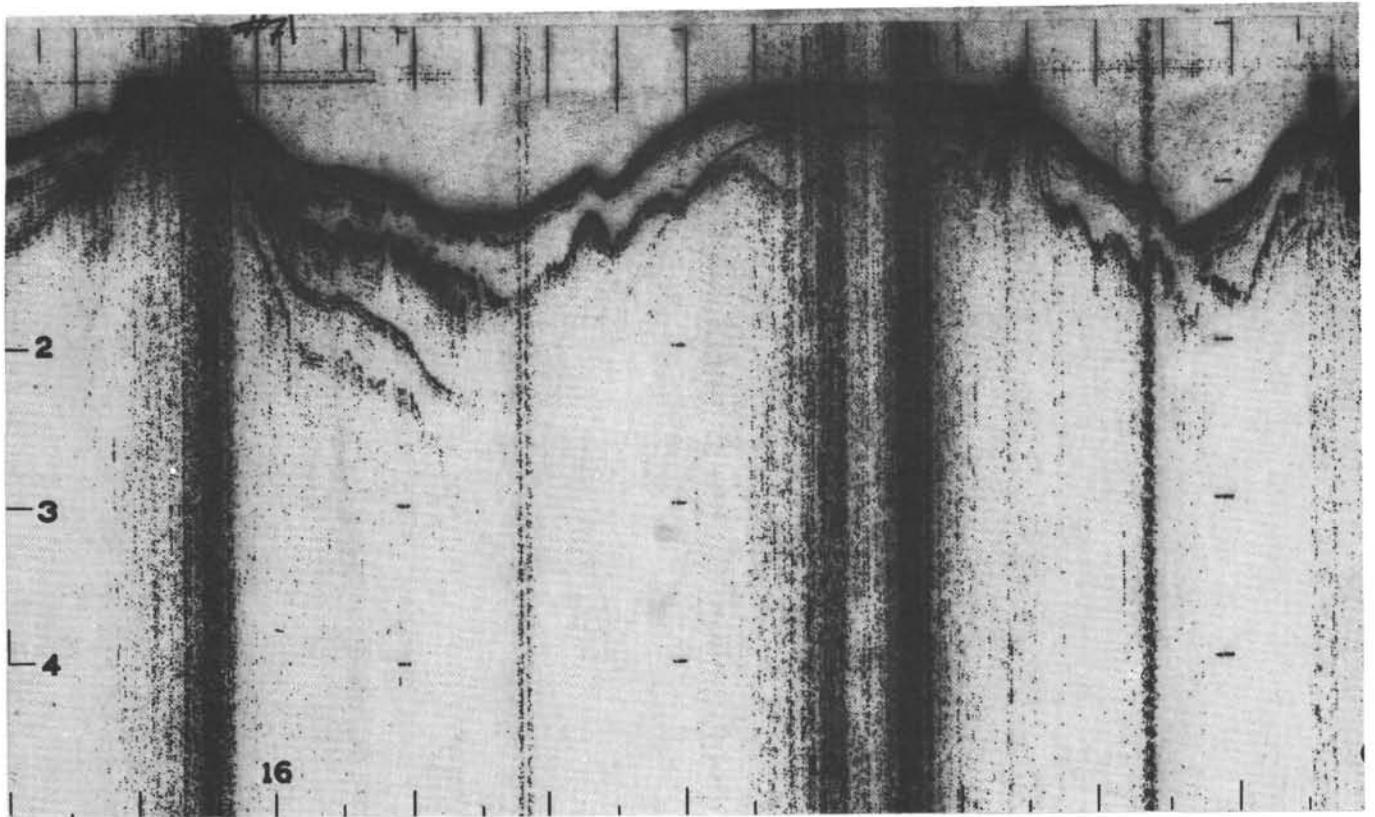


Figure 3U.

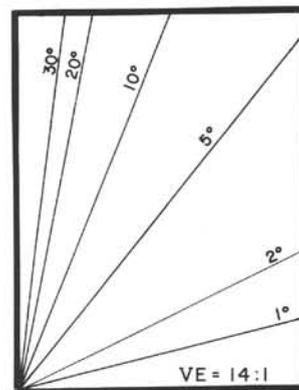
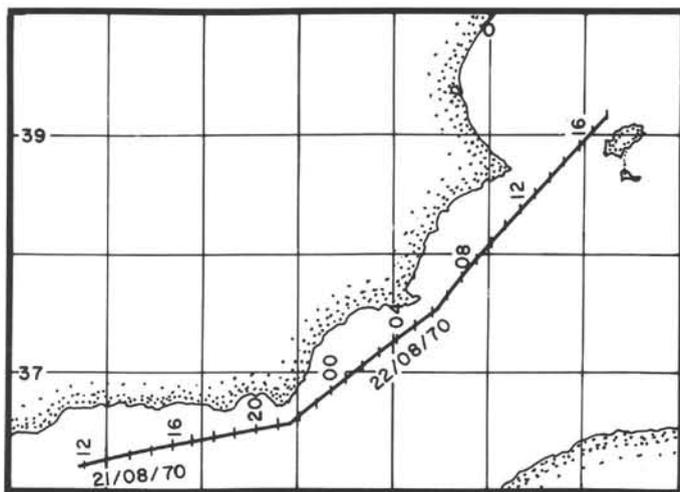
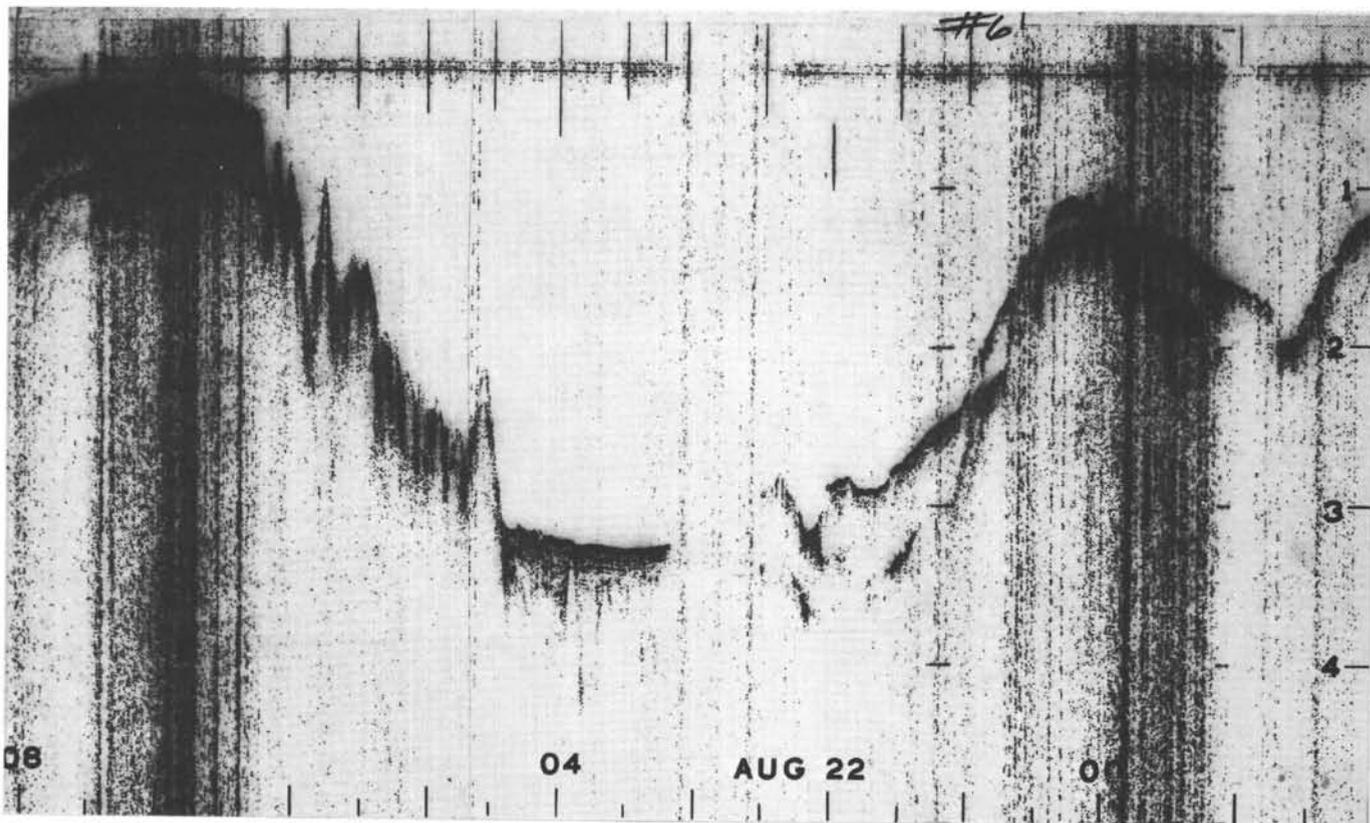


Figure 3V.

Vertical scale in seconds of two-way travel time.

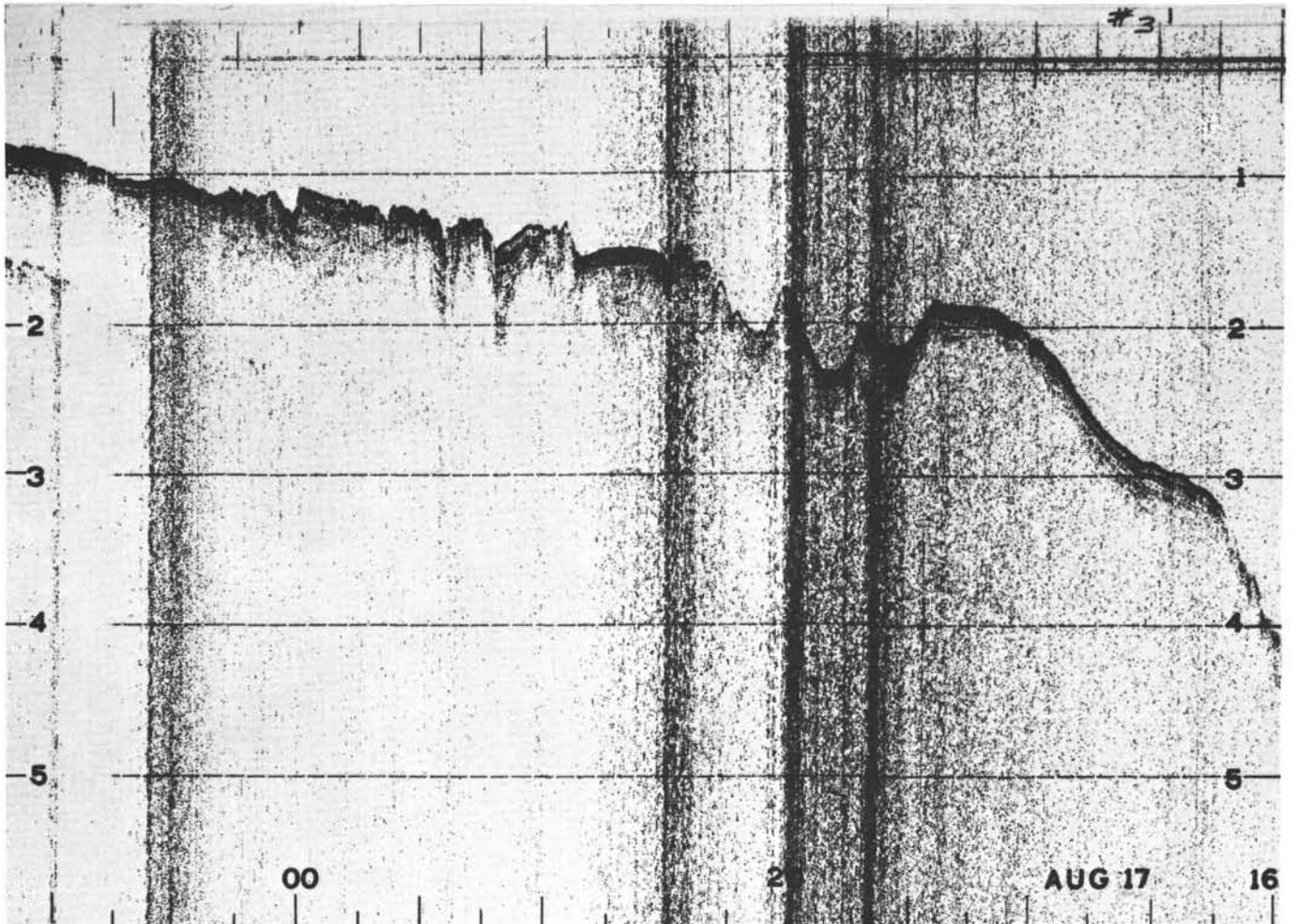
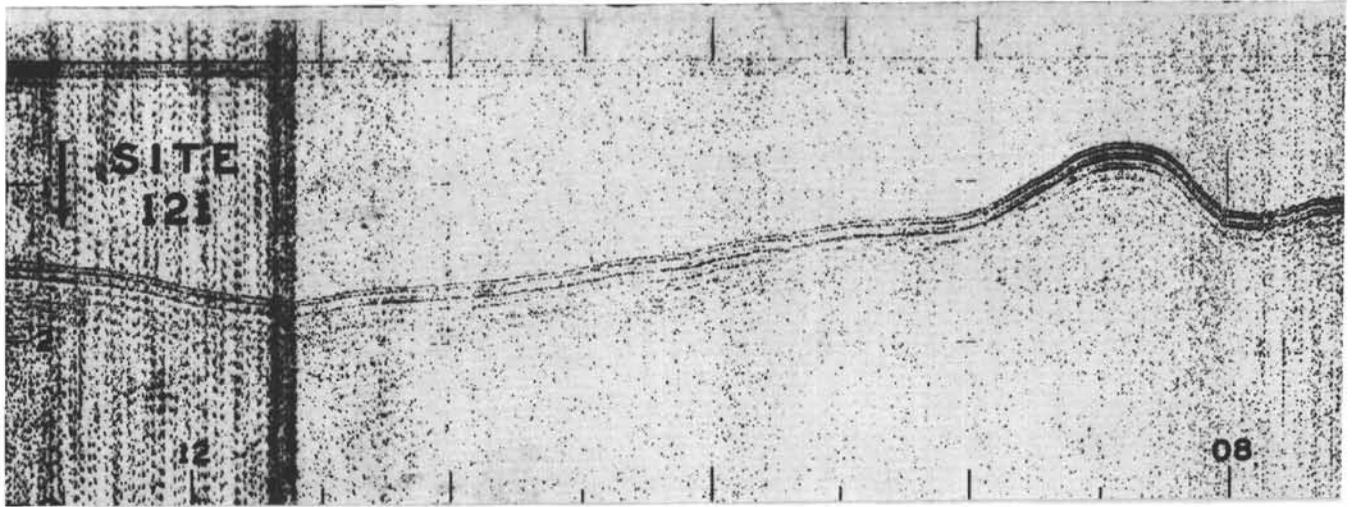


Figure 3W.

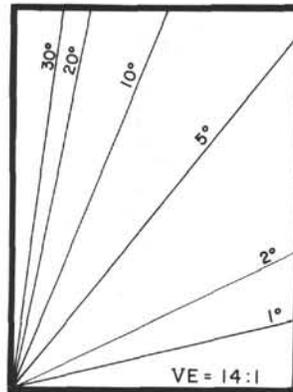
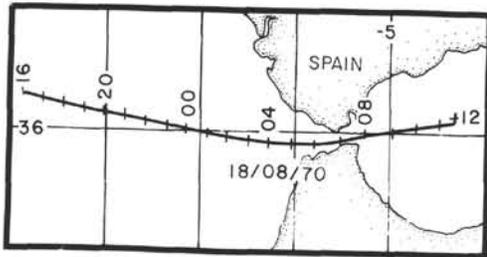
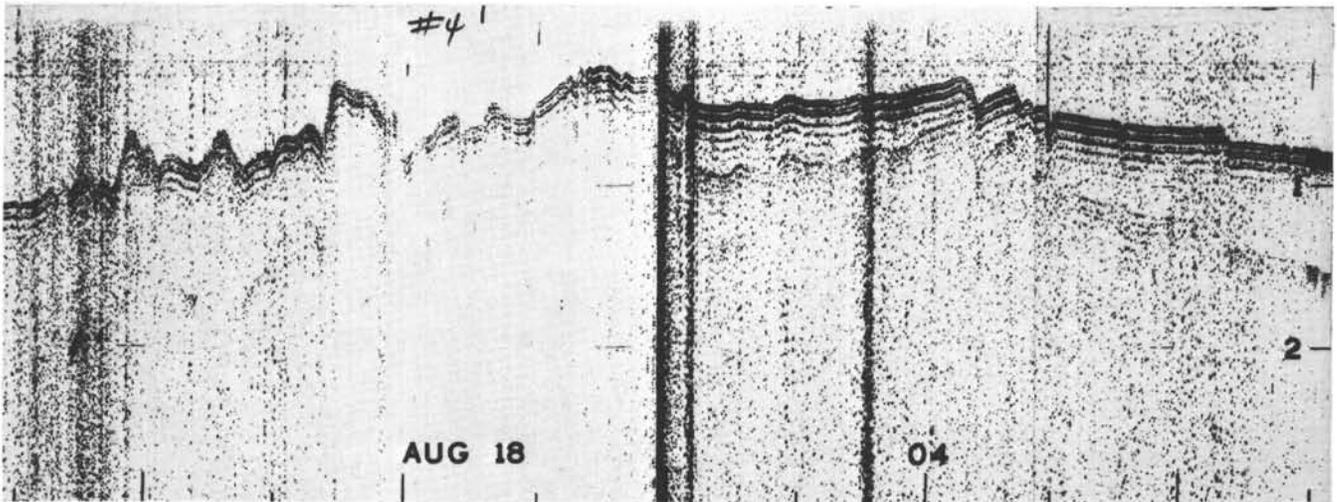


Figure 3X.

Vertical scale in seconds of two-way travel time.

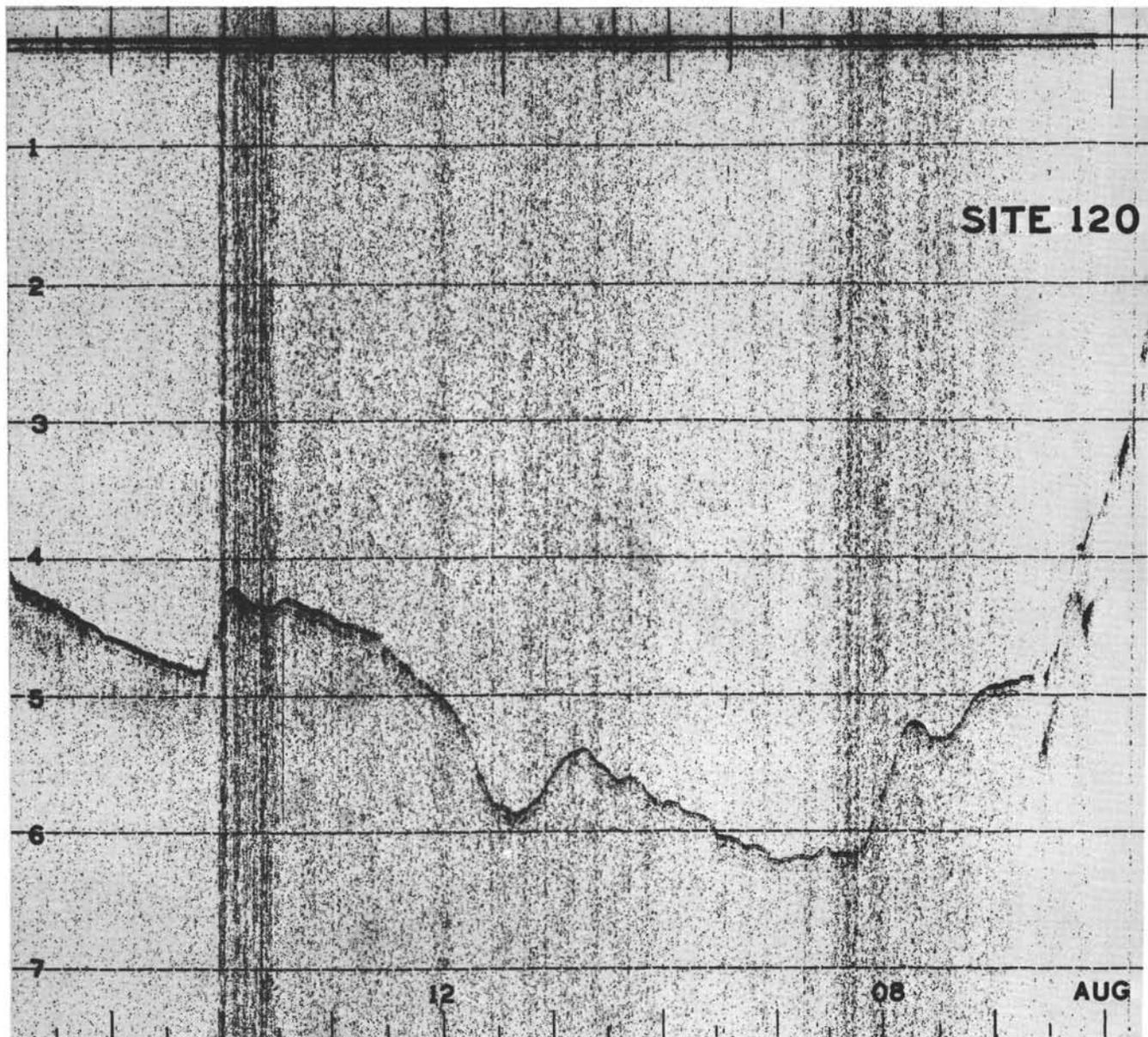


Figure 3Y.

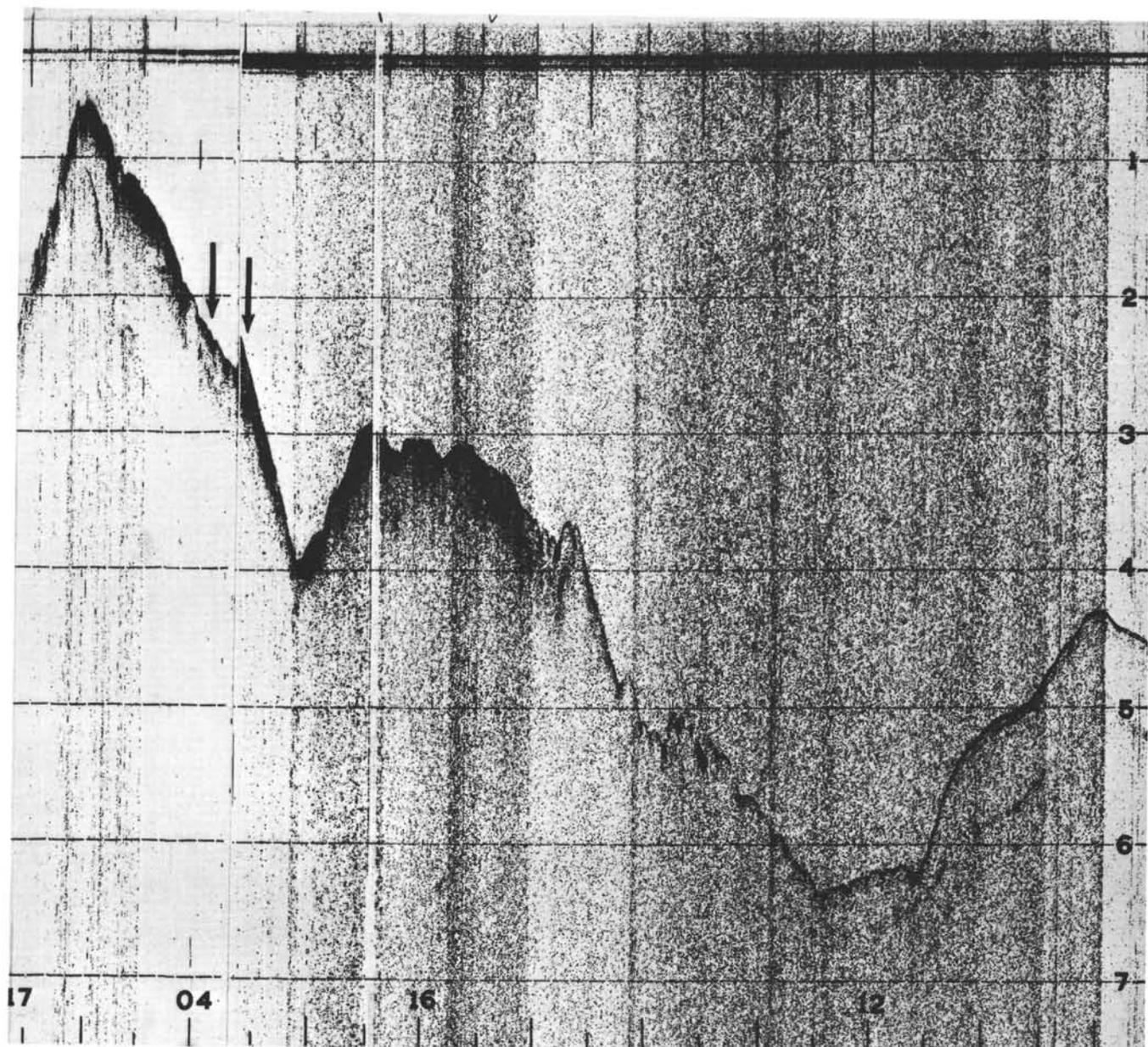


Figure 3Z.

Vertical scale in seconds of two-way travel time.

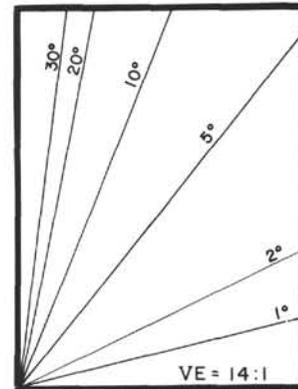
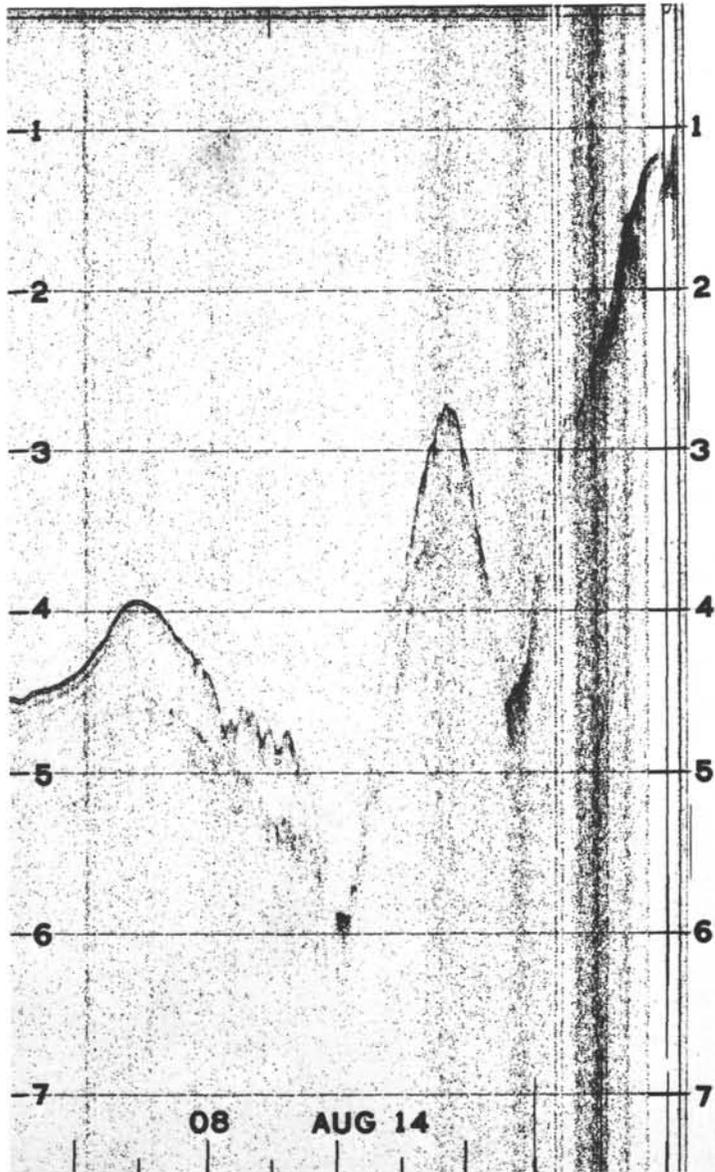


Figure 3AA.