INSTITUTE FOR GEOPHYSICS

UNIVERSITY OF TEXAS AT AUSTIN

CRUISE REPORT

R/V FRED H. MOORE - CRUISE FM 10

NORTH ATLANTIC TRANSECT PROJECT

a two-ship multichannel seismic study
by R/V FRED H. MOORE and S/V PROSPEKTA

9 August 1981 - 22 October 1981

Chief Scientists	J.D. Phillips	Legs 1, 3
	E. Rosencrantz	Lag 2

9 November 1981
Galveston Marine Geophysics Laboratory
Galveston, Texas

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ABSTRACT

During the period 9 August to 22 October, multiple ship and single ship multichannel seismic investigations were conducted in the north west Atlantic Ocean by the University of Texas (UT), Galveston, Texas; Bundesandtalt für Geowissenschaften und Rohstoffe (BGR), Hanover, Germany; Lamont-Doherty Geological Observatory (LDGO) of Columbia University, Palisades, New York; and the University of Rhode Island (URI) Kingston, Rhode Island using the research vessels R/V FRED H. MOORE and S/V PROSPEKTA. New synthetic large aperture techniques were employed to study the deep crust and mantle structure.

INTRODUCTION

Recent successes in performing single-ship and two ship multichannel seismic experiments in the Western Pacific, Caribbean Sea, and Norwegian Sea indicated that a major seismic experiment in the North Atlantic along a corridor from the Blake Plateau area to the Mid-Atlantic Ridge crest would be useful (Figure 1). The objectives of the experiment were both acoustic and geological.

The acoustic objectives was to test and improve single-ship and two-ship multichannel, synthetic aperture techniques in a variety of geological settings for obtaining the continuous velocity structure of the crust. Calibrated sources and receivers should also permit us to use quantitative amplitude information directly in the determination of velocity structure. This knowledge of the velocity structure is an essential requirement of low frequency sound propagation studies under the oceans.

The geological objective was to solve the following geological problems which defied unambiguous solution with earlier conventional seismic methods:

1. Is the crustal layering continuous from the ridge crest to the ocean basin?
2. Is there a systematic change in the velocity (P- and S-wave) and thickness of layers 2 and 3 as they continue away from the axis?
3. Does the crust thicken with age or distance away from the ridge crest?
4. Is layer 3 present beneath the ridge axis?
5. Is layer 3B present beneath the ridge axis and ocean basin?
6. What is the topography of the crust-mantle interface?
7. What is the change in mantle velocity approaching the ridge crest and continental margin?

8. Is there a correlation between refraction and reflection horizons? Why is layer 3 a good refractor and a poor reflector of seismic energy?
9. Is there layering within layer 2A and layer 2B?
10. What is the nature of the rough/smooth oceanic basement topography boundary?
11. Does velocity anisotropy occur in the upper mantle? What is the direction of maximum velocity? Does it correspond to the direction of sea floor spreading?

METHODS

To accomplish the above objectives, we collected multichannel seismic data using very large aperture hydrophone receiving arrays. Specifically, three operational techniques were employed.

1. Constant Offset Profiles (COP) - Two vessels steaming together along track at a fixed separation (Figure 2). For array magnification of multiple ships, each with receiving arrays, the separation (6000m) is equal to twice the length of the array of the lead ship (PROSPEKTA). Each ship fires its guns alternately (Figure 3). In this experiment, MOORE and PROSPEKTA fired the airguns on a 60 sec schedule. Each ship recorded both its own shots and those of the other ship. By combining the recordings from both ships during processing it should be possible to obtain stacked data over a synthetic aperture of about 10 km with a CDP spacing of about 70 m. Velocity analysis procedures have previously been devised to obtain highly accurate velocity structures from such wide aperture CDP data. Ultimately we should obtain a continuous stacked section with velocity resolution and depth of penetration which is much enhanced over that which is possible using single ship measurements.
2. At selected locations we obtained Expanding Spread Profiles (ESP). In this experiment the two ships steam on reciprocal headings away from a common midpoint with S/V PROSPEKTA firing its guns and R/V FRED H. MOORE recording (Figure 4). The ships steamed apart to provide up to 60 km separation. In this way, it is possible to obtain very deep and high resolution structure at a single location. Non-AGC sonobuoys (SSQ-51) were also deployed at certain ESP mid-point locations to provide calibration of both the MOORE and PROSPEKTA acoustic sources and receiving arrays.

3. We also collected single ship conventional CDP data with R/V MOORE and S/V PROSPEKTA in areas of critical interest, mainly on the Puerto Rico Trench Outer Ridge with the MOORE, in order to make comparisons of the conventional method with the newer methods.

The areas of study included the Blake Plateau, the Bahama Outer Ridge and the Blake Outer Ridge, the East Coast Magnetic Anomaly (ECMA), the Blake Spur Magnetic Anomaly, the Nares Abyssal Plain, the Puerto Rico Trench and Outer Ridge, the West flank of the Mid-Atlantic Ridge and the Mid-Atlantic Ridge crest and Axial valley (23°N). Thus we employed the new techniques in widely different geologic settings to establish its reliability under various situations.

The deeper penetration combined with enhanced resolution from the wide aperture - CDP data should help to resolve several important problems in the region including the structure associated with the East Coast Magnetic, the Blake Spur Anomalies and the anomalous mantle beneath the Puerto Rico Trench Outer Ridge, variations with age in oceanic crustal structure across the Mid-Atlantic Ridge flank, and the deep structure in the continental margin regions.

Leg 1 Narrative Chronology* (See Chart 1)

R/V MOORE and PROSPEKTA departed Ft. Lauderdale Fla. at 0915 p.m. 9 Aug. 1981, approximately 2 days behind the scheduled departure of 8 Aug. 1981. This delay resulted from delays in the S/V PROSPEKTA dry dock work at the Tracor Shipyard. After one day of equipment testing of the intership navigation and radio communication systems off Ft. Lauderdale, certain electronics personnel aboard the MOORE were transferred to the PROSPEKTA (1900, 10 Aug.). The PROSPEKTA then returned to Ft. Lauderdale to disembark the MOORE personnel as well as certain PRAKLA and Tracor Shipyard personnel.

MOORE then steamed full speed (10kts) to the Blake Plateau study area to deploy, balance and test its streamer and airgun systems. These tests were completed and MOORE was ready to begin the 2-ship work at 1500, 12 August. However, PROSPEKTA was not able to complete its streamer deployment and balancing operations as rapidly as expected. MOORE and PROSPEKTA finally rendezvoused to start Line NAT-1 at 0600, 14 August. Both ships were in position on line at 0800 and were to begin shooting on an alternate 60 sec repetition rate (PROSPEKTA on the even minute and MOORE on the half minute +5 seconds). However, problems in the LDGO - NOVA 4 computer airgun fire control system caused spurious firing of MOORE's guns on a 30 sec repetition interval rather than at the required alternate firing at a 60 sec interval. Thus, the start of Line 1 was aborted at 1145, 14 August. The airgun fire control problem was partially solved by 1900, 14 August. Accordingly, PROSPEKTA and MOORE were repositioned and restarted shooting of Line NAT-1 at 0002, 15 August.

Efforts to correct the airgun fire control problem were continued during the shooting of Line 1. The problem was solved during the turn onto Line 2 at 1030, 15 August. However, shortly after the beginning of Line 2, it now became apparent that PROSPEKTA was firing its guns simultaneously with MOORE at the half minute +5s time mark! Accordingly both ships were repositioned to restart Line 2 at a point near DSDP drill site 361, rather than return to the original starting point of Line 2. It was verified that PROSPEKTA was now firing at the correct time mark! Two-ship constant offset (COP) and expanding spread (ESP) operations continued satisfactorily for the shooting of Line NAT-2A, 3, 3A, 4, and 5 until 1400, 19 August. At this time heavy seas were encountered as Hurricane "Dennis" passed on a northerly track along the Georgia/South Carolina Coast to the west. MOORE's streamer came near the sea surface and could not be depressed.

* All time are GMT unless indicated as local EDT - am/pm

It became "very noisy". All attempts to sink the streamer were in vain and seas were too rough to recover streamer. Accordingly, it was decided to begin shooting Line 6 at 0110, 20 August. At the end of Line 6, 0011, 21 Aug., the seas moderated slightly and the streamer was recovered. It was found the many of the PVC type streamer bird wings were broken while none of the fiberglas-type wings were broken. The broken wings were replaced with the fiberglas wings. Unfortunately continued heavy seas prevented redeployment of the streamer for the shooting the next COP Line NAT-7 at 1820, 21 August. Accordingly MOORE was only able to shoot to PROSPEKTA's streamer for Line NAT-7. However, this scheme still effectively doubled the length of PROSPEKTA's streamer. In any event at 1300, 22 Aug. the sea moderated sufficently to allow redeployment of the MOORE's streamer and normal 2-ship operation were carried out for the shooting of Lines NAT-7A thru 13 until 1700, 25 August. At this time after completion of ESP #2 it was decided that planned ESP #1 would be abandoned due to the time constraint of arriving in San Juan 1 September. Accordingly a new track plan was devised which called for a COP line to be shot from ESP #2 to the intersection Line 2A and 3 and thence to ESP #5 and then southward as originally planned.

Unfortunately during the manuvering to begin Line NAT-14 PROSPEKTA's INDAS computer control and data logging system failed. However, they were still able to fire their airguns via the MOORE's ZDXX radio shot command tone signals. Accordingly the relative ship positions were reversed with MOORE now the lead ship and PROSPEKTA trailing at 7100 meter (twice MOORE's streamer length) and shooting to MOORE beginning at 0811, 26 August. This was the opposite configuration used for shooting Line NAT-7. In any event, this arrangement proved satisfactory but fortunately PROSPEKTA was eventually able to modify their DFS V system by 1115, 26 Aug. so that MOORE's shot command tone radio signals could also trigger their seismic data acquisition recording without need of the INDAS computer. The remainder of Line NAT-14 was shot with this configuration.

For the shooting of Lines 15-17 PROSPEKTA was returned as the lead ship with MOORE controlling PROSPEKTA's airgun firing and DFS V recording with the ZDXX radio tone system. However, all navigational data, shot point times and intership distance recording on PROSPEKTA was done manually!

The remainder of Leg 1 proceeded satisfactorily through the completion of shooting for Line NAT-17 at 1000, 31 August. Magnetic/Bathymetry data contin-

ued to be collected until 0500, 1 September with the MOORE arriving in San Juan at 0800 a.m. 1 September.

Leg 2 Narative Chronology * (See Chart 2)

The second leg of the NAT transect, San Juan, Puerto Rico to San Juan, Puerto Rico, continued the two-ship studies of Leg 1, extending the transect from the Puerto Rico trench to the Mid-Atlantic Ridge.

During the San Juan in-port period, 1 - 4 September, a series of meetings for all senior scientist from both Legs 1 and 2 were held to discuss Leg 2 track changes for the transect of the Mid-Atlantic Ridge Flank. The following decisions were made at this meeting:

1. Of the two proposed "flow line" tracks, northern and southern, the southern track was deemed the better in view of time constraints. This track would extend the "flow line" track established by profiles 3, 15, and 17 of Leg 1.
2. The ships would shoot a constant offset profiled (COP) eastward along the southern track until bottom roughness increased to a degree where continuing such a line would be clearly unprofitable. Where and when this profile would end would be left to the discretion of the senior scientist aboard.
3. Time permitting, after the two ships broke from the above COP line, each would pull their arrays and steam to a well-surveyed area on the Mid-Atlantic Ridge near 23°N, immediately south of the Kane fracture zone, where they would shoot 2 days of expanding spread profiles (ESP) as well as a COP.
4. Upon finishing shooting, MOORE and PROSPEKTA would exchange personnel and gear. MOORE would then return to San Juan, PROSPEKTA would continue on to Europe.

PROSPEKTA departed San Juan at 2100 on 4 September 1981, on schedule. MOORE was delayed a day for the reason that the ship was short crew, but sailed at 0018 on the 6th of September. PROSPEKTA shot a series of single ship CDP profiles across the Puerto Rico trench and inner wall during 4, 5, & 6 September. MOORE after an evening of slow steaming was positioned near the end of the Line NAT-22 on the morning of 6 Sept., and deployed her streamer array during the daylight hours of 6 September. MOORE and PROSPEKTA establish contact during the early evening of that day, rendezvoused and maneuvered onto station, relative to one another. Both ships were in position on Line NAT-22 and recording by 0553 on 7 September.

* All times are GMT unless indicated as local EDT - am/pm

MOORE and PROSPEKTA maintained standard COP and ESP shooting configurations throughout Leg 2. During the constant offset profiles PROSPEKTA led and MOORE followed at an inter-ship distance of 6 kilometers. The maximum ship separation distance during expanding spread profiles was 40 kilometers, approximately the maximum VHF range bewteen MOORE and PROSPEKTA. PROSPEKTA directed all station keeping, vectoring MOORE into position for the start of all lines and monitored ships' positioning during COP shooting.

MOORE and PROSPEKTA completed Lines NAT-22 through NAT-27 without incident, including PROSPEKTA's reshoots of both ESP's. During the late afternoon of 8 September however, weather reports indicated that hurricane "Gert" had moved north of Puerto Rico and was tracking toward the survey area. With weather and seas rapidly worsening, MOORE, near the end of ESP 7 (NAT-27) broke off operations to recover its streamer and airgun arrays. MOORE completed recovery at approximately 0200 and turned to the NE at maximum speed to clear the storm track. PROSPEKTA quit her single ship CDP reshot of ESP 7 shortly thereafter (NAT-27) and steamed to the NE also.

As both ships were hampered by heavy seas while steaming to the northeast, the senior scientists decided that, in view of the weather and sea situation, to abandon shooting ESP 8 and related COP lines on the Puerto Rico Trench Outer Ridge and to proceed directly to point 8 A where they would shoot an unscheduled ESP, ESP 8A.

PROSPEKTA redeployed her gear prior to arriving at point 8A and shot a single ship CDP line west to east into point 8A (line NAT-28). MOORE began to deploy its array during the evening of 9 September. Both ships were in position to shoot ESP 8A (NAT-29) at 0020, with ships abeam at 0124, 10 September.

Upon completion of ESP 8A, MOORE maneuvered back to point 8A while PROSPEKTA reshot ESP 8A as a single ship CDP line (NAT-30). The ships regrouped, established relative COP positions and began shooting line NAT-31 at approximately 1900 on 10 September. The line was completed at 1039, 12 September. Nine sonobuoys were thrown along the track.

During the morning of 11 September, while shooting NAT-31, the MOORE began to experience persistent difficulty in keeping her streamer down. The MOORE decided to complete the COP line but would pull and rebalance her streamer array at the end of the line while PROSPEKTA shot a CDP profile along ESP 9. However, during the early morning of 12 September, it became clear tha hurricane "Harvey" would pass just south of the operations area. Consequently, after recovering her streamer between 1345 and 1615, MOORE steamed to the NE at top speed. Subsequent plotting

of "Harvey" showed that the hurricane would pass to the north of the operations area, so MOORE reversed course. PROSPEKTA broke off her CDP reshot of ESP 9 after being advised of the hurricane's severity and joined MOORE running southwest to clear the storm track. At 1000 13 September MOORE reversed course to regain point 9 and begin ESP 9; "Harvey" was 100 miles to the north and moving away.

PROSPEKTA completed the single ship CDP survey of ESP 9 (NAT-32) while MOORE rebalanced and deployed her streamer array. MOORE continued to experience problems with towing her array after rebalancing. The streamer balanced well on a downwind course but would not sink on any upwind or crosswind course. MOORE decided to recover and rebalance ber array, but PROSPEKTA argued against additional delay. Consequently, MOORE continued and once on a downwind course for ESP 9 the array sank to proper depth. MOORE and PROSPEKTA began ESP 9 (NAT-33) at 1222, 14 September, completing the line at 1455. Both ships subsequently maneuvered to take position to shoot the next COP line, NAT-34. MOORE experienced additional difficulty with her array pulling to the surface during maneuvers to position with the PROSPEKTA to shoot NAT-34, but once on station the streamer behaved properly. At 1635, 14 September both ships were on line, in COP position and shooting.

Two-ship operations proceeded without undue incident through 16 September, shooting along Line NAT-34. At 0838, PROSPEKTA broke shooting to reset her clocks. The remainder of the COP line was designated Line NAT-35.

Basement topography became progressively rougher eastward. On 17 September both MOORE and PROSPEKTA decided that the topography had become too rough to produce acceptable seismic data. The COP Line NAT-35 was terminated at 1101 on 17 September. This location was designated point 10. MOORE pulled her gun array while the ships maneuvered to shoot ESP 10 (NAT-30), which was begun at 1858. Upon completion of ESP 10 at 2209, 17 September MOORE puller her streamer array and began her transit to point 11 on the Mid-Atlantic Ridge. PROSPEKTA, after completing the single ship CDP reshoot of ESP 10 (NAT-31) did the same.

Both ships experienced heavy seas enroute to point 11 and were delayed approximately one-half day. During transit MOORE and PROSPEKTA decided to abandon the planned ESP site west of the MAR rift axis in favor of shooting ESP's at sites 12, in the rift valley, and 13, east of the rift, insofar as proposed site 11 appeared to be the least promising of the sites on the basis of available data. Site 12 was redesignated 11, site 13 became 12.

PROSPEKTA reached the survey area ahead of the MOORE and made bathymetric surveys of both proposed ESP sites while MOORE completed her transit and deployed her gear.

MOORE reached site 11 and began deploying her arrays at 2000, 20 September. Deployment was completed by 0030, 21 September and both ships had completed maneuvers and were already for the start of ESP 11 (NAT-38) at 0445. With the completion of ESP 11, MOORE proceeded eastward to point 12, shooting a single ship CDP profile enroute (NAT-39). PROSPEKTA transited to point 12 and shot a single ship CDP line along ESP 12 (Line NAT-40). MOORE completed profile 39 at 0630, 22 September, pulled her gun arrays and began maneuvering to record ESP 12. Both ships were on station abeam at the start of ESP 12 (NAT-41) at 0850. MOORE completed ESP 12 at 1201 and had completed recovering and securing her array at 1516, 22 September.

Subsequently MOORE and PROSPEKTA closed to well within 1 mile of each other to transfer of personnel and equipment with PROSPEKTA's launch. H. Meyer transferred from the MOORE to PROSPEKTA, R. Houtz and K. Manchester transferred from the PROSPEKTA to the MOORE. All transfers were completed by 1655, 22 September. Whereupon MOORE set a course for San Juan and PROSPEKTA headed for Gibraltar.

Enroute to San Juan, on 24 and 25 September, it became apparent that MOORE was to encounter yet a third hurricane "Irene". Initially the MOORE slowed to let the storm pass ahead, then steamed north for several hours. When it became clear that "Irene's" track would intersect the MOORE's position, the MOORE steamed SSW at maximum speed across the front of the storm. MOORE had cleared "Irene" by the morning of 26 September and turned west toward Antigua. This island was raised during the late afternoon of 27 September. After transiting the Leeward and Virgin Islands, MOORE docked in San Juan, Puerto Rico during the early evening 0730 p.m., 28 September.

Leg 3 Narrative Chronology* (See Chart 3)

R/V MOORE departed San Juan, Puerto Rico at 1830 p.m., 5 October 1981 to carry out the single ship, conventional CDP portion of the North Atlantic Transect project. This work was north of the Puerto Rico Trench. The departure was delayed approximately 4 days due to the lack of a full crew and subsequent engine operation problems.

MOORE arrived at the streamer deployment site for the start of Line NAT-42 at 1045, 6 October. The streamer was deployed and several leaks repaired without incidence. Shooting of Line NAT-42 began at 2202, 6 October. For this leg of the NAT project the LDGO - Data General NOVA 4 computer system was not used to control the air gun firing or DFS IV data acquisition system. A conventional LDGO fire-control system was used for this purpose. It also provided a trigger for the EPC single-channel monitor chart recorders. This arrangement proved satisfactory for the entire leg.

The airgun sound sources initially deployed at beginning of Line NAT-42 consisted of one - 1000 in^3 and two - 466 in^3 Bolt airguns (1932 in^3 total) firing at a 30 sec repetition rate at 2000 psi. Also, a deep hydrophone source monitor was towed to 15 meters beneath the gun array to monitor the acoustic source. Inspection of these signatures as we experimented with different guns and consideration of the MOORE's compressor capacity during the shooting Line 43 resulted in changing the gun configuration to include two - 1000 in^3 and one - 466 in^3 guns. This arrangement provided the most energy at lower peak frequency ($\approx$ 40 hz) and was used for the duration of the cruise.

Sonobuoys were also deployed routinely from the MOORE during the Leg 3. All buoys were recorded with both the UTIG and LDGO receivers. A total of 39 buoys were launched. Approximately 30 buoys were judged to be useful. In fact, some buoys recorded with the UTIG Receiver, transmitted out to ranges greater than 22 nm. Seismic travel times (R_1) exceeded 30 seconds! This was excellent performance considering the low height of the MOORE's antenna and atests to the calm seas.

Overall, Leg 3 proceeded most satisfactorily. Aside from inconvenience associated with the lack of two tape drives on the LDGO-DFS IV data recording system, we experienced no scientific operational or equipment problems.

MOORE's streamer was recovered at the end of Line NAT-59 at 2015, 22 Oct-

ober, in virturally the same condition (electrically and mechanically) as it was deployed 17 days earlier! R/V MOORE arrived in San Juan 1145 p.m. 22 October 1981.

RESULTS

The results of the R/V FRED MOORE Cruise 10 Legs 1-3 are summarized in the enclosed charts and tables.

Charts 1, 2, and 3 show the seismic lines completed during Legs 1, 2, and 3 respectively. Table 1 lists the detailed data acquisition statistics for Legs 1-3, Table 2 lists the data acquisition statistics for all sonobuoy stations completed during Legs 1-3.

Below are summarized the overall, approximate multichannel line distances (km) for each type of data collected during the respective Legs 1-3. Also included is a summary of the sonobuoys launched with estimates of the number of successful sonobuoys in parentheses.

	COP	ESP	CDP(PROSPEKTA)	CDP(MOORE)	TOTALS	SONOBUOYS
Leg 1	2580	119	262	98	3059	92(60)
Leg 2	1253	172	937	157	2519	26(21)
Leg 3	-	-	-	3518	3518	39(30)
TOTALS	3833	291	1199	3773	9096	157(111)

The quality of the seismic data acquired by R/V MOORE is judged to be excellent except for those lines which were shot during heavy seas associated with Hurricane "Dennis" (Leg 1 - Lines NAT-6 & 7, 250 km total) and Hurricanes "Gert" & "Harvey" (Leg 2 Lines NAT-26, 31). These data were extremely noisy and are of doubtful value. In fact, no data were collected on Line 7 (69km) since the MOORE Streamer was pulled aboard! All data collected on Leg 3 were judged excellent since no heavy seas were encountered.

Careful inspection of the above summary information reveals that an impressive amount of multichannel seismic data was collected in a very short time in less than ideal weather conditions (4 hurricanes in 2 months!) Comparing the original proposed goals for the project with our results shows that the cruise met these goals within 10% or exceeded them!

	PROPOSED	ACTUAL	
Two-ship COP	4111	3833	-07%
Two-ship ESP	13(50 km spread stations) 325	11(55 km spread stations) 291	-10%
Single ship CDP	2278	3773(MOORE ONLY)	+36%

EQUIPMENT STATUS

1. Streamer

Heavy seas were encountered during Hurricanes "Dennis"(20, 21 Aug.), "Gert" (8,9 Sept.), and "Harvey" (12,13 Sept.). The streamer came to the surface at these times and was subsequently recovered. PROSPEKTA appeared to be less affected by the heavy seas since they had controllable streamer birds which could depress the streamer to depths below the high wave bases. In any event it was found that many of the bird wings made of PVC plastic were broken. None of the fiberglas-type wings were broken. The broken wings were always replaced with fiberglas wings. Consequently by Leg 3, no problems were encountered with the streamer birds. The configuration of the MOORE's Streamer and air gun array is shown is Figure 5a - 5e.

2. Air guns/Compressors

The 2000 psi Airgun/Compressor system performed extremely well. Other than periodic shut downs for oil checks and maintenance, the system functioned continuously for the entire cruise.

3. Data Acquisition System

The LDGO-DFS IV Tape Drive 2 malfunctioned on several occasions throughout the cruise. It would not rewind properly before each shot, sometimes ran away after a shot, and showed excessive parity errors. The problem was not located. Tape Drive #2 eventually failed completely at the start of Leg 3. It would not rewind properly at all! The leg was completed using only Tape Drive #1.

The LDGO-Data General NOVA Computer Control System for firing the airguns, triggering the DFS IV recording and Data logger recording and tranmitting shot command radio tones to PROSPEKTA worked well during the cruise after an initial start-up problem on Leg 1. This problem caused spurious firing of the MOORE guns on a 30 sec interval rather than 60 seconds as planned. It was due to a hardware problem in the fire control circuitry, not the computer, which was solved.

4. Navigation Systems

The primary navigation for most of Leg 1 was the Northstar-6000 LORAN-C receiver. It performed very well for both speed control and line steering. However, outside of the LORAN-C coverage area (from line NAT-15 on, for Leg 1 and all of Legs 2 and 3), the integrated Magnavox 1107 Satellite/Doppler Sonar system became the only navigational aid. Predictably it was found that the

single axis Doppler input to the Magnavox System is only adequate for dead-reckoning of ship's velocity in calm sea conditions with small current sets and small cross track "crab" angles. In any event the system was useful for shooting Lines NAT-15-58. However, it was found that although we required only one axis of the 4-axis Austek-Straza transducer for input to the Magnavox 1107 receiver, only two of the sonar trunsducer elements on the MOORE were functioning properly. Fortunately by manually rotating the transducer pod and exchanging spare electronics modules among the element circuits we were able to find a useful element to give the ship's forward speed. The cause of the malfunctions in the other transducer elements was not determined.

5. Echo-sounding

The 3.5 Raytheon echo-sounding system was used routinely only on Leg 3 of the cruise since PROSPEKTA had a digital bathymetry system and was preceeding MOORE along the same track on Legs 1 & 2. However, during the ESP lines which were not reshot by PROSPEKTA on Leg 1, the MOORE 3.5 kHz was used. In calm to slight sea states, the MOORE system performed very well with bottom penetration up to 50 meters on the Puerto Rico Trench Outer Ridge (5000 meter depth). However, in seas above $\approx$ 3-4 ft. the quality of the E/S recording rapidly deteriorated even in shallow water depths. Virtually no data was obtained in rough seas. Clearly the signal to noise ratio of the present transducer system can not overcome the strong bubble turbulance generated beneath the MOORE's hull.

6. Magnetometer

Although the magnetometer system performed well throughout the cruise, the system was periodically noisy due to winch signal-cable connector problems. Presently only light duty, water resistant connectors and cable are used on the after deck wiring! The connector and wiring were repeatedly replaced/repaired during the cruise. Also no digital recording of the magnetometer data was done during the cruise due to malfunction of the HP 562 printer system and the lack of proper interface electronics for using the PDP 11/02 Data logger computer system. Accordingly, manual digitalization was done from the strip chart recorder throughout the cruise.

7. Seismic/Bathymetry Chart Recorders

The real-time, single channel seismic monitor recording was initially attempted with the Raytheon flat bed recorder during Legs 1 and 2. However, very poor records were obtained due to mechanical problems in the start-stop pen/

clutch mechanism and electronic failures in the power supply. These problems were never solved despite intensive work by both LDGO and UT personnel. Eventually the Raytheon recorder completely failed during Leg 2. For Leg 3 the remaining two EPC digital type recorders were utilized for both the single channel seismic monitor and 3.5 kHz bathymetry recording. These units worked very well. However, modifications had to be made to the electronic circuitry to simulate a start-stop operation mode for the EPC recorder for the seismic recording. This was done. We also had the capability to delay the chart record presentation and utilize a different sweep interval. This was most convenient.

PARTICIPATING INSTITUTIONS

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  TWX: 910 885 5236

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  Stilleweg 2, 3000 Hannover 51, Telefon (0511) 6468-1

  Telex: 923 730 bgr ha d

- Lamont-Doherty Geological Observatory (LDGO)

  of Columbia University

  Palisades, N.Y. 10964/USA

  Telephone (914) 359-2900

  TWX: 710-576-2653

SHIP SPECIFICATIONS

R/V FRED H. MOORE

CLASS:	Modified offshore supply vessel
LENGTH:	50.29 m
BEAM:	11.58 m
DRAFT:	3.65 m
TONNAGE:	297 t
ENGINES:	2 x Caterpiller Diesel Type D 398 - 570 HP, twin screw propulsion
OWNER:	University of Texas at Austin
	700 The Strand
	Galveston, Texas 77550/USA
	Telephone (713) 765-2173

S/V PROSPEKTA

CLASS:	+100 A 4 "E L" MC 16/24 Germanischer Lloyd
LENGTH:	72.64 m
BEAM:	11.80 m
DRAFT:	4.15 m
TONNAGE:	968 t
ENGINES:	Klöckner-Humbolt-Deutz - 1295 KW, with (1) variable pitch propeller

SHIP SPECIFICATIONS (cont.)

S/V PROSPEKTA

OWNER: PRAKLA-SEISMOS GEOPHYSICAL CO.

Haarstr. 5, Postfach 4767

D-3000 Hannover 1

Telephone (0511) 8072 -1

Telex: 922 847

GEOPHYSICAL INSTRUMENTATION

R/V FRED H. MOORE

Seismics System:

Digital Acquisition System- Texas Instruments DFS IV, 48 channels, 4ms sampling rate, IFP Gain mode, Format SEG B 1600 BPI

Data General Nova 4 - Trigger and Logging Computer

Shot Command Telemetry System-ZDXX Bosch Radios provided by PRAKLA-SEISMOS

Satellite Clock Radio Receiver - True Time

2 - Laboratory Clocks, Stable Oscillator type - Systron/Donner and Chronolog

Airgun Trigger- LDGO supplied

Real Time Monitor Plotter- Raytheon Submarine Signal Division

EPC recorder

Galvo camera - ETL Mandrel

Sonobuoy receiver- LDGO Receiver - FM-Watkins-Johnson receiver, digitally recorded on DFS auxiliary channel 3.

UT Receiver - Realistic FM receiver, digitally recorded on DFS auxiliary channel 2.

Hydrophone Streamer- 3320 m - Western Geophysical Streamer with 48 traces, group interval: 70 m (see Figure 5)

Seismic Sources- 2 Bolt airguns @ 1000 in^3 each, towed 15 meters astern at 13 meters depth

2 Bolt airguns @ 466 in^3 each, towed 15 meters astern at 13 meters depth

Hydrophone Seismic source monitor - Benthos - recorded on auxiliary DFS channel 4 and Trace channel 16.

Data Logger:

PDP11/02 computer & Nova 4- Both recorded Satellite and Laboratory clocks shot times, Loran-C position and Inter-ship distance-RayDist.

Geophysical Instrumentation (cont.)

R/V FRED H. MOORE (cont.)

Magnetometer:

Proton Precession type- Varian model V75 - with floation type Cable towed 300 meters - Analog recording - Hewlett Packard

Bathymetry:

Raytheon PTR transceiver- 3.5 kHz with EPC analog recording, 4-MASSA Hulled mounted transducers

Navigation:

Loran-C radio navigation system-Northstar-6000 receiver - Data Marine - digitally recorded on PDP 11/02 data logger system. Chain GRI 7980, WYZ slaves provided the best positioning information.

Integrated Datellite/Doppler Navigation System - Magnavox 1107 Sat. Receiver with AMTEK-STRAZA Doppler Sonar digitally recorded on TI-700 Printer

Intership Distance Monitor- RayDist - Hasting receiver Model 76.

OMEGA Radio Navigation- Tracor Model II Navigation - not used.

S/V PROSPEKTA

Seismic System:

Digital Acquisition System- Texas Instruments DFS V, 60 channels, 2 auxiliary channels, 4 ms sampling rate, IFP gain mode; Format: SEG B 1600 BPI (see Figure 6 for details of the PROSPEKTA Streamer configuration and digital data acquisition system.)

True Time Satellite Clock Radio Receiver

Realtime Monitor Plotter- Oscillograph ETL Mandrel

EDO Recorder provided by BGR

2 x EPC Recorders, 4 Sec sweep

Cross - section Camera Geospace, MR 101

Sonobuoy Receiver- LDGO provided, digital recorded on auxiliary channel 1

Hydrophone Streamer- 3000 m - PRAKLA-SEISMOS Streamer - type HSSH/HSSK with 60 channels, group interval 50 meters (See Figure 6)

Seismic Sources- 2 linear Airgun arrays with 11 chambers each totaling 36.54 liters volume overall at 2000 psi (see Figure 7 for details of the PROSPEKTA airgun array)

Gravimetery:

ASKANIA-Seagravimeter

Anschütz-Stable platform - Hewlett-Packard Analog recorder

Bathymetry:

ELAC-Echo sounder with Analog and Digital recording for water depths to 6000 m.

Navigation:

Loran-C radio navigation system - North star 6000 receiver - Data Marine - provided by LDGO.

Integrated Satellite/Doppler Sonar Navigation System - INDAS-V computer System - PDP 11/34

Intership Distance - Raytheon Miniranger System (MRS III) rovided by LDGO

INTERSHIP COMMUNICATIONS

Four radio links were established for continuous intership voice communication:

1. Bridge to Bridge - VHF Channel 6, RAYTHEON 50A (25w)

2. Science Lab. to Science Lab. - VHF channel 10, RAYTHEON 50A (25w) VHF-ZDXX-88 telemetry Radio

3. MOORE Science Lab. to PROSPEKTA Bridge - HF 2182 kHz, 2635 kHz, CAI Radio Telephone (200/1000w)

R/V MOORE also used its NASA ATS-3 Satellite Radio (VHF) link to maintain twice daily contact with the University of Texas, Galveston Geophysics Laboratory and The Lamont-Doherty Geophysical Observatory.

SCIENTIFIC PERSONNEL

Below are listed the ecientific personnel and their institutional affiliation:

R/V MOORE CRUISE FM 10 - 1
Ft. Lauderdale, Fl. to San Juan, Puerto Rico
9 August - 1 Sept. 1981

J.D. Phillips	UTIG	Chief Scientist
J. Austin	"	
M. Butterfield	"	
D. Divins	"	
J. McEuan	"	
S. Ferguson	"	
J. Salazar	"	
H. Lynch	"	
A. Popvici	BGR (Germany)	
J. Diebold	LDGO	
C. Gutierrez	"	
W. Robinson	"	
M. Iltzche	"	
J. Yang	"	

Transferred to PROSPEKTA (10 Aug.) for return to Ft. Lauderdale after Instrumentation Test at beginning of Leg 1.

L. Griffiths	UTIG
E. Nichol	"
P. Buhl	LDGO
W. Ward	RAYDIST

R/V MOORE CRUISE FM 10 - 2
San Juan to San Juan, P.R.
5 - 28 Sept. 1981

E. Rosencrantz	UTIG	Chief Scientist
K. Griffiths	"	
J. McEuan	"	
D. Divins	"	
J. Salazar	"	
H. Lynch	"	
R. Detrick	URI-GSO	
P. Belknap	"	
H. Meyer	BGR (Germany)	
J. Alsop	LDGO	
R. Mithal	"	
M. Iltzche	"	
A. Calvert	Cambridge (England)	

On PROSPEKTA - Transferred to R/V MOORE (22 Sept.) for return transit to San Juan, P.R. at end of Leg 2.

R. Houtz	LDGO
K. Manchester	BIO (Canada)

R/V MOORE CRUISE FM 10 - 3
San Juan to San Juan, P.R.
5 - 22 Oct. 1981

J.D. Phillips	UTIG	Chief Scientist
F. Taylor	"	
J. Salazar	"	
G. Pearcy	"	
J. McEuan	"	
D. Divins	"	
H. Lynch	"	
M. Iltzche	LDGO	
J. Yang	"	
H. Van Santford	"	
J. Gutierrez	"	

Figure 1. Index Chart showing general location of principal study areas for the North Atlantic Transect Project.

BP Blake Plateau (see Chart 1)

MR Mid-Atlantic Ridge Crest (see Chart 2)

PR Puerto Rico Trench Outer Ridge (see Chart 3)

The heavy solid lines indicate the 2-ship Constant Offset Profile (COP) tracks.

The short bars show the location of the Expanding Spread Profile (ESP).

R,I,S, indicates regions of rugged, intermediate and smooth basement topographic roughness.

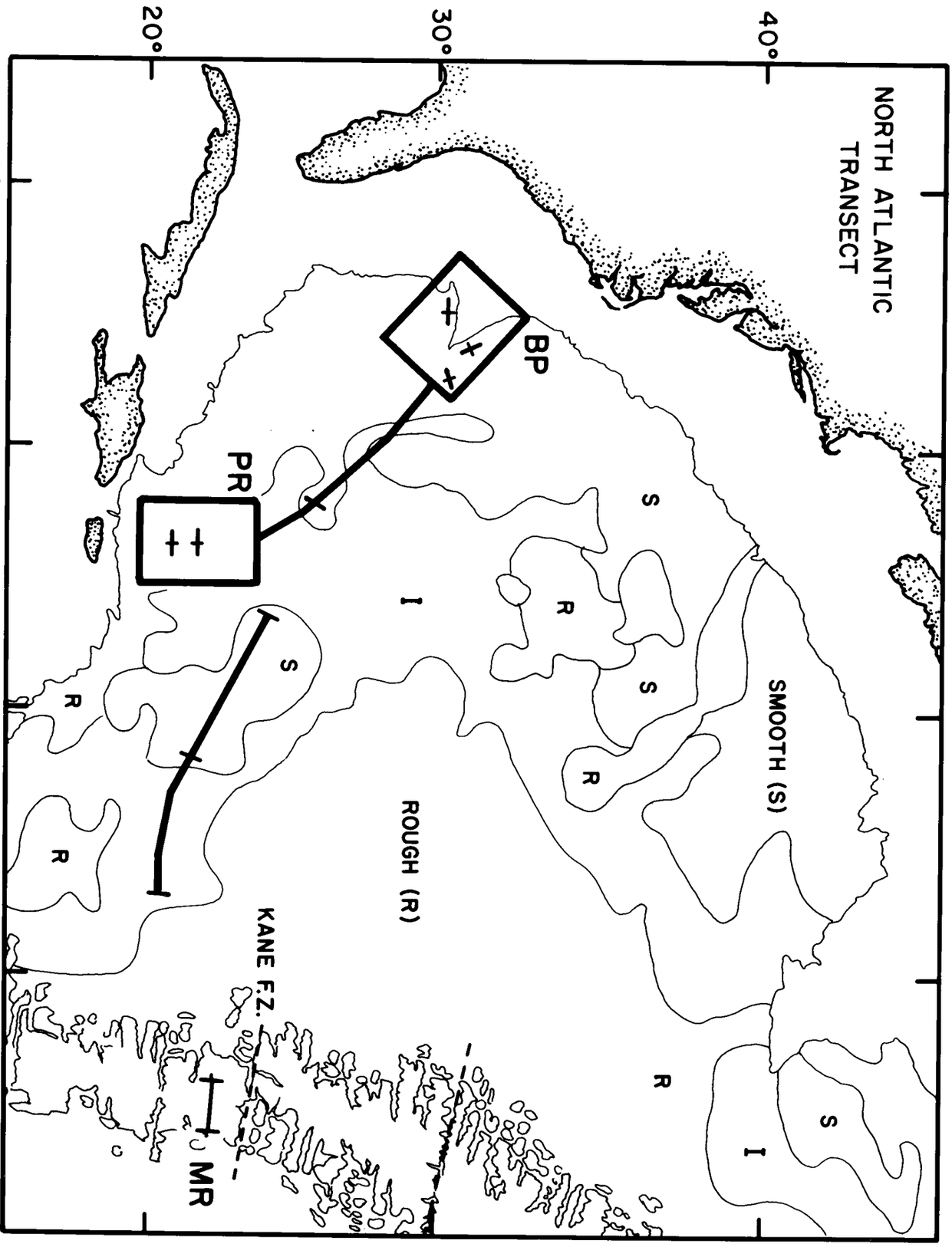
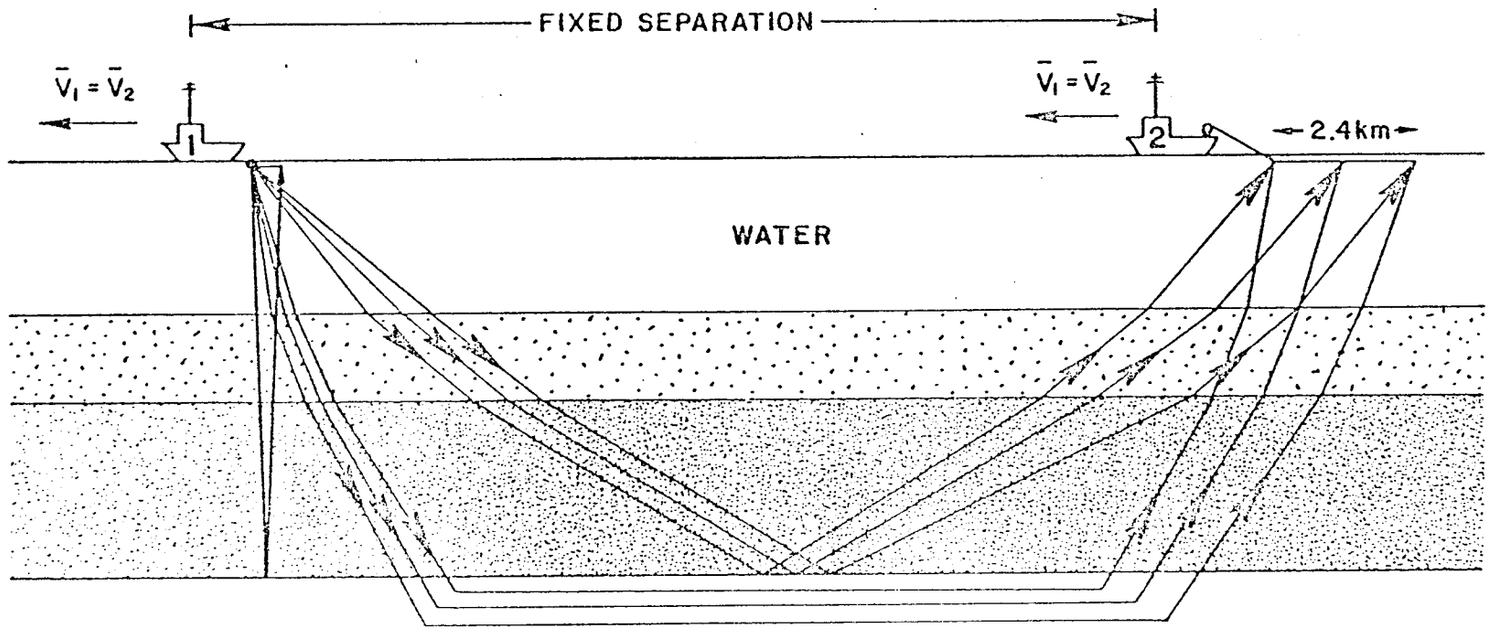

NORTH ATLANTIC
TRANSECT
BP
PR
MR
KANE F.Z.
SMOOTH (S)
ROUGH (R)
S
R
I
20°
30°
40°
80°
70°
60°
50°
40°

Fig. 2. The Constant Offset Profile (COP) experiment. Both ships travel at the same speed and in the same direction. Separation is continuously monitored by the receiving ship and speed changes are made when it falls outside the prescribed bounds. Raypaths are shown for reflected and refracted events.



CONSTANT OFFSET EXPERIMENT

Fig. 3. The multiple-source/receiving array shot sequence for maximum fold CDP gathering of 3 ship data with no initial offset. (S_3-R_3 is not shown.) The sources and arrays procede from right to left. The S_1-R_1 data is obtained first as shown at the top, and is similar to normal CDP gathering. Immediately after the S_1-R_1 data, both the S_1-R_2 and S_2-R_1 Data are recorded. Since S_1 and S_2 are fired at different times, the S_1-R_2 and S_2-R_1 bounce points will not in general coincide, smearing the CDP. The heavy ray paths indicate source receiver pairs which contribute to a single CDP. The light ray paths indicate source receiver pairs which contribute to other CDPs. Since the complete source-receiving sequence contains three shots, one from each ship, the CDP bin size for full fold coverage is three times that of single CDP profiling.

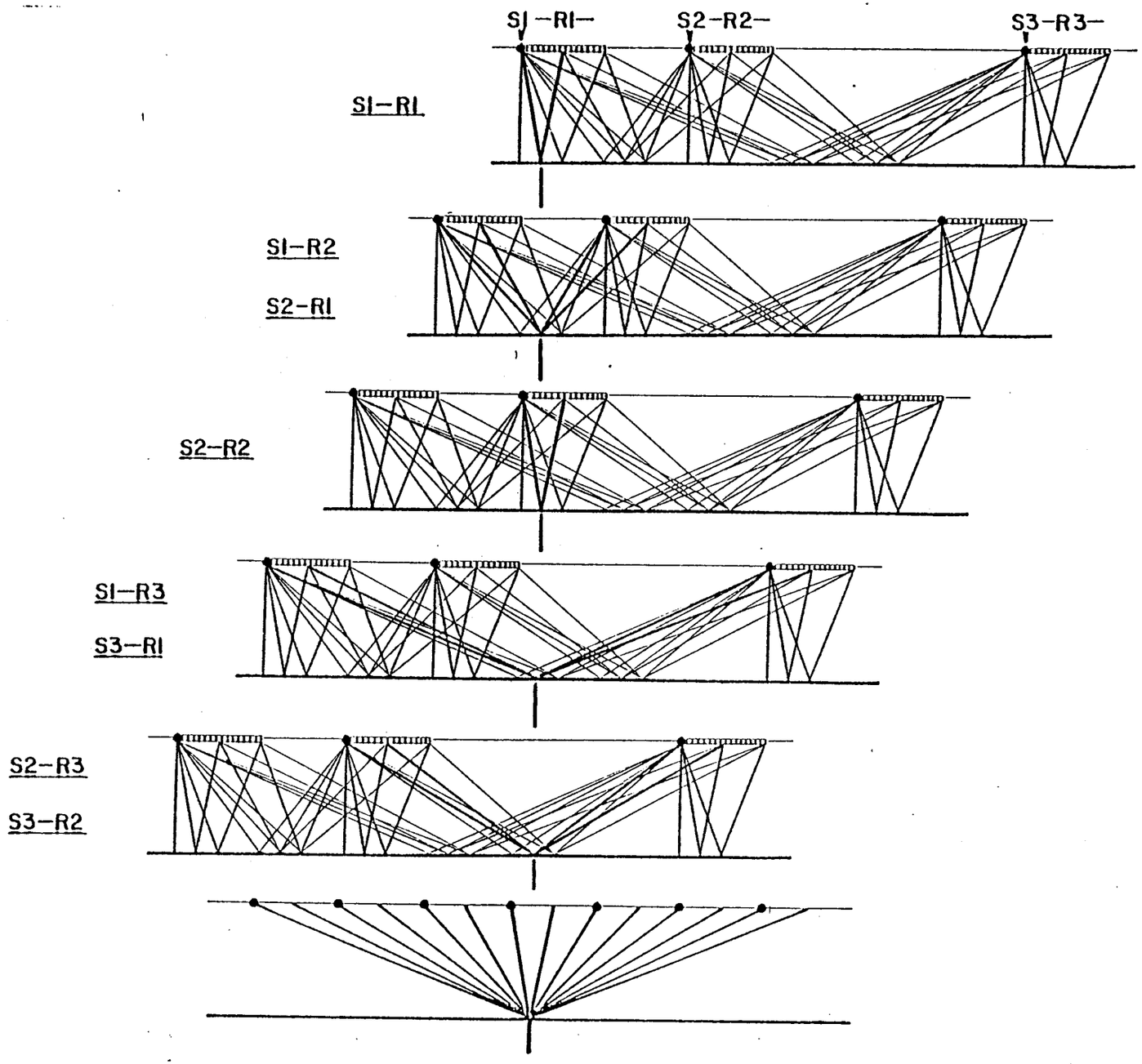


Figure 3

Figure 4 The Expanding Spread Profile (ESP) Experiment. The two ships start at the center of the diagram and each steams outward @ 5 knots. The shooting ship is on the right and the receiving ship is on the left. Reflections are received across the 1.8 km wide column in the center of the diagram. This reflection zone does not move as the ships separate. Refractions which travel horizontally along the various interfaces are also recorded, but their ray paths are not shown in the diagram.

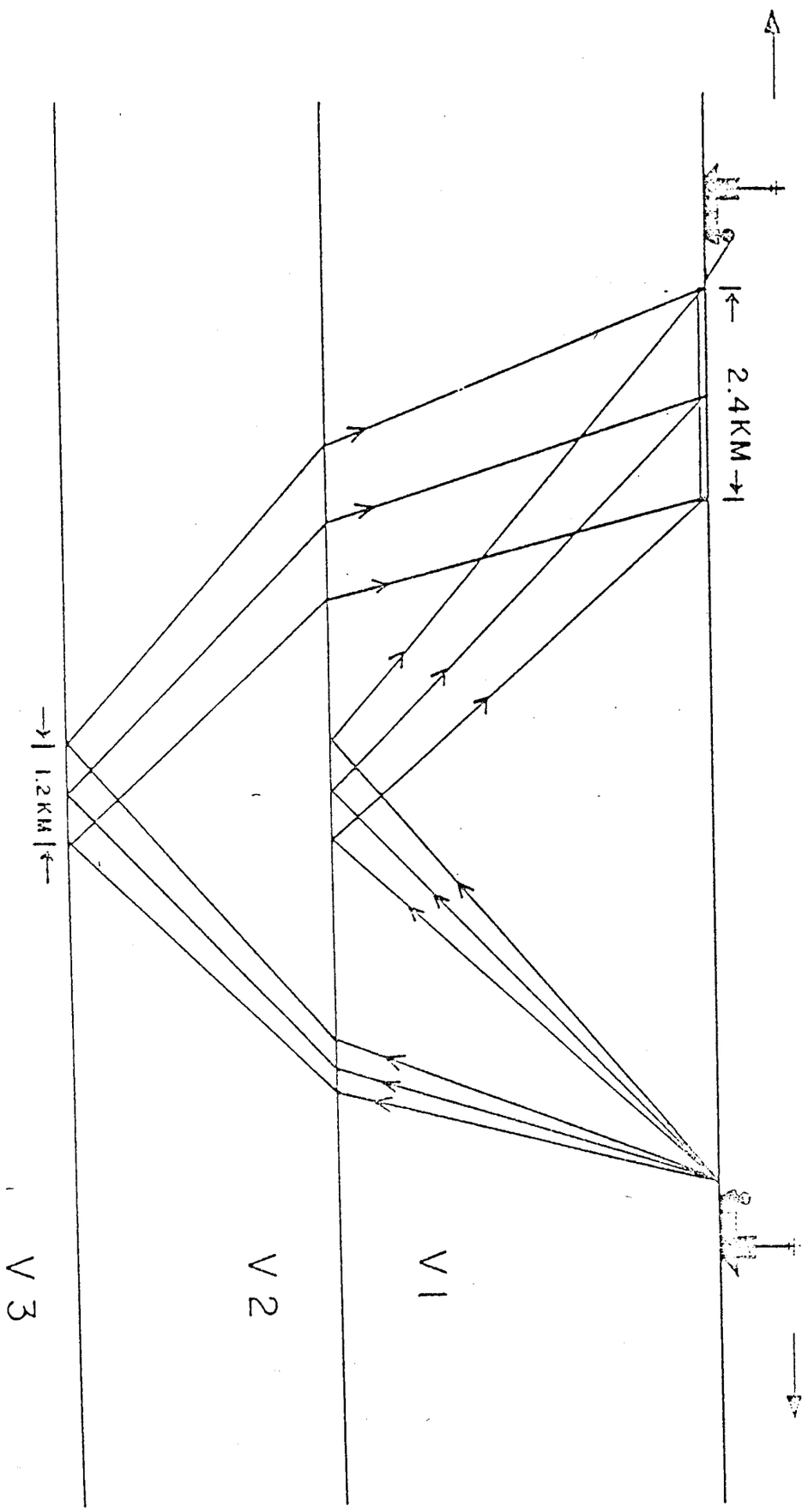
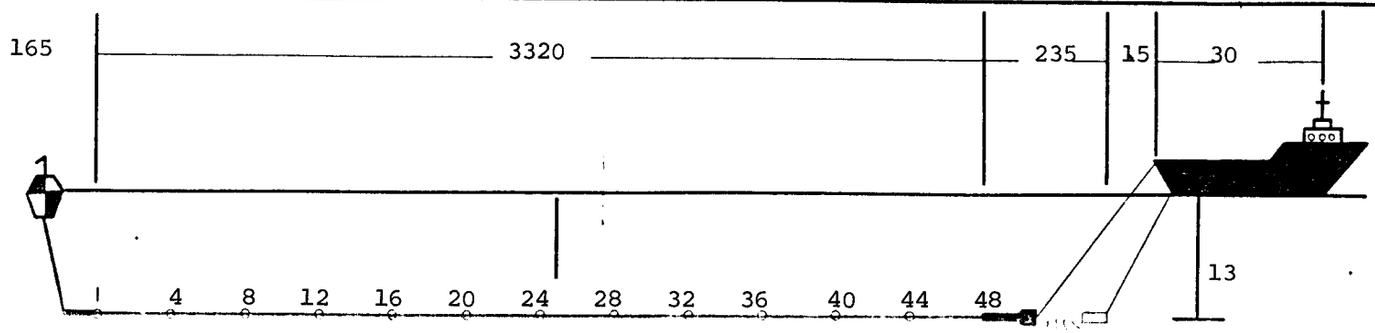


Figure 4

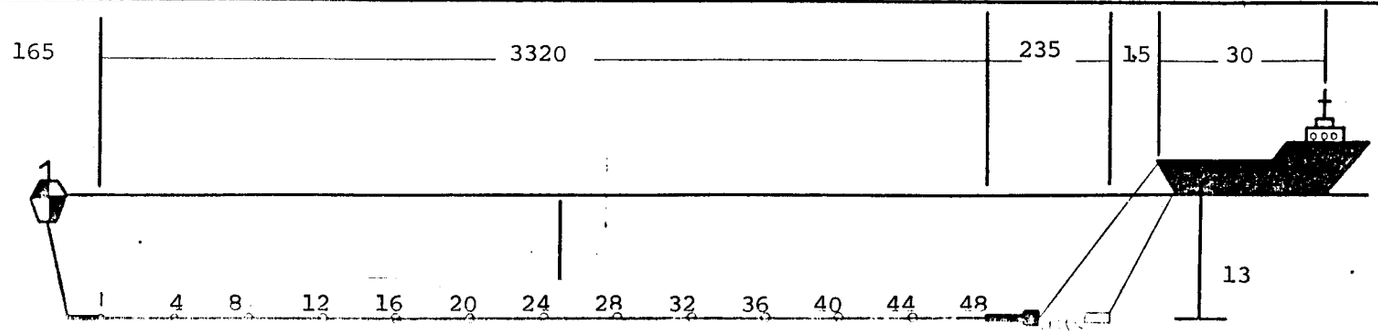
UT-MSI GEOPHYSICS LABORATORY

CRUISE FM 10, Leg 1	LINE S Test 1 - 17
START TIME 0346 Z 12 Aug. START LAT. - START LONG. -	END TIME 1000 Z 31 Aug. ENDING LAT. - ENDING LONG. -
SOURCE Bolt Airguns SOURCE DEPTH 13.0 meters	SOURCE CAPACITY #1 Gun = 1000 in^3 Port 2932 in^3 @ 2000 psi #2 Gun = 466 in^3 @ 60 sec Rep Rate #3 Gun = 466 in^3 #4 Gun = 1000 in^3 Starboard
NO. OF TRACES 48. NEAR TRACE 250 (stern) 235 (Gun array)	GROUP INTERVAL 70 meters FAR TRACE 3570 (stern) 3555 (gun array)
INSTRUMENT DFS IV FILTERS: LOW out HIGH 62 NOTCH out	GAIN MODE Instantaneous Floating Point (IFP) SLOPE - SLOPE 72 db/Oct. SLOPE -
DATA LENGTH MIN. 0-20 MAX. 0-39 SAMPLE RATE 4 ms NOMINAL FOLD 12	
REMARKS Western Geophysical Hydrophone streamer, 2.7 in O.D., 30 meter active with 40 meter dead sections = 70 meter group interval, nomilal depth = 13 m active length (traces 1 - 48) = (70 x 48) - 40 = 3320 Near trace (48) distance = 250 m = 100 m leader + 70 m stretch + 40 m dead + 40 m dead	



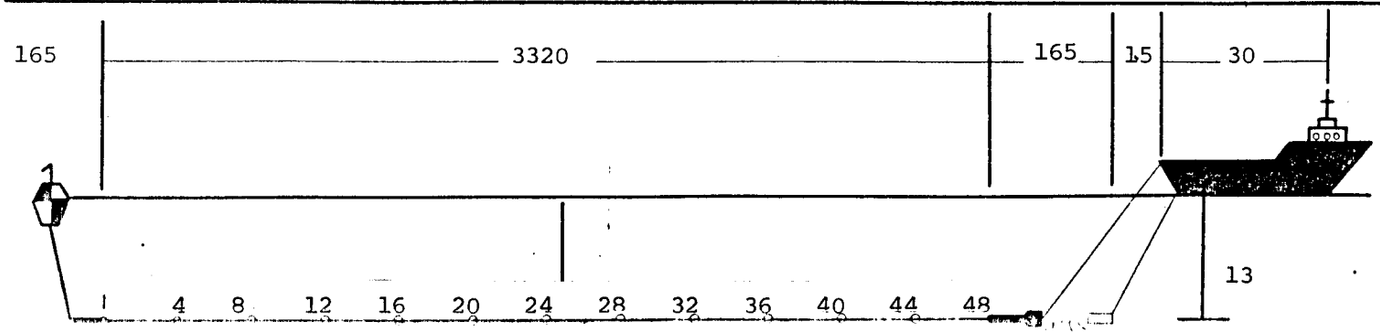
UT-MSI GEOPHYSICS LABORATORY

CRUISE FM 10, LEG 2	LINES 22-36
START TIME 0553 7 September START LAT. - START LONG. -	END TIME 2209 17 September ENDING LAT. - ENDING LONG. -
SOURCE Unchanged from FM 10-1 SOURCE DEPTH Unchanged	SOURCE CAPACITY Unchanged
NO. OF TRACES Unchanged NEAR TRACE Unchanged	GROUP INTERVAL Unchanged FAR TRACE Unchanged
INSTRUMENT Unchanged FILTERS: LOW Unchanged HIGH Unchanged NOTCH Unchanged	GAIN MODE Unchanged SLOPE Unchanged SLOPE Unchanged SLOPE Unchanged
DATA LENGTH MIN. unc. MAX. unc SAMPLE RATE unc NOMINAL FOLD unc.	
REMARKS Unchanged	



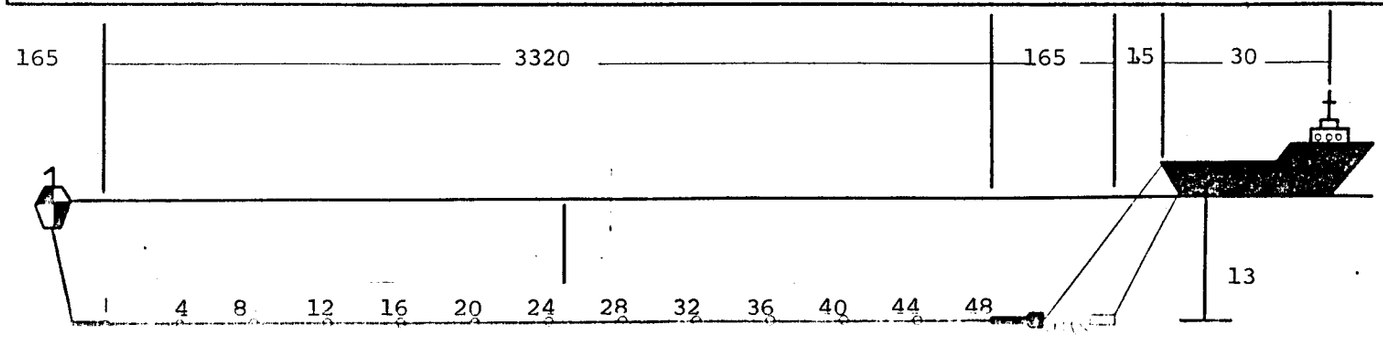
UT-MSI GEOPHYSICS LABORATORY

CRUISE FM 10, LEG 2	LINEs 38-41
START TIME 0445 21 September START LAT. - START LONG. -	END TIME 1201 22 September ENDING LAT. - ENDING LONG. -
SOURCE Unchanged from FM 10-1 SOURCE DEPTH Unchanged	SOURCE CAPACITY Unchanged
NO. OF TRACES Unchanged NEAR TRACE 180 (stern) 165 (Gun array)	GROUP INTERVAL Unchanged FAR TRACE 3500 (stern 3485 (Gun array)
INSTRUMENT Unchanged FILTERS: LOW Unchanged HIGH Unchanged NOTCH Unchanged	GAIN MODE Unchanged SLOPE Unchanged SLOPE Unchanged SLOPE Unchanged
DATA LENGTH MIN. UNC. MAX. UNC. SAMPLE RATE UNC. NOMINAL FOLD UNC.	
REMARKS Near Trace (48) Distance = 180 m = 100 m leader + 40 m Dead + 40 m Dead (stretch section removed) Otherwise Streamer/Source Configuration Unchanged	



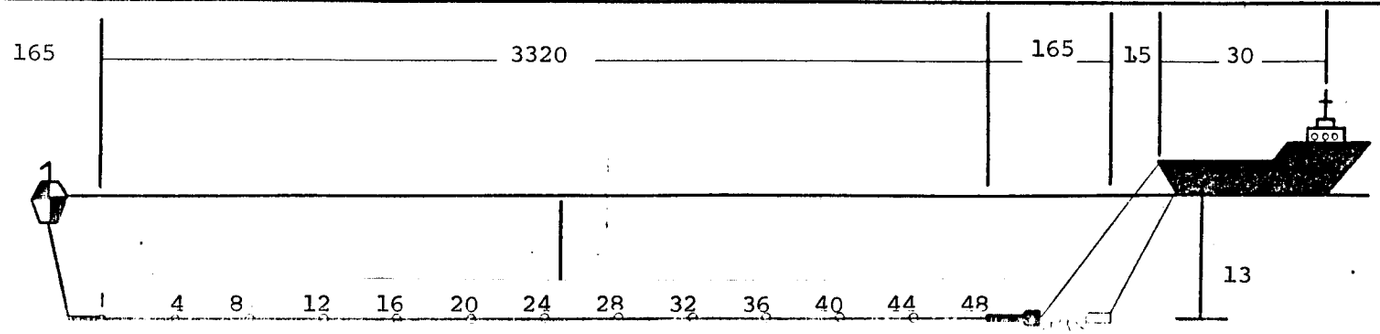
UT-MSI GEOPHYSICS LABORATORY

CRUISE FM 10, Leg 3	LINE S 42-43
START TIME 2202 6 October START LAT. - START LONG. -	END TIME 1307 8 October ENDING LAT. - ENDING LONG. -
SOURCE Unchanged from FM10-1 SOURCE DEPTH Unchanged	SOURCE CAPACITY #1 Gun = 1000 in^3 1932 in^3 @ 2000 pdi #2 Gun = 466 in^3 @ 30 sec. Rep. Rate #3 Gun = 466 in^3
NO. OF TRACES Unchanged from FM-10 - 2 NEAR TRACE	GROUP INTERVAL Unchanged FAR TRACE Unchanged from FM 10 - 2
INSTRUMENT Unchanged FILTERS: LOW Unchanged HIGH Unchanged NOTCH Unchanged	GAIN MODE Unchanged SLOPE Unchanged SLOPE Unchanged SLOPE Unchanged
DATA LENGTH MIN. 0-12 MAX. 0-15 SAMPLE RATE 4 ms NOMINAL FOLD 24	
REMARKS Streamer Configuration Unchanged from FM 10-2	



UT-MSI GEOPHYSICS LABORATORY

CRUISE FM 10 LEG 3	LINE S 43-58
START TIME 1307 8 October START LAT. - START LONG. -	END TIME 1730 22 October ENDING LAT. - ENDING LONG.-
SOURCE Unchanged from FM 10-1 SOURCE DEPTH Unchanged	SOURCE CAPACITY #1 Gun = 1000 in^3 2466 in^3 @ 2000 psi #2 Gun = 466 in^3 @ 30 sec Rep. Rate #4 Gun = 1000 in^3
NO. OF TRACES Unchanged NEAR TRACE Unchanged	GROUP INTERVAL Unchanged FAR TRACE Unchanged
INSTRUMENT Unchanged FILTERS: LOW Unchanged HIGH Unchanged NOTCH Unchanged	GAIN MODE Unchanged SLOPE Unchanged SLOPE Unchanged SLOPE Unchanged
DATA LENGTH MIN. 5-10 MAX. 6-26 SAMPLE RATE 4ms NOMINAL FOLD 24	
REMARKS Unchanged	



Important remarks:
"Two ship method" together with S/V Fred H. Moore
See drawing for "Wide Aperture CDP Survey" and
"Expanding Spread Profiles"

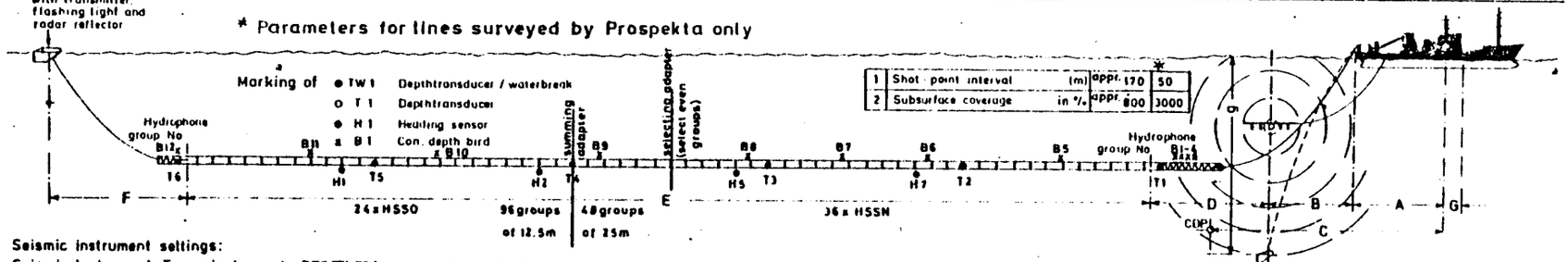
Client: BGR
812002

Operating Parameters

(Marine Geophysical Surveys)

Survey Vessel Prospekta Party Chief G. Müller

* Parameters for lines surveyed by Prospekta only



1	Shot - point interval (m)	appr.	170	50
2	Subsurface coverage in %	appr.	800	3000

Seismic instrument settings:

Seismic Instrument: Texas Instruments, DFS V (IFP)

31	Number of seismic channels	60
32	Number of auxiliary channels	2
33	Record length, recording time (s)	20
34	Sampling rate (ms)	4
35	Gain constant (dB)	24
36	Filter LC (Hz - dB/Oct)	5.3/18
37	Filter HC (Hz - dB/Oct)	64/70
38	Polarity on tape (compressional arrivals)	negative
39	Recording mag. tape size/track	1/2"/9
40	Recording format / packing density	SEGB/1600 BPI
41	Mode of data protection	none
42	Monitor seismogr recorded at every SP	th
43	Line profiler recording of every SP; detector group	
44	Auxiliary channel 1	Sone buoy
45	" " 2	2 x DD (shot release)
46	" " 3	
47	" " 4	
48	" " 5	

Marine seismic streamer: System PRAKLA-SEISMOS

51	Type with transformer, number of sections HSSH/HSSK (pcs)	/
52	Type, transformerless, number of sections HSSN/HSSO (pcs)	36/24
53	Length of main streamer / high resolution str. (m)	3000 /
54	Main streamer, detector spacing/hydroph.p group, (m/pcs)	22/33
55	High resolution streamer, detect.spac/hydroph.p group, (m/pcs)	/
56	Streamer interface DSS V 60 channels, selectivity setting V/bar	20/1
57	Type of hydrophones, HSSH/HSSK streamer	
58	Type of hydrophones, HSSN/HSSO streamer HC 202 E	
59	Number of waterbreaks / Number of depthtransduc.	6
60	Number and evenspacing of heading sensors (pcs/m)	4 /
61	Number of Con depth birds ADCD (pcs)	12

Data logging: System PRAKLA-SEISMOS, "INDAS V" comprising of:

74	Computer system pdp 11/24 with terminals and storing cap	128 K
75	Dead reconing mode: bottom track, watertrack, nav. radio	yes
76	Prior navigation system Loran C receiver/s	2
77	Secondary nav system Sat.-Nav.	
78	Tertiary nav. system Omega	
79	Spheroid: WGS 72 / 71 Datum:	
80	Central Meridian:	

Digital navigation data recordings

71	Recording interval: 1 record - 1 SP (m)	appr. 110	50
72	Recording mag tape size/track	1/2" 9	
73	Recording format IBM compatible		

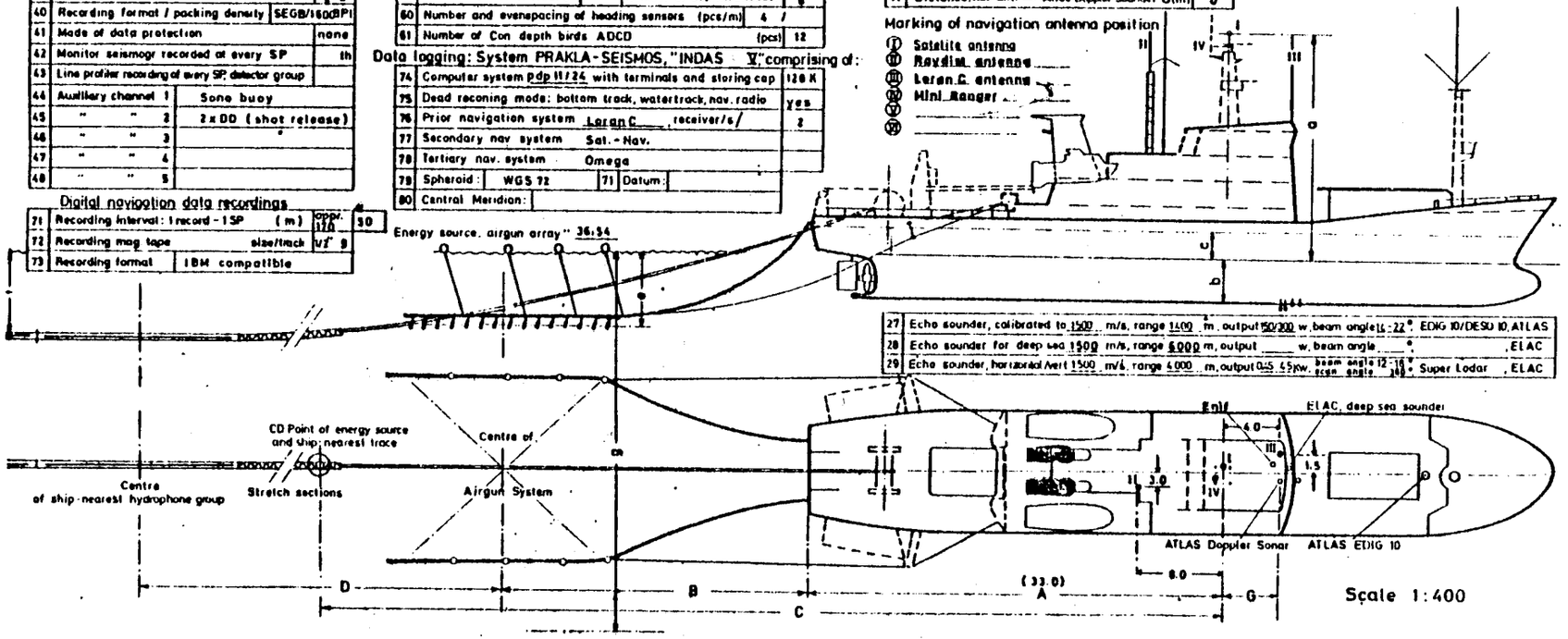
Geometric configuration of energy source and detectors

11	Distance, nav. antenna — ship's stern A (m)	33	
12	Distance, ship' stern — energy source cent B (m)	55	
13	Distance, nav. ant prior syst. — com depth point C (m)	167	
14	Distance, centre source — centre ship's D (m)	150	
	nearest detector group		
15	Distance, centre ship's nearest — centre E (m)	2975	
	ship's farthest detector group		
16	Distance, centre farthest detect group-tailbuoy F (m)	185	
17	Distance, nav ant. — Atlas Doppler Sounder G (m)	0	

19	Hight, nav ant — sea level a' (m)	20	
20	Hight, nav. ant. — sea level a'' (m)	20	
21	Depth, sea level — echo sounder b (m)		
22	Hight, main deck — sea level c (m)		
23	Depth of energy source e (m)	6.5	
24	Depth of seism. streamer detectors f (m)	13	
25	Depth of deep tow hydrophone, far field g (m)		

Marking of navigation antenna position

I Satelite antenna
II Raydist. antenna
III Loran C. antenna
IV Mini Ranger
V
VI
VII

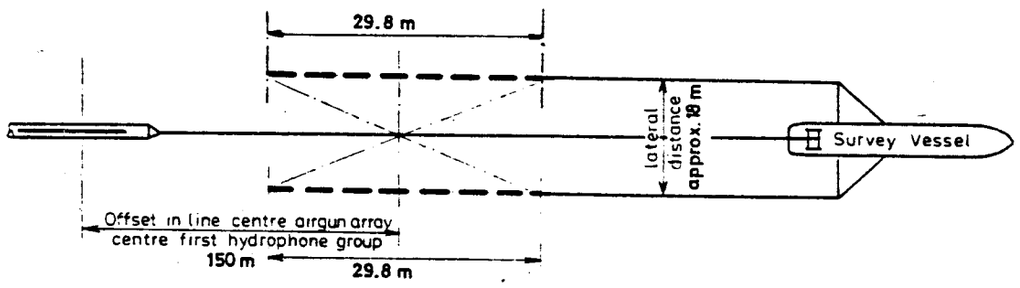


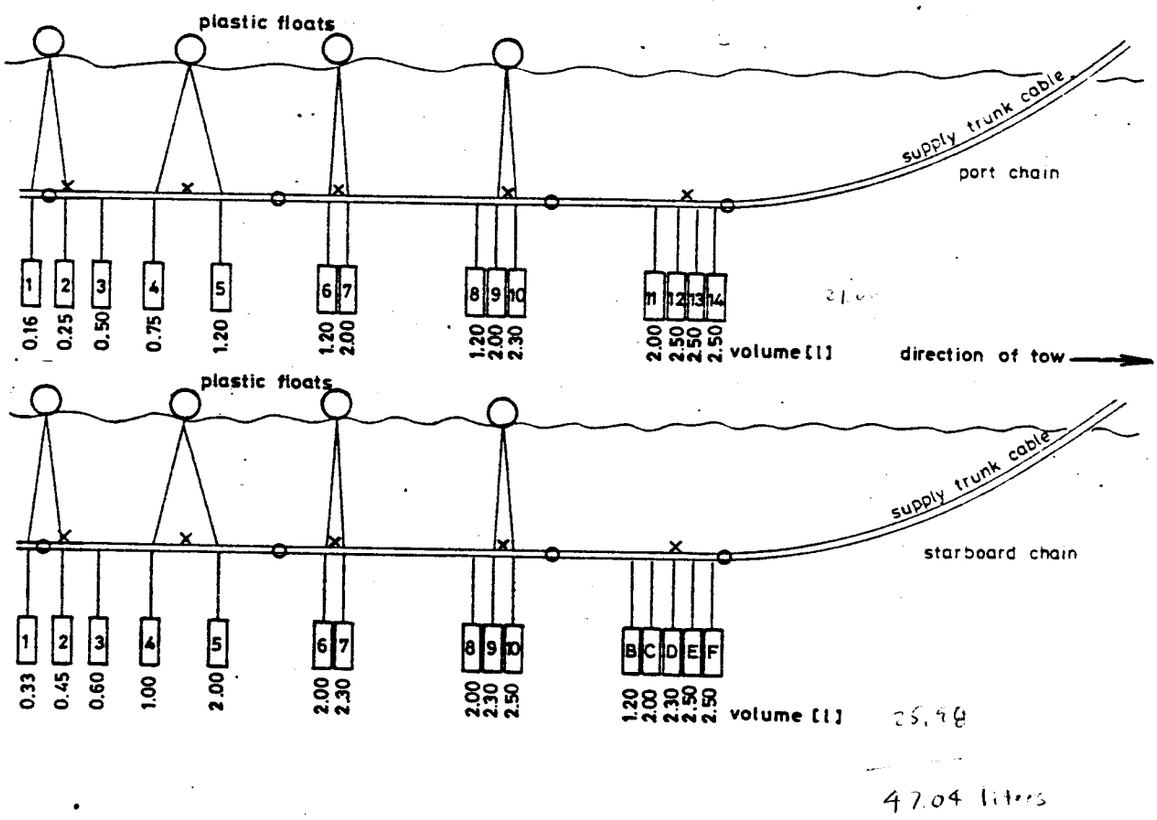
27	Echo sounder, calibrated to 1500 m/s, range 1400 m, output 150/300 w, beam angle 16 : 22 °	EDIG 10/DESO 10, ATLAS		
28	Echo sounder for deep sea 1500 m/s, range 6000 m, output w, beam angle °	ELAC		
29	Echo sounder, horizontal/vert 1500 m/s, range 4000 m, output 0.5 4.5 kw, beam angle 12 - 16 ° ocean angle 30 °	Super Lodar	ELAC	

Figure 6

Technical Data of Energy Source

Figure 7





47.04 litres

X = near field hydrophones

O = open air hoses for hydrostatic depth indication

Table 1a
SEISMIC LINE SUMMARY

CRUISE Fred H. Moore 10-1 DATES Aug 12 - 31, 1981 PAGE 1 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS(KM)	COMMENTS	LINE TYPE	START TAPE	END TAPE	RECORD INTERVAL
Test 1	8/12	0346:35	29°06.95N	-077°10.650	8/12	0509:35	29°08.765	-077°01.542	12	15	Moore single ship CDP Line	CDP	101001	101002	0-12
Test 2	8/12	0510:05	29°08.76S	-077°01.542	8/12	1433:05	28°39.199	-076°27.097	12	83	Moore single ship CDP Line	CDP	101003	101012	0-12
NAT-01	8/15	0002:35	28°35.060	-076°24.220	8/15	0900:05	28°03.820	-075°40.270	12	93	Prospekta/Moore 2-ship wide Aperture line both ships shooting & receiving togeth	COP	101013	101030	0-20
NAT-02	8/15	1306:35	28°06.810	-075°50.000	8/15	1815:05	28°18.510	-075°23.420	12	52	Prospekta/Moore 2-ship wide Aperture Line both ships shooting & rec. togeth.	COP	101031	101040	0-20
NAT-02A	8/15	2300:05	28°13.970	-075°37.820	8/17	0515:05	29°37.820	-072°57.530	12	301	Prospekta/Moore 2-ship wide Aperture line ea. ship rec & shooting alternately	COP	101041	101099	0-20
NAT-03	8/17	1020:05	29°27.94	-072°55.14	8/18	1530:05	30°43.640	-075°32.740	12	203	Prospekta/Moore 2-ship wide Aperture line ea. ship rec & shooting alternately	COP	101100	101155	0-20
NAT-03A	8/18	1937:35	30°40,560	-075°25.540	8/19	0030:05	30°53.900	-075°52.580	12	52	Prospekta/Moore 2-ship wide Aperture line ea. ship rec & shooting alternately	COP	101156	101166	0-20
NAT-04	8/19	0405:05	30°52.960	-075°50.540	8/19	0651:05	30°48.580	-076°06.170	-	28	Moore receiving only ESP4	ESP	101167	101171	0-39
NAT-5(4A)	8/19	0825:00	30°56.900	-076°75.7	8/19	1353:00	30°48.7	-076°076.4	30	56	Prospekta single ship CDP Line reshoot of ESP4	CDP			
NAT-06(5)	8/29	0110:35	30°51.830	-076°06.450	8/21	0010:05	31°44.370	-077°40.110	12	181	Prospekta/Moore 2-ship wide Aperture line,High seas, Noisy data Trop. Str. Denni	COP	101172	101217	0-20
NAT-100	8/21	1019:05	32°44.000	-077°38.400	8/21	1818	32°20.600	-077°08.100	30	56	Prospekta single ship CDP Line	CDP			
NAT-07	8/21	1820:05	32°22.670	-077°10.120	8/22	0130:05	31°59.400	-076°38.400	12	69	Prospekta/Moore 2-ship wide Aperture line, Moore shooting only. Streamer aboard	COP			
NAT-07A	8/22	0131	31°57.100	-076°35.6	8/22	0330	31°51.100	076°26.9	30	37	Prospekta shingle ship CDP line	CDP			

TABLE 1a
SEISMIC LINE SUMMARY

CRUISE Fred H. Moore 10-1 DATES Aug 12-31, 1981 PAGE 2 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS (KM)	COMMENTS	LINE TYPE	START TAPE	END TAPE	RECORD INTERVAL
NAT-08	8/22	0440	31°50.300	-076°32.2	8/22	1006	32°08.900	077°00.2	30	50	Prospekta single ship CDP Line	CDP			
NAT-09			PROSPEKTA FALSE START OF		NAT-09A		NO DATA TAKEN			0					
NAT-09A	8/22	1800:05	32°11.590	-076°46.380	8/24	0519:35	31°10.780	-073°41.950	12	324	Prospekta/Moore 2-ship wide Aperture line ea. ship shoo ing & rec. alternately	COP	101218	101288	0-20
NAT-10	8/24	0813:05	31°11.79	-073°43.38	8/24	1124:05	31°26.29	-073°51.1	-	30	Moore receiving only ESP 3	ESP	101289	101294	0-39
NAT-11 (10A)	8/24	1541:00	31°06.10	-073°42.5	8/24	1855:21	31°24.50	-073°50.0	30	63	Prospekta single ship CDP line reshoot of ESP 3	CDP			
NAT-12 (11)	8/24	2136:05	31°12.170	-073°47.860	8/25	1100	30°50.680	-072°37.260	12	120	Prospekta/Moore 2-ship wide Aperture ea. ship rec. & shooting alternately	COP	101295	101321	0-20
NAT-13	8/25	1321:05	30°51.710	-072°40.370	8/25	1659:05	31°08.080	-072°32.350	-	33	Moore receiving only ESP 2	ESP	101322	101328	0-39
NAT-14	8/26	0311:05	30°51.970	-072°40.130	8/26	1926:05	29°24.460	-073°12.040	12	157	Moore/Prospekta 2-ship wide aperture, Moore leading shooting both ships guns	COP	101329	101361	0-20
											Prospekta shoot only initial ly, later Moore trigger Pro spekta DFS recording also.				
											after 1831 DFS IV recording on Prospekta				
NAT-15	8/26	2230:05	29°31.850	-073°14.390	8/29	1920:20	24°50.176	-068°07.660	12	695	Prospekta/Moore 2-ship wide aperture, both ship rec. & shooting alternately with	COP	101362	101498	0-20
											Moore triggering and record all timing nav. info. Prospekta's computer down				

TABLE 1a
SEISMIC LINE SUMMARY

CRUISE Fred H. Moore 10-1 DATES Aug 12-31, 1981 PAGE 3 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS (KM)	COMMENTS	LINE TYPE	START TAPE	END TAPE	RECORD INTERVAL
NAT-16	8/29	2230:05	24°54.086	-068°06.343	8/30	0146:05	25°08.054	-067°59.572	-	28	Moore receiving only ESP-5	ESP	101499	101505	0-39
NAT-17	8/30	0535:05	24°57.773	-068°09.336	8/31	1000:05	22°27.614	-066°29.026	12	333	Prospekta/Moore 2-ship wide aperture both ship shooting alternately & rec. w/Moore triggering & recording all timing Nav. info. Prospekta computer down	COP	101506	101561	0-20
								TOTAL		3059 km					

TABLE 1b
SEISMIC LINE SUMMARY

CRUISE FM10-2 DATES 6 Sept. - 22 Sept. 1981 PAGE 1 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS (KM)	LINE TYPE	START TAPE	END TAPE	COMMENTS	RECORD INTERVAL (S)
NAT-18	9/6	0506	18°45.0'N	65°45.0'W	9/6	1827	19°-55.8'N	65°45.38'W	30	131.1	CDP			Prospekta positions, very approximate	
NAT-19	9/6	2037	19°54.06'N	65°44.26'W	9/6	0237	19°51' N	66°15"W	30	53.8	CDP			Prospekta positions, very approximate	
NAT-20	9/6	0516	19°50.98'N	66°15'W	9/6	1741	18°43.47'N	66°13.71"W	30	125.04	CDP			Prospekta positions, very approximate	
NAT-21	9/6	2026	18°45.24'N	66°14.97'W	9/7	0106	18°45.36'N	66°37.44'W	30	38.0	CDP			Prospekta positions, very approximate	
NAT-22	9/7	0553	19°01.9'N	66°32.6'W	9/7	2253	20°30.0'N	66°30.0'W	12	162.6	COP	101563	101593		0-20
NAT-23	9/8	0130	20°30.0'N	66°30.0'W	9/8	0335	20°26.0'N	66°43.0'W	12	23.7	ESP 6	101594	101598	Moore position at end & center of ESP 6	0-39
NAT-23	9/8	0125	20°30.45'N	66°30.96'W	9/8	0325	20°32.28'N	66°20.02'W	12	19.27				Prospekta position at end of ESP 6 Approx.	center &
NAT-24	9/8	0447	20°31.78'N	66°22.36'W	9/8	0630	20°29.87'N	66°31.67'W	30	16.53	CDP			Prospekta positions, very approximate	
NAT-25	9/8	0806	20°25.0'N	66°30.0'W	9/8	1645	21°11.0'N	66°30.0'W	12	84.8	COP	101599	101615		0-20
NAT-26	9/8	1913	21°10.0'N	66°30.0'W	9/8	2210	21°10.0'N	66°44.0'W	12	24.3	ESP 7	101616	101622	Moore position at end & center of ESP 7	0-39
NAT-26	9/8	1855	21°10.03'N	66°31.16'W	9/8	2149	21°09.96'N	66°15.00'W	12	27.9				Prospekta position at end of ESP 7 approx.	center &
NAT-27	9/8	2239	21°09.09'N	66°16.06'W	9/9	0204	21°10.22'N	66°37.03'W	30	36.3	CDP			Prospekta positions, approximate	
NAT-28	9/9	2206	21°10.63'	64°27.14'W	9/10	0242	22°25.51'N	64°09.20'W	30	41.3	CDP			Prospekta positions, approximate	
NAT-29	9/10	0515	22°24.9'N	64°09.9'W	9/10	0804	22°38.0'N	64°04.6'W	30	25.8	ESP 8A	101623	101627	Moore position at end and center ESP 8A	0-39

TABLE 1b
SEISMIC LINE SUMMARY

CRUISE FM10-2 DATES 6 Sept.-22 Sept. 1981 PAGE 2 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS (KM)	LINE TYPE	START TAPE	END TAPE	COMMENTS	RECORD INTERVAL (S)
NAT-29	9/10	0515	22°25.83'N	64°09.68'W	9/10	0759	22°13.75'N	64°17.56'W	30	26.1				Prospekta position at end of ESP 8A approx.	center &
NAT-30	9/10	0914	22°13.76'N	64°17.54'	9/10	1416	22°36.82'N	64°04.75'W	30	46.2	CDP			Prospekta positions, very approximate	
NAT-31	9/10	1916	22°25'N	64°10'W	9/12	1039	21°00'N	60°50'W	12	378.9	COP	101628	101703		0-20
NAT-32	9/12	1637	20°47.01'N	60°54.98'W	9/12	1922	21°00.73'N	60°49.71'W	30	27.0	CDP			Prospekta preshot ESP 9 in two stages	
NAT-32A	9/13	2226	21°00.22'N	60°49.89'W	9/14	0107	20°14.07'N	60°44.59'W	30	27.3	CDP			Prospekta positions, approx. preshot ESP 9 in two stages	
NAT-33	9/14	1223	21°00.0'N	60°50.0'W	9/14	1455	21°12.8'N	60°46'W	30	24.6	ESP 9	101704	101709	Moore position at end & center ESP 9	0-39
NAT-33	9/14	1203	21°02.21'N	60°49.00'W	9/14	1518	20°45.97'N	60°55.45'W	30	32.0				Prospekta position at end of ESP 9 approx.	center &
NAT-34A	9/14	2032	21°00.0'N	60°50.0'W	9/15	1530	20°20'N	59°18'W	12	175.9	COP	101710	101787		0-20
NAT 34B	9/15	1530	20°20'N	59°18'W	9/16	0200	20°10'N	58°20'W	12	102.6	COP				0-20
NAT 34C	9/16	0200	20°10'N	58°20'W	9/16	1234	20°12'N	57°15'W	12	113.3	COP				0-20
NAT-35	9/16	1238	20°12'N	57°15'W	9/17	1501	20°00'N	55°00'W	12	235.2	COP	101788	101840		0-20
NAT-36	9/17	1907	20°00.2'N	54°56.8'W	9/17	2209	20°13.7'N	54°56.8'W	12	24.8	ESP10	101841	101846	Moore position at end & center ESP 10	0-39
NAT-36	9/17	1858	20°01.65'N	54°56.91'W	9/17	2139	19°46.54'N	54°56.78'W	12	28.0				Prospekta position at end of ESP 10 approx.	center &
NAT-37	9/17	2305	19°46.66'N	54°56.82'W	9/18	0443	20°13.68'N	54°58.08'W	30	50.1	CDP			Prospekta reshoots ESP 10 position approx.	

TABLE 1b
SEISMIC LINE SUMMARY

CRUISE FM10-2 DATES 6 Sept.-22 Sept. 1981 PAGE 3 OF 3

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS(KM)	LINE TYPE	START TAPE	END TAPE	COMMENTS	RECORD INTERVAL(S)
NAT-38	9/21	0445	22°37.7'N	45°02.3'W	9/21	0659	22°51.3'N	45°01.00'W	30	25.2	ESP11	101847	101851	Moore position at end & center ESP	0-39
NAT-38	9/21	0431	22°40.67'N	45°02.14'W	9/21	0743	22°23.99'N	45°03.60'W	30	31.0				Prospekta position at end of ESP 11 approx.	center &
NAT-39	9/21	1001	22°51.3'N	45°01.0'W	9/22	0616	22°51.3'N	43°29.7'W	24	156.6	CDP	101852	101892	Moore single ship CDP Line	0-20
NAT-40	9/21	2311	22°37.73'N	43°31.66'W	9/22	0414	23°03.93'N	43°27.54'W	30	49.0	CDP			Prospekta positions, approximate	
NAT-41	9/22	0850	22°51.3'N	43°29.6'W	9/22	1201	23°04.0'N	43°27.5'W	30	23.7	ESP12	101893	101899	Moore position at end & center ESP 12	0-39
NAT-41	9/22	0817	22°53.53'N	43°29.36'W	9/22	1153	22°37.62'N	43°32.05'W	30	29.8				Prospekta position at end ESP 12 approx.	center &
										2518.2					

TABLE 1c
SEISMIC LINE SUMMARY

CRUISE FM10-3 DATES 6 Oct. - 22 Oct. 1981 PAGE 1 OF 2

LINE #	START DATE	START GMT	START LATITUDE N +	START LONGITUDE W -	END DATE	END GMT	END LATITUDE N +	END LONGITUDE - W	FOLD	DIS (KM)	LINE TYPE	START TAPE	END TAPE	COMMENTS	RECORD INTERVAL (S)
NAT-42	10/6	2202	19°31.703	065°30.035	10/8	0846	22°28.018	065°29,833	24	327	CDP	103001	103051	Moore Single Ship	0-15
NAT-43	10/8	0933	22°29.151	065°33.285	10/8	2004	22°30.339	066°28.280	24	198	CDP	103052	103068	" " "	"
NAT-44	10/8	2053	22°24.830	066°31.520	10/10	2030	18°32.975	066°30.085	24	435	CDP	103069	103137	" " "	"
NAT-45	10/10	2231:30	18°39.893	066°28.304	10/11	1450:30	19°31.816	067°29.704	24	151	CDP	103138	103160	" " "	"
NAT-46	10/11	1452:30	19°31.976	067°29.784	10/13	0140:30	22°22.250	067°29.685	24	315	CDP	103161	103213	" " "	"
NAT-47	10/13	0812	22°15.00	067°56.650	10/14	1800	22°15.358	064°55.895	24	311	CDP	103214	103257	" " "	5-15
NAT-48	10/14	1811:30	22°14.572	064°55.895	10/15	0030	21°45.946	064°58.555	24	59	CDP	103258	103264	" " "	6-16
NAT-49	10/15	0058:30	21°44.000	064°59.934	10/16	1328:30	21°50.460	068°03.124	24	322	CDP	103264	103313	" " "	"
NAT-50	10/16	1329:30	21°50.460	068°03.124	10/16	2210	21°11.259	068°03.988	24	73	CDP	103314	103322	" " "	"
NAT-51	10/16	2245	21°10.311	068°01.674	10/18	1015	21°10.231	064°56.943	24	319	CDP	103323	103364	" " "	"
NAT-52	10/18	1034	21°08.570	064°56.390	10/18	1830	20°31.916	064°55.664	24	68	CDP	103365	103372	" " "	"
NAT-53	10/18	1900	20°29.953	064°58.006	10/20	0730	20°30.454	067°59.846	24	313	CDP	103373	103422	" " "	"
NAT-54	10/20	0745	20°31.628	068°00.511	10/20	1159:30	20°49.896	067°58.537	24	34	CDP	103423	103426	" " "	"
NAT-55	10/20	1200	20°49.369	067°58.537	10/21	1215	20°49.407	065°47.244	24	315	CDP	103426	103451	" " "	"

TABLE 1c
SEISMIC LINE SUMMARY

CRUISE FM10-3 DATES 6 Oct. - 22 Oct. 1981 PAGE 2 OF 2

LINE #	START DATE	START GMT	START LATITUDE	START LONGITUDE	END DATE	END GMT	END LATITUDE	END LONGITUDE	FOLD	DIS(KM)	LINE TYPE	START TAPE	END TAPE	COMMENTS	RECORD INTERVAL(S)
NAT-56	10/21	1230	20°47.833	065°47.327	10/21	1930	20°14.912	066°00.012	24	73	CDP	103451	103458	Moore Single Ship	6-16
NAT-57	10/21	1930:30	20°14.912	066°00.012	10/22	0810	20°14.214	067°05.905	24	113	CDP	103459	103473	" " "	"
NAT-58	10/22	0812	20°13.485	067°05.680	10/22	1730	19°23.830	067°02.591	24	92	CDP	103474	103485	" " "	"

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2a SONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	PROSPEKTA POSITION LATITUDE N	PROSPEKTA POSITION LONGITUDE W	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
01	TEST ONLY	2257:35	14 Aug	28°37.40'	76°25.59'	101016	Not recorded By Moore		For Test Only
02	NAT- 01	0204:35	15 Aug	28°28.38'	76°13.078'	101016	1000	0-20	OK
03	NAT- 01	0605:35	15 Aug	28°14.32'	75°55.22'	101025	1000	0-20	OK
04*	NAT- 02	1331:05	15 Aug	28°10.108'	75°45.65'	101031	1000	0-20	collision w/ FM
05	NAT- 02	1511:35	15 Aug	28°11.028'	75°34.046'	101035	1000	0-20	OK
06*	NAT- 02	0104:05	16 Aug	28°20.65'	75°22.74'	101044	1000	0-20	collision w/
07*	NAT- 02A	0155:05	16 Aug	28°22.76'	75°18.37'	101046	1000	0-20	collision w/ streamer of/P
08	NAT- 02A	0229:35	16 Aug	28°24.31'	75°15.55'	101047	1000	0-20	ok
09*	NAT- 02A	0650:05	16 Aug	28°36.36'	74°53.45'	101056	1000	0-20	noisey
10	NAT- 02A	0741:35	16 Aug	28°38.57'	74°49.2'	101058	1000	0-20	ok
11*	NAT- 02A	1450:05	16 Aug	28°59.77'	74°09.71'	101071	1000	0-20	not operation- al
12	NAT- 02A	1515:35	16 Aug	29°00.96'	74°07.3'	101072	1000	0-20	ok
13*	NAT- 02A	1603:35	16 Aug	29°03.49'	74°03.31'	101073	1000	0-20	Moore rec. Pro- spekta not

*Sonobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to have been entangled in Hydrophone Streamer.

All sonobuoys recorded by Moore on DFS channels 3 (LDGO RCVR) and 4 (UTIG RECVR)

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2aSONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
14	NAT- 02A	1642:35	16 Aug	29°05.29'	73°59.85'	101075	1000	0-20	ok
15	NAT- 02A	1931:05	16 Aug	29°13.21'	73°44.77'	101080	1000	0-20	ok
16	NAT- 03	1519:35	17 Aug	29°41.54'	73°22.95'	101109	1000	0-20	OK
17*	NAT- 03	1621:37	17 Aug	29°44.15'	73°28.39'	101111	1000	0-20	not operational
18*	NAT- 03	1652:30	17 Aug	29°45.54'	73°31.33'	101112	1000	0-20	abandoned because of noise
19	NAT- 03	1728:45	17 Aug	29°47.1'	73°34.7'	101113	1000	0-20	ok
20	NAT- 03	2255:05	17 Aug	30°01.38'	74°04.71'	101124	1000	0-20	ok
21*	NAT- 03	0208:05	18 Aug	30°10.09'	74°22.65'	101130	1000	0-20	failed
22	NAT- 03	0234:35	18 Aug	30°11.20'	74°24.94'	101131	1000	0-20	ok
23	NAT- 03	0539:01	18 Aug	30°18.92'	74°41.37'	101137	1000	0-20	noisey
24*	NAT- 03	1031:35	18 Aug	30°32.16'	75°08.42'	101147	1000	0-20	not operational
25	NAT- 03	1052:05	18 Aug	30°33.09'	75°10.47'	101147	1000	0-20	ok
26*	NAT- 03A	2027:48	18 Aug	30°44.25'	75°33.05'	101157	1000	0-20	not operational

*Sonobuoy Buoys at these stations transmitted for only a short time or not al all. These buoys appear to have been entangled in Hydrophone Streamer.

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2a SONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
27*	NAT- 03A	2052:05	18 Aug	30°45.35'	75°35.30'	101158	1000	0-20	Not operational
28	NAT- 03A	2117:35	18 Aug	30°46.39'	75°37.47'	101160	1000	0-20	ok
29	NAT- 03A	0001:05	19 Aug	30°54.37'	75°53.06'	101165	1000	0-20	calibrated buoy SSQ57A
30	NAT- 06	0257:35	20 Aug	30°57.64'	76°17.69'	101175	1000	0-20	ok
31	NAT- 06	0736:35	20 Aug	31°06.75'	76°34.98'	101184	1000	0-20	ok
32	NAT- 06	1211:05	20 Aug	31°16.39'	76°52.84'	101194	1000	0-20	ok
33	NAT- 06	1746:12	20 Aug	31°30.30'	77°17.14'	101205	1000	0-20	ok
34	NAT- 100	1115:17	21 Aug	32°41.49'	77°34.11'	line not steamed by Moore			ok
35	NAT- 07	1834:05	21 Aug	32°19.69'	77°06.73'	Moore shooting only this line. No DFS recording			ok
36	NAT- 07	2118:42	21 Aug	32°10.87'	76°54.70'	Moore shooting only this line. No DFS recording			ok
37	NAT- 07	0018:34	22 Aug	32°01.21'	76°41.12'	Moore shooting only this line 7. No DFS recording			ok
38	NAT- 09A	1926:35	22 Aug	32°05.27'	76°38.51	101220	1000	0-20	noisey there fore abandond
39*	NAT- 09A	2250:35	22 Aug	31°54.91'	76°24.36'	101227	1000	0-20	ok

*Sonobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to have been entangled in Hydrophone Streamer.

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2aSONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
40*	NAT- 09A	2315:05	22 Aug	31°53.62'	76°22.48'	101228	1000	0-20	not operation-al
41	NAT- 09A	2349:05	22 Aug	31°51.68'	76°19.88'	101230	1000	0-20	ok
42	NAT- 09A	0312:35	23 Aug	31°40.54'	76°04.94'	101236	1000	0-20	ok
43*	NAT- 09A	0728:54	23 Aug	31°29.86'	75°44.87'	101245	1000	0-20	not opera-tional
44	NAT- 09A	0759:20	23 Aug	31°29.30'	75°42.04'	101246	1000	0-20	ok
45*	NAT- 09A	1213:35	23 Aug	31°25.14'	75°18.65'	101254	1000	0-20	not opera-tional
46*	NAT- 09A	1239:35	23 Aug	31°24.83'	75°16.38'	101255	1000	0-20	not opera-tional
47	NAT- 09A	1305:05	23 Aug	31°24.55'	75°14.48'	101256	1000	0-20	ok
48*	NAT- 09A	1650:35	23 Aug	31°21.37'	74°55.81'	101263	1000	0-20	not opera-tional
49	NAT- 09A	1712:50	23 Aug	31°21.08'	74°53.94'	101264	1000	0-20	ok
50	NAT- 09A	2328:05	23 Aug	31°15.42'	74°17.06'	101276	1000	0-20	ok
51	NAT- 09A	0250:35	23 Aug	31°12.15'	73°54.33'	101283	1000	0-20	ok
52	NAT- 09A	0430:25	23 Aug	31°10.50'	73°43.73'	101286	1000	0-20	calibrated SB. for signal test only SSQ57S

*Sonobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to have been entangled in Hudrophone Streamer.

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2a SONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
53*	NAT- 11	1622:50	24 Aug	31°09.73'	73°44.39'	Line not steamed by Moore.			Not operational
54	NAT- 11	1644:20	24 Aug	31°09.73'	73°45.34'	Line not steamed by Moore.			ok
55	NAT- 12	2245:05	24 Aug	31°09.36'	73°37.69'	101297	1000	0-20	ok
56*	NAT- 12	0241:35	25 Aug	31°02.33'	73°16.35'	101304	1000	0-20	not operational
57	NAT- 12	0319:05	25 Aug	31°01.6'	73°13.24'	101306	1000	0-20	ok
58	NAT- 12	0728:05	25 Aug	30°55.01'	72°51.88'	101314	1000	0-20	ok
59	NAT- 12	0946:35	25 Aug	30°51.44'	72°39.41'	101318	1000	0-20	calibrated sonobuoy SQ57A
60**	NAT- 14	0432:05	26 Aug	30°44.66'	72°42.49'	101331	1000	0-20	Moore launched SB-60 N.G.
61**	NAT- 14	0510:05	26 Aug	30°41.18'	72°43.65	101332	1000	0-20	ok
62**	NAT- 14	0902:05	26 Aug	30°20.50'	72°52.08'	101341	1000	0-20	ok
63	NAT- 15	0253:05	27 Aug	29°19.92'	72°46.57'	101370	1000	0-20	ok
64	NAT- 15	0627:00	27 Aug			101377	1000	0-20	ok
65	NAT- 15	0903:58	27 Aug	29°03.41'	72°08.99'	101382	60	0-20	ok

*Sonobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to habe been entangled in Hydrophone Streamer.

** These sonobuoys launched by Moore which was lead ship for Line NAT-14

NORTH ATLANTIC TRANSECT- LEG 1

TABLE 2a SONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
66	NAT- 15	1211:34	27 Aug	28°52.06'	71°51.65'	101388	60	0-20	ok
67	NAT- 15	1540:35	27 Aug	28°35.65'	71°37.28'	101395	60	0-20	ok
68*	NAT- 15	1915:35	27 Aug	28°20.02'	71°23.34'	101403	60	0-20	noisey, therefore abandoned
69	NAT- 15	1949:20	27 Aug	28°17.18'	71°20.66'	101404	60	0-20	ok
70	NAT- 15	2302:35	27 Aug	28°04.61'	71°05.14'	101410	60	0-20	ok
71*	NAT- 15	0300:05	28 Aug	27°47.23'	70°49.66'	101419	60	0-20	not operational
72*	NAT- 15	0305:35	28 Aug	27°46.82'	70°49.24'	101419	60	0-20	abandoned
73	NAT- 15	0412:40	28 Aug	27°42.09'	70°44.15'	101421	60	0-20	
74	NAT- 15	0503:50	28 Aug	27°38.21'	70°40.94'	101423	60	0-20	ok
75	NAT- 15	0837:05	28 Aug	27°21.93'	70°24.27'	101428	60	0-20	ok
76	NAT- 15	1252:05	28 Aug	27°02.05'	70°06.29'	101438	60	0-20	ok
77	NAT- 15	1659:35	28 Aug	26°43.06'	69°47.83'	101446	60	0-20	ok
78	NAT- 15	2110:35	28 Aug	26P24.51'	69°30.16'	101454	60	0-20	ok

onobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to have been entangled in Hydrophone Streamer.

NORTH ATLANTIC TRANSECT - LEG 1

TABLE 2a SONOBUOY STATIONS NAT81-LEG 1

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	POSITION LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
79	NAT- 15	0056:05	29 Aug	26°09.55'	69°15.84'	101462	60	0-20	ok
80	NAT- 15	0444:35	29 Aug	25°53.07'	69°00.67'	101469	60	0-20	ok
81	NAT- 15	0834:00	29 Aug	25°37.77'	68°46.47'	101476	60	0-20	ok
82	NAT- 15	1207:34	29 Aug	25°21.46'	68°34.60'	101483	60	0-20	ok
83	NAT- 15	1526:35	29 Aug	25°07.58'	68°19.79'	101490	60	0-20	ok
84	NAT- 15	1819:40	29 Aug	24°54.62'	68°07.23'	101496	60	0-20	calibrated SQ57A
85	NAT- 17	0557:58	30 Aug	24°53.06'	68°06.14'	101496	60	0-20	ok
86*	NAT- 17	0848:30	30 Aug	24°38.63'	67°55.66'	101512	60	0-20	hit by Moore
87	NAT- 17	0937:35	30 Aug	24°34.55'	67°52.80'	101513	60	0-20	ok
88	NAT- 17	1249:05	30 Aug	24°18.09'	67°40.11'	101520	60	0-20	ok
89*	NAT- 17	2059:35	30 Aug	23°34.22'	67°12.21'	101536	60	0-20	not operational
90	NAT- 17	2123:55	30 Aug	23°32.05'	67°10.80'	101536	60	0-20	caught by Moore streamer
91	NAT- 17	2247:05	30 Aug	23°24.22'	67°05.70'	101539	60	0-20	ok
92	NAT-17	0236:35	31 Aug	23°03.47'	66°51.95'	101547	60	0-20	ok

*Sonobuoy Buoys at these stations transmitted for only a short time or not at all. These buoys appear to have been entangled in Hydrophone Streamer.

NORTH ATLANTIC TRANSECT - LEG 2

TABLE 2b SONOBUOY STATIONS NAT81-LEG 2

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	PROSPEKTA POSITION LATITUDE	PROSPEKTA POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
							60		
93	NAT-22	1256	7 Sept	19°42.40'	66°30.18'	101575	60	0-20	
94	NAT-22	2044	7 Sept	20°23.32'N	66°30.39'W	101590	60	0-20	
95	*NAT-25	1207	8 Sept.	20°50.67'N	66°30.00'W	101606	60	0-20	N.G.
96	*NAT-30	0917	10 Sept.	22°13.93'N	64°17.46'W	Received only on PROSPEKTA	60	0-20	N.G.
97	*NAT-30	0926	10 Sept.	22°14.65'N	64°17.05'W	Received only on PROSPEKTA	60	0-20	N.G.
98	NAT-31	1935	10 Sept	22°24.09'	64°0844'	101629	60	0-20	
99	NAT-31	2305	10 Sept	22°17.42'	63°41.61'	101636	60	0-20	
100	NAT-31	0304	11 Sept	22°08.04'	63°30.73'	101644	60	0-20	
101	NAT-31	0645	11 Sept	22°01.08'	63°12.38'	101651	60	0-20	
102	NAT-31	1006	11 Sept	21°53.04'	62°55.33'	101657	60	0-20	
103	NAT-31	1418	11 Sept	21°44.75'	62°33.66'	101665	60	0-20	
104	NAT-31	1830	11 Sept	21°34.82'	62°08.22'	101673	60	0-20	

*Missing data available from Prospekta records - All sonobuoy data recorded of DFS auxiliary channels #3 & 4.

NORTH ATLANTIC TRANSECT - LEG 2

TABLE 2b SONOBUOY STATIONS NAT81-LEG 2

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	PROSPEKTA POSITION LATITUDE	PROSPEKTA POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH	RECORD INTERVAL(S)	COMMENTS
105	* NAT-32	1648	12 Sept.	20°48.04'	60°54.60'W	Received only on PROSPEKTA	60	0-20	N.G.
106	* NAT-34	2045	14 Sept.	20°59.55'N	60°48.94'W		60	0-20	
107	NAT-34	2247	14 Sept	20°54.90'	60°40.20'	101714	60	0-20	
108	NAT-34	0327	15 Sept	20°44.46'	60°14.98'	101724	60	0-20	
109	NAT-34	0715	15 Sept	20°36.81'	59°55.39'	101730	60	0-20	
110	NAT-34	1009	15 Sept	20°30.95'	59°41.09'	101736	60	0-20	
111	NAT-34	1644	15 Sept	20°18.32'	59°07.12'	101748	60	0-20	
112	NAT-34	2017	15 Sept	20°14.76'	58°47.35'	101746	60	0-20	
113	NAT-34	2134	15 Sept	20°13.36'	58°39.99'	101758	60	0-20	
114	NAT-34	0225	16 Sept	20°10.00'	58°17.00'	101767	60	0-20	
115	NAT-34	0346	16 Sept	20°10.53'	58°06.98'	101770	60	0-20	
116	NAT-35	1251	16 Sept	20°12.00'	57°13.00'	101788	60	0-20	
117	NAT-35	1420	16 Sept	20°10.97'	57°04.72'	101791	60	0-20	
118	NAT-37	1815	16 Sept	20°07.84'	56°42.46'	101799	60	0-20	

*Missing data available from Prospekta records - All conobuoy data recorded of DFS ausiliary channels #3 & 4.

NORTH ATLANTIC TRANSECT - LEG 3

TABLE 2c SONOBUOY STATIONS NAT81-LEG 3

STATION #	LINE #	TIME HR. MIN.	D. MO.	MOORE POSITION LATITUDE	LONGITUDE	START TAPE #	HYDROPHONE DEPTH Ft.	RECORD INTERVAL(S)	COMMENTS
1	NAT-42	0415	8 Oct	22°04.979	065°29.129	103045	60	0-15	
2	NAT-44	2302	8 Oct	22°16.165	066°26.266	103073	60	0-15	
3	NAT-44	0459	9 Oct	21°42.447	066°28.841	103080	60	0-15	
4	NAT-44	0907	9 Oct	21°23.560	066°31.816	103086	60	0-15	
5*	NAT-44	1326	9 Oct	21°04.560	066°32.380	103092	60	0-15	
6	NAT-44	1632	9 Oct	20°50.160	066°32.560	103096	60	0-15	
7	NAT-44	1945	9 Oct	20°35.951	066°29.595	103101	60	0-15	
8	NAT-44	2300	9 Oct	20°19.957	066°29.624	103106	60	0-20	
9*	NAT-46	0015	12 Oct	20°16.436	067°29.541	103174	60	0-15	
10*	NAT-46	0029	12 Oct	20°19.751	067°29.617	103174	60	0-15	
11*	NAT-46	0106	12 Oct	20°20.051	067°29.677	103175	60	0-15	
12	NAT-46	0130	12 Oct	20°22.414	067°29.812	103176	60	0-15	
13	NAT-46	0715	12 Oct	20°30.767	067°29.821	103184	60	0-15	

NORTH ATLANTIC TRANSECT - LEG 3

TABLE 2c SONOBUOY STATIONS NAT81-LEG 3

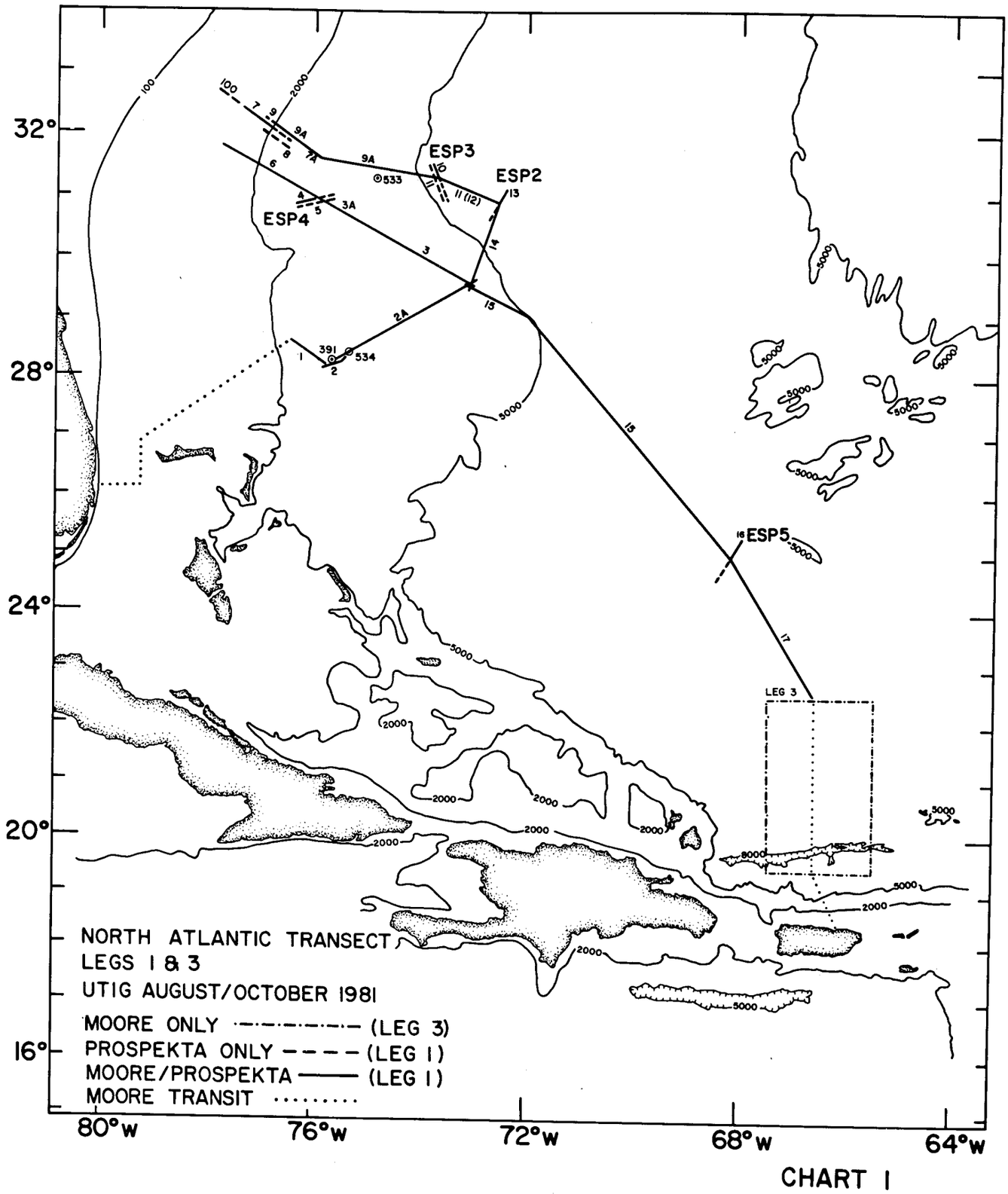
STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	MOORE LATITUDE	POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH Ft.	RECORD INTERVAL(S)	COMMENTS
14	NAT-46	1300	12 Oct	21°19.926	067°31.002	103192	60	0-20	
15*	NAT-46	1945	12 Oct	21°53.164	067°29.751	103204	60	0-20	
16	NAT-46	2020	12 Oct	21°56.150	067°29.707	103205	60	0-20	
17*	NAT-46	NEVER RECEIVED ON RADIO----------		----------		103206	60	0-20	
18	NAT-47	1230	13 Oct	22°15.697	067°36.144	103219	60	5-25	
19	NAT-47	1830	13 Oct	22°14.740	067°02.596	103226	60	5-25	
20	NAT-47	0421	14 Oct	22° 15.008	066°09.900	103238	60	5-25	
21	NAT-47	1053	14 Oct	22°16.388	065°35.340	103247	60	5-25	
22	NAT-49	0640	15 Oct	21°44.945	065°23.020	103270	60	6-26	
23*	NAT-49	1315	15 Oct	21°44.751	065°57.430	103279	60	6-26	
24	NAT-49	1330	15 Oct	21°44.637	065°58.731	103279	60	6-26	
25	NAT-49	1745	15 Oct	21°44.666	066°20.801	103287	60	6-26	
26	NAT-49	0100	16 Oct	21°43.270	066°55.192	103297	60	6-26	

NORTH ATLANTIC TRANSECT - LEG 3

TABLE 2c SONOBUOY STATIONS NAT81-LEG 3

STATION #	LINE #	TIME HR. MIN.	TIME D. MO.	MOORE POSITION LATITUDE	MOORE POSITION LONGITUDE	START TAPE #	HYDROPHONE DEPTH Ft.	RECORD INTERVAL(S)	COMMENTS
27	NAT-49	0618	16 Oct	21°47.950	067°25.443	103304	60	6-26	
28*	NAT-49	0641	16 Oct	NEVER RECEIVED	ON RADIO	103305	60	6-26	
29	NAT-51	0300	17 Oct	21°10.449	067°39.547	103327	60	6-26	
30	NAT-51	1450	17 Oct	21°10.001	066°39.325	103340	60	6-26	
31	NAT-51	0142	18 Oct	21°10.090	065°37.600	103353	60	6-26	
32	NAT-53	0001	19 Oct	20°29.977	065°22.900	103377	60	6-26	
33*	NAT-53	0600	19 Oct	20°29.202	065°53.048	103386	60	6-26	
34	NAT-53	0745	19 Oct	20°30.581	066°01.993	103387	60	6-26	
35	NAT-53	1200	19 Oct	20°29.666	066°22.975	103395	60	6-26	
36	NAT-53	1630	19 Oct	20°29.067	066°44.876	103402	60	6-26	
37	NAT-53	2100	19 Oct	20°30.331	067°06.662	103409	60	6-26	
38	NAT-55	2100	20 Oct	20°50.039	067°14.633	103435	60	6-26	
39	NAT-57	0300	21 Oct	20°13.544	066°40.701	103466	60	6-26	

*Sonobuoy Buoys at these station transmitted for only a short time (≈ 10-20 minutes) or not at all. These Buoys appear to have been entangled in Hydrophone Streamer (≈ 3600 meters long).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24°
20°
16°
80°W
76°W
72°W
68°W
64°W
ESP2
ESP3
ESP4
ESP5
LEG 3
NORTH ATLANTIC TRANSECT
LEGS 1 & 3
UTIG AUGUST/OCTOBER 1981
MOORE ONLY (LEG 3)
PROSPEKTA ONLY (LEG 1)
MOORE/PROSPEKTA (LEG 1)
MOORE TRANSIT

CHART 1

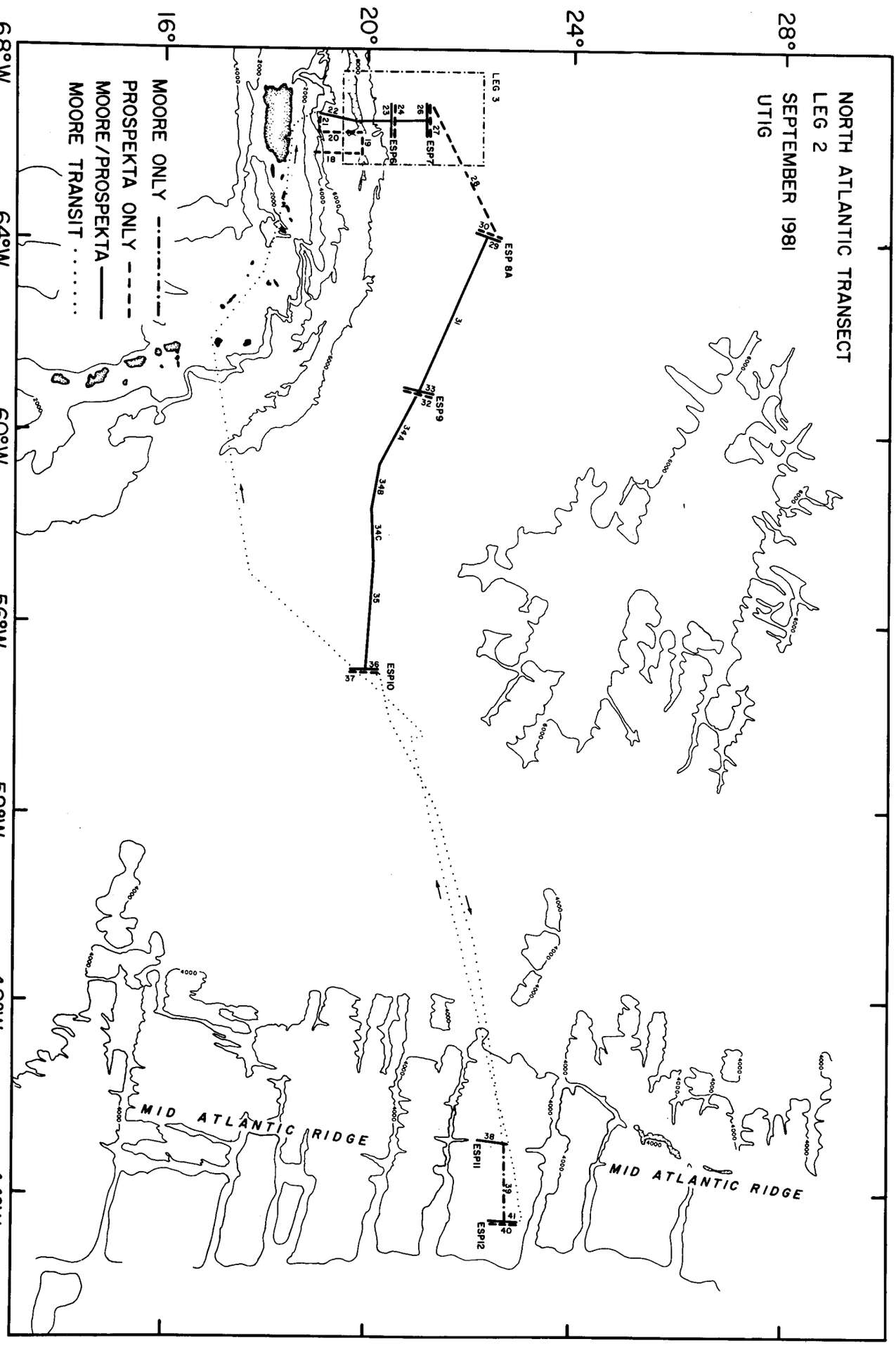
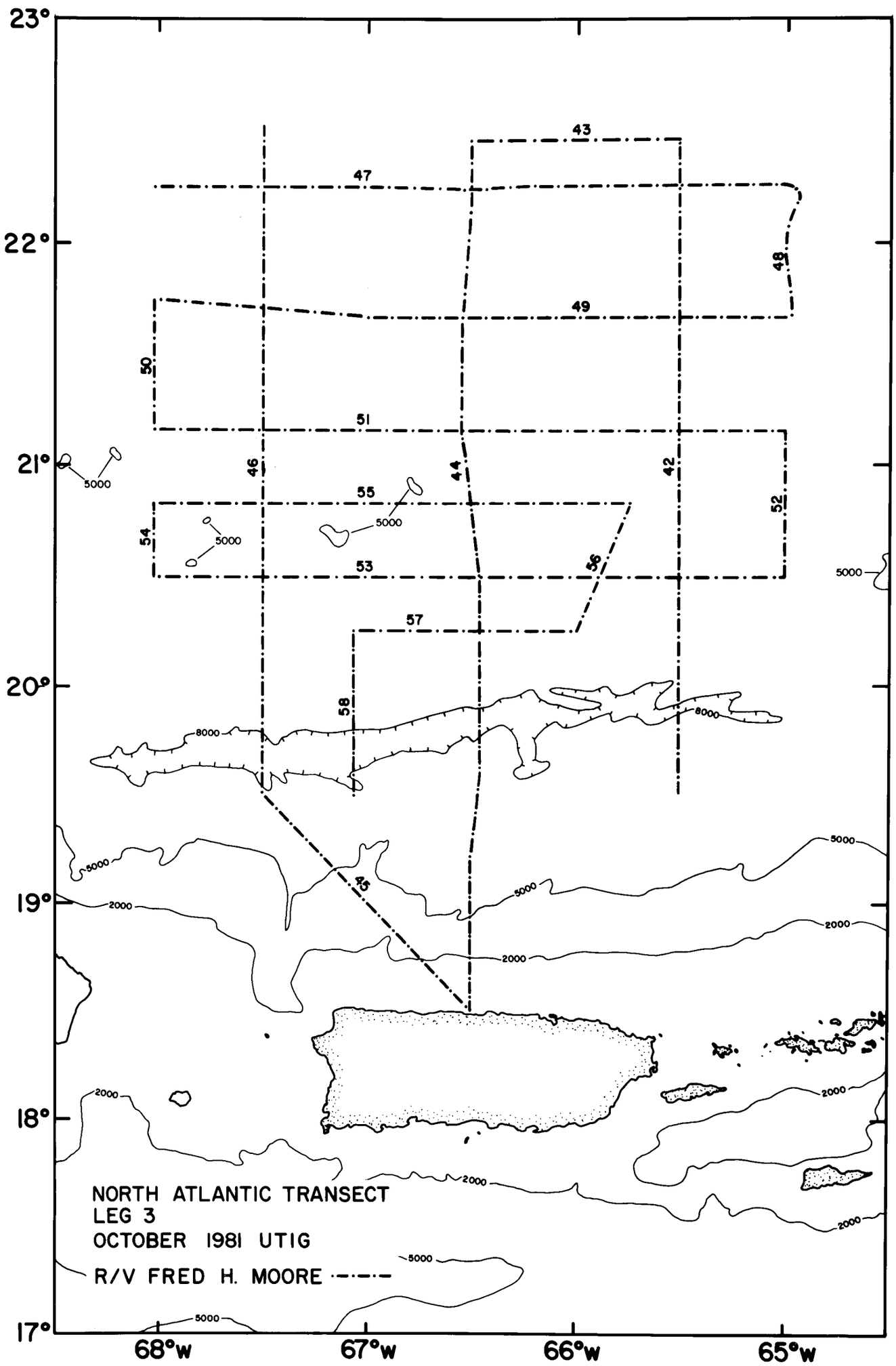

NORTH ATLANTIC TRANSECT
LEG 2
SEPTEMBER 1981
UTIG
MOORE ONLY
PROSPEKTA ONLY
MOORE/PROSPEKTA
MOORE TRANSIT
LEG 3
ESP 8A
ESP9
ESP10
ESP11
ESP12
MID ATLANTIC RIDGE
MID ATLANTIC RIDGE
68°W
64°W
60°W
56°W
52°W
48°W
44°W
28°
24°
20°
16°

CHART 2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5000
8000
2000
NORTH ATLANTIC TRANSECT
LEG 3
OCTOBER 1981 UTIG
R/V FRED H. MOORE

CHART 3