3. UNDERWAY GEOPHYSICS DURING LEG 113[1]

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INTRODUCTION

Underway geophysics data were acquired by the *JOIDES Resolution* and the ice-picket vessel *Maersk Master* during Leg 113. The *Resolution* acquired 12- and 3.5-kHz bathymetric high-resolution seismic, single-channel seismic, and magnetic data near drill-site locations. Bathymetric, high-resolution seismic, and magnetic data were acquired during most transit periods aboard *Resolution* while single-channel seismic data were collected during 30% of the between-site transit periods, mostly in the southern Weddell Sea region and in the Scotia Sea. *Maersk Master* was equipped to collect magnetic data which it did during all transit periods as well as during surveys done while the drillship was on site. *Maersk Master* also acquired a limited quantity of bathymetric data with a shallow-water (50-kHz) echo-sounder.

The track of the two ships is shown in Figure 1 with the intervals where single-channel seismic data were collected shown as a thicker line. The seismic profiles during transit between sites were collected at speeds between 10 and 12 kt. In the vicinity of the drill sites, the data were acquired at speeds of 4–6 kt to achieve a better signal-to-noise ratio. Toward the end of the leg, sea states greater than 7 were encountered and found to generate significant noise that made interpretation of the seismic data difficult.

DATA ACQUISITION ABOARD *MAERSK MASTER*

The primary objective of *Maersk Master* was to assist the *Resolution* during transit between sites and during drilling. This duty consisted of scouting ahead of the drillship to assess ice conditions while both ships were underway and by surveying for ice around the *Resolution* while it was drilling. If ice threatened the drillship while on site, *Maersk Master* attempted to tow the ice away from the drillship. When ice conditions were favorable, permission was given to acquire underway magnetic data within a specified distance (usually 3–6 hr) from the drilling ship or to deploy sediment traps (see Biggs et al., this volume).

Seven hundred and two hours of underway magnetic data were acquired over a total distance of 12,690 km, representing 45% of the total time spent at sea. Thirty-nine percent of the magnetic data was acquired while *Resolution* was on site. All allowable time for taking magnetic data was utilized and no time was lost due to faulty equipment. In addition, 524 km of bathymetric data on the South Orkney Platform was acquired during a total of 33 hr.

NAVIGATION

Navigation data were collected by a Danish-made Shipmate RS5000 DS satellite receiver system, connected to a dedicated printer. When underway magnetic data were being recorded, all transit-satellite fixes, 20-min dead-reckoning (DR) positions, and most course and speed change positions were communicated to the printer. Minor editing of the navigation data was required to rectify bad satellite fixes, or when course and speed changes occurred during long periods of time without satellite fixes in areas with strong surface currents.

MAGNETOMETER EQUIPMENT

Mounted on the starboard side of the large aft deck of *Maersk Master* was a Barringer DMS123 proton precession magnetometer which was used to measure the total strength of the Earth's magnetic field. When deployed, the magnetometer sensor was 150 m from the vessel, at an estimated tow depth greater than 5 m. A knotted rope was tied to the neck of the sensor to increase its stability when being towed at high speeds (up to 14 kt).

The data were recorded on an analog chart roll, from which readings were digitized every 5 min, as well as at peaks and troughs. Computer software was written to interpolate between the satellite fixes and DR positions to produce a navigation point every 5 min. The magnetic and navigation data were combined, and the 1975 International Geomagnetic Reference Field (IGRF) was used to reduce the magnetic data to obtain the observed magnetic anomaly. Subsequent analysis with the 1985 IGRF revealed only minor differences in the shift of the reduced magnetic data.

ECHO-SOUNDER EQUIPMENT

Maersk Master was also equipped with a Furuno FE-880 (50-kHz) navigational echo-sounder. The system source was capable of penetrating to a water depth of 1600 m. On the shallow continental margin of the South Orkney microcontinent, close to Sites 695 and 696, bathymetric data were acquired with this echo-sounder, while running magnetic lines. The bathymetric data can be used to distinguish regions where basement crops out at the seabed, which aids interpretation of the underway magnetic data. This, in turn, will help to delineate the sedimentary basins in the vicinity of the drill sites.

PUNTA ARENAS TO SITE 689

Maersk Master left Punta Arenas at 006/0330 (Julian Day (JD) 006 at 0330 hr), 14 hr behind *JOIDES Resolution*. It was intended that the two ships would run parallel tracks and that both vessels could acquire magnetic data. If visibility or ice conditions worsened, then *Maersk Master* would be recalled to precede the drillship. Figures 2–4 show the route taken to the first drill site. The magnetics are plotted at the same scale as the GEBCO chart (General Bathymetric Chart of the World's Oceans, scale is 1:10,000,000 at the equator). The vertical scale of the magnetics plotted along track are 1000γ per inch with an offset so that the anomalies are centered about the trackline.

JOIDES Resolution sailed on a direct route to the first drill site at Maud Rise. After passing through the Strait of Magellan,

[1] Barker, P. F., Kennett, J. P., et al., 1988. *Proc. ODP, Init. Repts.*, 113: College Station, TX (Ocean Drilling Program).

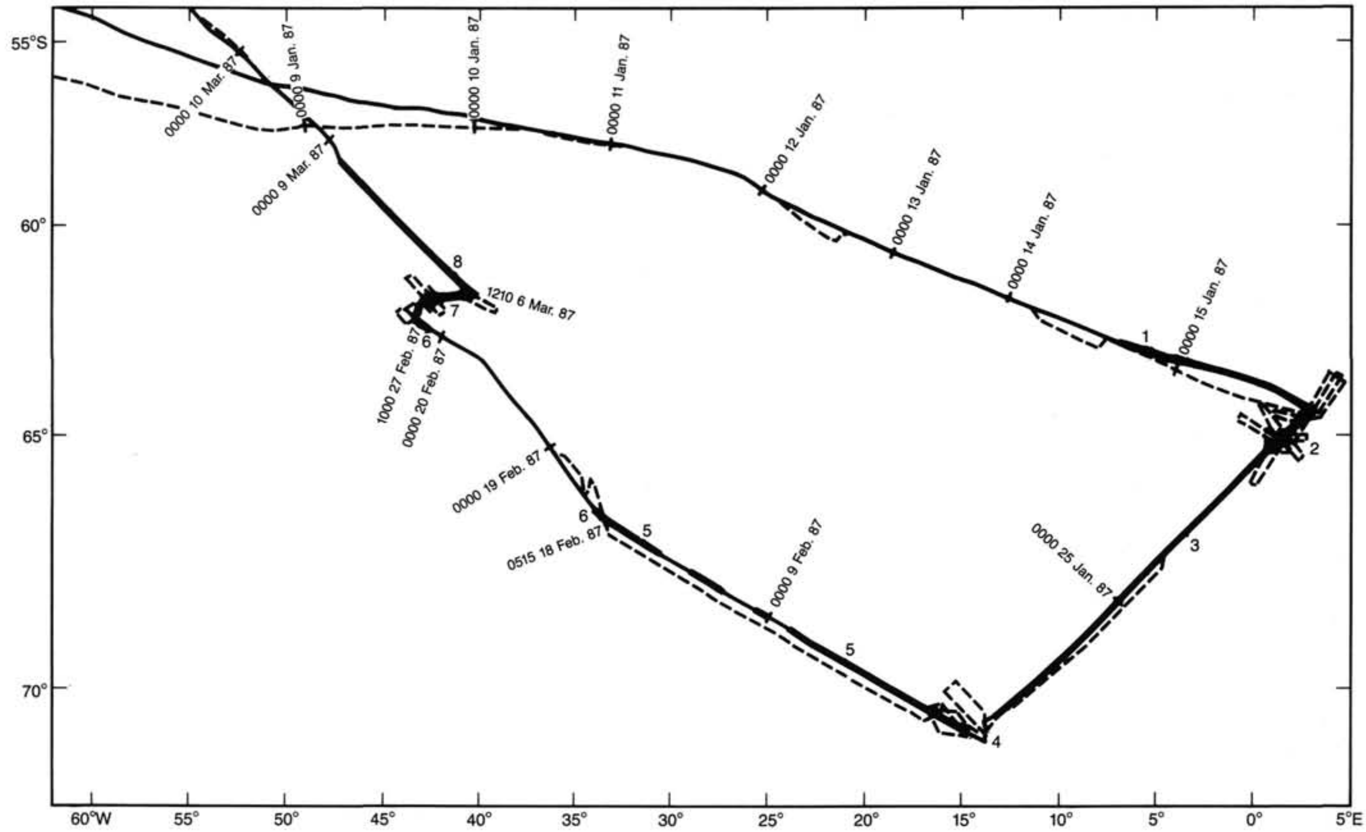

Figure 1. Track chart showing the routes of *Maersk Master* and *JOIDES Resolution* during ODP Leg 113, when underway geophysical data were collected. The solid line indicates *JOIDES Resolution*'s track with the single-channel seismic reflection data shown by a thick, solid line. A dashed line indicates the track of *Maersk Master*. Ticks indicate a change of day or the end of the line. The drill sites are indicated by site number.

Maersk Master headed toward the first way point at 56°S 62°W. At that point, the magnetometer was launched, and a course of 102° was taken to run a magnetic profile to the south of the Quest Fracture Zone. *Maersk Master* ran this course in a region of the western Scotia Sea which lacks sufficient magnetic data coverage to give unambiguous age determinations of the seafloor (Barker and Burrell, 1977). After the tuning characteristics of the Barringer magnetometer aboard *Maersk Master* were determined, excellent and uninterrupted underway magnetic data were acquired. Upon completion of the magnetic line south of the fracture zone, at position 57°30′S, 51°09′W, *Maersk Master* was required to alter course to 90° to intercept *Resolution*, and to proceed 3–10 km in front of the drillship because of poor visibility.

Our new course was parallel to the identified central Scotia Sea anomalies (Hill and Barker, 1980). Increase in floating ice at 57°28′S, 37°25′W, required a course change to 105°, and again, at 58°47′S, 26°18′W, to 126°. This course ran at a slight angle to the active back-arc basin spreading in the eastern Scotia Sea. High amplitude (~800γ) magnetic anomalies were recorded. These anomalies agree with the previously published anomalies from the eastern Scotia Sea (Barker and Hill, 1981).

The two ships passed through the South Sandwich Islands arc between Montagu Island and Bristol Island. After crossing the South Sandwich Fracture Zone at 18.5°W, identifiable magnetic anomalies were again observed, and the very prominent Anomalies 33 and 34 (80.4 Ma and 84 Ma; Palmer, 1983) were identified before arrival at Maud Rise. *Maersk Master* arrived at Site 689 (64°31.01′S, 03°05.99′E) at 015/1640, several hours before *Resolution*, because *Resolution* slowed to deploy the seismic streamer. A total of 3886 km of magnetic data was acquired on passage to the first drill site at Maud Rise.

SITES 689 AND 690: MAUD RISE

Magnetic data previously acquired in the area are documented by LaBrecque and Cande (1987) and Bergh (pers. comm., 1988). From their work, a magnetic bight for Anomaly 33/34 can be seen about 500 km northeast of Maud Rise. The Anomaly 33/34 observed to the west of Maud Rise is lineated in a direction of 60°, while those observed to the northeast of the Rise are lineated in a direction of 120°. The objectives for the underway magnetic data acquired at these sites were to date the age of the seafloor and to attempt to determine whether or not Maud Rise formed at a spreading axis.

The ice conditions and visibility at both sites were excellent and as a consequence, *Maersk Master* was allowed to collect magnetic data within a radius of 6 hr steaming time from the drill sites. On arrival at each site, *Maersk Master* performed ice surveys in the vicinity of the drill sites; these were of radius 18 km at Site 689, and radius 28 km at Site 690. Underway magnetic data were acquired during these surveys which provided an initial grid for estimating the direction of anomaly lineation.

The underway magnetic data collected at these sites are shown in Figure 5. On the tracks to the northeast of Site 689 a magnetic anomaly lineation was observed to lie in a direction of 120°. This contrasts with an anomaly lineation of approximately 45° observed on the tracks run to the west of both sites. The lineations to the north agree with the observed trend of the Africa/Antarctica anomalies found to the East (LaBrecque and Cande, 1987; Bergh, in preparation) while the anomalies to the

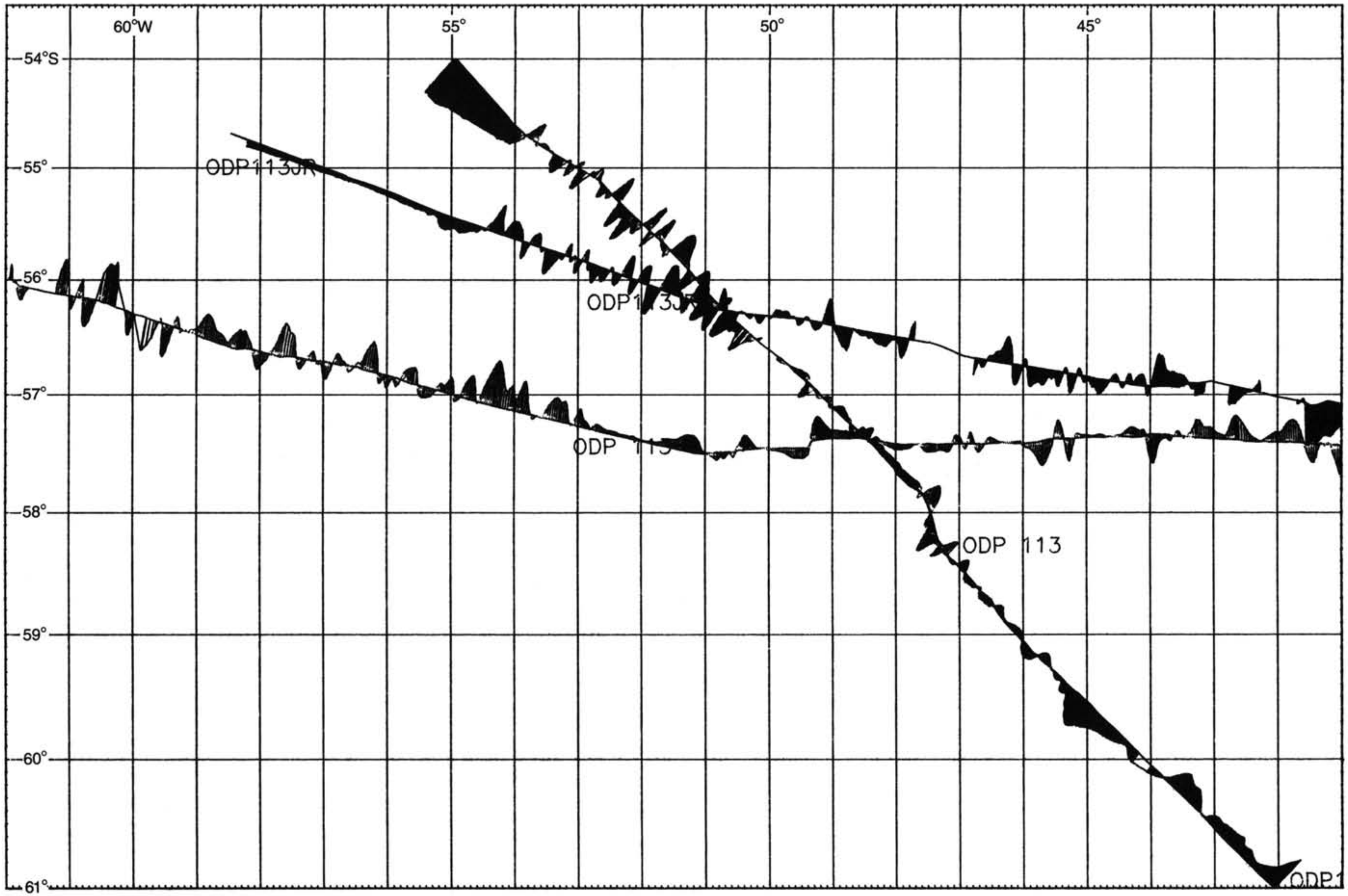

Figure 2. Magnetic anomalies are plotted along track. The scale of the figure is 1:10,000,000 at the equator, which conforms with the GEBCO charts of the world. *Maersk Master*'s track is dotted. The vertical scale for the magnetic anomalies is 1000γ per inch. The magnetic anomalies are plotted orthogonal to the track. The figure includes the *Maersk Master* track from 007/1320 (Julian Day 7 at 1320 hr) to 009/2205 and 066/2230 to 069/1420, as well as *JOIDES Resolution* (JR) track from 007/0915 to 009/1705 and 066/2240 to 069/1600.

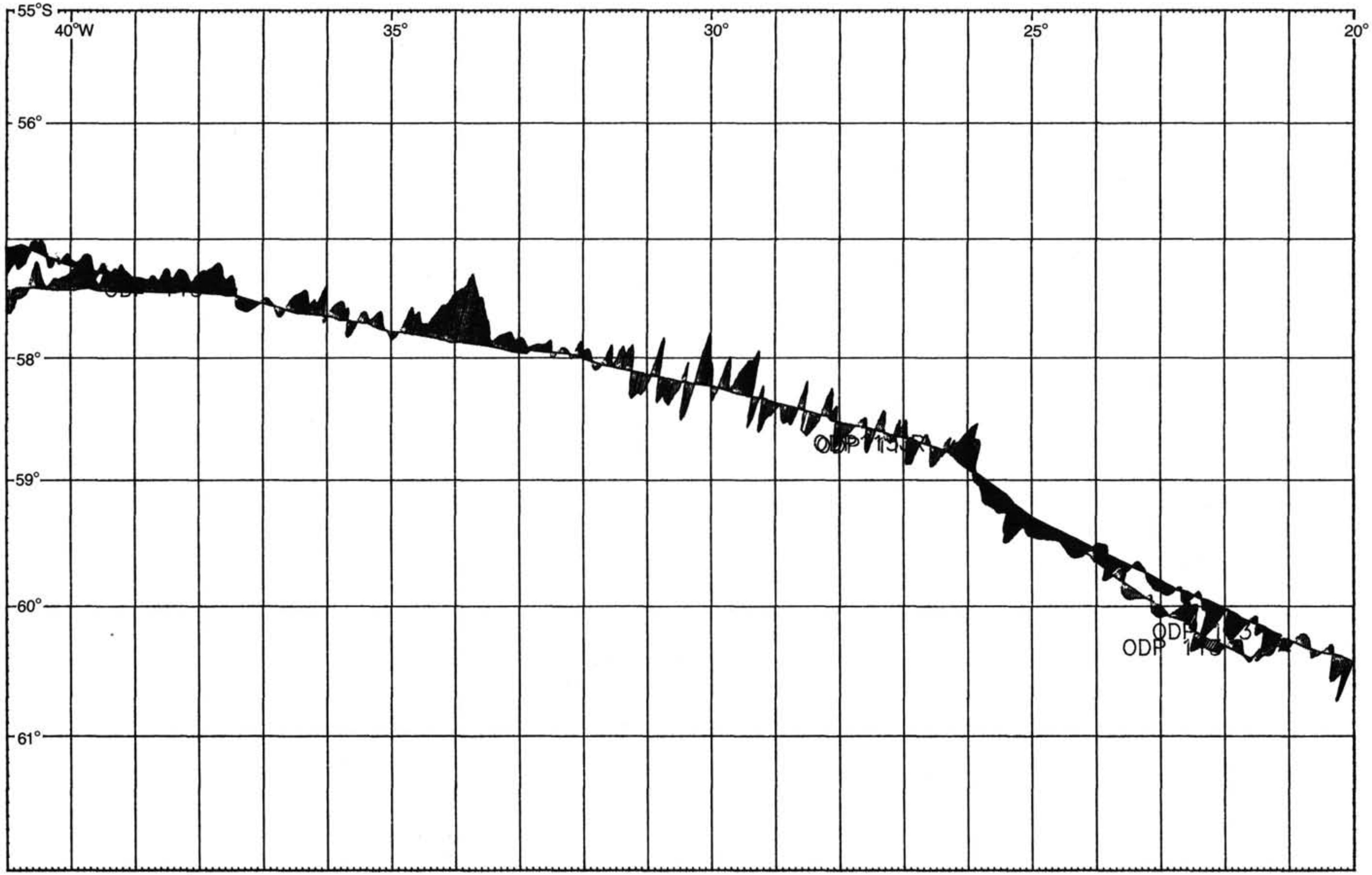

Figure 3. Same plot parameters as in Figure 2. *Maersk Master* track from 009/2210 to 012/1735. *JOIDES Resolution* track from 009/1710 to 012/1750.

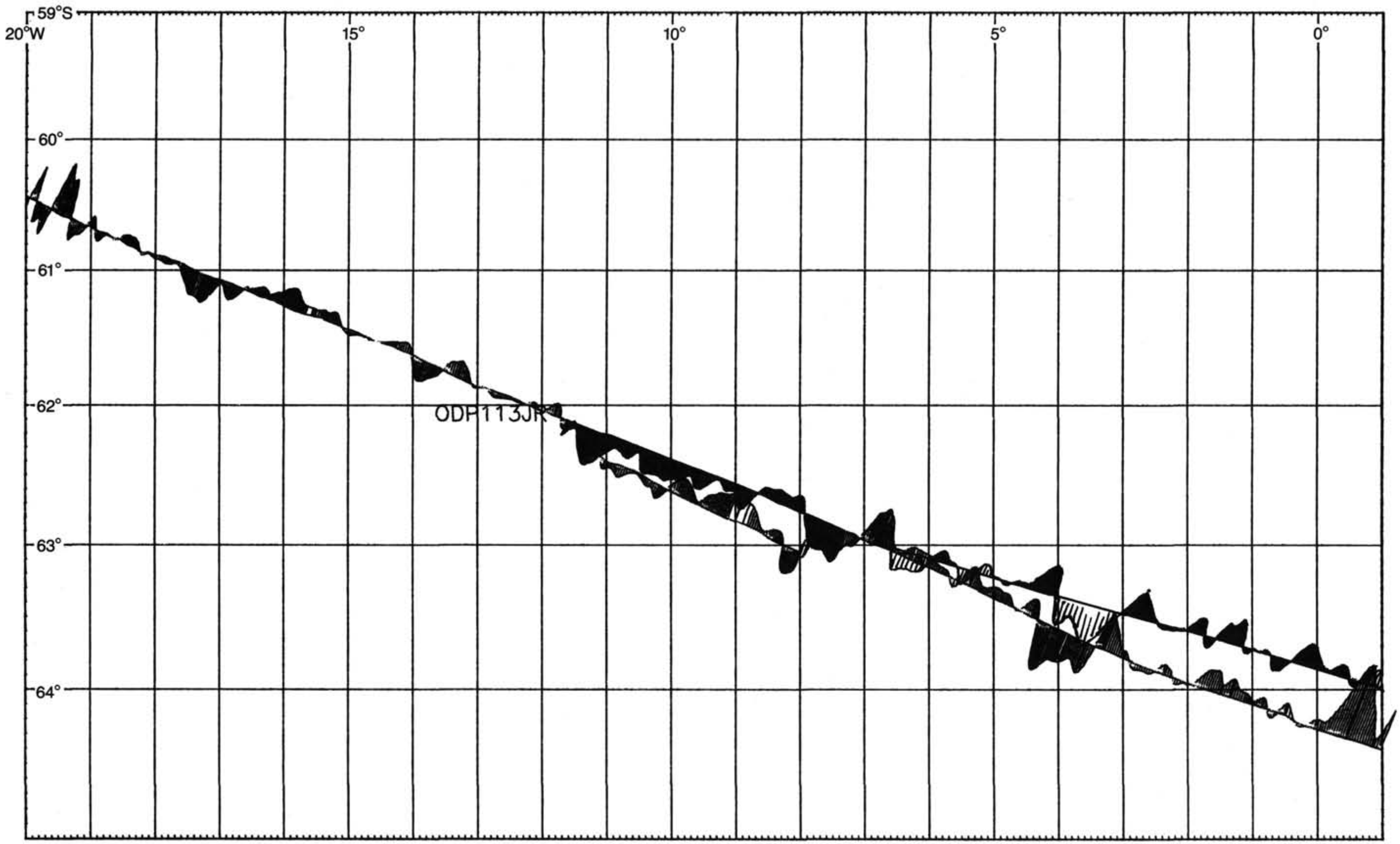

Figure 4. Same plot parameters as in Figure 2. *Mærsk Master* track from 012/1740 to 015/1155. *JOIDES Resolution* track from 012/1755 to 015/1220.

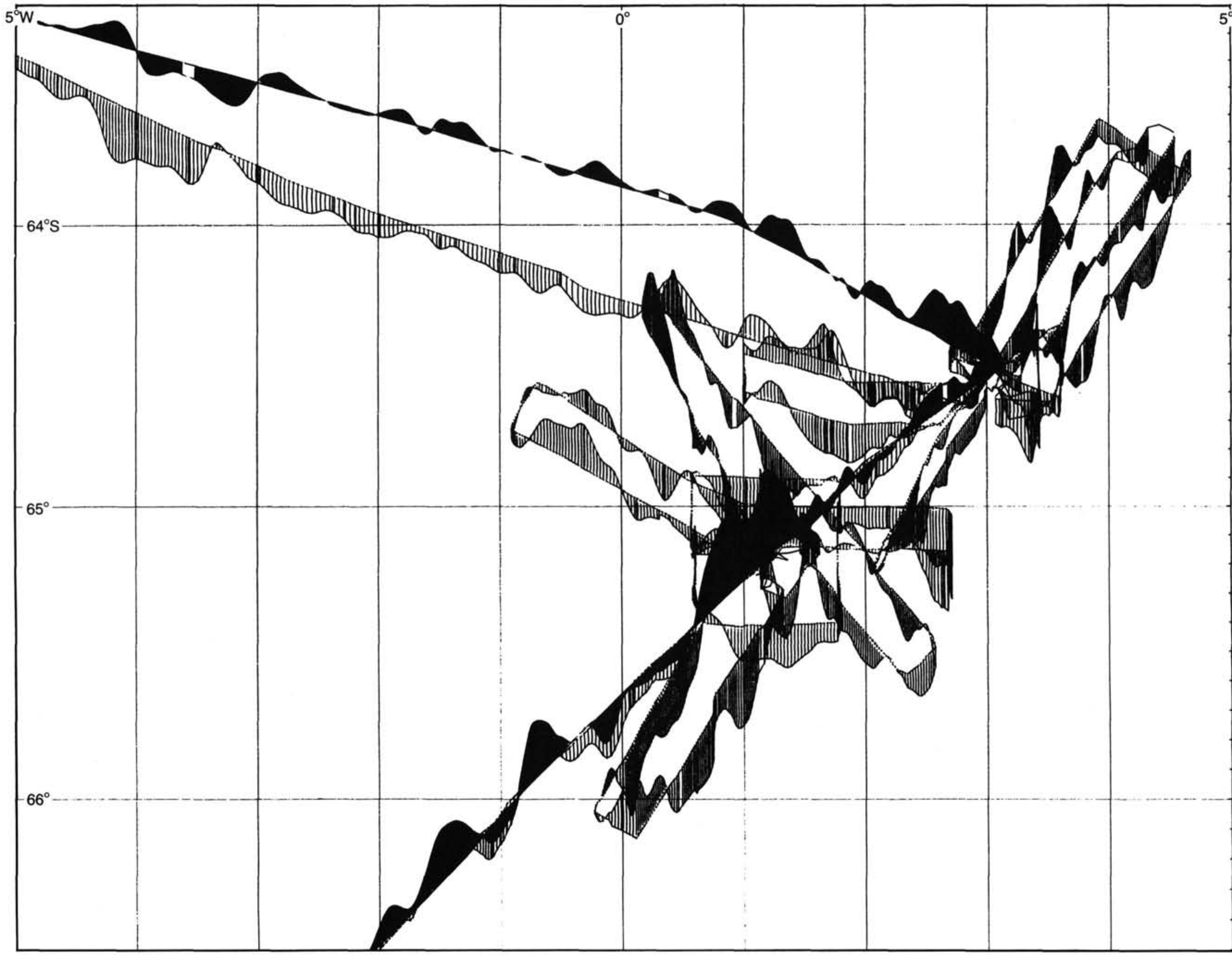

Figure 5. The scale of this figure is 1:5,000,000 at the equator. The vertical scale is 1250γ per inch. The magnetic anomalies are plotted at an azimuth of 000°. *Maersk Master* track from 014/1820 to 024/1415. *JOIDES Resolution* track from 014/1845 to 024/1425.

west are at a distinct angle to the Antarctic-South America anomalies shown by LaBrecque and Cande (1987) and Barker and Jahn (1980). A total of 2668 km of magnetic data was acquired at these locations.

SITES 690 TO 691

Maersk Master departed Site 690 at 024/0050, with the magnetometer streamed, for a direct passage to Site 691 on course 225°. At 67.5°S, 4.5°W, improved visibility permitted *Maersk Master* to deviate 18 km south of the drillship and to run a parallel track. Several thin ice strings were encountered during the morning of 25 January, but no deviations from the course were required. Arrival at Site 691 was at 025/1540 after a passage of 859 km.

Reasonable short-period high-amplitude magnetic anomalies were found between Maud Rise and 3°W. West of 3°W, the magnetic anomalies change to very broad highs and lows with wavelengths as great as 100 km. One of the broad highs correlates with a major bathymetric high that is nearly orthogonal to the two ships' tracks. The data are shown in Figure 6.

SITES 691, 692, AND 693: DRONNING MAUD LAND MARGIN

Ice conditions at these sites limited the amount of underway magnetic data *Maersk Master* could collect while *Resolution* was drilling. A closely spaced line of icebergs and strings of growlers drifted across the sites from the north and northeast. *Maersk Master* was required to remain in close proximity, and on only four occasions was permission given for the vessel to travel more than 3 hr away from the sites. Since *Polarstern*, the West German polar research vessel, was working in the area, and had made available to us the local Sea Beam bathymetry, we did not collect bathymetric data on the shelf even though it was within the 1600-m range of the *Maersk Master* echo-sounder.

The underway magnetic data collected at these sites are shown in Figure 7. The data acquired on the continental slope near the sites showed a broad positive anomaly, but no high-frequency anomalies as might be expected on crossings of shallow volcanic basement were seen. The edge of the continental slope was 2 hr from the drill sites so only very short traverses over oceanic crust were possible. The choice of tracks in directions of 150° and 330° for the acquisition of the oceanic magnetic data was based on data from west of the present study area discussed by Barker and Jahn (1980).

A possible oceanic magnetic anomaly lineation was observed in a direction of 70°, with a possible fracture zone offset. The offset is on line with the Wegener Canyon which cuts into the continental shelf. A total of 859 km of magnetic data was acquired in the vicinity of the Dronning Maud Land margin.

SITES 693 TO 694

At 038/1920, permission was given for *Maersk Master* to leave the vicinity of Hole 693 and to collect underway magnetic data for 9 hr. *Maersk Master* was to rejoin the *Resolution* at 70.5°S, 16.5°W for passage to Site 694. Since *Resolution* was delayed leaving the site, a small box survey was done. A direct passage to Site 694 was begun at 039/0600 on course 300°. The two vessels ran parallel tracks 18 km apart, with *Maersk Master* to the south. Progress was unhampered by ice or poor visibility, and arrival on Site 694 was at 040/1855. One thousand ninety-six kilometers of magnetic data was collected enroute to Site 694 (Figs. 7 and 8).

The track crossed the spreading direction of the southern Weddell Sea, as interpreted by Barker and Jahn (1980), at an angle of about 40°. The magnetic data help constrain the age of the seafloor of the Weddell Sea south of Anomaly 34 which lies north of Site 694. If a constant spreading rate for this region is assumed, then the age of the seafloor at Site 694 is 87 m.y.

SITE 694: NORTHERN WEDDELL BASIN

Collection of magnetic data was not possible because ice conditions required *Maersk Master* to be constantly employed in towing and prop-washing icebergs.

SITE 694 TO 695

Maersk Master left Site 694 at 049/0535, several hours before *Resolution*. It was intended that a magnetic line would be run through way points at 66°S, 35°10′W and 64°50′S, 37°10′W. This track would run parallel and 18 km to the east of the more direct route *Resolution* was to take. At 049/1310, *Maersk Master* was recalled to the *Resolution*, which had left Site 694 but was experiencing poor visibility. At 049/1548 *Maersk Master* rejoined the drillship, preceding it in a direction of 320°. At 63°18′S, 40°W, course was altered to 300°, direct to Site 695. Jane Basin was crossed between 050/2300 and 051/0800 at an angle of approximately 20° to the assumed direction of opening. Bad weather on passage caused arrival on site to be delayed until 051/1320.

The magnetic anomaly data are displayed in Figures 8 and 9. From Site 694 to Jane Bank, good anomaly data were collected which can be used to determine the age of the ocean floor and to help locate fracture zones in conjunction with the previous data of Barker and Jahn (1980). In Jane Basin, the observed magnetic anomalies are subdued which agrees with Barker and Jahn (1980). A total of 828 km of magnetic data was collected in transit.

SITES 695, 696, AND 697: SOUTH ORKNEY MICROCONTINENT AND JANE BASIN

Ice conditions were better at these sites than at Site 694. However, *Maersk Master* was required to scout for growlers during the hours of darkness. Sites 695 and 696 were located on the South Orkney microcontinent. In a study of the South Orkney area, King and Barker (1988) used seismic data to interpret the eastern margin of the platform to have been rifted. They identify several locations where basement appears to crop out at the seabed. The two drill sites were located in separate basins separated by a basement high. The magnetic tracks were run in the directions of 135° and 315°, parallel to the direction of extension. A total of 823 km of data was acquired (Fig. 9).

The observed magnetic anomalies were generally smooth. In a few places, high-frequency anomalies were observed and are interpreted to be caused by volcanic outcrops at the seabed. The anomalies are lineated in a direction of 45° and are thought to be an expression of the rifting episode.

A total of 428 km of bathymetric data was acquired on the South Orkney microcontinent. Several areas of the high-amplitude, short-period magnetic anomalies were found to coincide with an often significant shallowing of the seabed. Between Sites 696 and 697, 152 km of magnetic data was acquired.

Site 697 was located in Jane Basin, which is considered to be a back-arc basin formed behind the Jane Bank island arc (Barker et al., 1984). Because of bad weather, magnetic data acquisition was limited to a total of 269 km, displayed in Figure 9. The tracks were run in the directions of 115° and 295°, parallel to the direction of seafloor opening. The anomalies observed were extremely subdued and lineations between the tracks were not observed. A positive peak in the anomaly data was observed over Jane Bank, at the easternmost limit of the track run to the southeast.

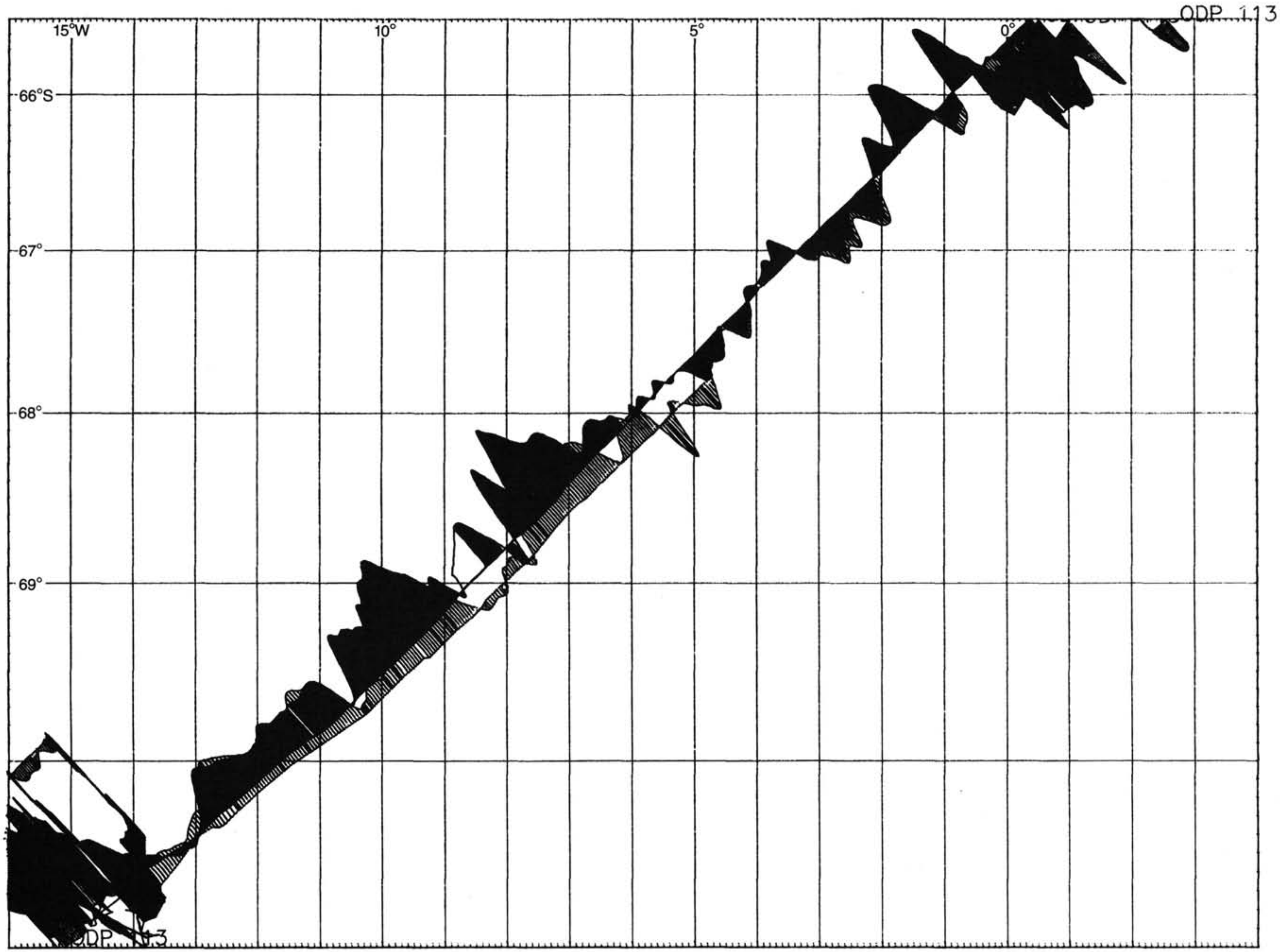

Figure 6. Same plot parameters as in Figure 2. *Maersk Master* track from 023/1515 to 023/1650 and 024/0335 to 026/0815. *JOIDES Resolution* track from 024/0355 to 025/1730.

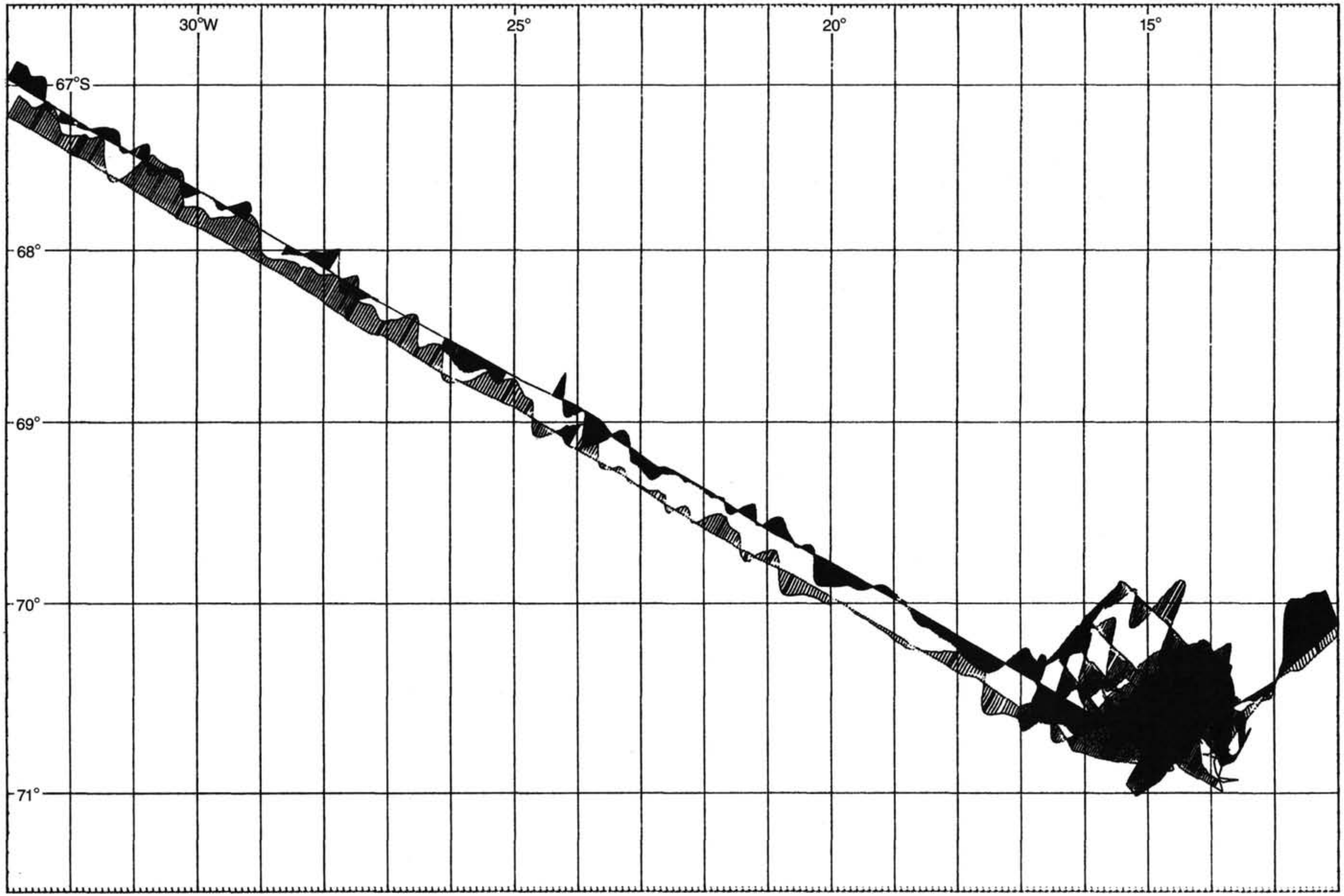

Figure 7. Same plot parameters as in Figure 2. *Maersk Master* track from 025/1205 to 040/1650. *JOIDES Resolution* track from 025/1210 to 040/1815.

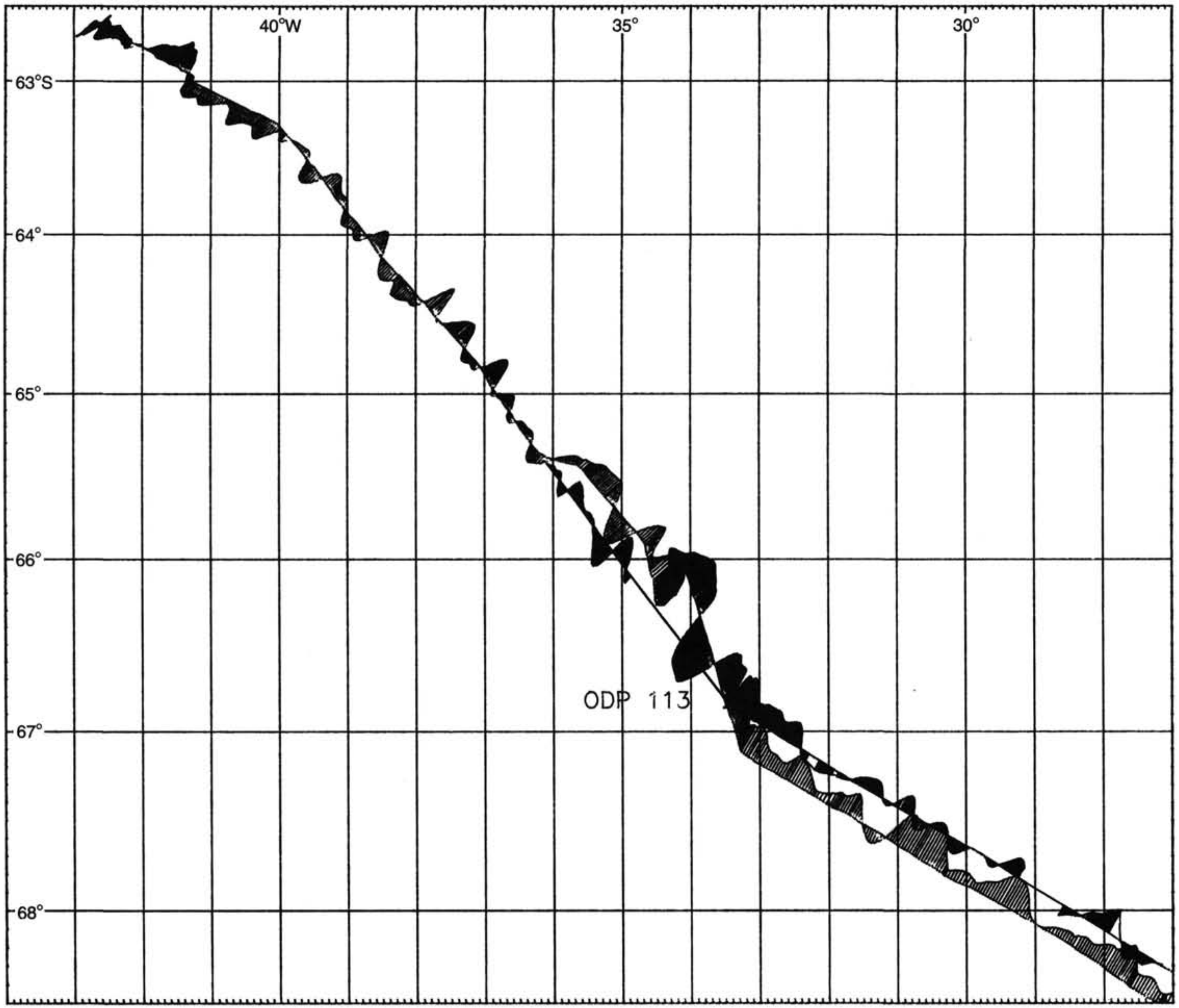

Figure 8. Same plot parameters as in Figure 2. *Maersk Master* track from 040/0340 to 051/0605. *JOIDES Resolution* track from 040/0415 to 051/0045.

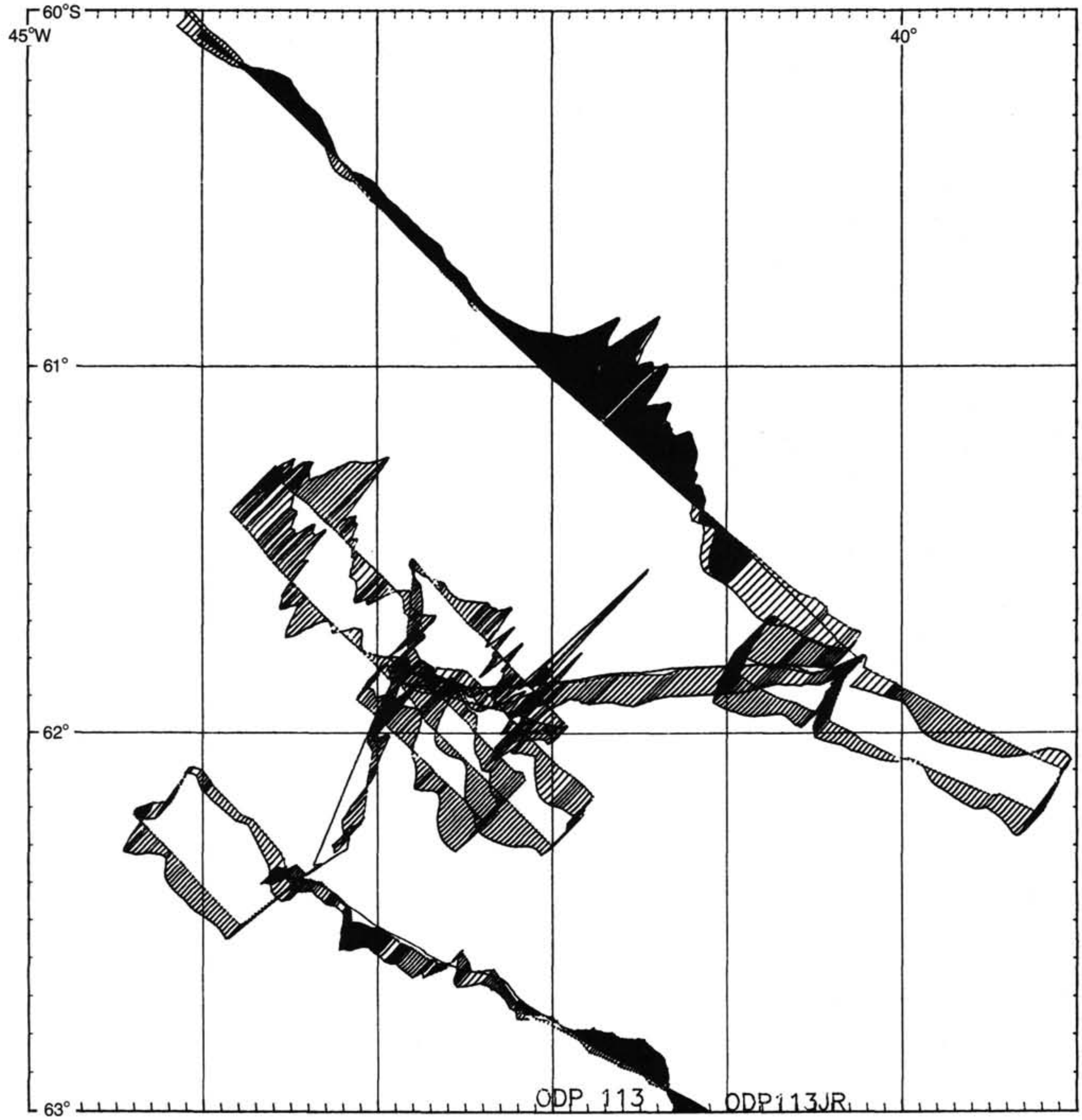

Figure 9. The scale of this figure is 1:4,000,000 at the equator. The vertical scale is 1000γ per inch. The magnetic anomalies are plotted at an azimuth of 45°. *Maersk Master* track from 050/2005 to 067/0825. *JOIDES Resolution* track from 050/2000 to 067/0845.

SITE 697 TO MARE HARBOUR, FALKLAND ISLANDS

The vessels departed Site 697 at 066/1645, and set a direct course of 315° for Mare Harbour, Falkland Islands. The two ships ran the same track for the entire transit.

The first part of the passage was over Jane Basin and the South Orkney microcontinent. Subdued anomalies were again observed over the basin, which contrasted with the shorter wavelength, higher amplitude magnetic anomalies observed across the northeast corner of the platform. Ninety-six kilometers of bathymetry data was acquired on the platform.

The next area crossed in transit was the central southern Scotia Sea where distinct but lower amplitude magnetic anomalies were observed. Beginning at 56°40′S, 50°W, good oceanic anomalies were observed as the transit progressed over the western Scotia Sea. With these data, age of the ocean floor in the vicinity of the Quest and Endurance fracture zones have been determined.

After crossing the North Scotia Ridge at 54°25′S, 54°10′W, the observed magnetic anomalies again became very subdued. The collection of magnetic data was terminated at 069/1420, when *Maersk Master* was at 54°S, 55°W. A total of 1250 km of data was acquired in transit (Figs. 2 and 9).

DATA ACQUISITION ABOARD *JOIDES RESOLUTION*

A total of 3555 km of magnetic data was acquired by the *Resolution*, representing 73% of the total distance of 4900 km traveled during the leg. The magnetometer aboard *Resolution* was only deployed between drill sites. However, during fog, ice, and other adverse weather conditions, the underway geophysical gear was retrieved. When weather conditions were deemed unsuitable for *Maersk Master* to be away from the drillship during transit, the two ships would steam the same track with *Maersk Master* about 1 or 2 km in front of *Resolution*.

NAVIGATION

Navigation points were obtained with a Magnavox MX702A satellite navigation system (SATNAV) and a Global Positioning System (GPS) receiver. GPS, which gives a satellite fixed position every 2 min, was only available for 5 hr of each day, so the position of *Resolution* was determined by SATNAV for the majority of the time during the leg. Scripps Institution of Oceanography recomputed the navigation by merging the GPS and SATNAV data. Large errors are observed in the calculated ship's speed when GPS coverage commenced after a period of several hours without a SATNAV fix. Unreasonable ship and drift velocities were therefore used as markers to edit poor position fixes. The edited navigation data are shown in Table 1.

SEISMIC REFLECTION PROFILES

The normal seismic source was one 80-in.^{3} water gun, firing at a pressure of 1900 psi, with a shot interval of 10–12 s. On line 4, two 80-in.^{3} water guns were used. A single-channel Teledyne 178 hydrophone streamer was used to record the data which were processed by a supermicro 561 MASSCOMP computer. The data were displayed on a 15-in.-wide Printronix high-resolution graphic printer. The data were also recorded in analog format on two EDO 550 dry-paper recorders, employing only the streamer, amplifier, and band-pass filters. EDO-1 was set on a 4-s sweep and EDO-2 on a 2-s sweep. Data processing before display included band-pass filtering (generally 50–120 Hz) and the application of a gain correction (85–110 db with a 10-Hz rolloff). Relevant information for each seismic profile is displayed in Table 2. The data from EDO-1 are presented in Figures 10A–H.

DISCUSSION OF SEISMIC REFLECTION RESULTS

Most of the Leg 113 seismic data were collected in areas where previous multichannel seismic data were available with the exception of Site 697 where the previous seismic data consisted of two single-channel profiles. Since the multichannel data show greater penetration and resolution, only two regions of particular interest will be discussed in this chapter. Previous seismic data in the region of Sites 691–693 have been shown by Hinz and Krause (1982).

Maud Rise to Dronning Maud Land Margin

Seismic profile 3 was acquired between Maud Rise and the continental shelf off Dronning Maud Land. At 024/1230 (Fig. 11), a prominent step in the oceanic basement is observed. Associated with the step is a graben-type structure with 0.3-s two-way traveltime (twt) of sedimentary fill. This has been interpreted to be an unusual sediment-filled side channel of the Sanae Canyon as seen on the bathymetric map of this region (Johnson, Vanney, Drewry, and Robin, 1983).

Weddell Basin

Seismic profile 5 (Fig. 10E) was recorded while underway to Site 694. Two possibly active, and a few buried, channels are ob-

Table 1. Navigation data for Leg 113.

Date	Time	Latitude	Longitude	Hole information
870105	1624:00	52°52.3′S	70°28.4′W	
870105	1703:00	52°46.3′S	70°29.8′W	
870105	2042:00	52°36.3′S	69°42.6′W	
870105	2125:00	52°31.0′S	69°35.1′W	
870105	2206:00	52°25.7′S	69°26.0′W	
870105	2302:00	52°22.6′S	69°07.4′W	
870106	0308:00	52°39.4′S	67°50.0′W	
870106	0747:00	52°57.0′S	66°22.3′W	
870106	1201:00	53°14.8′S	64°55.6′W	
870106	1630:00	53°29.7′S	63°33.3′W	
870106	2054:00	53°53.0′S	62°12.2′W	
870107	0103:00	54°09.4′S	60°44.6′W	
870107	0516:00	54°25.5′S	59°23.2′W	
870107	0930:00	54°47.1′S	58°05.1′W	
870107	1337:00	55°04.2′S	56°43.4′W	
870107	1748:00	55°21.8′S	55°21.3′W	
870107	2205:00	55°38.3′S	53°57.6′W	
870108	0205:00	55°54.5′S	52°32.8′W	
870108	0609:00	56°11.6′S	51°08.4′W	
870108	1002:00	56°20.0′S	49°39.0′W	
870108	1416:00	56°29.1′S	48°10.0′W	
870108	2122:00	56°41.4′S	46°41.8′W	
870109	0147:00	56°49.5′S	45°11.5′W	
870109	0749:00	56°55.4′S	43°40.4′W	
870109	1335:00	57°00.0′S	42°08.5′W	
870109	1817:00	57°05.2′S	40°36.7′W	
870109	2347:00	57°19.1′S	39°08.0′W	
870110	0845:00	57°28.1′S	37°36.4′W	
870110	1547:00	57°37.7′S	36°04.8′W	
870110	2028:00	57°46.1′S	34°32.1′W	
870111	0102:00	57°55.0′S	32°59.2′W	
870111	0656:00	58°04.8′S	31°26.6′W	
870111	1110:00	58°15.2′S	29°53.9′W	
870111	1526:00	58°28.4′S	28°21.6′W	
870111	1944:00	58°41.0′S	26°48.7′W	
870112	0010:00	59°06.7′S	25°25.3′W	
870112	0445:00	59°32.9′S	24°01.1′W	
870112	0924:00	59°54.3′S	22°31.2′W	
870112	1445:00	60°15.0′S	20°59.8′W	
870112	1939:00	60°34.9′S	19°26.6′W	
870113	0338:00	60°54.0′S	17°52.0′W	
870113	1230:00	61°12.6′S	16°15.9′W	
870113	1842:00	61°31.7′S	14°34.1′W	
870113	2332:00	61°51.4′S	12°57.1′W	
870114	0350:00	62°10.2′S	11°17.6′W	
870114	0807:00	62°27.7′S	9°36.4′W	
870114	1304:00	62°46.7′S	7°55.2′W	
870114	1813:00	63°03.5′S	6°11.4′W	
870114	2253:00	63°18.0′S	4°25.3′W	
870115	0323:00	63°31.4′S	2°37.2′W	
870115	0749:00	63°45.1′S	0°48.6′W	
870115	0921:00	63°50.1′S	0°11.4′W	
870115	0950:00	63°51.6′S	0°00.2′E	
870115	1424:00	64°11.4′S	1°45.4′E	
870115	1455:00	64°14.4′S	1°56.4′E	
870115	1519:00	64°16.7′S	2°05.0′E	
870115	1548:00	64°18.8′S	2°12.6′E	
870115	1552:00	64°31.9′S	3°06.0′E	Begin Hole 689A
870116	0800:00			End Hole 689A
870116	0800:00	64°31.1′S	3°06.0′E	Begin Hole 689B
870116	0445:00			End Hole 689B
870118	0045:00	64°31.1′S	3°06.0′E	Begin Hole 689C
870118	1215:00			End Hole 689C
870118	1215:00	64°31.1′S	3°06.0′E	Begin Hole 689D
870119	0935:00			End Hole 689D
870119	1704:00	65°09.6′S	1°12.3′E	Begin Hole 690A
870120	0315:00			End Hole 690A
870120	0315:00	65°09.6′S	1°12.3′E	Begin Hole 690B
870121	0700:00			End Hole 690B
870121	0700:00	65°09.6′S	1°12.3′E	Begin Hole 690C
870123	2130:00			End Hole 690C
870124	0050:00	65°10.6′S	1°12.1′E	
870124	0203:00	65°15.6′S	0°58.7′E	
870124	0244:00	65°20.6′S	0°46.2′E	
870124	0321:00	65°25.7′S	0°33.5′E	
870124	0358:00	65°30.8′S	0°21.0′E	
870124	0437:00	65°35.9′S	0°07.1′E	
870124	0459:00	65°38.9′S	0°00.6′W	
870124	0910:00	66°15.0′S	1°25.7′W	

Table 1 (continued).

Date	Time	Latitude	Longitude	Hole information
870124	1319:00	66°50.4′S	2°54.7′W	
870124	1726:00	67°25.7′S	4°26.5′W	
870124	2129:00	68°01.2′S	5°59.6′W	
870125	0135:00	68°37.7′S	7°32.8′W	
870125	0543:00	69°13.2′S	9°11.1′W	
870125	0952:00	69°48.4′S	10°52.7′W	
870125	1348:00	70°20.4′S	12°45.9′W	
870125	1600:00	70°44.5′S	13°48.7′W	Begin Hole 691A
870126	0245:00			End Hole 691A
870126	0245:00	70°44.6′S	13°48.6′W	Begin Hole 691B
870126	0600:00			End Hole 691B
870126	0600:00	70°44.6′S	13°58.7′W	Begin Hole 691C
870126	1415:00			End Hole 691C
870126	1415:00	70°43.5′S	13°49.2′W	Begin Hole 692A
870126	2130:00			End Hole 692A
870126	2130:00	70°43.4′S	13°49.2′W	Begin Hole 692B
870130	0115:00			End Hole 692B
870130	0415:00	70°43.4′S	13°49.2′W	
870130	0504:00	70°48.0′S	13°55.0′W	
870130	0545:00	70°53.0′S	13°56.0′W	
870130	0815:00	70°49.9′S	14°34.4′W	Begin Hole 693A
870205	0315:00			End Hole 693A
870205	0315:00	70°49.9′S	14°34.5′W	Begin Hole 693B
870206	2115:00			End Hole 693B
870208	0556:00	70°30.3′S	16°21.2′W	
870208	1020:00	70°04.8′S	18°28.8′W	
870208	1430:00	69°40.3′S	20°36.0′W	
870208	1843:00	69°15.5′S	22°39.8′W	
870208	2310:00	68°48.1′S	24°39.4′W	
870209	0330:00	68°24.0′S	26°40.5′W	
870209	0800:00	67°58.1′S	28°36.4′W	
870209	1213:00	67°32.4′S	30°29.6′W	
870209	1644:00	67°06.8′S	32°21.5′W	
870209	1650:00	66°50.8′S	33°26.8′W	Begin Hole 694A
870120	1630:00			End Hole 694A
870210	1630:00	66°50.8′S	33°26.9′W	Begin Hole 694B
870214	1337:00			End Hole 694B
870214	1422:00	66°50.8′S	33°26.8′S	Begin Hole 694C
870218	0900:00			End Hole 694C
870218	1620:00	66°12.5′S	34°41.3′W	
870218	2144:00	65°32.2′S	35°53.7′W	
870219	0450:00	64°51.3′S	37°02.6′W	
870219	1018:00	64°14.0′S	38°20.3′W	
870219	1445:00	63°34.4′S	39°30.4′W	
870219	1637:00	63°18.1′S	39°59.5′W	
870220	0930:00	62°23.5′S	43°27.1′W	Begin Hole 695A
870223	1000:00			End Hole 695A
870223	1300:00	61°50.1′S	42°56.0′W	Begin Hole 696A
870224	1630:00			End Hole 696A
870224	1630:00	61°51.0′S	42°56.0′W	Begin Hole 696B
870302	0415:00			End Hole 696B
870302	1130:00	61°49.4′S	41°11.9′W	
870302	1153:00	61°49.3′S	41°01.9′W	
870302	1218:00	61°49.0′S	40°51.1′W	
870302	1250:00	61°49.5′S	40°40.4′W	
870302	1325:00	61°50.1′S	40°27.0′W	
870302	1410:00	61°48.7′S	40°17.3′W	
870303	1130:00	61°48.6′S	40°17.3′W	Begin Hole 696A
870304	1645:00			End Hole 697A
870304	1645:00	61°48.6′S	40°17.8′W	Begin Hole 697B
870307	1400:00			End Hole 697B
870307	1856:00	61°30.2′S	40°53.7′W	
870307	2146:00	61°07.1′S	41°47.4′W	
870307	2210:00	61°03.8′S	41°55.1′W	
870308	0414:00	60°28.4′S	43°07.4′W	
870308	0526:00	60°21.0′S	43°22.0′W	
870308	0926:00	59°53.4′S	44°19.7′W	
870308	1054:00	59°41.0′S	44°44.6′W	
870308	1339:00	59°18.4′S	45°30.4′W	
870308	1413:00	59°13.9′S	45°39.7′W	
870308	1747:00	58°41.1′S	46°35.2′W	
870308	1944:00	58°23.7′S	47°06.8′W	
870308	2130:00	58°06.9′S	47°25.1′W	
870308	2215:00	57°58.1′S	47°29.1′W	
870308	2259:00	57°50.2′S	47°35.7′W	
870309	0510:00	57°15.1′S	48°43.0′W	
870309	1120:00	56°40.2′S	49°52.1′W	
870309	1635:00	56°06.3′S	51°00.0′W	
870309	2210:00	55°29.5′S	52°01.1′W	

Table 1 (continued).

Date	Time	Latitude	Longitude	Hole information
870310	0605:00	54°59.3′S	53°03.0′W	
870310	0645:00	54°57.4′S	53°08.8′W	
870310	0905:00	54°50.1′S	53°30.1′W	
870310	1240:00	54°26.2′S	54°17.5′W	
870311	1000:00	51°54.0′S	58°26.0′W	

Table 2. Beginning and end times and approximate locations for seismic lines for Leg 113.

Line	Start time	End time	Location
1	014/1536	015/1900	Approach to Site 689, Maud Rise.
2	019/1246	019/2017	Between Sites 689 and 690.
3	024/0012	025/1750	Between Sites 690 and 691.
4	030/0429	030/1125	Between Sites 692 and 693.
5	039/0049	040/1955	Between Sites 693 and 694.
6a	049/1100	049/1212	Departure from Site 694, Weddell Basin.
6b	051/0930	051/1241	Approach to Site 695, South Orkney margin.
7	061/1240	061/1413	Approach to Site 697, Jane Basin
8	066/1708	067/2040	Departure from Site 697, Jane Basin

served between 039/0900 and 040/0630. An example is shown in Figure 12. Seafloor channels have been recognized farther north in the Weddell Sea (Pudsey, Barker, and Hamilton, in press). They trend east-northeast and are assumed to be pathways for turbidity currents flowing from the southeast coast of the Antarctic Peninsula.

MAGNETICS

Underway magnetic data were recorded digitally and stored as part of the seismic data acquisition header. The MASSCOMP computer aboard *Resolution* was used to collect and process the underway seismic reflection data, so magnetic data were collected at the same rate as the firing rate of the seismic source. When the seismic gear was not deployed, magnetic data were collected at a rate set by the underway data collection technician, often every 99 s. At such an interval, it was not possible to translate the data into the same 5-min format used for the magnetic data collected aboard *Maersk Master*.

The underway navigation data from the drillship presented certain processing problems. Until JD 24 the only navigation data available were satellite fixes that varied in number from a minimum of 3 fixes for JD 11 to 12–15 fixes for most other days. No DR positions were available prior to JD 24, unlike the navigation data collected on *Maersk Master*. Starting on JD 24, some global positioning data were available combined with some satellite navigation fixes and DR fixes when the GPS were out of receiving range. The same fix interpolation program was used to produce 5-min navigation points as was used for the *Maersk Master*. The latitudes and longitudes were truncated at four decimal places giving 20-m precision on latitude values and approximately 6–10-m precision on the longitude values.

Considering the inherent problems with the navigation data from *Resolution*, particularly for the data collected prior to JD 024, a remarkably good match between the underway magnetic data collected aboard the two ships was found when the two ships were traversing the same track. The magnetic data collected in the western Scotia Sea at the beginning of the cruise north of the Quest Fracture Zone combined with those at the end of the cruise (see Fig. 2) show remarkable lineation and are easily correlatable with the magnetic time scale of Palmer (1983). Ice and adverse weather conditions affected the magnetic collected aboard *Resolution* enroute to Maud Rise. After the drillship left Site 693 on the Antarctic margin, the continuity of the underway magnetic collected aboard *Resolution* suffered because the MASSCOMP equipment experienced five system failures enroute to the South Orkney microcontinent sites.

ACKNOWLEDGMENTS

For work on *JOIDES Resolution* we would like to thank the ODP marine technicians who, in cooperation with the scientific party and the officers and crew of the *Resolution*, maintained and operated the underway equipment.

We would like to thank Captain Peter Messmann and the officers and crew of *Maersk Master* for their invaluable assistance in setting up our equipment, in the launching and recovery of the magnetometer sensor, and the recording of the navigational data. We would also like to thank Steve Berkowitz who helped by standing watches while the magnetic data were acquired.

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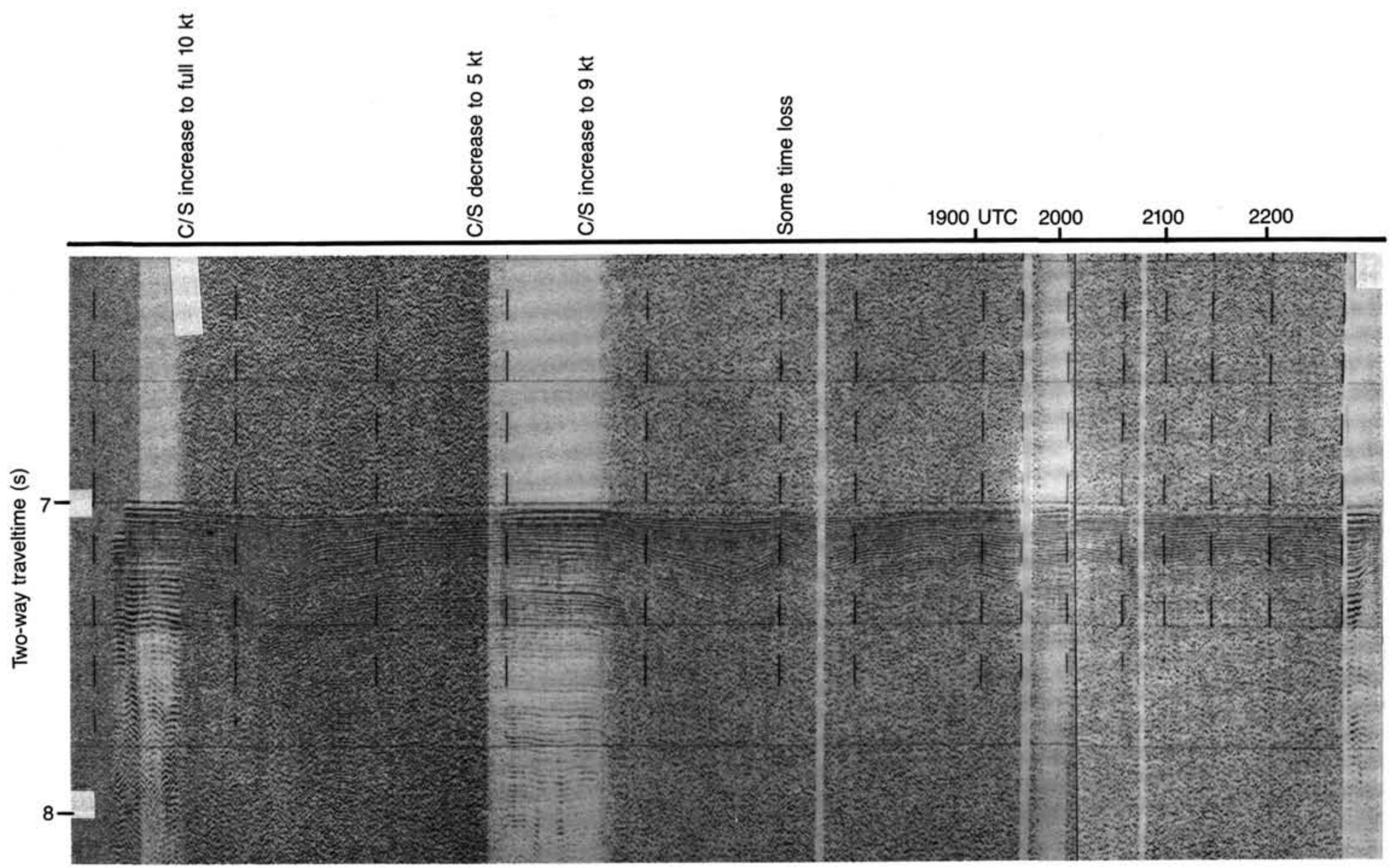
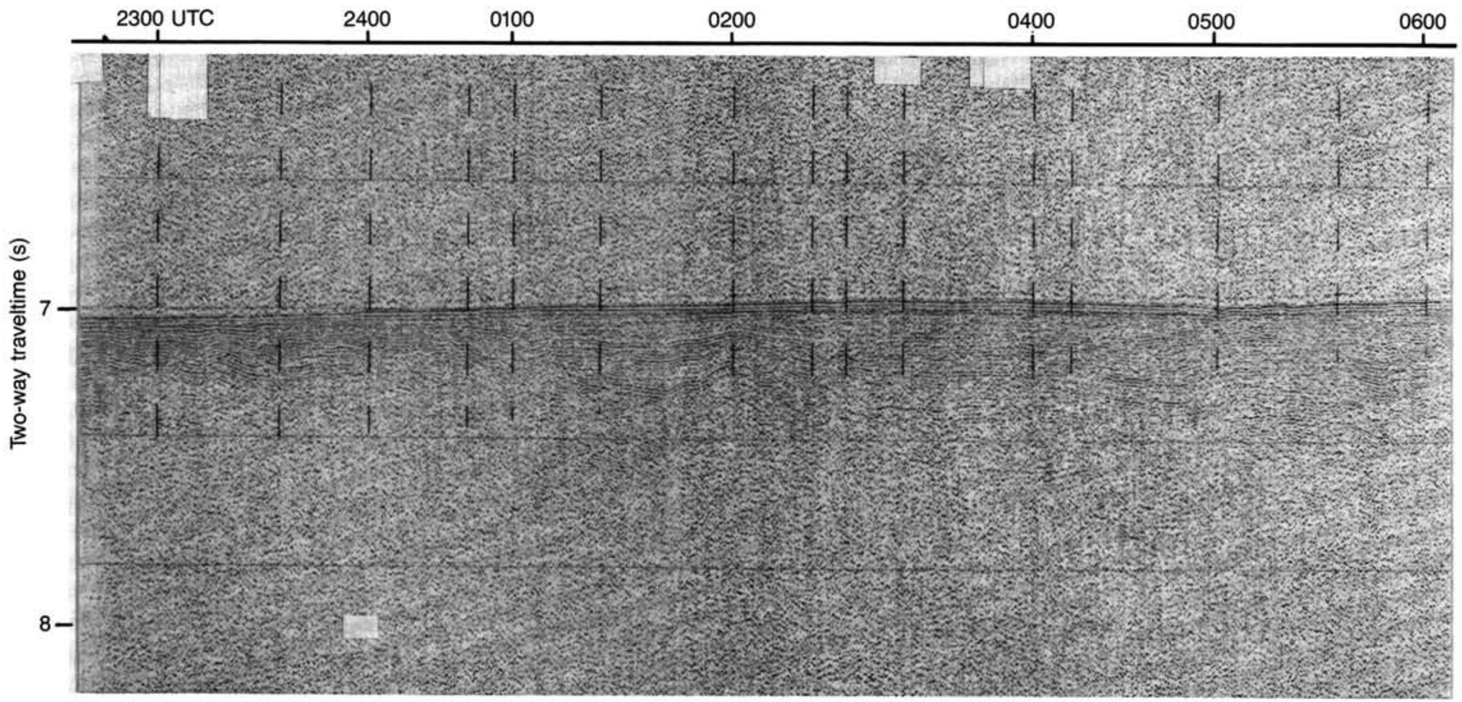


Figure 10. Underway seismic profiles from the EDO-1 dry-paper recorder on *JOIDES Resolution*. Data were recorded on a 4-s sweep. Processing before printing included band-pass filtering (generally 50–120 kHz) and the application of a gain correction (85–110 db with a 10-Hz rolloff). Track lines are shown in Figure 1 and start and end times are given in Table 2. A. Profile 1—approach to Site 689, Maud Rise. B. Profile 2—between Sites 689 and 690. C. Profile 3—between Sites 690 and 691. D. Profile 4—between Sites 692 and 693. E. Profile 5—between Sites 693 and 694. F. Profile 6a—departure from Site 694, Weddell Basin. G. Profile 6b—approach to Site 695, South Orkney margin. H. Profile 7—approach to Site 697, Jane Basin.



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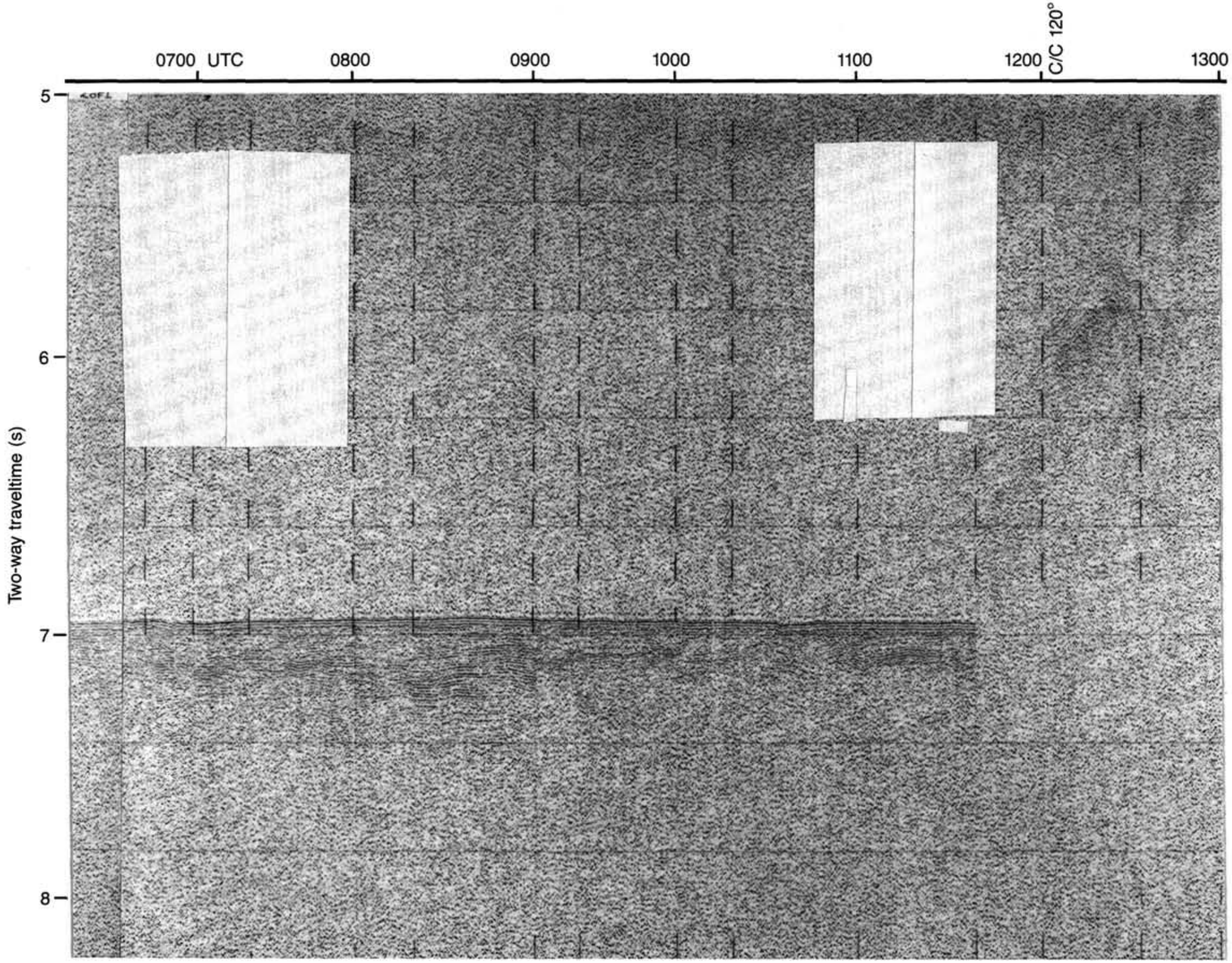

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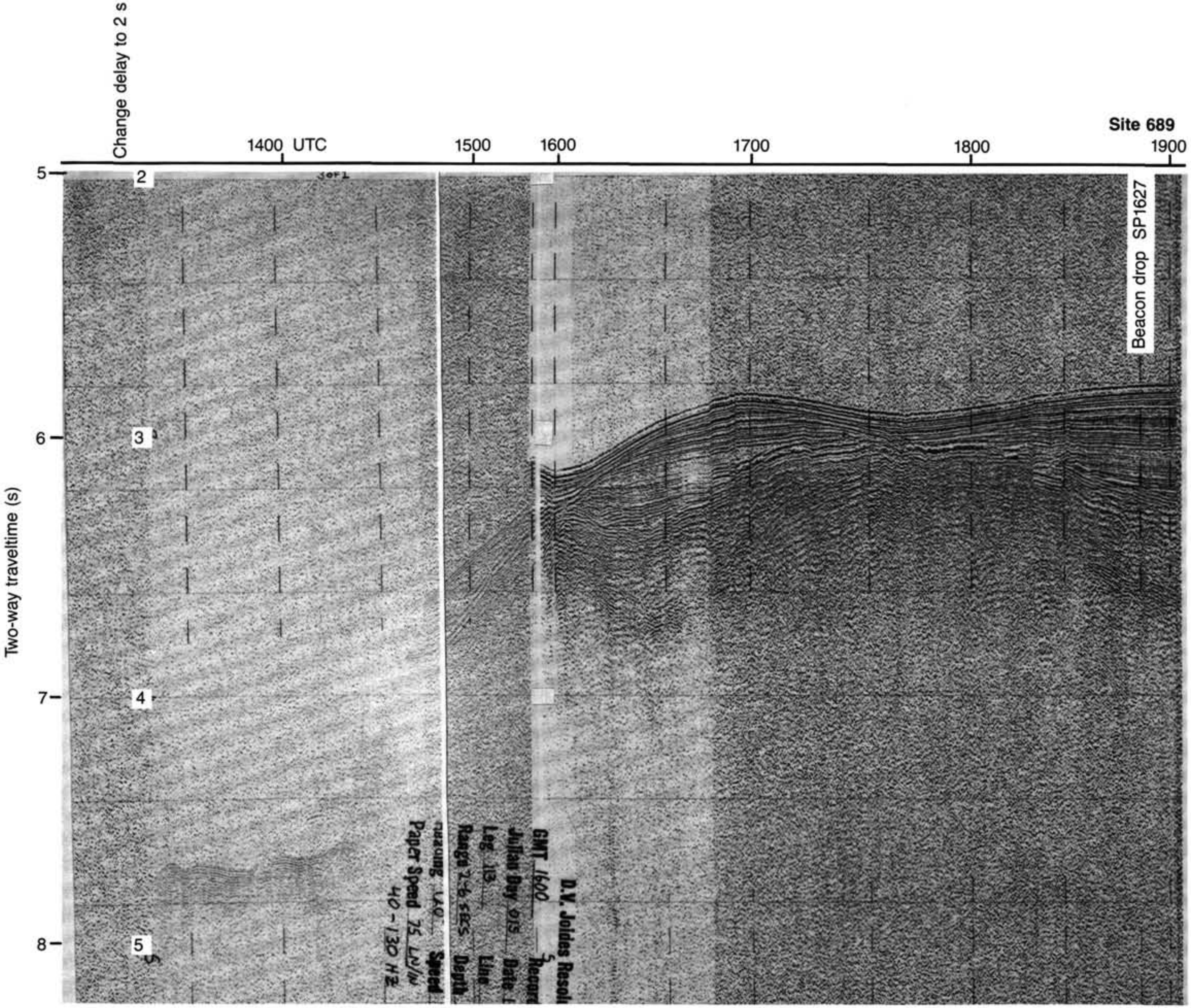

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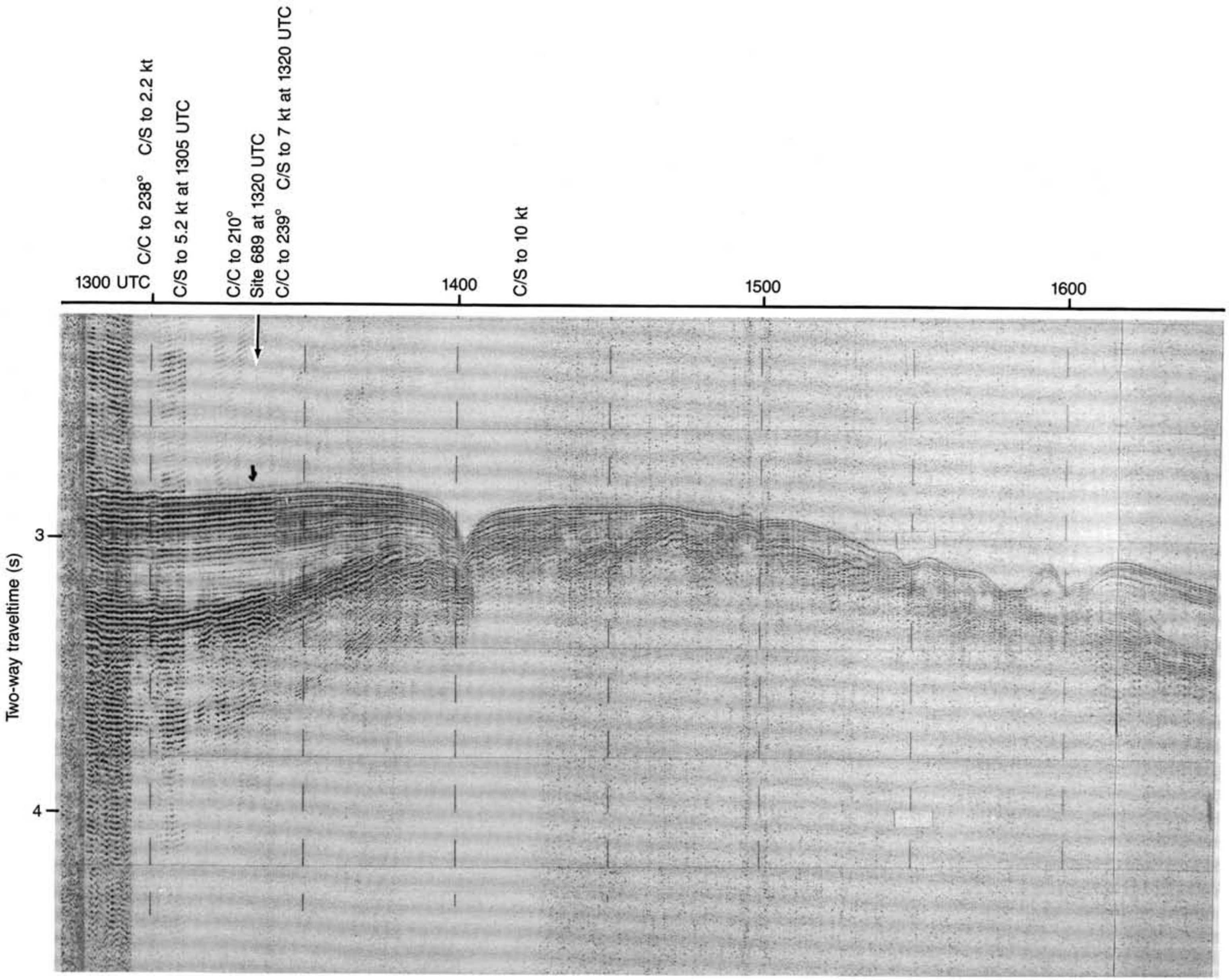

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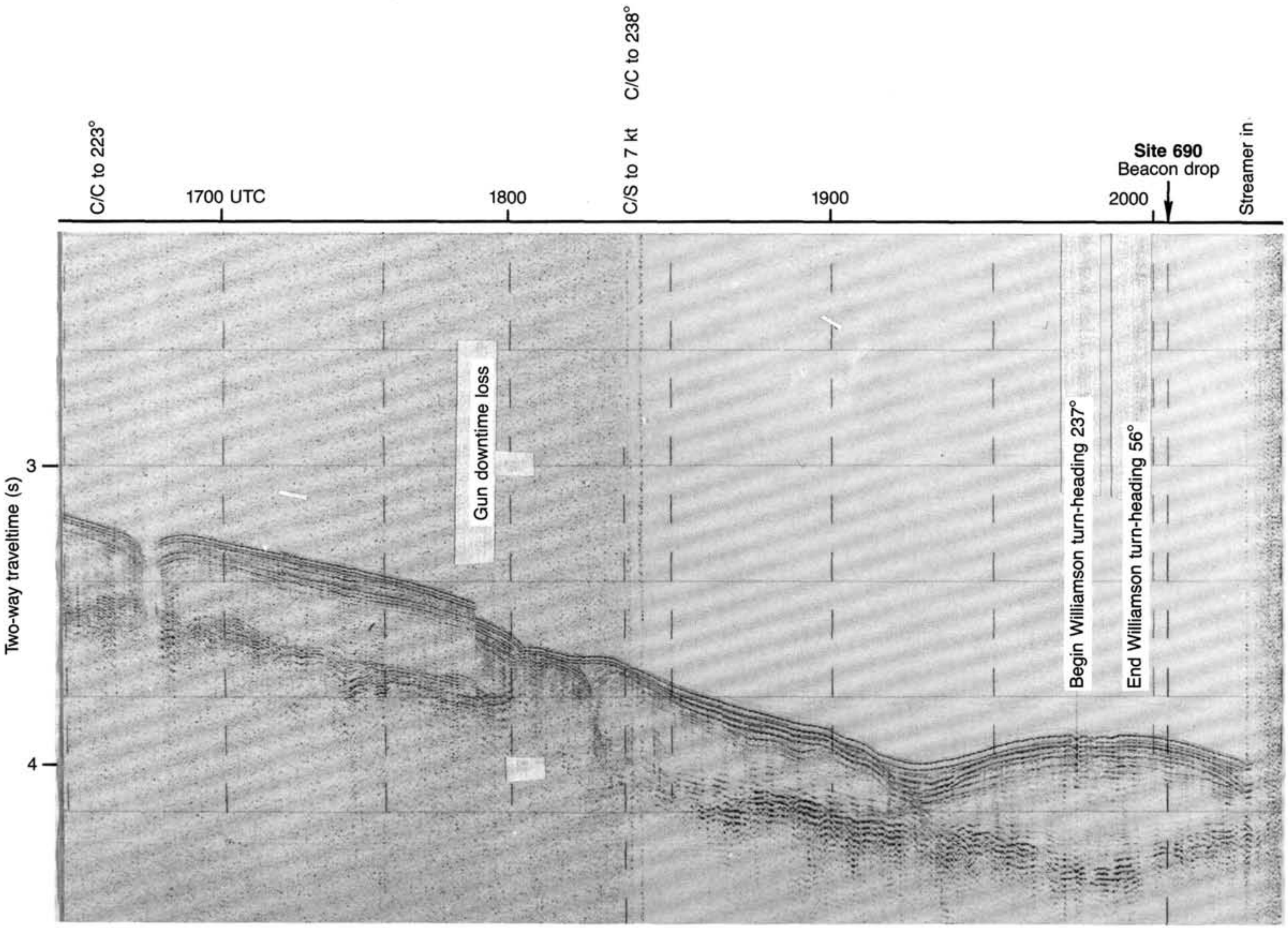

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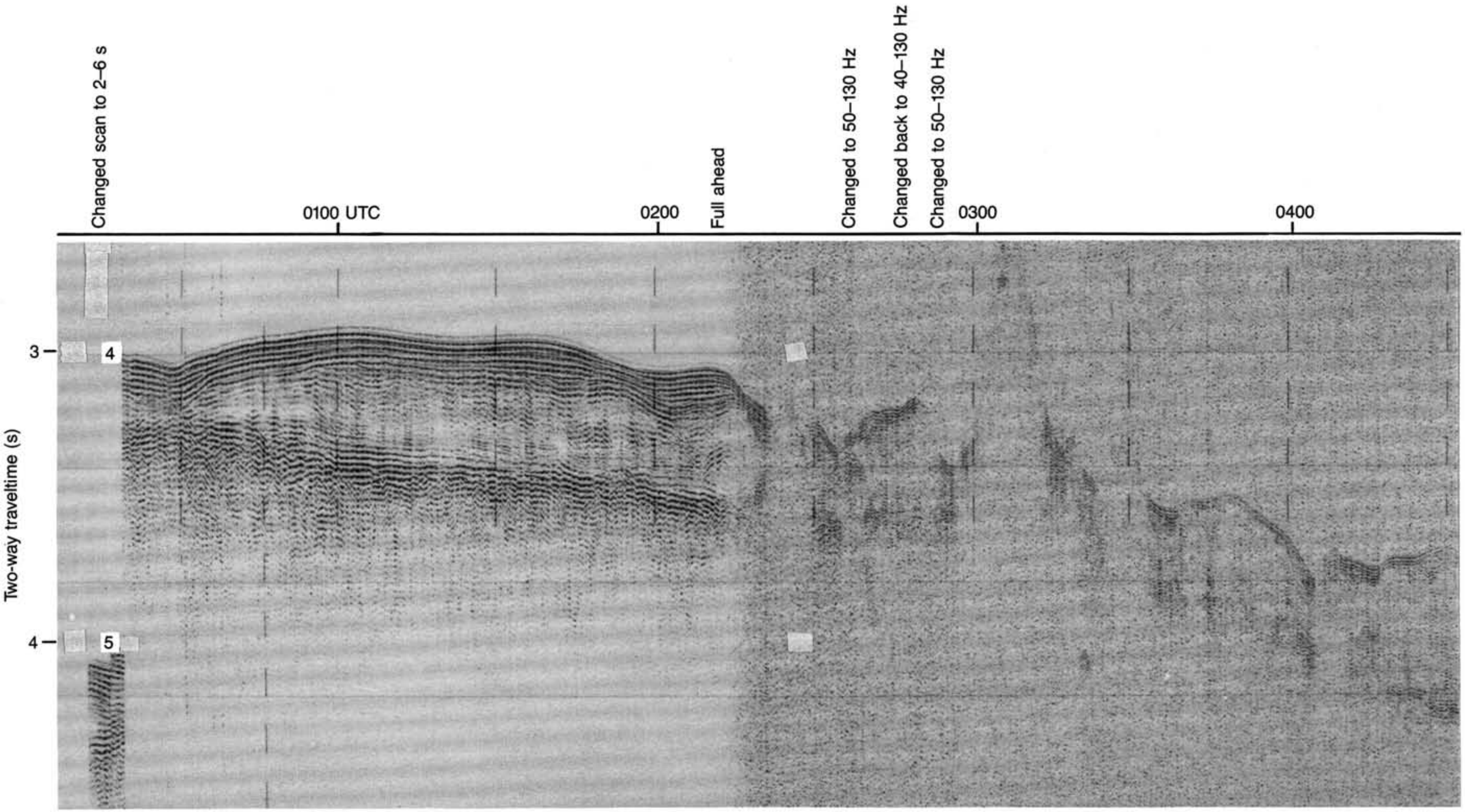

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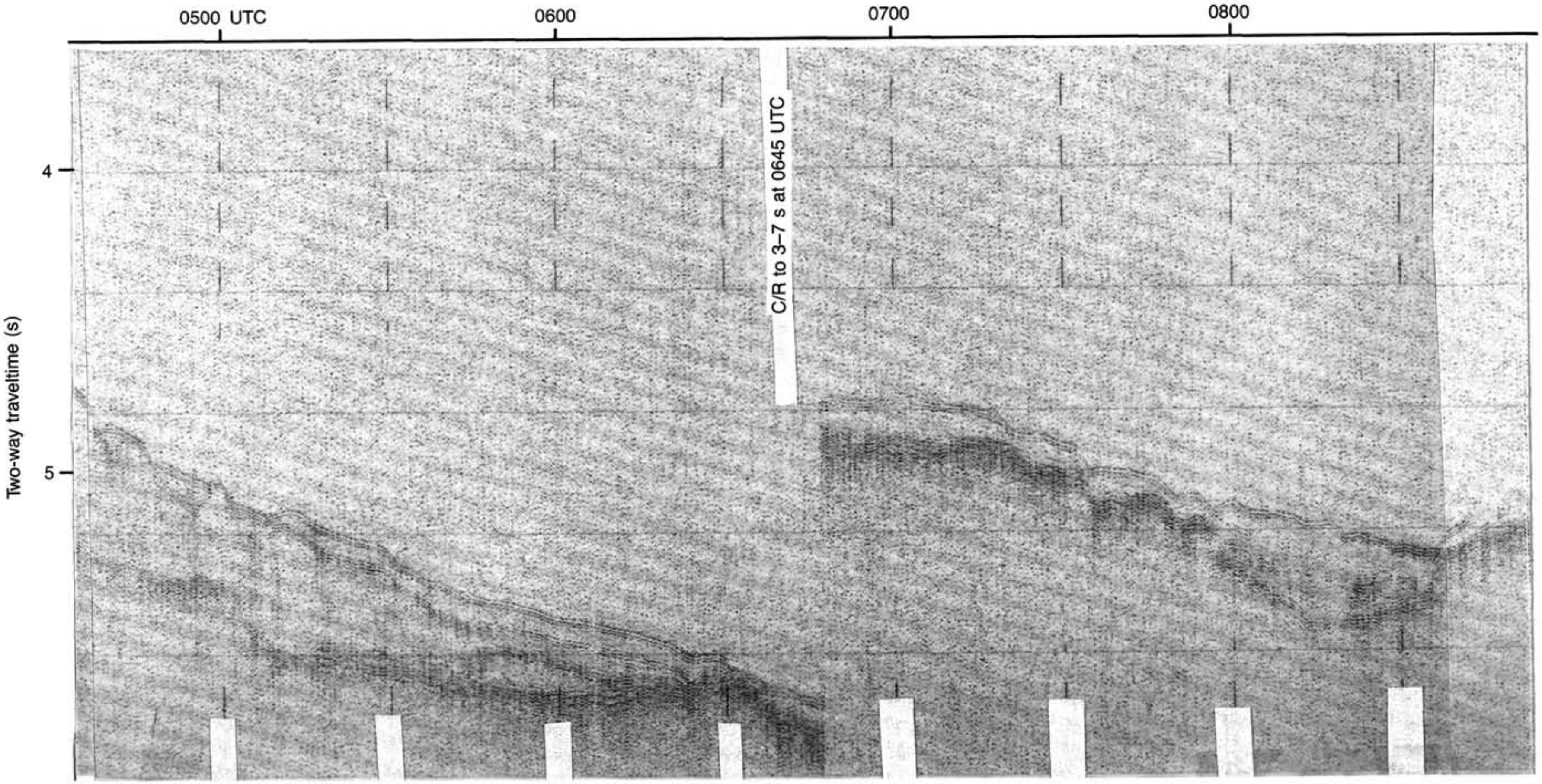

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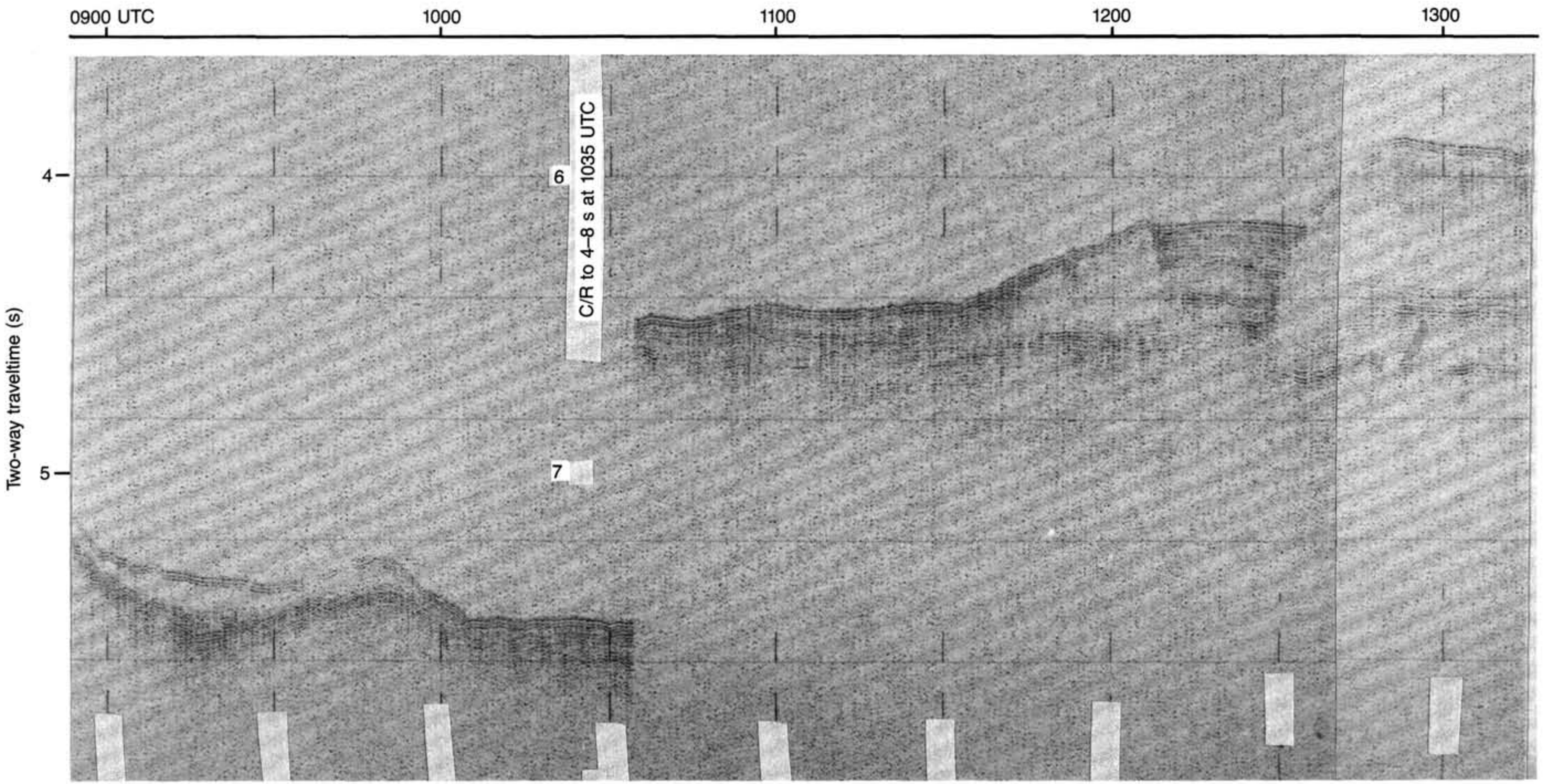

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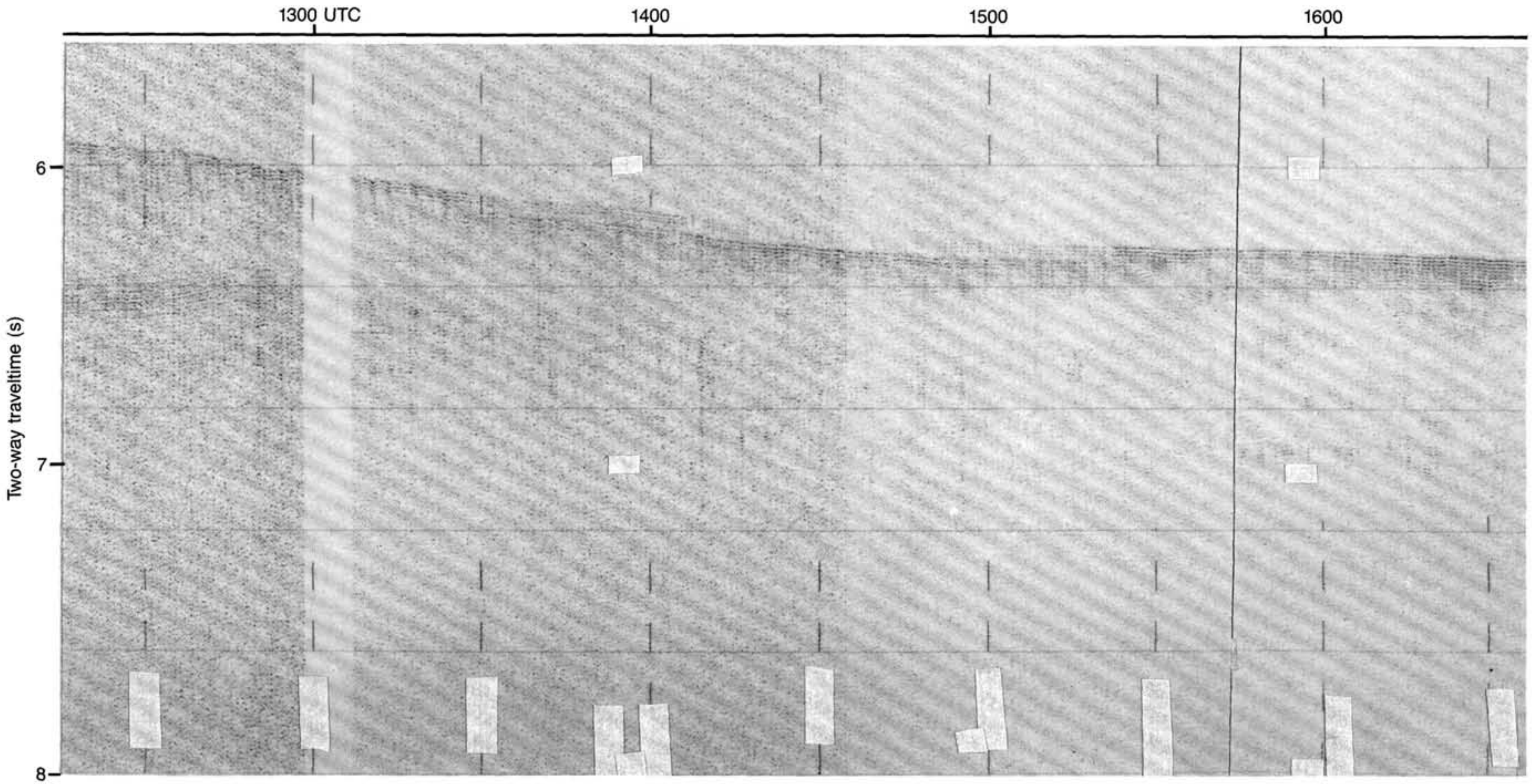

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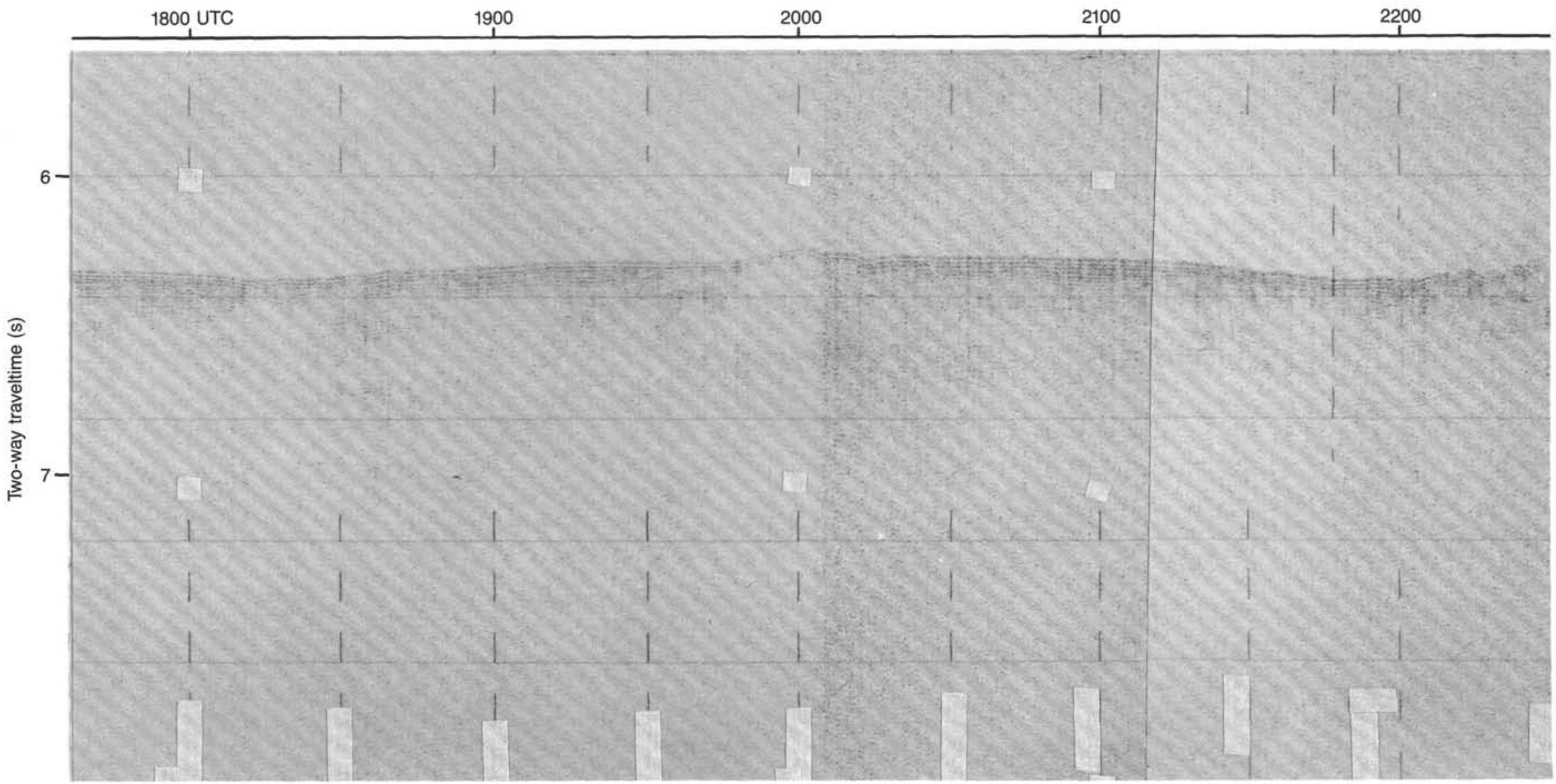

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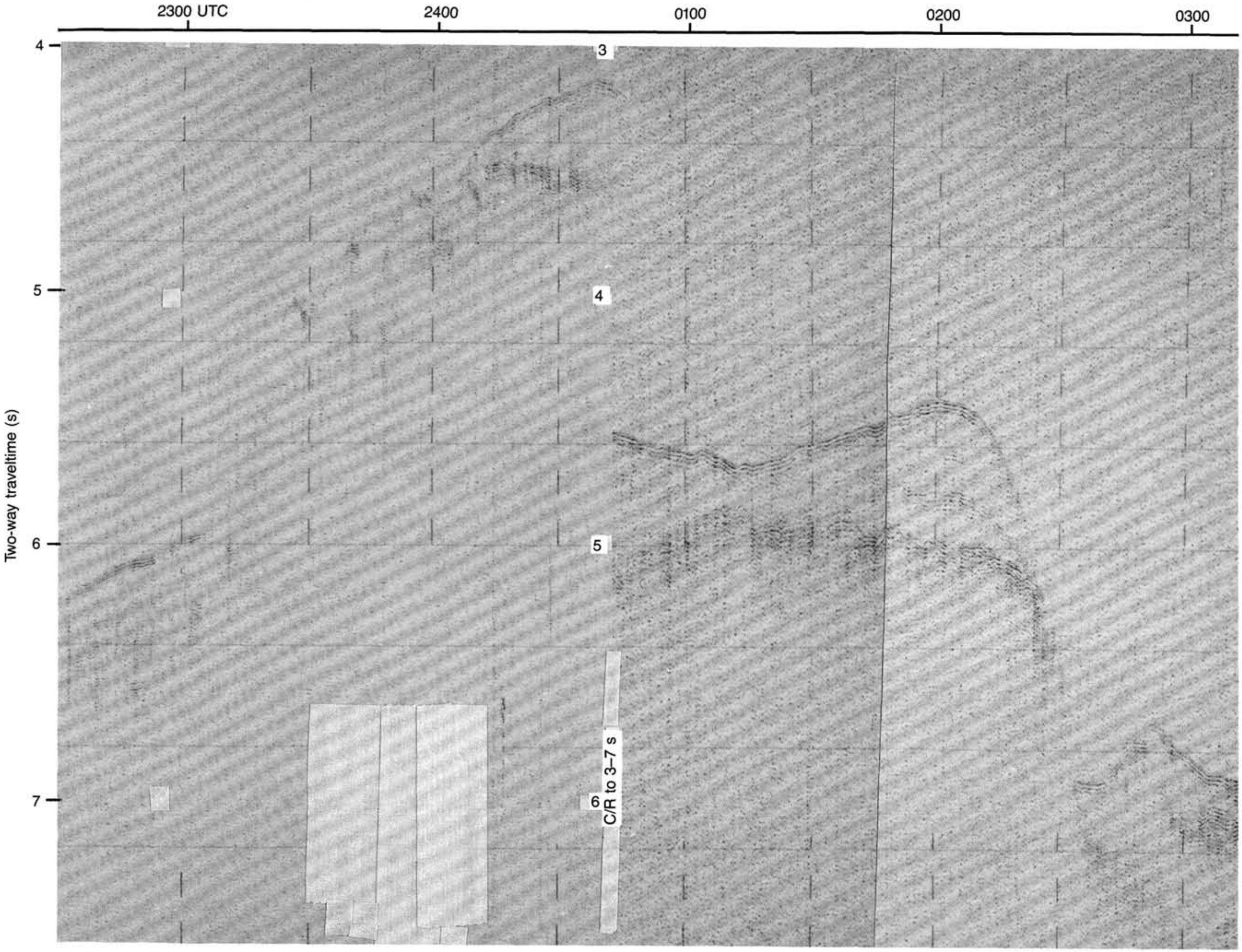

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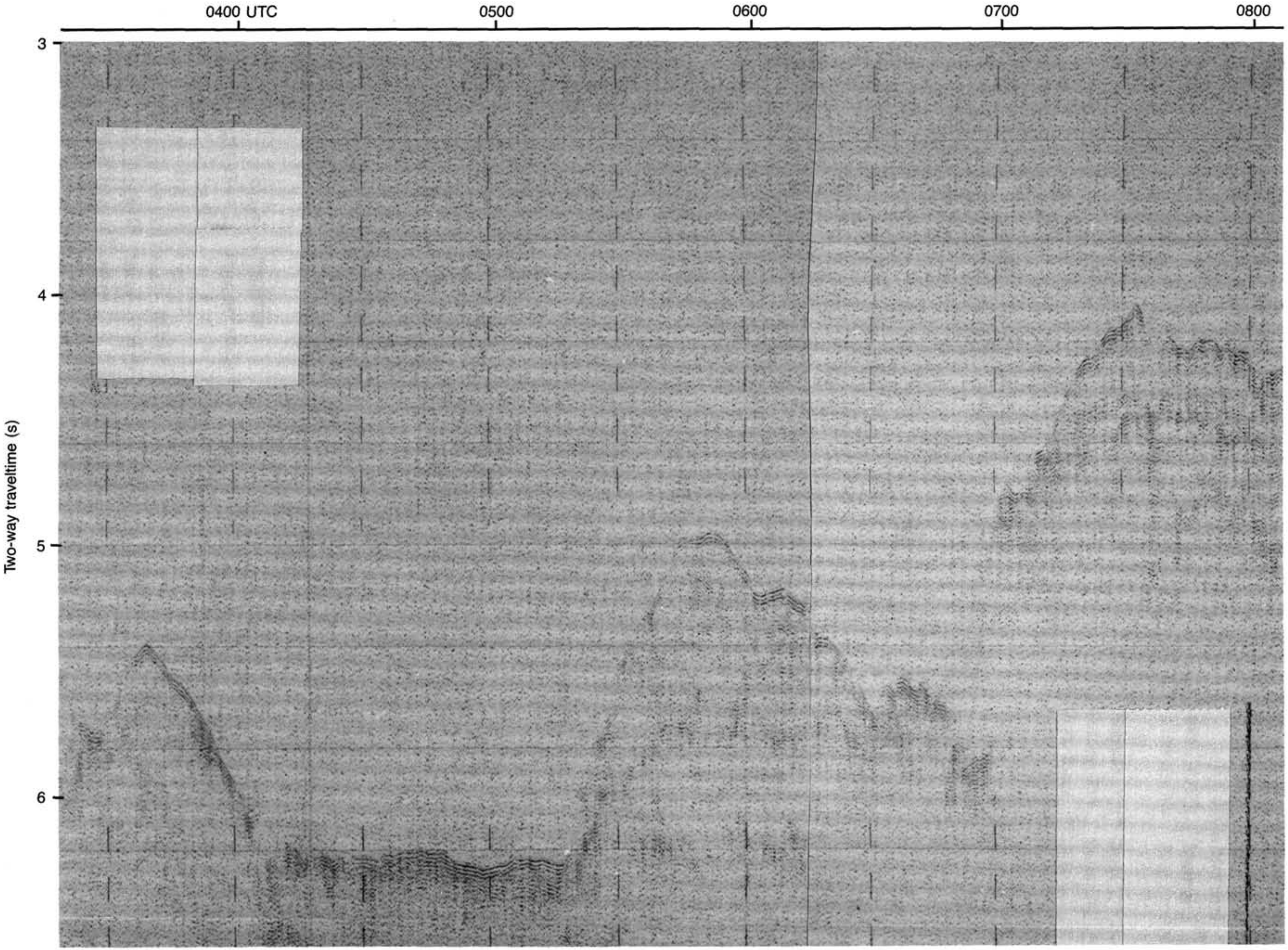

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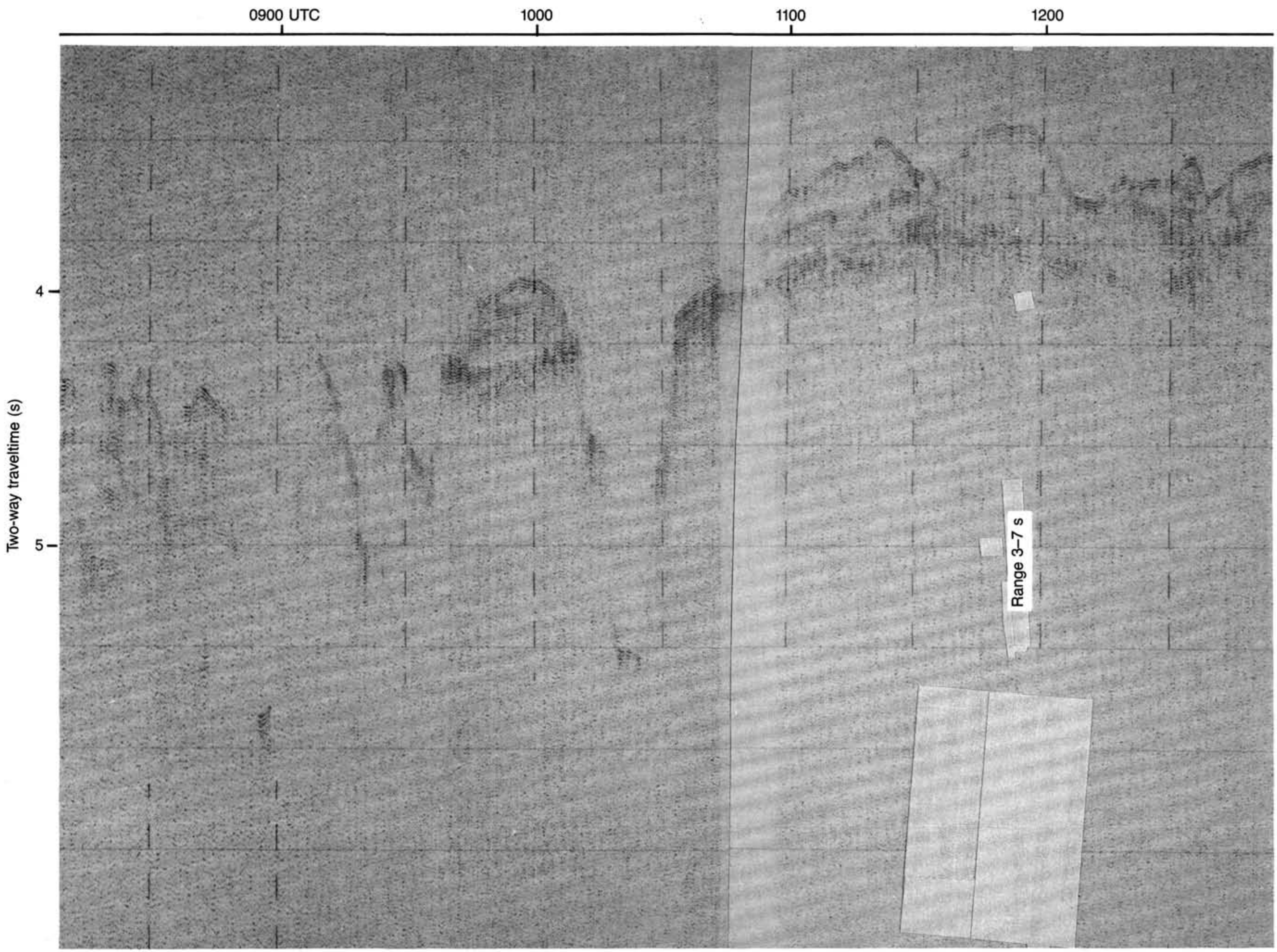

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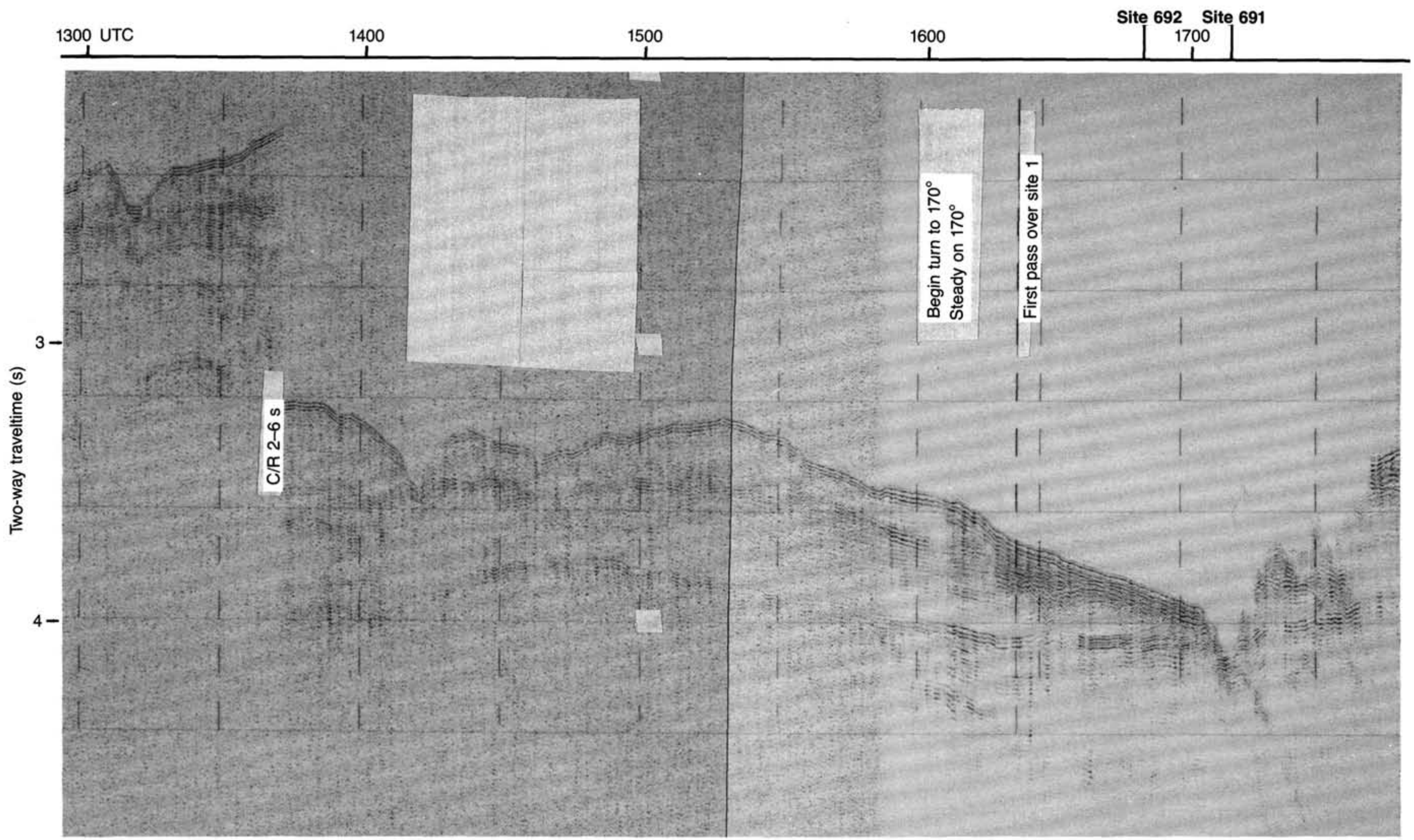

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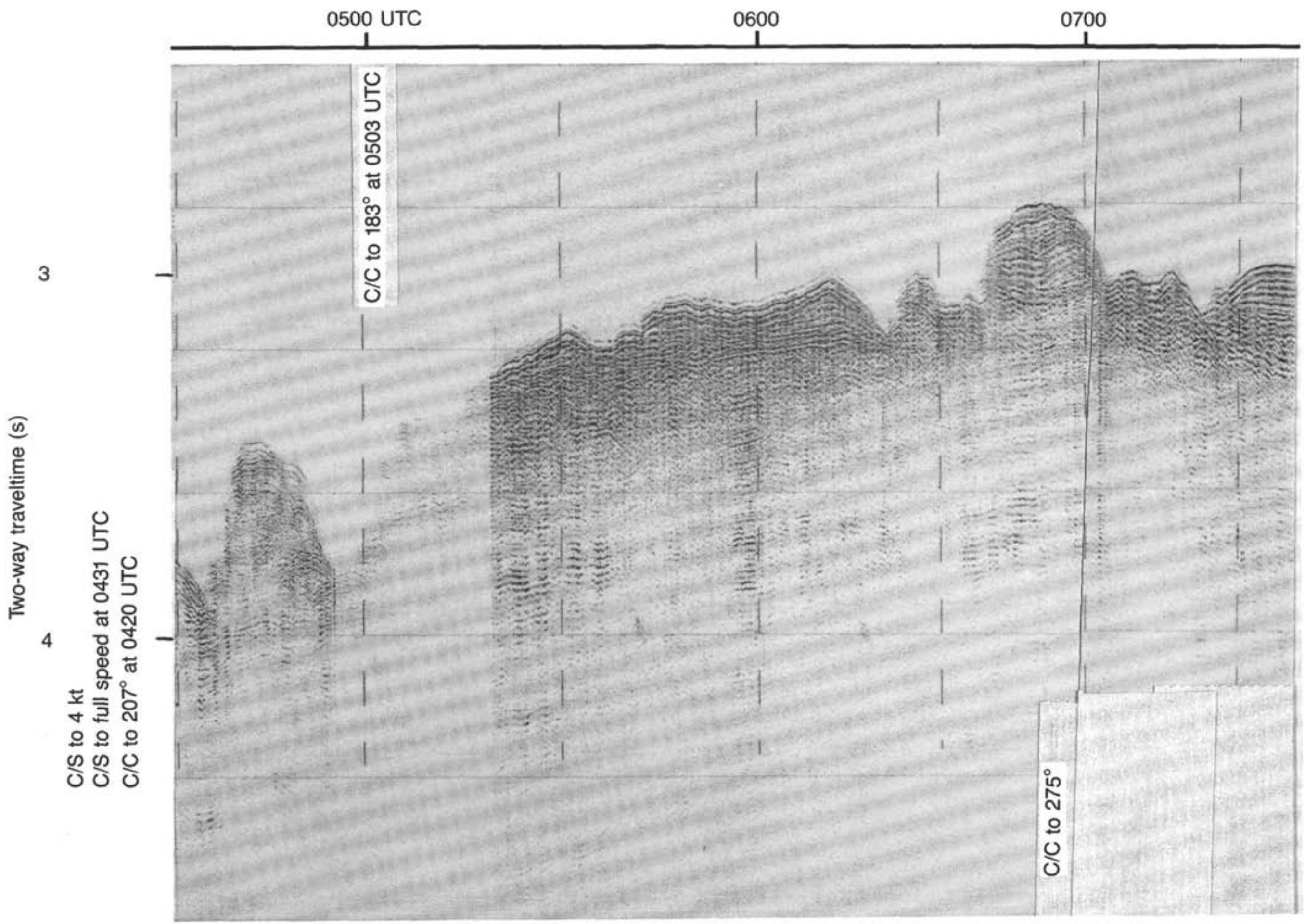

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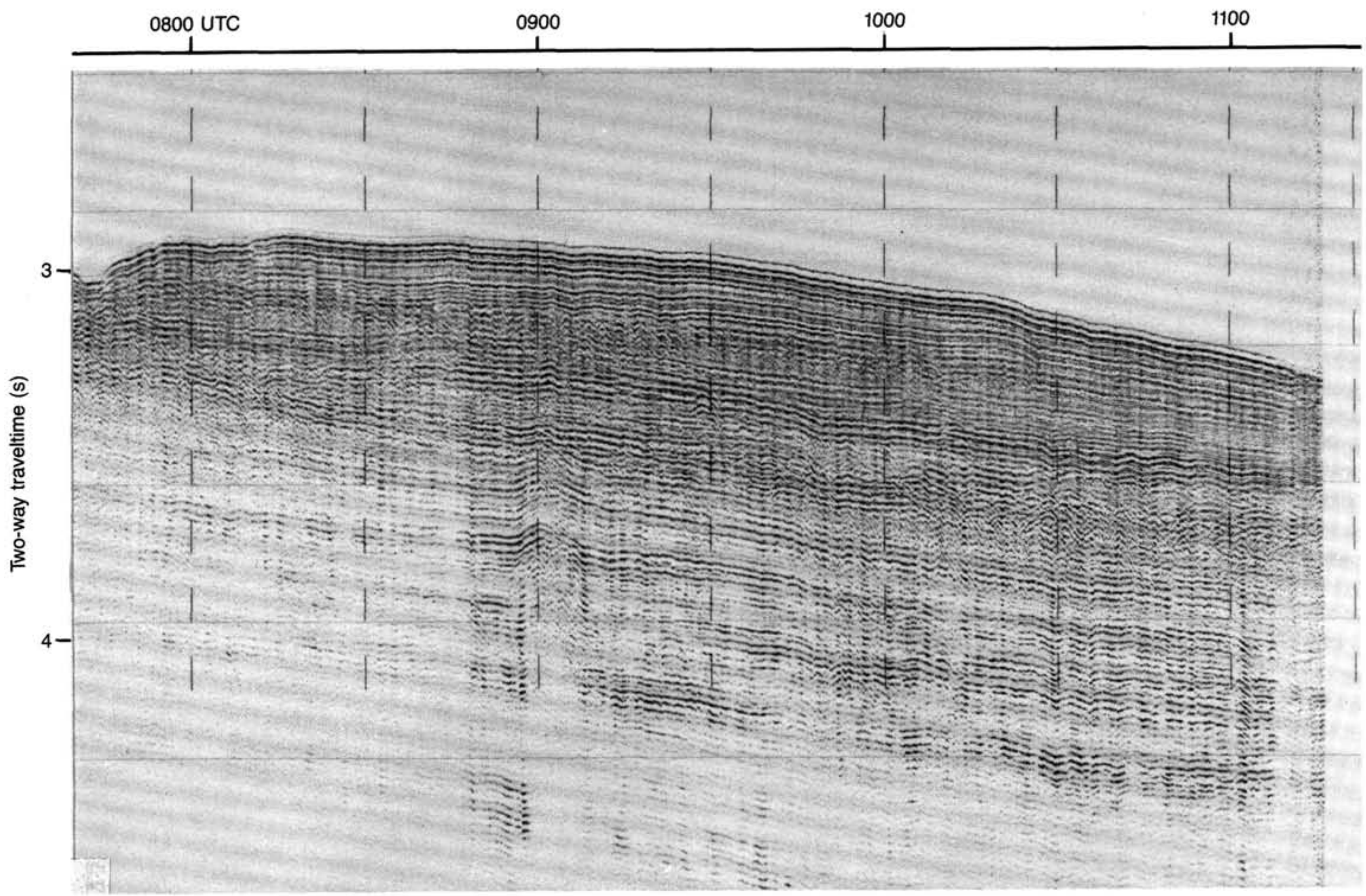

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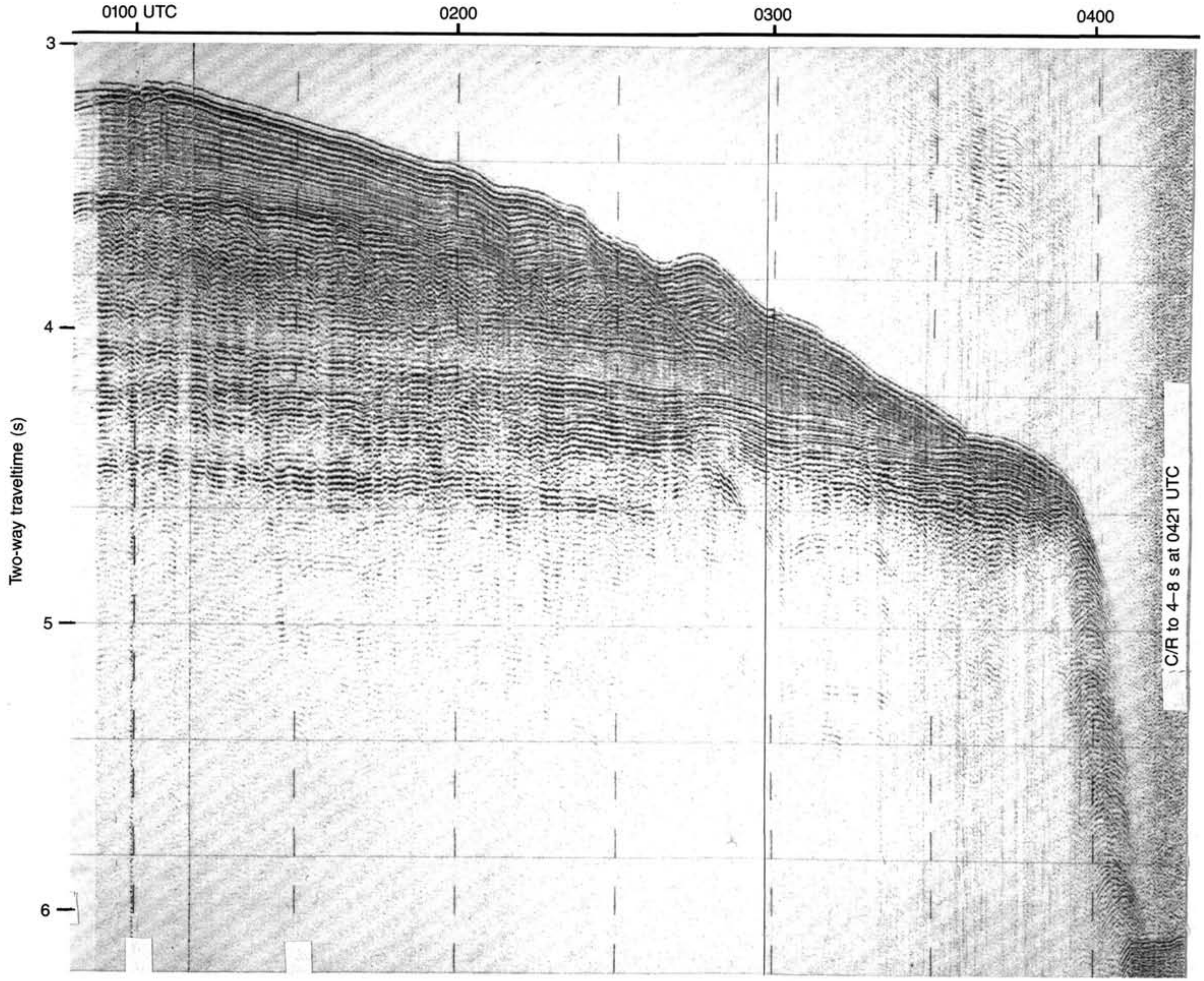

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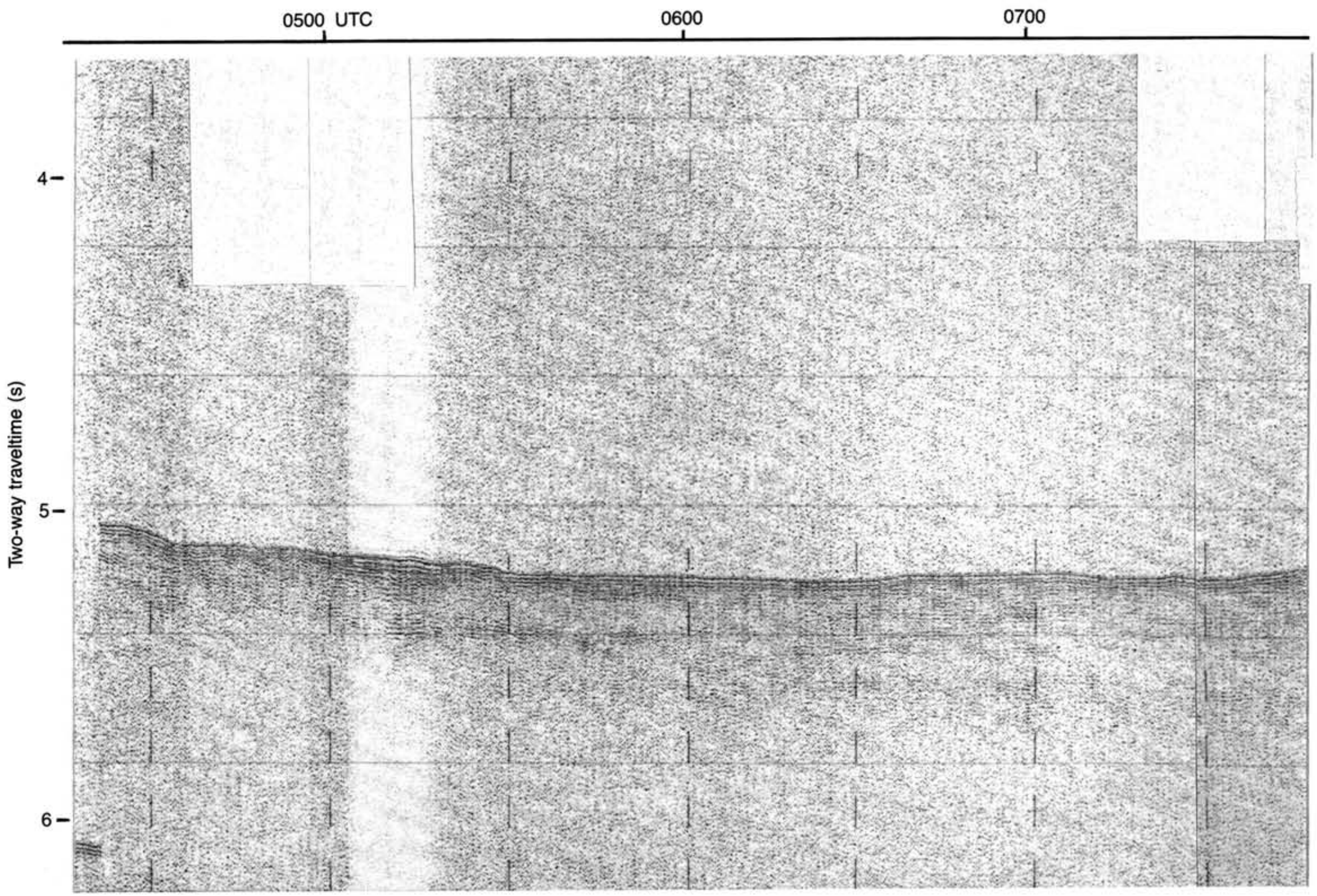

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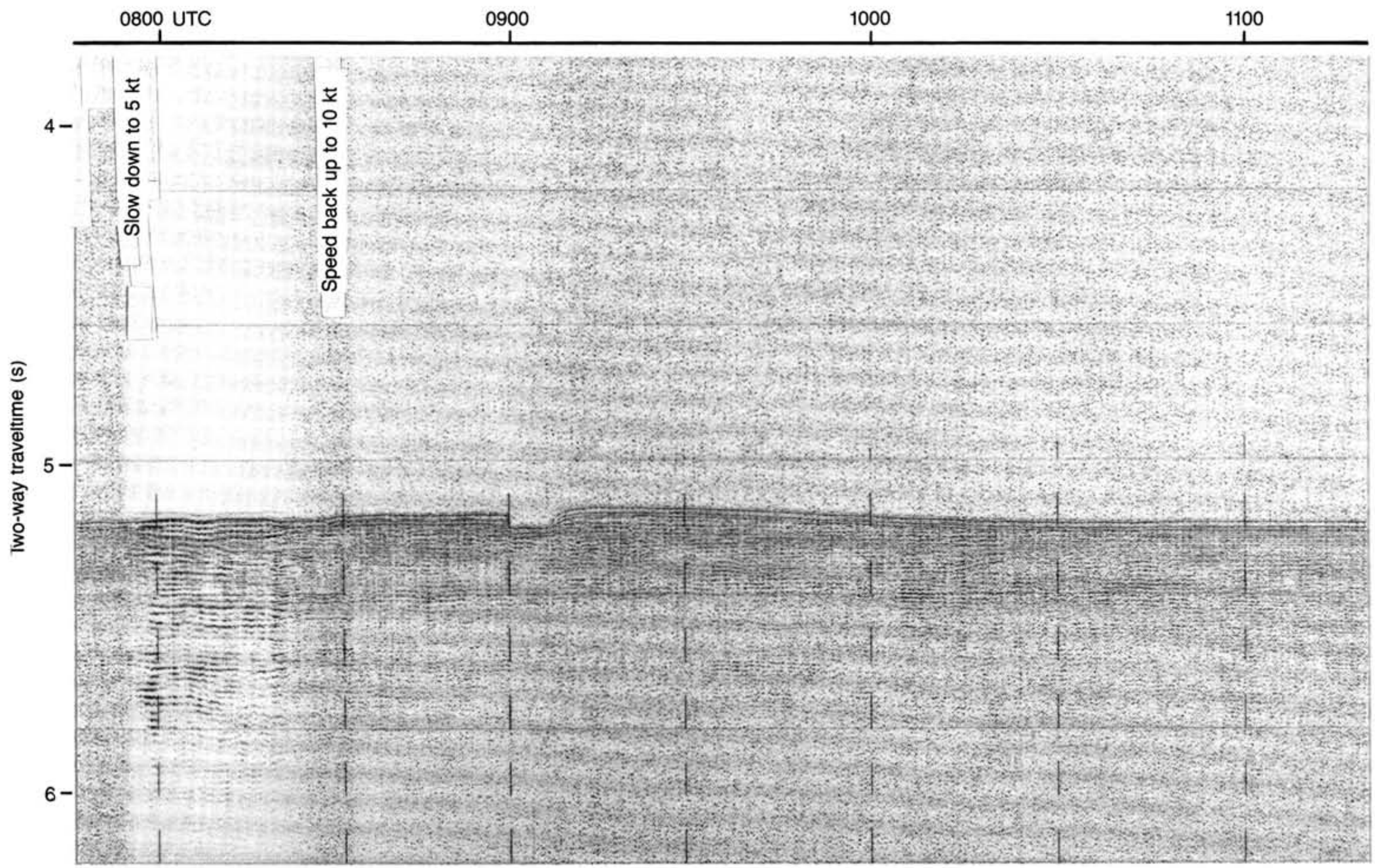

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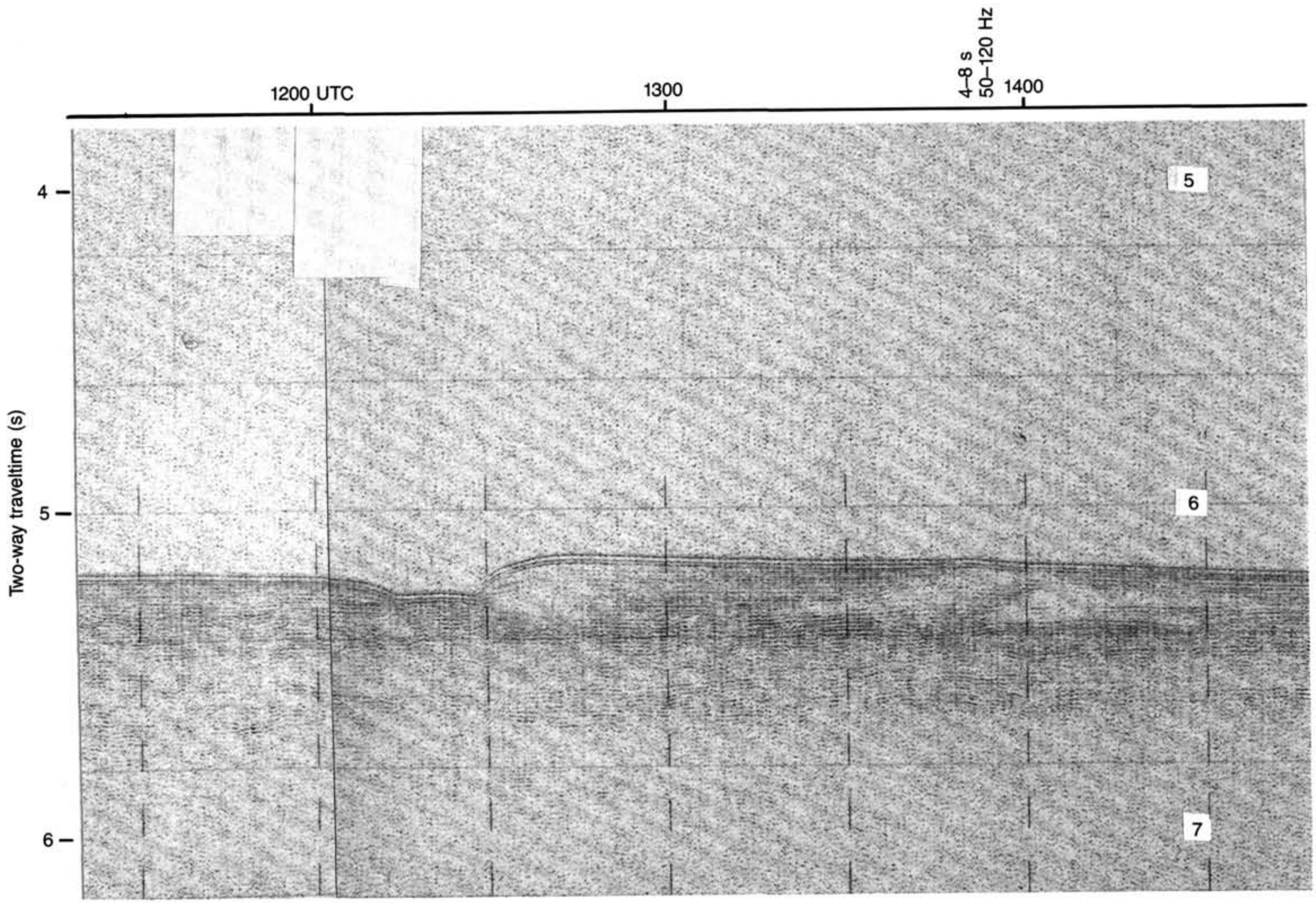

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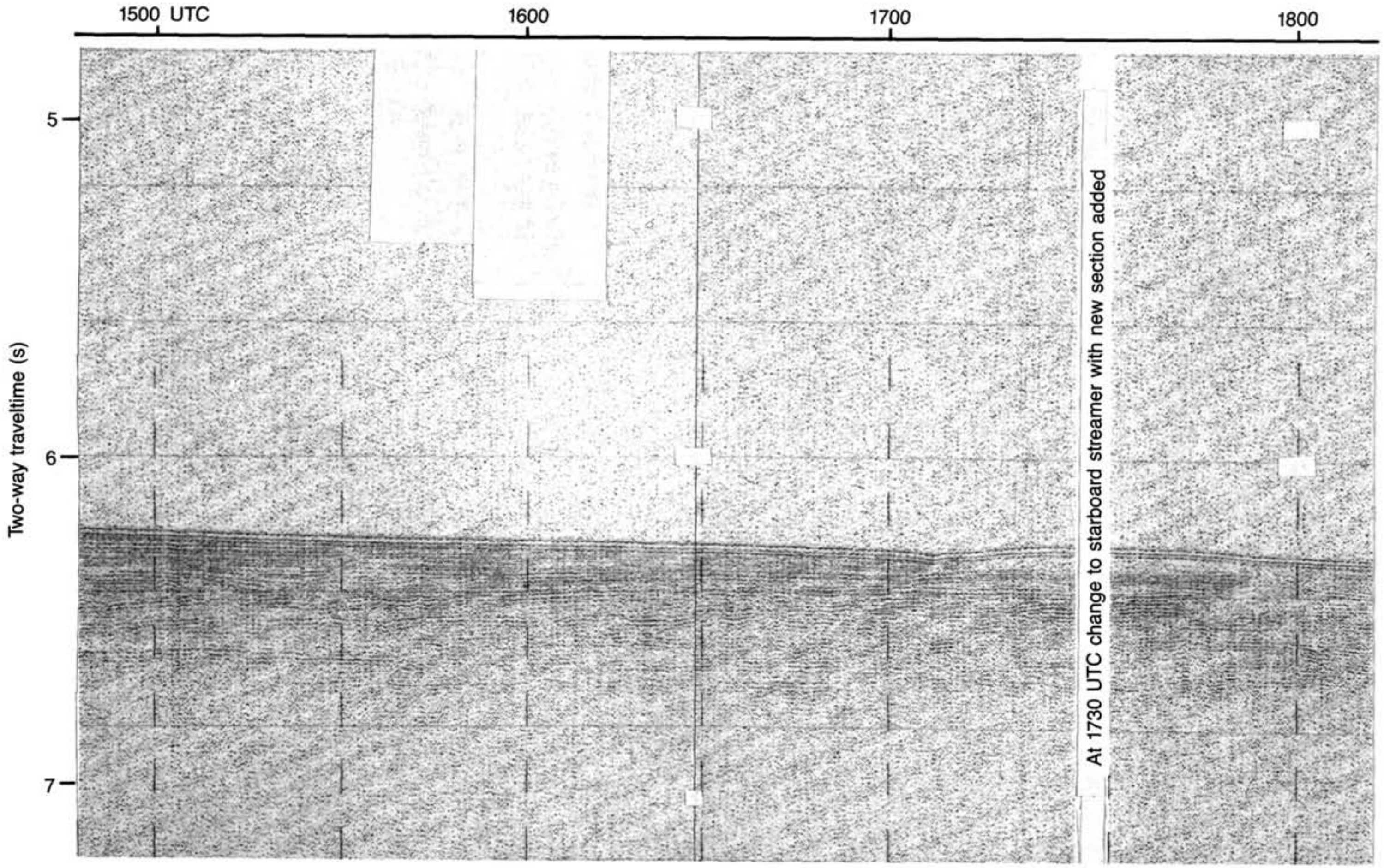

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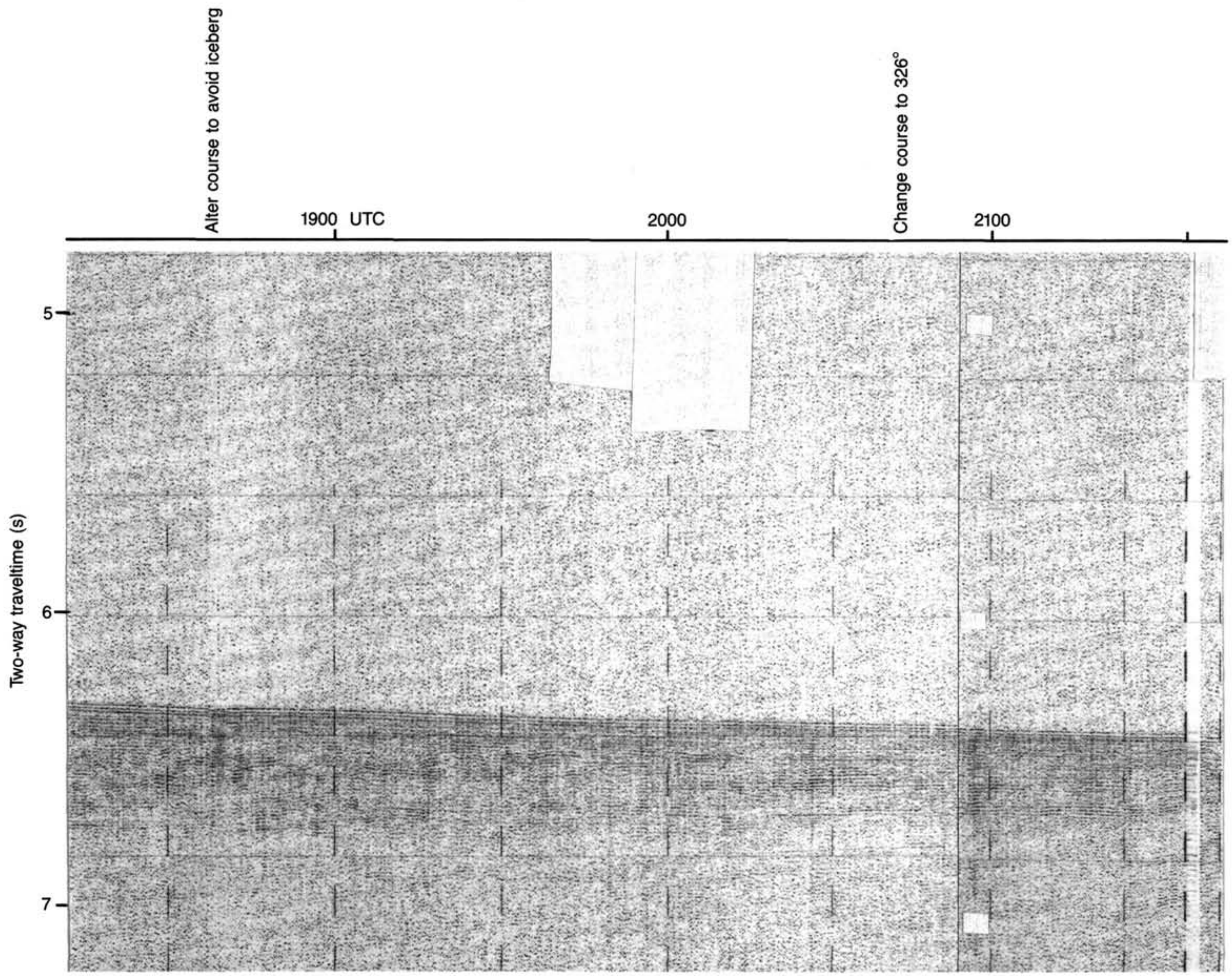

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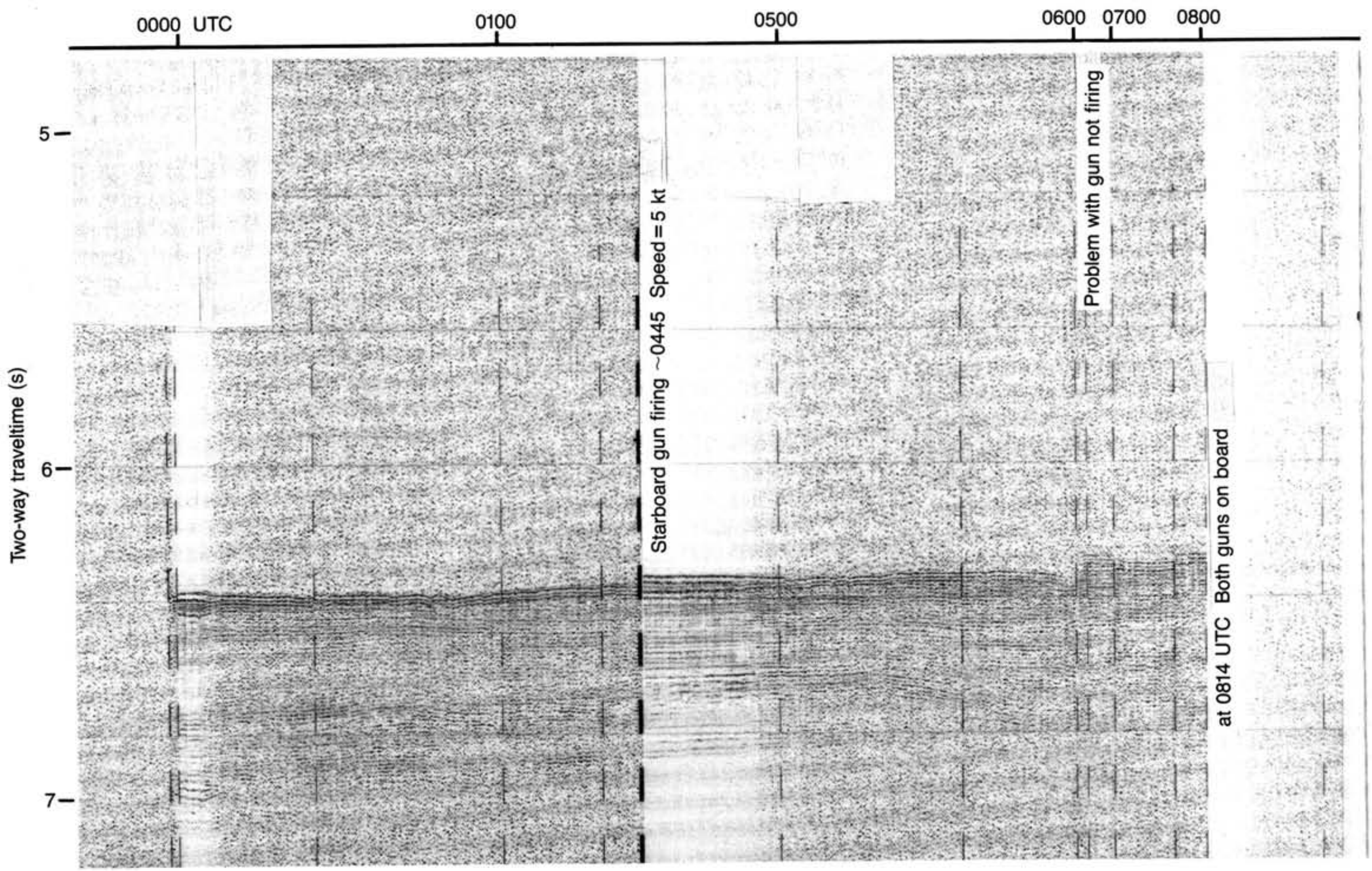

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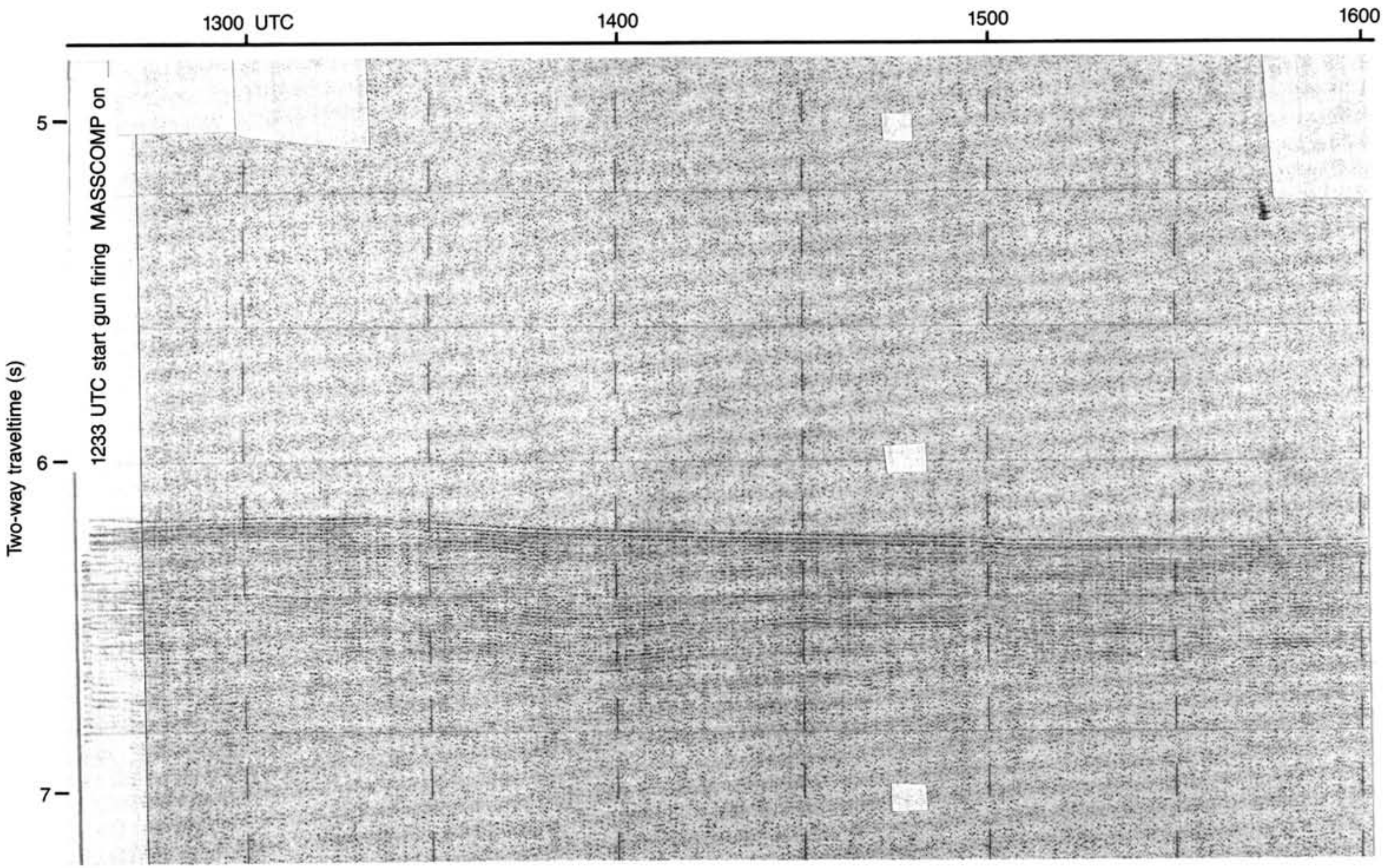

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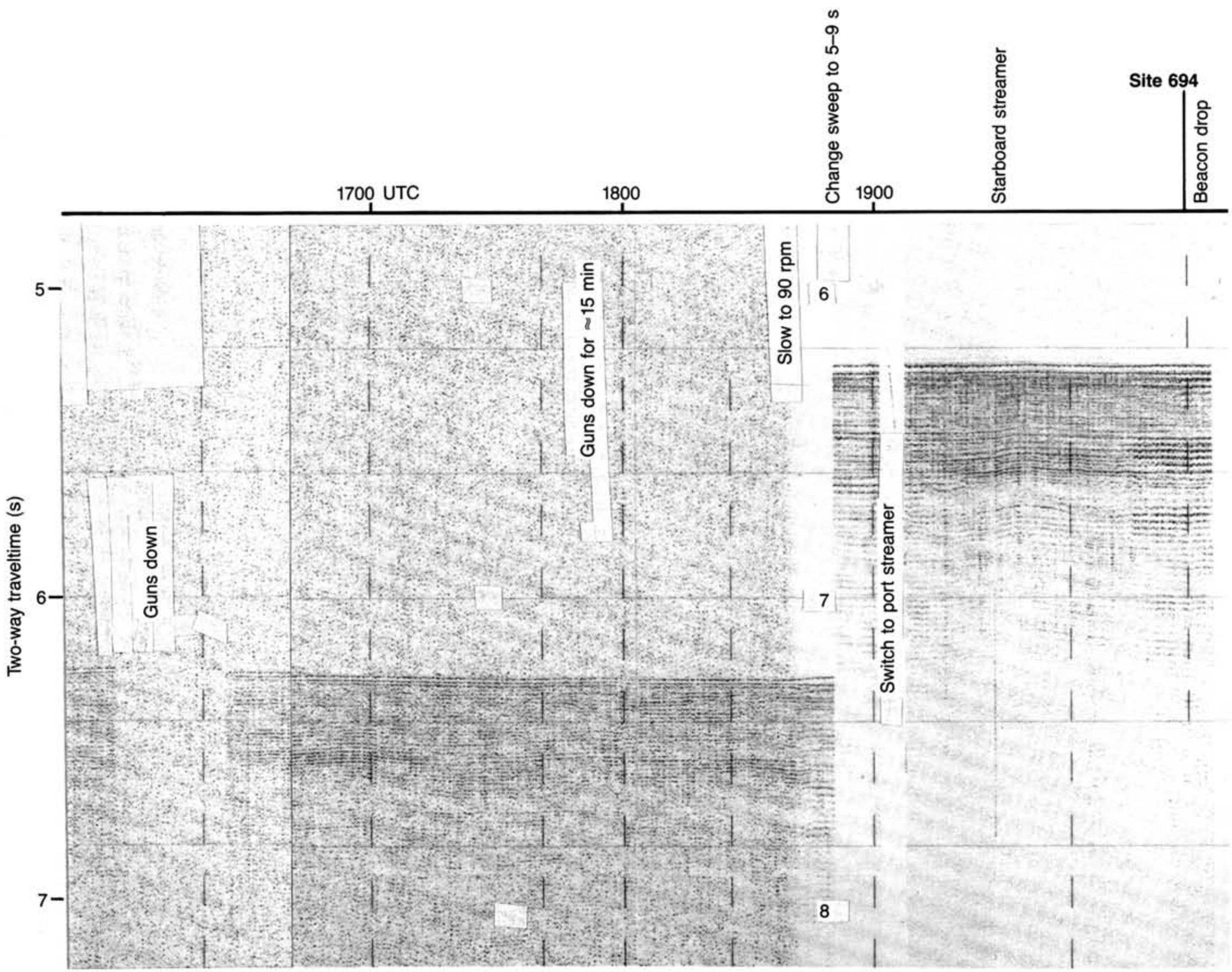

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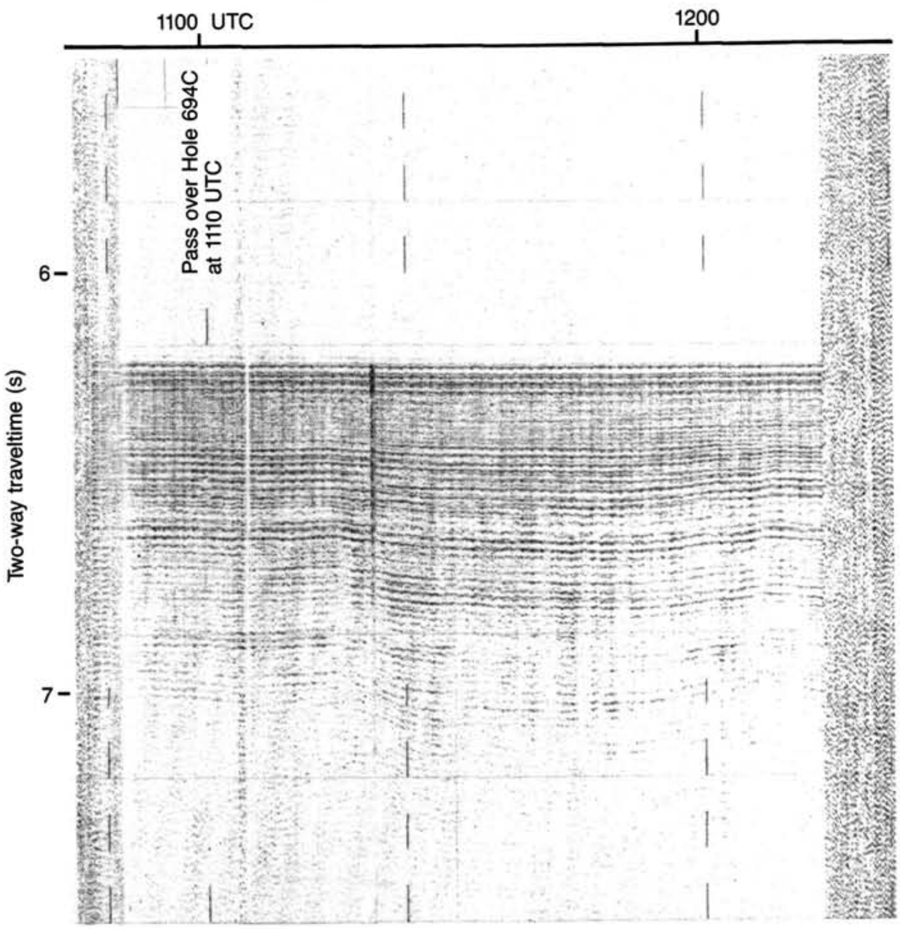

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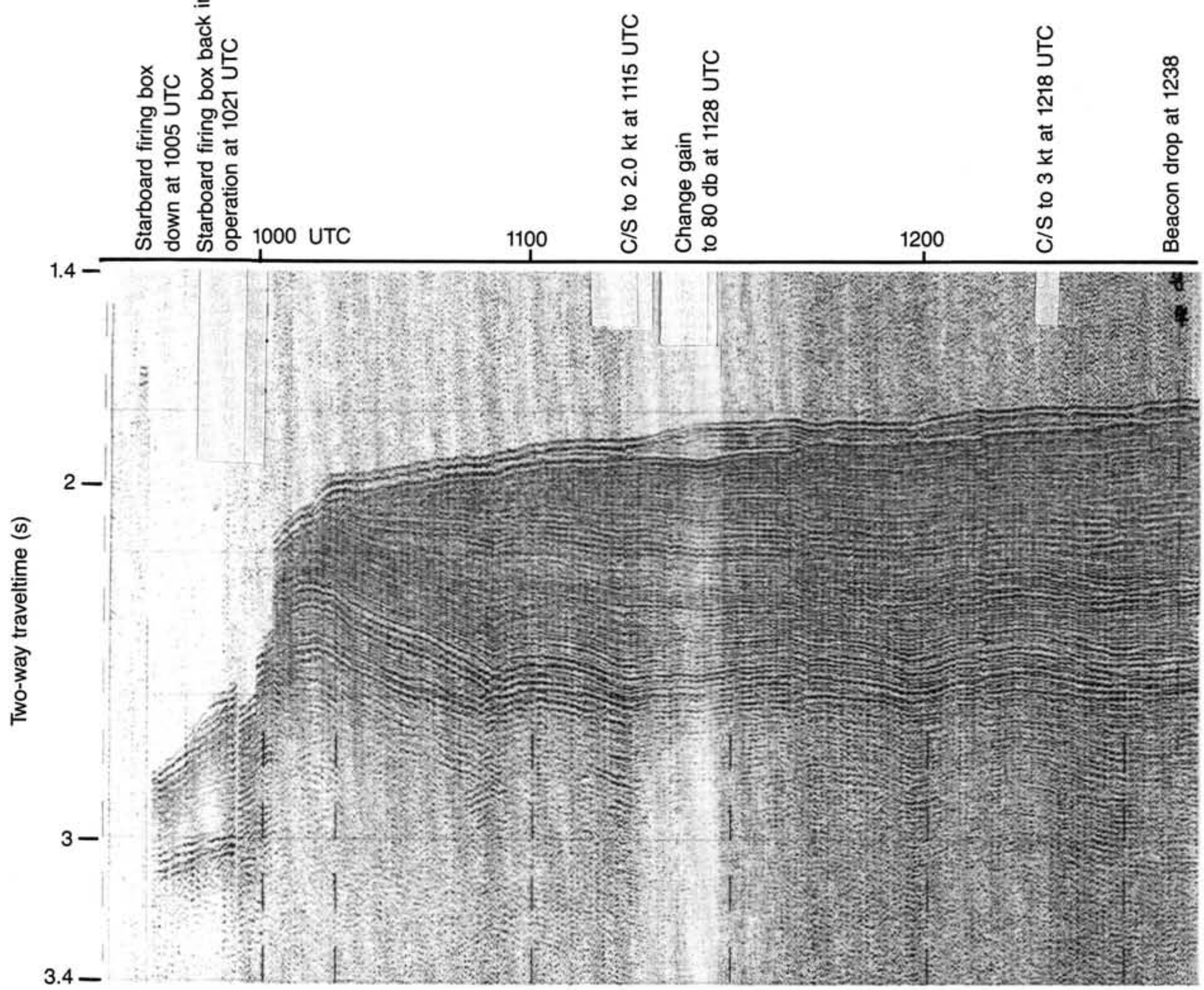

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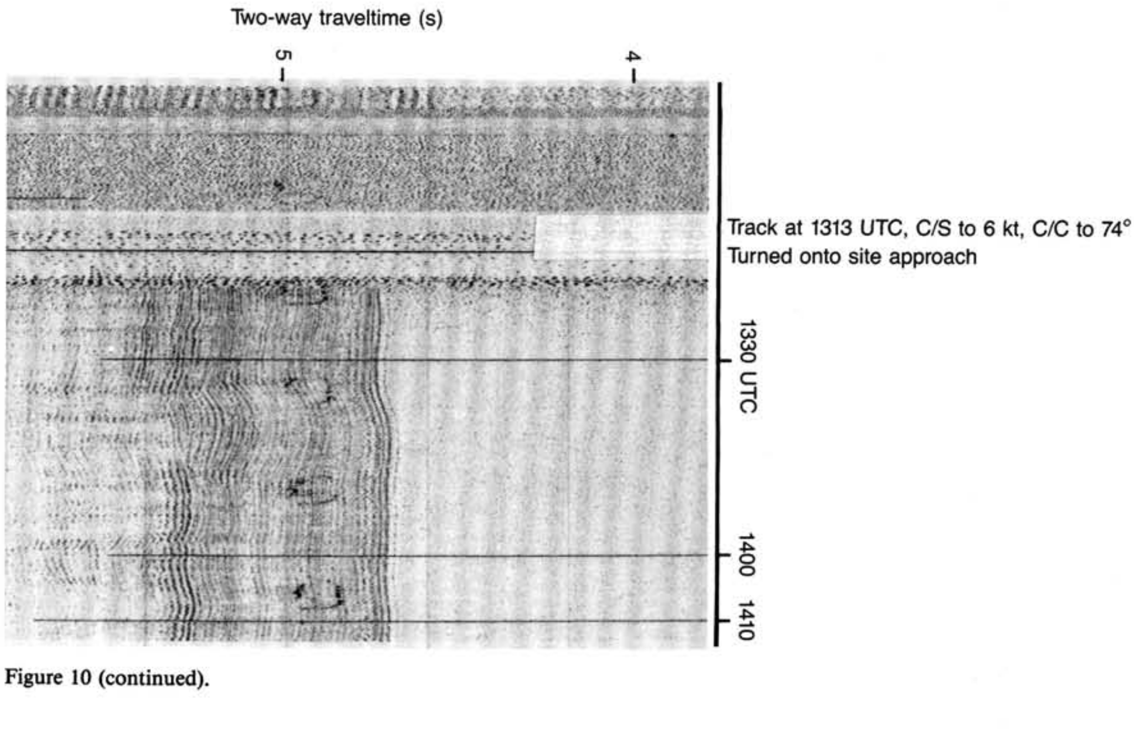

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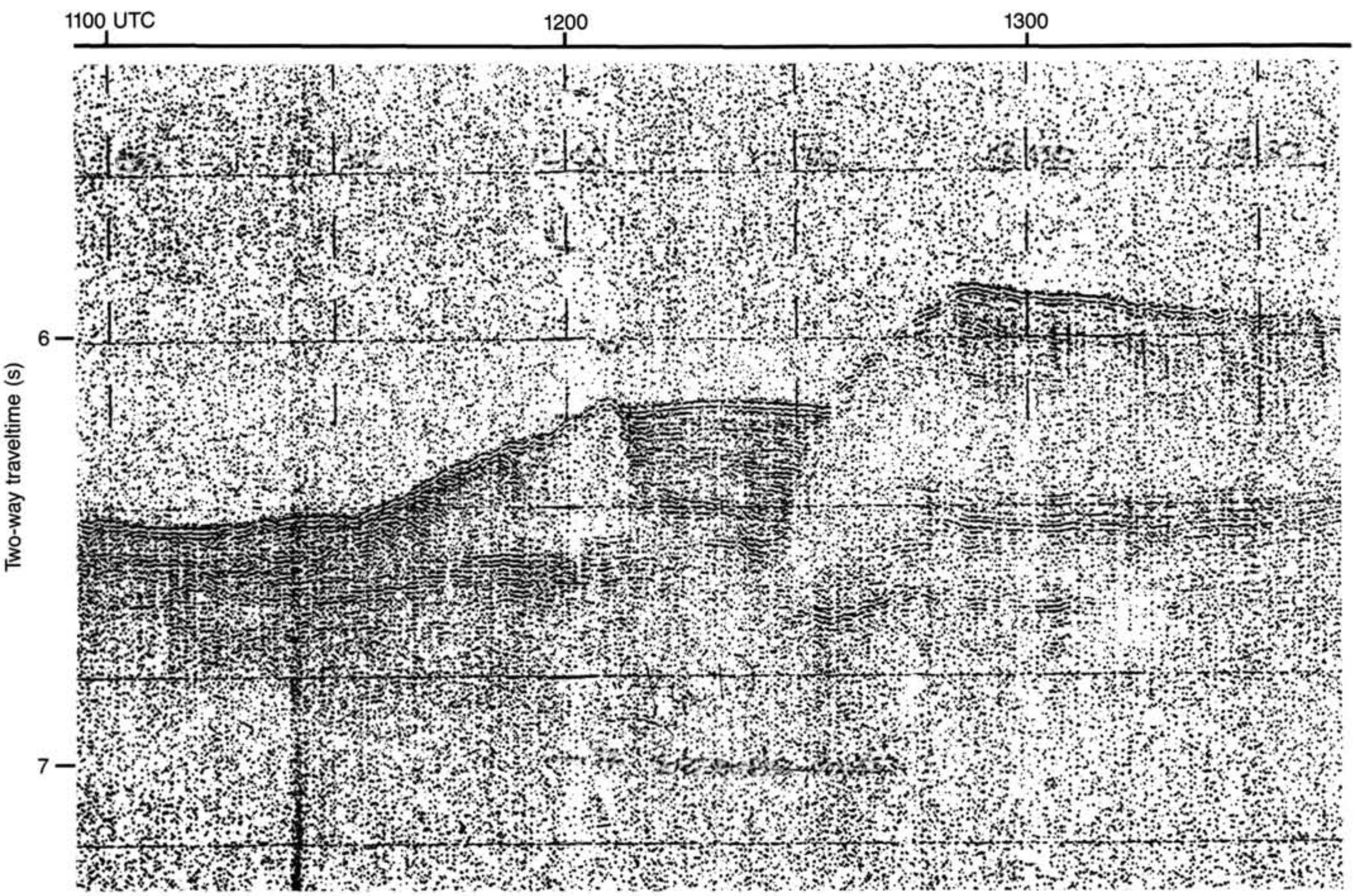

Figure 11. Profile 3. 024/1100–1330. Fracture zone with associated graben structure. Recorded on EDO-1 with 4-s sweep.

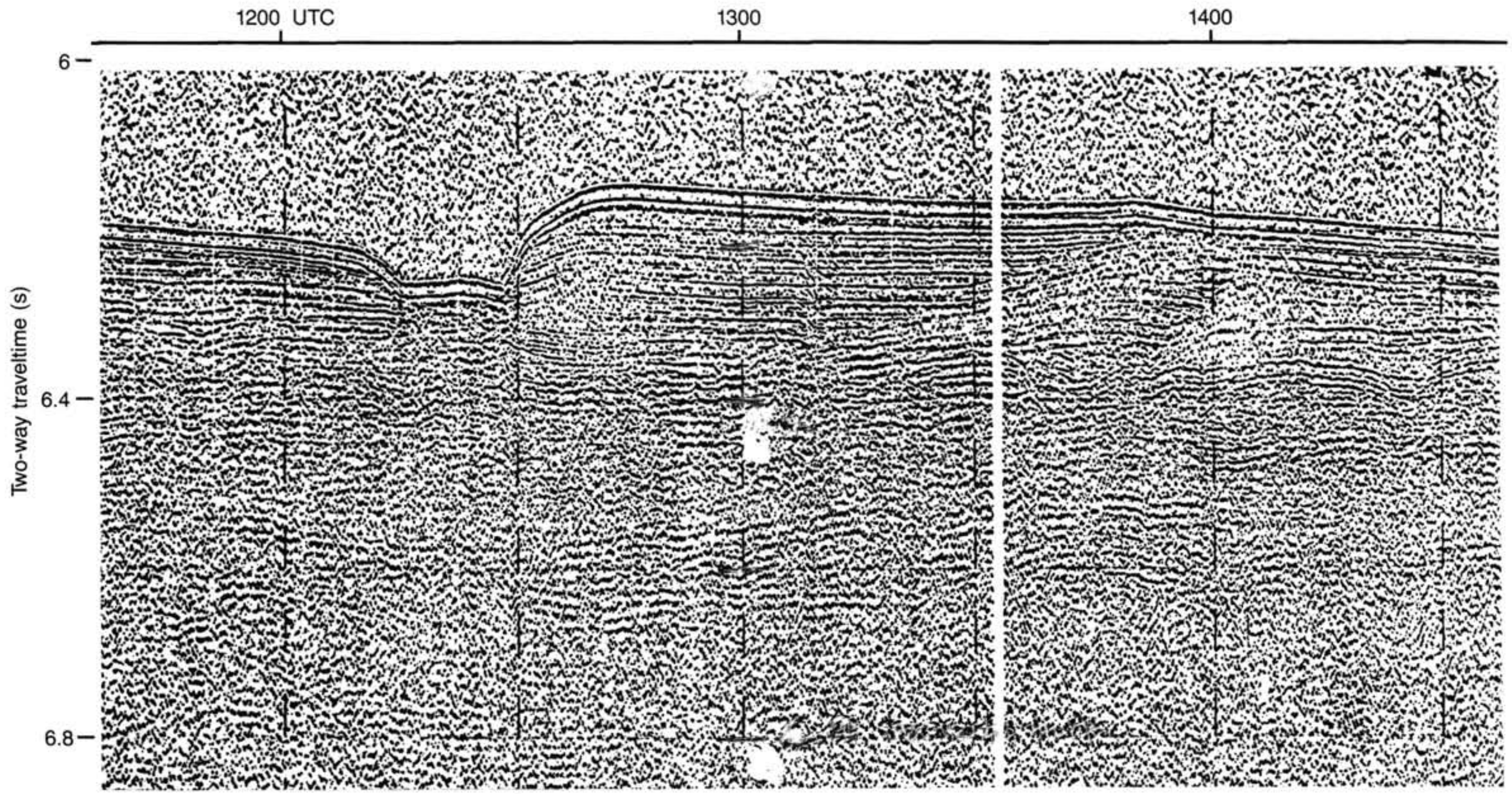

Figure 12. Profile 5. 039/1200–1430. Channels seen both at the seabed at 1230 and buried at 1430 (6.4-s twt). Recorded on EDO-2 with 2-s sweep.