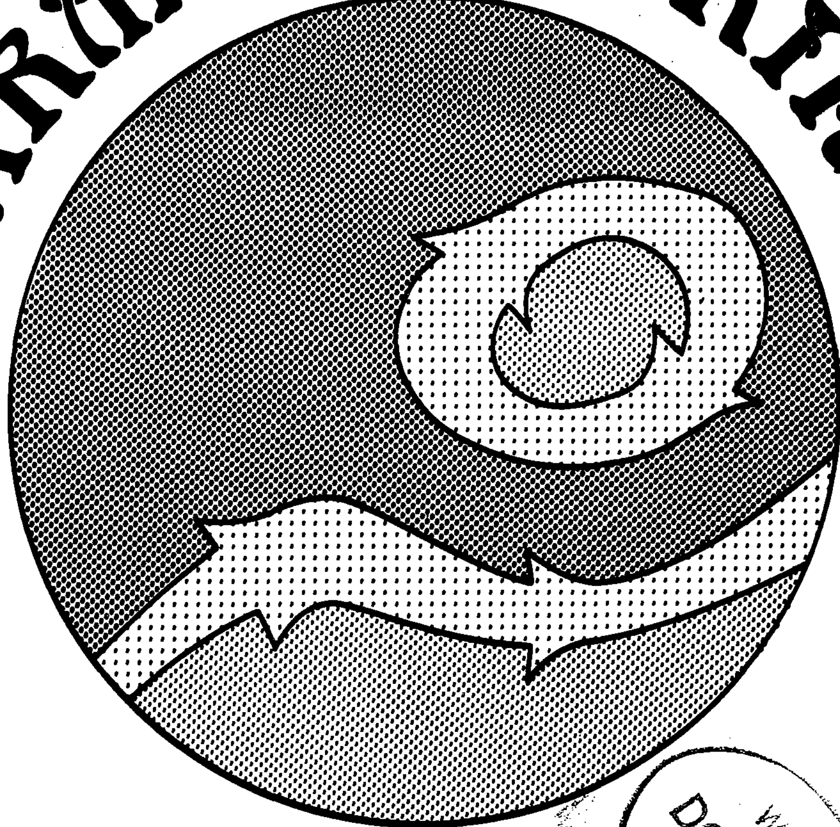
WARM CORE RINGS



an Interdisciplinary Study of Warm Core Ring Physics, Chemistry and Biology

CRUISE REPORTS

RV/ENDEAVOR - RV/KNORR - RV/OCEANUS

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CRUISE REPORT

ENDEAVOR CRUISE NO. 88, 8/5/82 - 8/25/82

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WARM CORE RINGS CRUISE REPORT: ENDEAVOR 88

This report summarizes the scientific studies carried out on the R/V ENDEAVOR during Cruise No. 88, 5-25 August, 1982. It consists of a cruise narrative and additional reports on the studies carried out by the various investigators. It is meant to serve as an informative and useful document for scientists within the WCR program - not as a publication for circulation to the general scientific community.

CRUISE NARRATIVE

R/V ENDEAVOR departed Woods Hole on Cruise 88 for the August field experiment of the Warm Core Rings Program at 1400 Hours (LT) August 5, 1982. This was only two hours behind schedule. The delay was caused by a late arrival of ENDEAVOR in Woods Hole and a malfunctioning ship's crane. Despite having only a day and a half to load the ship, the ENDEAVOR scientists managed to get nearly every component of the program in working order before departure. It was a tired but optimistic group that left the dock.

ENDEAVOR was embarking on the fourth cruise for the Warm Core Rings Program, an experiment which included the KNORR and OCEANUS as well. At the pre-cruise meeting for the August field work, held the night before ENDEAVOR sailed, there was a marked difficulty in coming to a concensus as to what ring to survey. The satellite imagery suggested that 82B was much reduced in size and probably interacting with a shingle of the Gulf Stream. However, there was considerable interest in completing the time series on 82B, if it proved to be a viable entity. Ring 81G was also discussed but was less interesting because previous 'ship of opportunity' data showed it to have little or no Sargasso core water. Also discussed for the first time was a large robust ring far to the east, 82E. Given the steaming time and the station time required for surveying this ring, 82E was deemed suitable for ENDEAVOR only if it was the sole object of the cruise, not part of a 2-ring survey. Thus at the Chief Scientists meeting on the ENDEAVOR at 1100 on August 5, it was decided that ENDEAVOR would first survey 82B and would have the option of also visiting 81G if 82B could no longer be tracked.

ENDEAVOR set course for the ring center position supplied by the University of Miami Remote Sensing Group, 36.63N, 73.81W. Enroute we occupied a test station with both CTD fish, BOPS and the free fall profiler SCIMP. A calibration run for the APOC velocimeter and a test XBT drop were also performed during this transit.

The First XBT star was begun at 0000 Hrs (GMT) on the 7th. Because of the small size of the ring, XBTs were dropped every half hour. Figure 2 shows the 10°C isotherm topography and APOC velocity vectors. The APOC velocity profiles showed strong shears which suggest that the Gulf Stream may have been overriding the surface layer (50 m) of the ring.

The surface salinities are very low, only reaching 36.00 in the very southern part of the survey. Thus the overriding water must be of shelf or slope origin, having been entrained by the Gulf Stream to the South. These strong surface currents (> 1 m/s) made a drifter deployment at this time seem particularly risky. The one drifter which was considered expendable (the PRL mini-drifter) could not be made to function. Also, we were not receiving any satellite imagery due to heavy cloud cover; thus drifter deployment was deferred. One aspect of the first XBT survey which assured us that 82B was still a coherent entity was the thermostad found at about 15.7°C.

There was more than 200 m of 15°C water in the ring center, while this thermostad completely disappeared outside the ring boundary. Given the mappable structure of the ring and the fact that OCEANUS and KNORR were still far from the area, we assured them that 82B was still an excellent site for ring studies. ENDEAVOR then proceeded to do its first CTD/BOPS section, consisting of 11 stations with 8 nm spacing from the southeast to the northwest. Stations of the early part of the section showed a slight rise in isotherm depths between the ring and the stream, suggesting that the stream was moving away from the ring. Through ATS communication with the other ships, a concensus was reached to devote all of our time to Ring 82B rather than attempting to sample two rings. This decision was reached during the later part of the CTD section. We therefore decided to deploy a drifter in ring center on the second section.

After Station 15 at the end of the section, we steamed to the east and began our second section. Stations 16, 17 and 18 went smoothly with Station 18 having 'steppy' type profiles in temperature and salinity. Such profiles were observed during EN086 and were the primary target for the SCIMP profiler. Accordingly, the third SCIMP dive was made after CTD 18. Unfortunately some malfunction caused it to stop rising at about 300 m as it was coming back. At the time, it appeared that the fast decent weight (5 lb) failed to detach while the release weight (10 lb) functioned properly. Acoustic communication with SCIMP was hindered by ships noise, the shadow zones of the instrument and the sharp seasonal thermocline. Repeated attempts to activate the acoustic release mechanism failed. It was decided to return to search for SCIMP in 24 hrs when the corrosible link holding the weight would let go. In order to facilitate the search we deployed a radar reflector buoy drogued to 100 m at the location of SCIMP. We then proceeded with Stations 19 and 20.

During Station 20, an urgent call from the KNORR indicated that the ring was moving rapidly. The KNORR found that there was no longer any 15°C thermostad at the ring center location from our first section. All three ships were within sight of one another and two had 15°C beneath them while the third did not. In order to resolve this movement of the ring, the KNORR and ENDEAVOR undertook a rapid XBT survey to the NE and NW respectively. Additional XBTs were dropped in the southeast region during the search for SCIMP; these gave a clear indication of the limits of the 15°C thermostad in which SCIMP was left floating. This data set indicated that a significant portion of the ring was carried away by the stream, probably including the portion which contained SCIMP. During the night of the search for SCIMP, there were frequent thunder squalls which made detection of the radar reflector buoy extremely unlikely. The bad weather, combined with the strong currents, made the search unsuccessful; no radar return from the buoy nor any radio or visual contact with SCIMP was made. It seems likely that both were advected away to the east or northeast. Later close examination of SCIMP fall rates indicated that the failure was not with the weight release mechanism but rather a flooded instrument case or the loss of syntactic foam buoyancy. The acoustic tracking record is noisy and ambiguous, but post-cruise analysis suggests that SCIMP had actually sunk to the bottom, in which case it would not be expected to return to the surface.

After this ring-stream interaction it was deemed necessary to re-survey the ring to determine the extent of its mass loss and its new center location. KNORR scientists began to express doubt that 82B could still be successfully surveyed. They were also concerned that the loss of ring surface water invalidated phytoplankton productivity experiments that they had planned. Investigators on ENDEAVOR and OCEANUS were still hopeful that useful data could be gleaned from further study of 82B. In order to quickly ascertain the location and extent of the ring a second XBT star survey was begun. Part way through the star it became clear that the pattern was centered too far to the south to resolve the ring and extra legs were added to the north. The survey showed that the ring had been displaced to the north and still showed some connection with the stream. During this survey we also deployed the University of Miami Loran drifter with a Lamont sediment trap.

The 15°C water was the focus of our next operation, a CTD Tow-yo across the thermostad. This exercise was highly successful, about 60 casts between 25 and 425 m depth were made over a horizontal distance of 15 nm. During the later part of the cast, the OCEANUS performed a mid-water tow parallel to our course. This Tow-yo should provide excellent data on the intrusive edges of the thermostad as well as the steppy finestructure at its base.

At the conclusion of the Tow-yo we steamed to the drifter location (nominally ring center) and did CTD and BOPS casts. About this time we received word from the KNORR that they intended to steam to 82E; OCEANUS and ENDEAVOR opted to stay in 82B. In order to guide further work we then executed a rapid 'perimeter' 5-point star using the Tow-yo as one leg of the pattern. The isotherm depths show marked shoaling in the southeast portion of the area, indicating that the Gulf Stream had removed itself from close proximity to the ring. This encouraged us to commit further time to 82B as it again appeared to be a tractable target for study. We also received a message from the Albatross IV that indicated that 81G was a rather weak ring with no distinct core water. Thus we decided to commit all remaining time to a study of 82B.

Our first act after coming to that decision was to deploy the WHOI and RSMAS satellite-tracked drifters and redeploy the RSMAS Loran drifter. Another WHOI mini-drifter and RSMAS Loran drifter failed to function and were not deployed. The particulars on the drogues and buoys are detailed in another section. The three drifters were deployed about 3 nm from one another in a triangular array.

ENDEAVOR then commenced to do three CTD sections through and around the ring. The first of these sections missed the ring which had begun to move rapidly to the southwest. This resulted in the station pattern shown in Figure 3. After this CTD work, we performed one final XBT survey of the ring. This star was quite successful, even though an adjustment in the star pattern was made when it became clear that our initial plan would partially miss the ring. The depth of the 10°C isotherm and APOC velocity vectors are displayed in Figure 6.

At the conclusion of the star we performed a final CTD/BOPS station in the ring center. We then retrieved all three drifters and redeployed the WHOI satellite drifter in ring center. This drifter should provide valuable information on the final demise of 82B.

ENDEAVOR then left 82B to begin a CTD/BOPS section from the shelf across the Gulf Stream and into the Sargasso Sea, beginning with Station 47 at 0100 hrs GMT on August 20, 1982. There as a NASA P3 overflight during Station 50 at 1352 on the 20th. XBTs were dropped between stations in order to map the isotherms crossing the Gulf Stream. The final CTD section was taken along 71W from 35N northward onto the shelf, with 20 nm spacing. Nutrient samples were taken in the deeper bottles.

An event log of ENDEAVOR's scientific activity for the cruise is given in Table 1. The various programs run by the scientists onboard are described in the following sections.

CTD/O_2 PROGRAM

A total of 71 CTD casts were made, all but the first being done with instrument No. 7. No sensors were changed; the CTD and Lamont transmissometer functioned well throughout the cruise.

Water samples were taken, using the 24-bottle rosette sampler with 20 bottles mounted. Twenty samples per station was sufficient since most stations were in water shallower than 3000 m depth. Oxygen and salinity samples were drawn and analyzed onboard, for calibration of the CTD/O_2 sensors. In addition, nutrient samples were collected and frozen for later analysis ashore. In stations associated with the ring, a complete set of nutrient samples was obtained, while samples from only the deepest ten bottles were taken for the Sargasso and Slope water sections.

The stations are grouped as follows: Stations 1 and 2 = test stations in Slope Water; 3,4 = Ring center stations, (no water samples on 3, because of rosette failure); 5-20 = first Ring CTD survey; 21 = Ring center; 22 = Tow-yo across Ring; 23 = Ring center; 24-45 = second CTD survey of Ring; 46 = Ring center; 47-56 = Slope-Sargasso section, 56-71 = section along 71°W from 35°N to 40°N. Positions and times for the stations are given in Table 2.

XBT PROGRAM

During this cruise, 197 XBTs were deployed. All were Type T7 and all were digitally logged on a Bathysystems Recorder. As with the CTD data, depths of selected isotherms were transcribed and distributed to other vessels and those ashore using the ATS link and Telemail. Positions and times of the XBTs are given in Table 3. The XBTs can be grouped in the following way:

1 - 55	First XBT Star Survey
56 - 69	First CTD Survey
70 - 88	Survey East of the Ring and Search for SCIMP
89 - 119	Second Star Survey
120 - 126	Underway to Tow-yo
127 - 146	Perimeter Star Survey
147 - 148	Second CTD Survey
149 - 185	Final Star Survey
186 - 197	Final CTD Section

ACOUSTIC PROFILING OF OCEAN CURRENTS (APOC)

The APOC System was operated throughout most of the cruise, except during the transit time over the Continental Shelf. The data were logged onto 42 (1200 foot) magnetic tapes. Recorded were the underway current profiles from the 300 kHz Ametek-Straza acoustic Doppler current meter, ship's position, sea surface temperature and surface salinity as computed from the conductivity and temperature of the uncontaminated seawater system shared with the Bio-Optical program. Real time calculations of absolute currents at selected depths were made, printed out, transmitted over

ATS, and used to aid in planning sampling strategies. Discrete water samples were collected at each XBT drop to aid in the post cruise calibration of the continuous salinities. Some problems were experienced with the APOC Loran unit; some noise occurred during the first calibration run which introduced uncertainties in the value of the offset angle. This only caused some problems with real time interpretation of the APOC vectors; post-cruise data analysis will be unaffected. It is planned that the data on ship's motion recorded by the underway gravity system will be used to improve the depth sorting of the APOC range bins.

FINESTRUCTURE AND MICROSTRUCTURE

The Self-Contained Imaging Microprofiler (SCIMP) was deployed three times on this cruise; at the test station and after CTD casts No. 9 and No. 18. As noted in the cruise narrative, it failed to return to the surface after the third dive. SCIMP was designed to profile temperature, salinity and relative velocity as it freely fell. In addition, it contained a laser shadowgraph system for recording optical microstructure on 8 mm movie film. Unfortunately, the camera system failed to turn on during the first two dives and no optical data was obtained, though the other components functioned properly. It was thought that the problem was corrected for the third dive; we are not likely to ever know. It is particularly disappointing to lose the data from this dive as there was a thermohaline staircase seen on the CTD trace, and strong salt fingering would be expected. As mentioned previously, the most likely cause of its loss was a leak in one of the pressure cases or the loss of some of its syntactic foam buoyancy. Given the complexity of SCIMP's structure and the fact that half of its two dozen O-ring seals were recycled for each dive, it is perhaps remarkable that it was able to complete more than 40 dives in its long and fruitful career. The CTD and shear data from the first two dives should still prove useful, since the variance in the conductivity signal can be used as an alternate microstructure indicator.

REMOTE SENSING AND DRIFTERS

University of Miami contributions for the August, 1982 Warm Core Rings cruise included two major efforts: shorebased remote sensing of temperature and chlorophyll by Otis Brown and Jim Brown, and ENDEAVOR-88 seagoing efforts of Robert Evans, Kevin Leaman and Stan Hooker directed towards integration of the remote sensing and in-situ data and Loran drifter deployments. Remote sensing opportunities were limited during the August cruise period. As imagery became available, it was used to sort and interpret in-situ data acquired during periods of rapid ring motion. Drifters were deployed twice: first Loran drifter deployment occurred after Ring 82-B interacted with the Gulf Stram and showed the ring moving westward. The buoy was drogued at 175 m and included two linear temperature sensors and Jim Bishop's sediment traps. The drifters were placed in a triangle with the two satellite drifters three miles apart along 87.05N and the Loran drifter placed north of the western satellite drifter at 87.08N. During the first three days of the five-day deployment, the drifters indicated that the ring was rapidly moving to the southwest. The more circular buoy trajectory of the last two days indicated that ring motion had slowed. At time of recovery the Loran drifter was southwest of the satellite drifters at 36.39N, 74.27W which placed it at the edge of the ring. The satellite drifters had converged on a common stream line with a final separation of 4.5 miles. At time of recovery, the satellite drifters showed evidence of vertical shear by the wake present at the surface float. This shear would be integrated more by the Loran drifter since no drogue was utilized. Launch and recovery configuration, position and time are given below.

Remote sensing efforts were restricted by the almost continuous cloud cover over 82-D. Imagery was processed as available and showed snapshots of the ring-stream interaction. Thermal processing was necessary to define the ring boundary due to the weak surface thermal gradients present after the loss of ring surface water. Following the stream interaction, development of slope water entrainment was tracked in the imagery. Another result of the stream interaction was the loss of old ring surface water and the subsequent departure of the R/V KNORR for 82E. Separation of these two rings gave an opportunity to observe the validity of the satellite thermal calibration. During the August cruise, satellite thermal retrievals and in-situ observations showed good agreement. This is in contrast to the 1°C daytime difference and 2-3°C nighttime difference observed during the June cruise. Intercomparison of the total XBT data set and the along-track thermal data collected by Ray Smith with the satellite data has demonstrated a consistent slope but a cruise-varying bias determined from approximately 12000 samples per cruise. Further work is necessary to examine the reason for the time-varying bias term. This result means that gradient information is preserved, but the overall thermal field can be offset by a constant.

The following is a summary of pertinent drifter data collected during the fourth Warm Core Rings cruise. Three drifters were deployed: a satellite drifter from WHOI (Drifter No. 0253S), a satellite drifter from RSMAS/University of Miami (Drifter No. 03482) AND A Loran-C drifter (Drifter No. 7) also from RSMAS/University of Miami.

LORAN-C DRIFTER

First Deployment: 13 August 1982 (Julian day 225)
0307Z 36,35.4N 73,30.0W

1950Z 12 August 1982 TDR No. 17
1951Z 12 August 1982 TDR No. 27

Channels 1, 2 and 4 were set for a two-minute rate.

Sediment trap holder No. 2 was used with the traps in the following positions:

Trap No. 1 --> Position A
Trap No. 2 --> Position B
Trap No. 3 --> Position C
Trap No. 4 --> Position D

First Recovery: 14 August 1982 (Julian Day 226)
0831Z 37,01.6N 78,50.8W

The radar reflector buoy sank some time during deployment. Consequently, the sediment traps were approximately 50 m deeper than planned. The sinking of the buoy is thought to be due to overloading. The drogue used was very heavy. In the past, this type of buoy has been very reliable and has been successfully drogued.

The TDRs were placed on standby as follows:

No. 17 at 1140Z 15s 14 August 1982
No. 27 at 1141Z 15s 14 August 1982

Second Deployment: 14 August 1982 (Julian Day 226)
2218Z 37,08.0N 73,48.7W

Channels 1, 2 and 4 of the TDRs were set for a two-minute rate and started up at:

2038Z 14 August 1982 TDR No. 17
2039Z 14 August 1982 TDR No. 27

Sediment trap holder No. 3 was used and the traps were put in the following positions:

Trap No. 5 --> Position A
Trap No. 6 --> Position B
Trap No. 7 --> Position C
Trap No. 8 --> Position D

Second Recovery: 19 August 1982 (Julian Day 231)
2114Z 36,33.2N 74,37.3W

No problem with the radar buoy used with this deployment. The corner reflector (U.S. Army surplus) proved very useful; the drifter was sighted on radar several times during the deployment period.

The TDRs were placed on standby as follows:

TDR No. 17 at 2221Z 15s 19 August 1982
TDR No. 27 at 2222Z 15s 19 August 1982

RSMAS SATELLITE DRIFTER

First Deployment: 14 August 1982 (Julian day 226)
2150Z 37,05.2N 73,47.4N

First Recovery: 19 August 1982 (Julian Day 231)
1658Z 36,49.3N 74,26.2W

WHOI SATELLITE DRIFTER

First Deployment: 14 August 1982 (Julian day 226)
2110Z 37,05.3N 73,13.3W

First Recovery: 19 August 1982 (Julian Day 231)
1730Z 36,52.5N 74,18.6W

Second Deployment: 19 August 1982 (Julian Day 231)
1924Z 36,39.2N 74,19.2W

The drifter was deployed without a radar buoy but it was still drogued at 100 m.

PHOTOECOLOGY STUDIES

During the R/V ENDEAVOR 88 cruise, data was taken with the BOPS (Bio-Optical Profiling System) instrument package from the surface to 200 m for 77 casts at each of 71 CTD/BOPS stations. On this cruise these data included: temperature, conductivity, depth, beam transmittance (670 nm), up and down-welling spectral irradiance (380, 410, 441, 465, 488, 520, 540, 560, 589, 625, 671, and 694 nm) spectral radiance (441, 488, 520, and 550 nm), and scalar irradiance PAR (Photosynthetically Available Radiant energy). In addition, newly installed "tilt sensors" gave continuous data on the underwater orientation of the instrument which will allow first-order correction to the optical data due to non-horizontal orientation. Also, a new monochromatic scalar irradiance instrument (441 nm) was tested to see if the absorption coefficient at the absorption band of chlorophyll could be directly measured underwater with the BOPS instrument. The SeaMartec fluorometer on the BOPS failed early during the cruise and was not used.

Discrete chlorophyll measurements were also made at nine selected depths from the vertical profile from rosette water samples. A subset of these samples from each station were filtered for, and will be analyzed by, Pat Blackwelder for coccolithophore enumeration.

As on previous WCR cruises, the horizontal distributions of both physical and biological parameters were continuously recorded for the entire cruise. The one-minute averages of these data were logged automatically and included: sea surface temperature and conductivity; total incident irradiance (0.3-3.0 micrometers) and UV-irradiance (340 nm); atmospheric parameters including wind speed and direction, air temperature and dew-point temperature, barometric pressure; and continuous measurements of chlorophyll, phycoerythrin, and fucoxanthin fluorescence.

A principal objective during this cruise was to coordinate the ENDEAVOR's activities with the testing of a new generation microwave radiometer for the remote sensing of sea surface salinity flown in a NASA P3 aircraft. The aircraft made three missions over the ENDEAVOR during this cruise: on 13 August, just after completion of our second XBT star and during BOPS Station No. 22B; on 19 August, during our last visit to ring center at CTD/BOPS Station No. 46; and on 20 August, while the ENDEAVOR was on a CTD/BOPS section from the shelf across the Gulf Stream and into the Sargasso Sea (the overflight occurred at Station No. 50, the southeast edge of the stream). Sea surface salinity, temperature and chlorophyll concentration were systematically determined before, during and after each overflight for intercomparison with the aircraft data.

These WCR cruises have provided a unique opportunity for obtaining both complementary ship and satellite and ship and aircraft data. For example, in collaboration with Brown and Evans at Miami more than 12,000 intercomparisons of ship sea surface temperature and satellite-derived temperature have been obtained on each WCR cruise to date. Similar, although fewer in number, chlorophyll intercomparisons will be made using our along-track chlorophyll data and CZCS imagery: Also in collaboration with the NASA overflight, an effort to quantify ship and aircraft intercomparisons of the Aircraft Oceanographic Lidar (AOL) was made. A number of large filtered samples have been obtained by Jim Nelson during this cruise for later laboratory analysis of accessory pigments (fucoxanthin and phycoerythrin).

UNDERWAY GRAVITY MEASUREMENTS

The first sea trials for the new stable platform-gravity meter system have been completed on ENDEAVOR, Cruise 88. This system consists of three major parts. The first of these is a recently developed gyro stabilized two-axis platform. This platform has been designed to carry the vibrating string accelerometer (VSA) and its associated oven assembly as the gravity sensor. The new platform represents a major reduction in both size and weight over other platforms suitable for gravity measurement. A second major part of this system is a newly developed gravity readout. The readout interfaces with the VSA, filters out the vehicular motion and then scales the data so that the gravity signal may be resolved. It has been designed to allow flexible use of the gravity system on a variety of vehicles, including ships, submarines and aircraft. The third major part of this new instrument is the data acquisition system. It consists of a recently purchased microprocessor interfaced to a Kennedy nine-track tape drive. Both the platform and the readout are connected to the microprocessor.

The first three days were used to complete the rudiments of software for a data acquisition system. Concurrently, the system was interfaced to the ship's Doppler speed equipment. The platform was turned-on August 6. The gimbel servos were unstable, but this condition could be corrected sufficiently by careful adjustment of the loop gain. It was observed that while in the navigate mode, there is insufficient damping, such that the platform oscillates at the Schuler period. It does tend to damp toward level. In the "fast erect mode" the system is much more responsive. The integrated accelerations come within 0.5 kts of the rough estimates of ship's speed. Some post-cruise processing will be needed to determine the accuracies of the system. Various changes were made to the damping equation coefficients while the platform performance was being recorded. These data will be analyzed post-cruise to determine proper navigate mode damping parameters.

An error on the side of sensitivity caused the data from the gravity readout to be useless in all but the calmest of seas. Correction of this condition requires a new voltage controlled oscillator. Data was obtained directly from the vertical sensor using a frequency counter in order to correctly estimate the range the redesigned phase-locked loop should have. Gravity meter data was recorded during the calmer weather. This information will be used in the development of the data reduction frequency filtering algorithms.

Data acquisition programs were developed for recording the inertial data and ship dynamic motion as sensed by the gyro stabilized platform. This time series data was merged with the frequency counts from the gravity readout so that the resultant time series could be recorded simultaneously on tape. Twenty tapes were recorded. The data includes platform behavior in the fast erect mode and in the navigate mode. It includes performance while the damping parameters were varied. Loran, speed and heading, and vertical acceleration are included. Data was recorded for one XBT star, for subsequent comparison with the APOC data.

Changes to the gravity system as indicated by this cruise include:

(1) Adjust frequency response in servo amplifiers for better response.
(2) Improve the platform temperature regulation.
(3) Add an error-handling routine to platform computer.
(4) Calibrate the gyros and accelerometers.
(5) Improve the navigate mode algorithm.
(6) Redesign the phase-lock loop.

PARTICIPANTS IN THE SCIENTIFIC PARTY

The members of the scientific party aboard ENDEAVOR for Cruise No. 88, their affiliation, and principal tasks are listed below:

Raymond W. Schmitt	WHOI	Chief Scientist
Marvel C. Stalcup	WHOI	Hydro, Drifters
Robert C. Millard, Jr.	WHOI	CTD
Nancy Galbraith	WHOI	CTD Processing
Cynthia Tynan	WHOI	AutoSal, SCIMP Processing
William J. McMahon	WHOI	APOC Processing
Cleo A. Zani	WHOI	APOC Hardware
Alan R. Duester	WHOI	SCIMP Hardware
Robert G. Goldsborough	WHOI	Underway Gravity
Raymond Smith	UCSB	Bio-Optics
Ben Fahy	UCSB	Bio-Optics
Jim Nelson	UCSB	Bio-Optics
Robert Evans	RSMAS	Drifters, Communications
Kevin Leaman	RSMAS	Drifters
Stan Hooker	RSMAS	Plots, Drifters
David Nelson	URI	Marine Technician

ACKNOWLEDGEMENTS

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TABLE 1: EN88 EVENT LOG

DATE DAMOYR	GMT TIME	YEAR DAY	LAT. DEG MIN.	LONG. DEG MIN.	EVENT CBXD	COMMENTS AND OBSERVATIONS
050882	1805	217			0001	DEPART WOODS HOLE, U/W TO TEST STATION
060882	0330	218	39 52.30	-71 47.40	0001	RING CTR POSITION FOR DAY 216/0700 AT 36.63 N, -73.81 W
060882	0430	218	39 42.30	-71 52.40	0001	BEGIN APOC CALIBRATION RUN: DUE SOUTH
060882	0512	218	39 35.57	-71 51.53	0001	APOC CALIBRATION RUN; DUE NORTH
060882	0638	218	39 34.71	-71 50.73	0001	END THIRD APOC CALIBRATION RUN SOUTH; C/C TO TEST STATION
060882	0937	218	39 04.40	-72 11.40	0001	APOC LONGITUDE DIFFERS FROM SHIP LORAN BY 3 DEG.; APOC CORRECTED
060882	1430	218	38 11.30	-72 46.56	0001	H/T STATION 1
060882	1443	218	38 10.50	-72 46.90	1000	CTD #1 TEST INST.# 98; 12 BOTTLE ROSETTE; NO PINGER
060882	1510	218	38 10.20	-72 46.80	0010	XBT #1 TEST 10 DEG @248
060882	1640	218	38 09.40	-72 46.60	1000	CTD #1 TEST STATION OUT
060882	1641	218	38 09.40	-72 46.60	0100	BOPS #1 IN WATER
060882	1712	218	38 09.22	-72 46.35	0101	BOPS #1 OUT
060882	1737	218	38 09.20	-72 46.00	1000	CTD #2 IN TEST INST.# 7
060882	1904	218	38 07.81	-72 46.95	0001	RING CTR DAY 216/1800 36 38.0 W, -73 48.0 W
060882	1904	218	38 07.81	-72 46.95	0001	RING CTR DAY 216/0700 36 38.0 W, -73 49.0 W; 30 X 25 KM
060882	1953	218	38 07.30	-72 47.80	1000	CTD #2 OUT
060882	1955	218	38 07.50	-72 48.00	0001	SCIMP DIVE 1 IN WATER
060882	2010	218	38 07.50	-72 48.00	0001	DOLPHINS APPEAR AFTER SCIMP IN WATER;AL'S FRAMES #27-30
060882	2347	218	38 06.70	-72 48.90	0001	SCIMP DIVE 1 RECOVERED
070882	0000	219	38 06.28	-72 49.11	0001	U/W TO XBT STAR
070882	0600	219	37 03.30	-73 37.00	0010	XBT #2 (G1) 10 DEG @237
070882	0630	219	36 57.20	-73 37.00	0010	XBT #3 (G2) 10 DEG @250
070882	0700	219	36 49.00	-73 37.00	0010	XBT #4 (G3) 10 DEG @275
070882	0730	219	36 42.60	-73 36.70	0010	XBT #5 (G4) 10 DEG @328
070882	0800	219	36 37.50	-73 36.50	0010	XBT #6 (G5) 10 DEG @397
070882	0830	219	36 29.90	-73 36.80	0010	XBT #7 (G6) 10 DEG @429
070882	0900	219	36 25.00	-73 36.90	0010	XBT #8 (G7) 10 DEG @432
070882	0930	219	36 18.40	-73 36.90	0010	XBT #9 (G8) 10 DEG @408
070882	1000	219	36 14.20	-73 36.90	0010	XBT #10 (G9) 10 DEG @366
070882	1030	219	36 10.50	-73 36.80	0010	XBT #11 (G10) 10 DEG @386
070882	1035	219	36 10.64	-73 36.84	0001	C/C 323
070882	1100	219	36 12.10	-73 39.60	0010	XBT #12 (G11) 10 DEG @349
070882	1130	219	36 17.50	-73 44.00	0010	XBT #13 (G12) 10 DEG @320
070882	1200	219	36 22.80	-73 49.50	0010	XBT #14 (G13) 10 DEG @333
070882	1230	219	36 26.00	-73 53.00	0010	XBT #15 (G14) 10 DEG @343
070882	1300	219	36 31.80	-73 58.30	0010	XBT #16 (G15) 10 DEG @205
070882	1330	219	36 37.40	-74 01.70	0010	XBT #17 (NO GOOD)
070882	1330	219	36 37.40	-74 01.70	0010	XBT #18 (G16) 10 DEG @349
070882	1400	219	36 42.32	-74 06.00	0010	XBT #19 (G17) 10 DEG @345
070882	1405	219	36 43.98	-74 07.40	0001	APOC LOST LORAN; PROGRAM BOMBED
070882	1430	219	36 47.30	-74 10.40	0010	XBT #20 (G18) 10 DEG @315
070882	1500	219	36 52.10	-74 14.60	0010	XBT #21 (G19) 10 DEG @250
070882	1510	219	36 53.11	-74 16.15	0001	C/C FOR LEG 3 OF XBT STAR 250
070882	1530	219	36 52.10	-74 12.70	0010	XBT #22 (G20) 10 DEG @250
070882	1600	219	36 50.60	-74 06.40	0010	XBT #23 (G21) 10 DEG @288
070882	1630	219	36 48.70	-73 58.80	0010	XBT #24 (G22) 10 DEG @347
070882	1700	219	36 47.00	-73 51.70	0010	XBT #25 (G23) 10 DEG @368
070882	1730	219	36 45.50	-73 45.40	0010	XBT #26 (G24) 10 DEG @351
070882	1800	219	36 43.80	-73 38.30	0010	XBT #27 (G25) 10 DEG @352
070882	1805	219	36 43.20	-73 35.70	0001	SPERM WHALES SIGHTED
070882	1830	219	36 41.30	-73 29.90	0010	XBT #28 (G26) 10 DEG @315
070882	1900	219	36 40.50	-73 24.50	0010	XBT #29 (G27) 10 DEG @300
070882	1930	219	36 38.40	-73 15.80	0010	XBT #30 (G28) 10 DEG @277
070882	1940	219	36 37.73	-73 13.45	0001	SCATTERING LAYER GOING DOWN; SUNSHINE INCREASING
070882	2000	219	36 36.60	-73 09.10	0010	XBT #31 (G29) 10 DEG @265
070882	2030	219	36 34.20	-73 00.30	0010	XBT #32 (G30) 10 DEG @295
070882	2039	219	36 33.45	-72 57.70	0001	C/C DUE NORTH; END OF LEG 3
070882	2103	219	36 38.30	-72 57.20	0010	XBT #33 (G31) 10 DEG @265

TABLE 1: EVENT LOG (Continued)

070882	2105	219	36 37.24	-72 57.06	0001	C/C TO 252, GET BACK ON STAR
070882	2130	219	36 37.30	-73 02.90	0010	XBT #34 (G32) 10 DEG @270
070882	2200	219	36 36.00	-73 08.30	0010	XBT #35 (G33) 10 DEG @280
070882	2230	219	36 34.80	-73 14.10	0010	XBT #36 (G34) 10 DEG @299
070882	2300	219	36 33.30	-73 20.90	0010	XBT #37 (G35) 10 DEG @333
070882	2330	219	36 32.10	-73 26.40	0010	XBT #38 (G36) 10 DEG @386
080882	0000	220	36 30.80	-73 32.60	0010	XBT #39 (G37) 10 DEG @404
080882	0030	220	36 29.20	-73 39.60	0010	XBT #40 (G38) 10 DEG @395
080882	0100	220	36 27.70	-73 46.50	0010	XBT #41 (G39) 10 DEG @345
080882	0130	220	36 26.20	-73 52.80	0010	XBT #42 (G40) 10 DEG @284
080882	0200	220	36 24.50	-74 00.10	0010	XBT #43 (NO GOOD)
080882	0205	220	36 24.50	-74 00.10	0010	XBT #44 (G1) 10 DEG @253
080882	0230	220	36 22.90	-74 07.10	0010	XBT #45 (G2) 10 DEG @208
080882	0300	220	36 21.40	-74 13.90	0010	XBT #46 (G3) 10 DEG @169
080882	0311	220	36 20.90	-74 15.10	0001	C/C TO 040
080882	0330	220	36 24.90	-74 11.50	0010	XBT #47 10 DEG @160
080882	0400	220	36 28.30	-74 08.40	0010	XBT #48 (G4) 10 DEG @220
080882	0430	220	36 33.30	-74 03.90	0010	XBT #49 (G5) 10 DEG @295
080882	0500	220	36 36.70	-73 57.70	0010	XBT #50 (G6) 10 DEG @353
080882	0545	220	36 38.00	-73 45.70	0010	XBT #51 (G7) 10 DEG @406
080882	0548	220	36 38.38	-73 44.60	0001	C/C
080882	0650	220	36 47.70	-73 50.60	0010	XBT #52 (G8) 10 DEG @364
080882	0730	220	36 53.70	-73 44.90	0010	XBT #53 (G9) 10 DEG @295
080882	0800	220	36 59.30	-73 39.90	0010	XBT #54 (G10) 10 DEG @264
080882	0830	220	37 03.40	-73 36.40	0010	XBT #55 (G11) 10 DEG @249 END LEG V
080882	0843	220	37 04.80	-73 34.90	0001	C/C 195 TOWARD RING CENTER
080882	1103	220	36 37.95	-73 45.71	1000	CTD #3 IN, PROBLEM WITH ROSETTE
080882	1305	220	36 38.00	-73 45.76	0100	BOPS #3 IN
080882	1422	220	36 38.15	-73 46.30	1000	CTD #4 IN TO COLLECT WATER SAMPLES
080882	1630	220	36 39.20	-73 46.30	0001	CTD #4 OUT; U/W TO 36 18.50 N; -73 16.00 W
080882	1700	220	36 35.70	-73 40.40	0010	XBT #56 (G12) 10 DEG @402
080882	1730	220	36 30.90	-73 33.30	0010	XBT #57 (G13) 10 DEG @384
080882	1800	220	36 27.80	-73 28.70	0010	XBT #58 (G14) 10 DEG @380
080882	1830	220	36 24.60	-73 23.00	0010	XBT #59 (G15) 10 DEG @350
080882	1850	220	36 22.00	-73 17.90	0010	XBT #60 (G16) 10 DEG @350
080882	1920	220	36 18.50	-73 15.52	0100	H/T BOPS STATION
080882	1939	220	36 18.80	-73 12.50	0100	BOPS #5 IN
080882	2021	220	36 19.30	-73 12.40	1000	CTD #5 IN
080882	2305	220	36 20.14	-73 08.82	0001	CTD #5 OUT, TO BLOCKED
080882	2314	220	36 20.24	-73 08.51	0001	U/W TO STATION 6
090882	0037	221	36 23.04	-73 22.31	0001	H/T STATION 6
090882	0041	221	36 22.80	-73 22.60	0100	BOPS #6 IN
090882	0119	221	36 23.84	-73 22.31	0100	BOPS #6 OUT
090882	0143	221	36 22.90	-73 23.90	1000	CTD #6 IN WATER AFTER STEAMING BACK TO STATION 6 POSITION
090882	0417	221	36 23.50	-73 21.60	1000	CTD #6 OUT 10 DEG @360
090882	0533	221	36 28.00	-73 32.00	1000	CTD #7 IN 10 DEG @375
090882	0805	221	36 28.10	-73 31.70	1000	CTD #7 OUT
090882	0806	221	36 28.10	-73 31.65	0100	BOPS #7 IN
090882	0838	221	36 28.22	-73 31.63	0100	BOPS #7 OUT
090882	0852	221	36 28.33	-73 31.65	0001	U/W TO STATION 8
090882	0941	221	36 33.00	-73 39.80	1000	CTD #8 IN 10 DEG @395
090882	1200	221	36 32.46	-73 41.01	1000	CTD #8 OUT
090882	1205	221	36 32.40	-73 41.00	0100	BOPS #8 IN
090882	1245	221	36 32.75	-73 40.41	0100	BOPS #8 OUT
090882	1248	221	36 37.75	-73 40.41	0001	U/W TO STATION 9
090882	1336	221	36 37.90	-73 45.90	0001	H/T STA 9
090882	1341	221	36 37.90	-73 45.90	0100	BOPS #9 IN
090882	1410	221	36 38.22	-73 46.53	0100	BOPS #9 OUT
090882	1419	221	36 38.20	-73 46.60	1000	CTD #9 IN
090882	1620	221	36 37.69	-73 46.54	1000	CTD #9 OUT
090882	1650	221	36 37.60	-73 46.40	0001	SCIMP DIVE #2 IN

TABLE 1: EVENT LOG (Continued)

090882	1915	221	36 37.70	-73 46.64	0001	SCIMP RECOVERED; DOLPHINS IN VICINITY
090882	1919	221	36 37.83	-73 46.43	0001	U/W TO STATION 10
090882	2006	221	36 42.90	-73 54.00	0001	H/T STATION 10
090882	2007	221	36 42.90	-73 54.00	0100	BOPS #10 IN
090882	2043	221	36 42.79	-73 53.92	1000	CTD #10 IN
090882	2237	221	36 42.04	-73 54.62	1000	CTD #10 OUT
090882	2337	221	36 49.10	-74 03.60	0100	BOPS #11 IN
100882	0020	222	36 49.20	-74 03.80	1000	CTD #11 IN
100882	0215	222	36 49.01	-74 03.42	1000	CTD #11 OUT
100882	0336	222	36 53.90	-74 11.00	1000	CTD #12 IN
100882	0528	222	36 53.42	-74 11.22	1000	CTD #12 OUT
100882	0535	222	36 53.30	-74 11.30	0100	BOPS #12 IN
100882	0618	222	36 53.30	-74 11.90	0100	BOPS #12 OUT
100882	0718	222	36 58.59	-74 19.00	1000	CTD #13 IN
100882	0908	222	36 57.98	-74 20.10	1000	CTD #13 OUT
100882	0912	222	36 57.94	-74 20.00	0100	BOPS #13 IN
100882	0930	222	36 57.80	-74 20.30	0001	U/W TO STATION 14
100882	1043	222	37 04.32	-74 27.35	1000	CTD #14 IN
100882	1204	222	37 03.60	-74 28.74	1000	CTD #14 OUT
100882	1206	222	37 03.47	-74 28.64	0100	BOPS #14 IN
100882	1254	222	37 03.45	-74 27.73	0100	BOPS #14 OUT
100882	1300	222	37 03.84	-74 29.16	0001	U/W TO STATION 15
100882	1342	222	37 09.20	-74 34.20	1000	CTD #15 IN
100882	1354	222	37 09.21	-74 34.19	1000	CTD #15 OUT
100882	1358	222	37 09.21	-74 33.97	0100	BOPS #15 IN
100882	1420	222	37 09.23	-74 33.92	0100	BOPS #15 OUT
100882	1423	222	37 09.23	-74 33.92	0001	U/W TO STATION 16
100882	1500	222	37 08.90	-74 24.40	0010	XBT #61 (G17) 10 DEG @200
100882	1600	222	37 08.90	-74 11.00	0010	XBT #62 (G18) 10 DEG @250
100882	1700	222	37 09.02	-73 52.32	0010	XBT #63 (G19) 10 DEG @274
100882	1804	222	37 08.90	-73 40.70	0100	BOPS #16 IN
100882	1833	222	37 08.59	-73 40.46	0100	BOPS #16 OUT
100882	1836	222	37 08.20	-73 40.55	1000	CTD #16 IN
100882	2053	222	37 07.39	-73 40.16	1000	CTD #16 OUT
100882	2130	222	37 00.50	-73 41.20	0100	BOPS #17 IN
100882	2213	222	37 00.56	-73 40.98	0100	BOPS #17 OUT
100882	2226	222	37 00.20	-73 40.90	1000	CTD #17 IN
110882	0032	223	36 59.41	-73 41.14	1000	CTD #17 OUT
110882	0132	223	36 53.02	-74 44.00	0001	H/T STATION 18
110882	0145	223	36 53.07	-73 43.84	0100	BOPS #18 IN
110882	0153	223	36 53.50	-73 43.70	0010	XBT #64 (G20) 10 DEG @357 (TO CHECK STRUCTURE)
110882	0219	223	36 52.83	-73 43.50	0100	BOPS #18 OUT
110882	0230	223	36 52.74	-73 43.60	1000	CTD #18 IN
110882	0447	223	36 51.54	-73 41.69	0001	SCIMP DIVE #3 IN
110882	0856	223	36 52.05	-73 39.94	0001	SCIMP FLOATING AT 300 M, 5 LB (BRIDGE LORAN USED)
110882	0856	223	36 52.51	-73 39.70	0001	APOC LORAN VALUES
110882	0906	223	36 52.15	-73 39.61	0001	DRIFTER IN TO MARK VICINITY OF SCIMP; DEPTH 2785 M
110882	1012	223	36 45.05	-73 45.99	1000	CTD #19 IN
110882	1140	223	36 45.14	-73 47.01	0001	SPERM WHALES SIGHTED ON STATION
110882	1225	223	36 45.10	-73 47.44	1000	CTD #19 OUT
110882	1230	223	36 46.00	-73 47.20	0100	BOPS #19 IN
110882	1309	223	36 46.90	-73 46.20	0010	XBT #65 10 DEG @376
110882	1336	223	36 46.96	-73 45.66	0100	BOPS #19 OUT, 1305 M
110882	1340	223	36 47.48	-73 45.38	0001	U/W COURSE OF 330 FOR XBT SURVEY
110882	1350	223	36 49.60	-73 46.60	0010	XBT #66 (G21) 10 DEG @384
110882	1420	223	36 53.40	-73 49.20	0010	XBT #67 (G22) 10 DEG @375
110882	1430	223	36 56.03	-73 51.26	0010	XBT #68 (G23) 10 DEG @362
110882	1450	223	36 59.90	-73 54.10	0010	XBT #69 (G24) 10 DEG @331
110882	1755	223	36 38.41	-73 47.29	0100	BOPS #20 IN
110882	1821	223	36 38.82	-73 46.67	0001	DOLPHINS SIGHTED, 100
110882	1830	223	36 38.94	-73 46.23	0100	BOPS #20 OUT

TABLE 1: EVENT LOG (Continued)

110882	1835	223	36 38.99	-73 46.32	1000	CTD #20 IN; LARGE POD OF DOLPINS 200 M OFF STERN
110882	2046	223	36 39.22	-73 46.46	1000	CTD #20 OUT
110882	2140	223	36 34.71	-73 47.03	0001	U/W TO THE EAST, XBTS
110882	1510	223	37 03.20	-73 56.70	0010	XBT #70 (G25) 10 DEG @305
110882	2200	223	36 34.30	-73 43.80	0010	XBT #71 (G26) 10 DEG @367
110882	2230	223	36 33.50	-73 36.48	0010	XBT #72 (NO GOOD)
110882	2233	223	36 32.70	-73 35.20	0010	XBT #73 (G27) 10 DEG @430
110882	2245	223	36 33.77	-73 32.99	0001	C/C TO 045
110882	2300	223	36 34.40	-73 29.40	0010	XBT #74 (G28) 10 DEG @455
110882	2330	223	36 38.90	-73 22.20	0010	XBT #75 (G29) 10 DEG @437
120882	0000	224	36 42.70	-73 16.50	0010	XBT #76 (G30) 10 DEG @379
120882	0030	224	36 49.90	-73 10.30	0010	XBT #77 (G31) 10 DEG @315
120882	0034	224	36 50.05	-73 10.10	0001	C/C TO 225; THUNDER STORM
120882	0130	224	36 43.70	-73 15.60	0010	XBT #78 (G32) 10 DEG @374
120882	0158	224	36 42.30	-73 19.70	0010	XBT #79 (NO GOOD)
120882	0200	224	36 41.80	-73 20.40	0010	XBT #80 (G33) 10 DEG @443
120882	0237	224	36 36.20	-73 25.70	0001	C/C TO 035
120882	0238	224	36 36.20	-73 25.70	0010	XBT #81 (G34) 10 DEG @437
120882	0300	224	36 40.30	-73 22.00	0010	XBT #82 (G35) 10 DEG @442
120882	0330	224	36 46.00	-73 18.00	0010	XBT #83 (G36)
120882	0345	224	36 48.03	-73 16.86	0001	C/C TO 240
120882	0400	224	36 45.24	-73 21.24	0010	XBT #84 (G37) 10 DEG @393
120882	0430	224	36 42.90	-73 26.10	0010	XBT #85 (G38) 10 DEG @433
120882	0500	224	36 41.46	-73 31.86	0010	XBT #86 (G39) 10 DEG @420
120882	0506	224	36 42.56	-73 31.30	0001	C/C TO 030
120882	0530	224	36 45.80	-73 29.70	0010	XBT #87 (G40) 10 DEG @433
120882	0602	224	36 51.05	-73 25.23	0010	XBT #88 (G1) 10 DEG @400
120882	0605	224	36 51.05	-73 25.23	0001	C/C TO HEAD FOR 36 43.00, -73 39.00; BEGIN SECOND STAR
120882	0740	224	36 41.20	-73 39.60	0010	XBT #89 (G2) 10 DEG @350
120882	0800	224	36 43.80	-73 42.70	0010	XBT #90 (G3) 10 DEG @350
120882	0830	224	36 48.50	-73 49.09	0010	XBT #91 (G4) 10 DEG @335
120882	0900	224	36 52.29	-73 54.83	0010	XBT #92 (G5) 10 DEG @291
120882	0930	224	36 55.86	-74 01.05	0010	XBT #93 (G6) 10 DEG @265
120882	0935	224	36 57.14	-74 01.28	0001	C/C 090
120882	1000	224	36 56.70	-73 54.20	0010	XBT #94 (G7) 10 DEG @312
120882	1030	224	36 56.32	-73 46.50	0010	XBT #95 (G8) 10 DEG @358
120882	1050	224	36 56.73	-73 42.28	0001	PASSING THE KNORR AND OCEANUS
120882	1100	224	36 55.52	-73 38.59	0010	XBT #96 (G9) 10 DEG @405
120882	1130	224	36 55.20	-73 30.80	0010	XBT #97 (G10) 10 DEG @404
120882	1200	224	35 54.50	-73 22.20	0010	XBT #98 (G11) 10 DEG @367
120882	1230	224	36 55.10	-73 12.20	0010	XBT #99 (G12) 10 DEG @361
120882	1300	224	36 55.20	-73 04.60	0010	XBT #100 (G13) 10 DEG @336
120882	1305	224	36 55.20	-73 04.60	0001	C/C THIRD LEG OF XBT STAR
120882	1330	224	36 53.00	-73 08.20	0010	XBT #101 (G14) 10 DEG @344
120882	1400	224	36 50.40	-73 14.40	0010	XBT #102 (G15) 10 DEG @398
120882	1430	224	36 49.00	-73 18.00	0010	XBT #103 (G16) 10 DEG @415
120882	1500	224	36 45.56	-73 25.80	0010	XBT #104 (G17) 10 DEG @415
120882	1530	224	36 43.50	-73 32.00	0010	XBT #105 (G18) 10 DEG @389
120882	1600	224	36 41.10	-73 38.30	0010	XBT #106 (G19) 10 DEG @328
120882	1630	224	36 39.80	-73 46.90	0010	XBT #107 10 DEG @270
120882	1630	224	36 39.80	-73 46.90	0001	ALTERED COURSE TO INVESTIGATE RADAR TARGETS; FISHING FLOATS
120882	1643	224	36 39.70	-73 48.00	0001	U/W TO NEXT POINT
120882	1700	224	36 36.40	-73 50.60	0011	XBT #108 (H1) 10 DEG @235 SPERM WHALES SIGHTED; C/C FOR FOURTH LEG
120882	1730	224	36 59.00	-73 50.10	0010	XBT #109 (H2) 10 DEG @226
120882	1800	224	36 41.30	-73 50.80	0010	XBT #110 (H3) 10 DEG @287
120882	1830	224	36 49.15	-73 47.50	0010	XBT #111 (H4) 10 DEG @306
120882	1900	224	36 51.90	-73 42.40	0010	XBT #112 (H5) 10 DEG @358
120882	1930	224	36 56.50	-73 39.50	0010	XBT #113 (H6) 10 DEG @380
120882	1950	224	36 59.61	-73 38.14	0001	DOLPHINS BESIDE VESSEL
120882	2000	224	37 01.72	-73 37.95	0010	XBT #114 (H7) 10 DEG @380
120882	2030	224	37 07.06	-73 37.81	0011	XBT #115 (H8) 10 DEG @339; APOC LORAN OFF, USED NORTH STAR 6000

TABLE 1: EVENT LOG (Continued)

120882	2100	224	37 12.90	-73 37.80	0011	XBT #116 (H9) 10 DEG @284; APOC LORAN OFF. USED NORTH STAR 6000
120882	2107	224	37 13.41	-73 37.27	0001	C/C 193
120882	2130	224	37 08.67	-73 36.06	0010	XBT #117 (H10) 10 DEG @318
120882	2200	224	37 04.34	-73 34.44	0010	XBT #118 (H11) 10 DEG @360
120882	2230	224	36 57.88	-73 32.15	0010	XBT #119 (H12) 10 DEG @402
120882	2300	224	36 57.68	-73 31.67	0001	RENDEZ-VOUS WITH THE KNORR VIA ZODIAC
130882	0230	225	36 55.77	-73 29.84	0001	PLANNING SESSIONS WITH KNORR AND OCEANUS
130882	0247	225	36 56.00	-73 30.10	0001	LAUNCH LORAN DRIFTER
130882	0307	225	36 55.40	-73 30.03	0001	LORAN DRIFTER AND SEDIMENT TRAP DEPLOYED
130882	0319	225	36 55.33	-73 30.04	1000	CTD #21 IN BY THE DRIFTER
130882	0542	225	36 57.90	-73 30.30	1000	CTD #21 OUT
130882	0548	225	36 58.06	-73 30.33	0100	BOPS #21 IN
130882	0627	225	36 58.86	-73 30.50	0100	BOPS #21 OUT
130882	0630	225	36 58.86	-73 30.50	0001	U/W 030
130882	0700	225	37 03.40	-73 27.00	0010	XBT #120 (H13) 10 DEG @365
130882	0730	225	37 08.50	-73 23.20	0010	XBT #121 (H14) 10 DEG @315
130882	0800	225	37 14.00	-73 19.40	0010	XBT #122 (H15) 10 DEG @296
130882	0830	225	37 18.80	-73 15.90	0010	XBT #123 (H16) 10 DEG @275
130882	0935	225	37 20.36	-73 14.90	0001	C/C 210 UNDERWAY TO PICK UP DRIFTER SIGNAL BEFORE CTD TOW-YO
130882	1000	225	37 15.31	-73 18.39	0010	XBT #124 (H17) 10 DEG @302
130882	1030	225	37 12.00	-73 20.70	0010	XBT #125 (H18) 10 DEG @307
130882	1120	225	37 05.30	-73 25.60	0010	XBT #126 (H19) 10 DEG @337
130882	1136	225	37 03.94	-73 26.91	0001	C/C 025
130882	1204	225	37 06.90	-73 24.80	0100	BOPS #22A IN
130882	1230	225	37 07.11	-73 24.79	0001	LORAN DRIFTER POSITION: 37 05.00, -73 40.00
130882	1331	225	37 06.10	-73 25.30	0001	PROBLEM WITH SLIP RINGS; REPLACED RINGS
130882	1249	225	37 07.02	-73 24.93	1001	CTD #22 IN TOW-YO UNDERWAY COURSE 210 @ 2 KNOTS
130882	1423	225	37 05.60	-73 25.40	1000	CTD #22 START DOWNCAST #3
130882	1441	225	37 05.20	-73 25.60	0100	BOPS #22B IN FOR OVERFLIGHT
130882	1525	225	37 05.17	-73 24.72	0100	BOPS OUT
130882	1540	225	37 04.93	-73 24.14	1000	CTD #22 OUT; CABLE PROBLEMS
130882	1630	225	37 04.10	-73 23.40	1000	CTD ON J-FRAME, RETURN TO TOW-YO
140882	0000	226	36 58.10	-73 39.30	0001	KNORR DECIDES TO GO TO RING 82E;ENDEAVOR AND OCEANUS STAY ON 82B AND 81G
140882	0326	226	36 55.04	-75 51.81	1001	CTD #22 TOW-YO OUT; OCEANUS TOWING ALONGSIDE
140882	0332	226	36 55.10	-73 51.69	0001	U/W TO LORAN DRIFTER
140882	0430	226	37 00.34	-73 46.24	0001	NEXT TO LORAN DRIFTER
140882	0514	226	37 02.29	-73 46.03	0100	BOPS #23 IN
140882	0548	226	37 02.36	-73 46.55	0100	BOPS #23 OUT
140882	0604	226	37 02.31	-73 46.75	1000	CTD #23 IN
140882	0810	226	37 02.26	-73 48.44	1000	CTD #23 OUT
140882	0831	226	37 01.64	-73 50.85	0001	H/T TO RECOVER DRIFTER
140882	1015	226	37 00.04	-73 41.65	0010	XBT #127 (G1) 10 DEG @317; BEGIN PERIMETER STAR
140882	1045	226	37 05.10	-73 42.80	0010	XBT #128 (G2) 10 DEG @330
140882	1115	226	37 11.50	-73 44.50	0010	XBT #129 (G3) 10 DEG @320
140882	1115	226	37 11.24	-73 44.54	0001	TEN SPERM WHALES AT SUNRISE; LOGGING
140882	1115	226	37 11.24	-73 44.54	0001	C/C 135
140882	1145	226	37 08.22	-73 40.39	0010	XBT #130 (G4) 10 DEG @325
140882	1215	226	37 03.20	-73 33.90	0010	XBT #131 (G5) 10 DEG @324
140882	1245	226	37 04.60	-73 28.60	0010	XBT #132 (G6) 10 DEG @324
140882	1315	226	37 08.30	-73 22.30	0010	XBT #133 (G7) 10 DEG @329
140882	1318	226	37 08.30	-73 22.30	0001	C/C 210
140882	1345	226	37 05.70	-73 23.50	0010	XBT #134 (G8) 10 DEG @326
140882	1415	226	36 59.90	-73 27.40	0010	XBT #135 (G9) 10 DEG @301
140882	1445	226	36 55.50	-73 23.80	0010	XBT #136 (G10) 10 DEG @233
140882	1514	226	36 51.80	-73 21.50	0001	C/C 275
140882	1515	226	36 51.80	-73 21.50	0010	XBT #137 (NO GOOD)
140882	1517	226	36 51.80	-73 21.50	0010	XBT #138 (G11) 10 DEG @202
140882	1545	226	36 52.11	-73 26.30	0010	XBT #139 (NO GOOD)
140882	1550	226	36 52.20	-73 27.40	0010	XBT #140 (G12) 10 DEG @225
140882	1609	226	36 52.34	-73 32.99	0001	C/C 197
140882	1615	226	36 52.30	-73 33.00	0010	XBT #141 (G13) 10 DEG @240

TABLE 1: EVENT LOG (Continued)

140882	1645	226	36 45.20	-73 36.80	0010	XBT #142 (G14) 10 DEG @205
140882	1700	226	36 42.94	-73 38.12	0001	C/C 350
140882	1715	226	36 45.40	-73 38.70	0010	XBT #143 (G15) 10 DEG @200
140882	1745	226	36 51.10	-73 40.10	0010	XBT #144 (G16) 10 DEG @243
140882	1900	226	36 54.26	-73 40.96	0001	C/C 284
140882	1815	226	36 54.90	-73 44.30	0010	XBT #145 (G17) 10 DEG @285
140882	1845	226	36 56.20	-73 52.16	0010	XBT #146 (G18) 10 DEG @305
140882	1859	226	36 56.90	-73 56.40	0001	C/C 055 TO RING CENTER
140882	1935	226	37 05.18	-73 45.94	0001	SPOTTED DOLPHINS ON BOW WAVE; ABOUT 75 IN VICINITY; FILM FRAMES TO 27 CINDY'S
140882	2030	226	37 05.23	-73 43.30	0100	BOPS #24A
140882	2110	226	37 05.32	-73 43.30	0001	DEPLOY WHOI SATELLITE DRIFTER
140882	2150	226	37 05.23	-73 47.40	0001	DEPLOY RSMAS SATELLITE DRIFTER
140882	2200	226	37 06.17	-73 48.13	0010	XBT #147 (G19) 10 DEG @333
140882	2218	226	37 07.96	-73 48.71	0001	DEPLOY DRIFTER #3 (RSMAS LORAN DRIFTER #7)
140882	2220	226	37 07.96	-73 48.71	0001	U/W TO 37 25.00, -74 00.00
140882	2300	226	37 14.01	-73 52.35	0010	XBT #148 (G20) 10 DEG @290
150882	0000	226	37 25.00	-74 00.00	0001	H/T STATION 24
150882	0008	227	37 25.05	-73 59.86	0100	BOPS #24B IN
150882	0044	227	37 24.94	-73 59.88	0100	BOPS #24B OUT
150882	0048	227	37 24.85	-73 59.98	1000	CTD #24 IN
150882	0213	227	37 25.00	-73 59.20	1001	CTD #24 OUT
150882	0214	227	37 25.00	-73 59.20	0001	U/W TO STATION 25
150882	0305	227	37 13.04	-73 54.14	0100	BOPS #25 IN
150882	0337	227	37 17.85	-73 53.56	0100	BOPS #25 OUT
150882	0340	227	37 17.85	-73 53.56	1000	CTD #25 IN
150882	0423	227	37 17.61	-73 52.65	1000	CTD #25 AT BOTTOM
150882	0534	227	37 17.21	-73 51.78	1000	CTD #25 OUT
150882	0545	227	37 17.21	-73 51.78	0001	U/W TO STATION 26
150882	0615	227	37 12.50	-73 50.50	0100	BOPS #26 IN
150882	0705	227	37 11.90	-73 49.70	1000	CTD #26 IN
150882	0820	227	37 11.90	-73 49.98	0001	LEACH'S PETRELS AND WILSON'S PETRELS ON DECK
150882	0858	227	37 12.02	-73 50.29	1000	CTD #26 OUT
150882	0950	227	37 07.80	-73 47.13	1001	CTD #27 IN WATER; NORTHERN WATERTHRUSH ON BOARD
150882	1146	227	37 07.86	-73 47.94	1000	CTD #27 OUT; BLACK AND WHITE WARBLER ON BOARD
150882	1150	227	37 07.86	-73 47.94	0100	BOPS #27 IN
150882	1213	227	37 07.84	-73 48.04	0100	BOPS #27 OUT
150882	1240	227	37 07.77	-73 48.40	0001	U/W TO STATION 28
150882	1329	227	37 02.79	-73 43.32	0001	ON STATION 28
150882	1337	227	37 02.64	-73 42.04	1000	CTD #28 IN
150882	1544	227	37 01.01	-73 43.32	1000	CTD #28 OUT (NO BOPS AT THIS STATION)
150882	1546	227	37 01.01	-73 43.32	0001	U/W TO STATION 29
150882	1625	227	37 01.58	-73 50.69	0100	BOPS #29 IN
150882	1705	227	37 00.86	-73 50.86	0100	BOPS #29 OUT
150882	1710	227	37 00.72	-73 50.90	1000	CTD #29 IN
150882	1753	227	37 00.59	-73 51.23	1000	CTD #29 ON BOTTOM
150882	1904	227	37 00.59	-73 51.79	1000	CTD #29 OUT
150882	1910	227	37 00.59	-73 51.79	0001	U/W TO STATION 30
150882	1930	227	36 55.83	-73 50.65	0100	BOPS #30 IN
150882	2022	227	36 55.59	-73 50.99	1000	CTD #30 IN
150882	2307	227	36 53.56	-73 51.93	1000	CTD #30 OUT
150882	2332	227	36 49.92	-73 50.58	0100	BOPS #31 IN
160882	0004	228	36 49.43	-73 51.08	0100	BOPS OUT
160882	0013	228	36 49.00	-73 51.60	1000	CTD #31 IN
160882	0206	228	36 47.98	-73 53.43	1000	CTD #31 OUT
160882	0242	228	36 43.99	-73 50.64	0001	H/T STATION 32
160882	0245	228	36 43.99	-73 50.64	0100	BOPS #32 IN
160882	0321	228	36 43.74	-73 51.06	0100	BOPS #32 OUT
160882	0325	228	36 43.67	-73 51.34	1000	CTD #32 IN
160882	0528	228	36 42.12	-73 51.96	1000	CTD #32 OUT
160882	0640	228	36 35.93	-73 50.93	0100	BOPS #33 IN
160882	0715	228	36 35.29	-73 51.42	0100	BOPS #33 OUT

TABLE 1: EVENT LOG (Continued)

160882	0719	228	36 35.29	-73 51.42	1000	CTD #33 IN
160882	0927	228	36 35.38	-73 52.71	1000	CTD #33 OUT
160882	0930	228	36 43.70	-74 22.56	0001	U/W TO STATION 34; NEW SECTION
160882	1133	228	36 43.65	-74 22.11	0001	ONE SPERM WHALE; LOGGING
160882	1150	228	36 44.96	-74 24.64	0001	H/T STATION 34
160882	1200	228	36 45.40	-74 27.60	1000	CTD #34 IN
160882	1314	228	36 46.14	-74 27.71	1000	CTD #34 OUT
160882	1317	228	36 46.22	-74 27.53	0100	BOPS #34 IN
160882	1400	228	36 46.82	-74 27.49	0001	U/W TO STATION 35
160882	1500	228	36 50.50	-74 16.50	0100	BOPS #35 IN
160882	1531	228	36 50.64	-74 16.59	0100	BOPS #35 OUT
160882	1535	228	36 50.64	-74 16.59	1000	CTD #35 IN
160882	1615	228	36 51.12	-74 16.88	0001	APPROX 6 HUMPBACKS NEAR LORAN DRIFTER; TWO SPERM WHALES IN VICINITY
160882	1719	228	36 51.59	-74 16.93	1000	CTD #35 OUT
160882	1727	228	36 51.59	-74 16.93	0001	U/W TO STATION 36
160882	1819	228	36 54.07	-74 07.53	0100	BOPS #36 IN
160882	1851	228	36 54.05	-74 07.39	0100	BOPS #36 OUT
160882	1855	228	36 54.05	-74 07.39	1000	CTD #36 IN
160882	2045	228	36 53.94	-74 06.81	1000	CTD #36 OUT
160882	2050	228	36 53.98	-74 07.00	0001	U/W STATION 37
160882	2100	228	36 54.20	-74 08.60	0001	ALONGSIDE MIAMI SATELLITE BUOY
160882	2122	228	36 54.90	-74 04.10	0001	ALONGSIDE WHOI SATELLITE BUOY
160882	2150	228	36 58.06	-73 59.93	0001	H/T STATION 37
160882	2151	228	36 58.05	-73 59.93	0100	BOPS #37 IN
160882	2222	228	36 57.59	-73 59.91	0100	BOPS #37 OUT
160882	2245	228	36 57.97	-73 59.76	1000	CTD #37 IN
170882	0022	229	36 56.92	-73 59.39	1000	CTD #37 OUT
170882	0027	229	36 56.92	-73 59.39	0001	U/W TO STATION 38
170882	0200	229	37 06.90	-73 43.00	0001	H/T STATION 38
170882	0203	229	37 06.90	-73 43.00	0100	BOPS #38 IN
170882	0238	229	37 06.60	-73 42.70	0101	BOPS #38 OUT
170882	0241	229	37 06.60	-73 42.70	1000	CTD #38 IN
170882	0433	229	37 05.96	-73 42.68	1000	CTD #38 OUT
170882	0435	229	37 05.96	-73 42.68	0001	U/W TO STATION 39
170882	0544	229	37 12.00	-73 30.90	0100	BOPS #39 IN
170882	0622	229	37 12.09	-73 30.86	1000	CTD #39 IN
170882	0720	229	37 12.08	-73 30.47	0001	CHANGED CASSETTE IN LORAN C RECORDER
170882	0827	229	37 12.80	-73 30.22	1000	CTD #39 OUT; 10 DEG AT 273
170882	1213	229	36 29.30	-73 50.50	0001	H/T STATION 40
170882	1220	229	36 29.30	-73 50.50	1000	CTD #40 IN
170882	1429	229	36 28.40	-73 49.28	0100	BOPS #40 IN
170882	1500	229	36 27.87	-73 48.99	0101	BOPS #40 OUT; U/W TO STATION 41
170882	1626	229	36 38.90	-73 57.20	0001	H/T STATION 41
170882	1635	229	36 38.93	-73 57.20	0100	BOPS #41 IN
170882	1727	229	36 38.90	-73 58.00	1000	CTD #41 IN
170882	2053	229	36 41.20	-74 03.60	0001	PASSED LORAN-C DRIFTER (NORTH STAR 6000: 36 40.73; -74 03.55)
170882	2130	229	36 46.44	-74 02.56	0100	BOPS #42 IN
170882	2211	229	36 45.60	-74 02.19	1000	CTD #42 IN
180882	0021	230	36 46.40	-74 02.60	1000	CTD #42 OUT
180882	0212	230	36 53.80	-74 08.30	0001	H/T STATION 43
180882	0212	230	36 53.80	-74 08.30	0100	BOPS #43 IN
180882	0255	230	36 53.80	-74 08.30	1000	CTD #43 IN
180882	0602	230	37 02.68	-74 13.28	0100	BOPS #44 IN
180882	0645	230	37 03.39	-74 13.43	0100	BOPS #44 OUT
180882	0645	230	37 03.39	-74 13.43	1000	CTD #44 IN
180882	0836	230	37 02.68	-74 14.63	1000	CTD #44 OUT; U/W TO STATION 45
180882	0934	230	37 10.00	-74 20.25	1000	CTD #45 IN
180882	1109	230	37 09.11	-74 21.88	1000	CTD #45 OUT 10 DEG @ 143 M
180882	1110	230	37 09.08	-74 21.66	0100	BOPS #45 IN
180882	1150	230	37 09.51	-74 21.79	0100	BOPS #45 OUT
180882	1200	230	37 08.45	-74 22.41	0001	U/W TO STATION 46, COURSE 195

TABLE 1: EVENT LOG (Continued)

180882	1245	230	37 00.60	-74 25.70	0001	TWO SPERM WHALES 50 YDS OFF SHIP; POSSIBLE MOTHER AND CALF
180882	1423	230	36 41.05	-74 34.29	0001	DOLPHINS RIDING BOW WAVE; UNSURE OF SPECIES
180882	1500	230	36 33.65	-74 36.35	0001	GREATER SHEARWATERS
180882	1525	230	36 29.87	-74 37.10	0001	30-40 CORY'S SHEARWATERS; BONITA (OR TUNA) JUMPING
180882	1700	230	36 09.90	-74 40.60	0010	XBT #149 (G1) 10 DEG @218; BEGIN FINAL STAR
180882	1730	230	36 14.80	-74 35.80	0010	XBT #150 (G2) 10 DEG @215
180882	1800	230	36 19.80	-74 31.80	0010	XBT #151 (G3) 10 DEG @250
180882	1800	230	36 19.80	-74 31.80	0001	FEMALE BROWN-HEADED COWBIRD ONBOARD
180882	1830	230	36 24.50	-74 27.00	0010	XBT #152 (G4) 10 DEG @303
180882	1900	230	36 29.40	-74 22.60	0010	XBT #153 (NO GOOD)
180882	1903	230	36 29.90	-74 22.00	0010	XBT #154 (G5) 10 DEG @330
180882	1930	230	36 33.90	-74 18.20	0010	XBT #155 (G6) 10 DEG @315
180882	2000	230	36 38.62	-74 13.76	0010	XBT #156 (G7) 10 DEG @320
180882	2030	230	36 43.76	-74 08.91	0010	XBT #157 (NO GOOD)
180882	2030	230	36 43.76	-74 08.91	0010	XBT #158 (G8) 10 DEG @306
180882	2100	230	36 47.94	-74 05.34	0010	XBT #159 (G9) 10 DEG @296
180882	2130	230	36 41.98	-74 04.53	0010	XBT #160 (G10) 10 DEG @306
180882	2200	230	36 36.72	-74 04.46	0010	XBT #161 (G11) 10 DEG @307
180882	2230	230	36 29.51	-74 04.39	0010	XBT #162 (G12) 10 DEG @285
180882	2300	230	36 23.35	-74 04.34	0010	XBT #163 (G13) 10 DEG @270
180882	2330	230	36 17.10	-74 04.26	0010	XBT #164 (G14) 10 DEG @290
180882	2345	230	36 14.37	-74 04.34	0001	C/C
190882	0028	231	36 14.93	-74 15.20	0010	XBT #165 (G15) 10 DEG @246
190882	0100	231	36 18.90	-74 21.80	0010	XBT #166 (G16) 10 DEG @245
190882	0132	231	36 23.70	-74 26.40	0001	SIGHTED LORAN DRIFTER 1-3 MILES
190882	0200	231	36 29.13	-74 26.84	0010	XBT #167 (G17) 10 DEG @287
190882	0230	231	36 35.73	-74 26.87	0010	XBT #168 (G18) 10 DEG @305
190882	0231	231	36 36.00	-74 26.90	0001	RSMAS DRIFTER ON RADAR @ 270 DEG TRUE, 3.2 NMI
190882	0300	231	36 41.90	-74 26.68	0010	XBT #169 (G19) 10 DEG @293
190882	0314	231	36 45.30	-74 26.50	0001	DRIFTER ON RADAR @ 261 DEG TRUE, 3.7 NMI, (WHOI DRIFTER ?)
190882	0330	231	36 48.82	-74 26.59	0010	XBT #170 (G20) 10 DEG @265
190882	0400	231	36 55.10	-74 26.70	0010	XBT #171 (G21) 10 DEG @246
190882	0405	231	36 55.10	-74 26.70	0001	C/C
190882	0430	231	36 51.80	-74 23.10	0010	XBT #172 (G22) 10 DEG @279
190882	0500	231	36 45.20	-74 18.60	0010	XBT #173 (G23) 10 DEG @325
190882	0530	231	36 41.30	-74 14.60	0010	XBT #174 (G24) 10 DEG @329
190882	0600	231	36 35.70	-74 10.00	0010	XBT #175 (G25) 10 DEG @313
190882	0630	231	36 30.50	-74 05.60	0010	XBT #176 (G26) 10 DEG @280
190882	0636	231	36 30.50	-74 05.60	0001	C/C
190882	0700	231	36 30.50	-74 10.30	0010	XBT #177 (G27) 10 DEG @315
190882	0730	231	36 32.80	-74 17.40	0010	XBT #178 (G28) 10 DEG @324
190882	0830	231	36 37.40	-74 32.10	0010	XBT #179 (G29) 10 DEG @299
190882	0900	231	36 39.30	-74 38.60	0010	XBT #180 (G30) 10 DEG @248
190882	0905	231	36 40.40	-74 41.02	0001	C/C 073 BEGIN SECTION IV XBT STAR
190882	0930	231	36 41.20	-74 37.00	0010	XBT #181 10 DEG @268
190882	0955	231	36 42.60	-74 29.50	0001	DRIFTER ON RADAR (RSMAS ?) 1 MILE AWAY
190882	1000	231	36 42.60	-74 29.20	0010	XBT #182 (G32) 10 DEG @311
190882	1045	231	36 39.20	-74 19.40	0011	XBT #183 (G34) 10 DEG @350; RING CENTER
190882	1046	231	36 39.20	-74 19.40	0001	C/C
190882	1120	231	36 44.65	-74 17.17	0001	C/C
190882	1130	231	36 45.30	-74 14.40	0010	XBT #184 (G36) 10 DEG @330
190882	1200	231	36 47.07	-74 08.05	0010	XBT #185 (G37) 10 DEG @320
190882	1210	231	36 47.28	-74 06.15	0001	C/C TO RING CENTER
190882	1320	231	36 39.30	-74 19.40	1000	CTD #46 IN
190882	1411	231	36 39.30	-74 19.40	0001	FLUORESCENCE PUMP TEST
190882	1456	231	36 39.30	-74 19.34	1000	CTD #46 OUT
190882	1456	231	36 39.30	-74 19.34	0100	BOPS #46 IN
190882	1525	231	36 39.27	-74 19.26	0001	U/W TO RECOVER DRIFTER
190882	1640	231	36 49.31	-74 26.17	0001	ALONGSIDE RSMAS SATELLITE DRIFTER
190882	1658	231	36 49.62	-74 25.87	0001	DRIFTER ABOARD
190882	1701	231	36 49.62	-74 25.87	0001	U/W TO OTHER DRIFTER

TABLE 1: EVENT LOG (Continued)

190882	1750	231	36 52.51	-74 18.58	0001	PICK UP WHOI DRIFTER
190882	1934	231	36 39.18	-74 19.23	0001	DEPLOY WHOI DRIFTER IN RING CENTER
190882	1945	231	36 39.06	-74 18.98	0001	U/W TO SEARCH FOR BUOY
190882	1950	231	36 39.43	-74 12.76	0001	SPERM WHALE SIGHTED
190882	1955	231	36 39.03	-74 22.48	0001	PILOT WHALES; FISH JUMPING
190882	2010	231	36 39.00	-74 26.52	0001	C/C TO PICK UP LORAN DRIFTER
190882	2114	231	36 33.21	-74 37.33	0001	LORAN DRIFTER ABOARD
190882	2245	231	36 20.84	-74 40.21	0001	FLYING FISH
200882	0047	232	35 56.50	-74 47.80	0001	H/T STATION 47
200882	0054	232	35 56.50	-74 47.80	1000	CTD #47 IN
200882	0116	232	35 56.20	-74 48.20	1000	CTD #47 OUT
200882	0120	232	35 56.18	-74 48.13	0100	BOPS #47 IN
200882	0153	232	35 56.13	-74 48.33	0100	BOPS #47 OUT
200882	0158	232	35 56.13	-74 48.33	0001	U/W TO STATION 48
200882	0250	232	35 53.40	-74 35.70	0010	XBT #186 (G38) 10 DEG @171
200882	0345	232	35 51.05	-74 24.46	0001	H/T STATION 48
200882	0347	232	35 51.06	-74 24.47	1000	CTD #48 IN
200882	0547	232	35 52.03	-74 22.97	1000	CTD #48 OUT
200882	0550	232	35 52.03	-74 22.97	0100	BOPS #48 IN
200882	0629	232	35 52.09	-74 22.31	0001	U/W TO STATON 49
200882	0725	232	35 48.44	-74 11.06	0010	XBT #187 (G39) 10 DEG @350
200882	0816	232	35 45.13	-74 01.60	1000	CTD #49 IN 10 DEG @462
200882	1022	232	35 47.00	-73 59.87	1000	CTD #49 OUT
200882	1035	232	35 47.40	-73 59.51	0100	BOPS #49 IN
200882	1106	232	35 47.40	-73 59.51	0100	BOPS #49 OUT
200882	1115	232	35 48.98	-73 58.41	0001	U/W TO STATION 50
200882	1156	232	35 44.70	-73 48.90	0010	XBT #188 (G40) 10 DEG @578
200882	1244	232	35 39.80	-73 38.40	0001	H/T STATION 50
200882	1250	232	35 39.80	-73 38.40	1000	CTD #50 IN
200882	1352	232	35 40.30	-73 37.69	0001	NASA OVER FLIGHT
200882	1518	232	35 41.08	-73 36.90	1000	CTD #50 OUT
200882	1525	232	35 41.04	-73 36.67	0100	BOPS #50 IN
200882	1650	232	35 37.60	-73 25.30	0010	XBT #189 (G1) 10 DEG >750
200882	1742	232	35 33.84	-73 14.64	0100	BOPS #51 IN
200882	1815	232	35 34.15	-73 14.69	0100	BOPS #51 OUT
200882	1820	232	35 34.15	-73 14.69	1000	CTD #51 IN
200882	2049	232	35 34.77	-73 14.45	1000	CTD #51 OUT
200882	2150	232	35 31.22	-73 02.33	0010	XBT #190 (G2) 10 DEG >750
200882	2242	232	35 27.71	-72 50.72	0100	BOPS #52 IN
200882	2316	232	35 27.56	-72 50.62	1000	CTD #52 IN
210882	0222	233	35 27.60	-75 50.60	0001	U/W TO STATION 53
210882	0315	233	35 24.88	-72 38.84	0010	XBT #191 (G3) 10 DEG >750
210882	0412	233	35 20.80	-72 25.50	1000	CTD #53 IN
210882	0721	233	35 18.20	-72 26.40	1000	CTD #53 OUT
210882	0728	233	35 18.20	-72 26.40	0100	BOPS #53 IN
210882	0922	233	35 17.70	-72 15.60	0010	XBT #192 (G4) 10 DEG >750
210882	1022	233	35 15.89	-72 02.08	1000	CTD #54 IN
210882	1318	233	35 15.17	-72 04.45	1000	CTD #54 OUT
210882	1326	233	35 16.23	-72 05.91	0100	BOPS #54 IN
210882	1400	233	35 15.50	-72 04.40	0101	BOPS #54 OUT; U/W TO STATION 55
210882	1706	233	35 09.69	-71 38.89	0100	BOPS #55 TIME SERIES
210882	2145	233	35 05.28	-71 36.28	0100	BOPS #55 OUT
210882	2145	233	35 05.28	-71 36.28	1000	CTD #55 IN
220882	0032	234	35 04.04	-71 38.29	1000	CTD #55 OUT
220882	0106	234	35 05.20	-71 40.63	0001	U/W TO STATION 56
220882	0157	234	35 04.19	-71 29.39	0001	C/C 090 FOR APOC CALIBRATION
220882	0618	234	35 00.18	-71 00.07	1000	CTD #56 IN 10 DEG @952
220882	0937	234	35 03.47	-71 01.04	1000	CTD #56 OUT
220882	1000	234	35 06.90	-71 03.90	0100	BOPS #56 IN
220882	1300	234	35 09.82	-71 06.04	0101	BOPS #56 OUT; U/W TO STATION 57
220882	1410	234	35 20.16	-70 54.80	0100	BOPS #57 IN

TABLE 1: EVENT LOG (Continued)

220882	1448	234	35 22.00	-71 01.49	0101	BOPS #57 OUT; CHECKING WINCH
220882	1532	234	35 22.11	-70 59.90	1000	CTD #57 IN
220882	1830	234	35 24.61	-70 58.86	1000	CTD #57 OUT
220882	1837	234	35 24.61	-70 58.86	0001	U/W TO STATION 58
220882	2000	234	35 40.58	-71 01.43	0001	H/T STATION 58
220882	2003	234	35 40.69	-71 01.56	0100	BOPS #58 IN
220882	2033	234	35 39.69	-70 59.46	0100	BOPS #58 OUT
220882	2042	234	35 39.69	-70 59.46	1000	CTD #58 IN
220882	2330	234	35 42.59	-70 57.98	1000	CTD #58 OUT
220882	2335	234	35 42.59	-71 57.98	0001	U/W TO STATION 59
230882	0110	235	36 01.00	-71 01.53	0100	BOPS #59 IN
230882	0136	235	36 00.81	-70 59.99	0100	BOPS #59 OUT
230882	0143	235	36 00.81	-70 59.99	1000	CTD #59 IN
230882	0435	235	36 03.76	-71 00.30	1001	CTD #59 OUT; NO AUDIO FOR THIS STATION
230882	0440	235	36 03.76	-71 00.30	0001	U/W TO STATION 60
230882	0607	235	36 20.19	-70 59.73	1000	CTD #60 IN
230882	0859	235	36 22.51	-70 57.97	1000	CTD #60 OUT
230882	0903	235	36 23.31	-70 59.34	0100	BOPS #60 IN
230882	0927	235	36 23.47	-70 59.12	0101	BOPS #60 OUT; U/W TO STATION 61
230882	1103	235	36 40.03	-70 59.59	1000	CTD #61 IN
230882	1340	235	36 41.51	-70 57.96	0100	BOPS #61 IN
230882	1414	235	36 41.51	-70 57.96	0100	BOPS #61 OUT
230882	1501	235	36 51.88	-70 58.99	0010	XBT #193 (G5) 10 DEG >750
230882	1542	235	36 59.97	-71 00.82	0100	BOPS #62 IN
230882	1616	235	37 00.91	-70 57.80	0100	BOPS #62 OUT
230882	1624	235	37 00.91	-70 57.80	1000	CTD #62 IN
230882	1912	235	37 01.80	-70 53.06	1000	CTD #62 OUT
230882	1920	235	37 01.80	-70 53.06	0001	U/W TO STATION 63
230882	2033	235	37 16.66	-70 59.29	0010	XBT #194 (G6) 10 DEG @474
230882	2054	235	37 20.00	-70 59.53	0100	BOPS #63 IN
230882	2122	235	37 20.16	-70 58.28	0100	BOPS #63 OUT
230882	2131	235	37 20.17	-70 57.46	1000	CTD #63 IN
240882	0010	236	37 21.05	-70 51.97	1000	CTD #63 OUT
240882	0106	236	37 30.00	-70 55.60	0010	XBT #195 (G7) 10 DEG @294
240882	0203	236	37 39.93	-71 00.00	1000	CTD #64 IN
240882	0429	236	37 40.43	-70 59.87	1000	CTD #64 OUT
240882	0429	236	37 40.43	-70 59.87	0100	BOPS #64 IN
240882	0505	236	37 40.52	-70 59.60	0100	BOPS #64 OUT
240882	0508	236	37 40.52	-70 59.60	0001	U/W TO STATION 65
240882	0555	236	37 49.60	-70 59.80	0010	XBT #196 (G8) 10 DEG @206
240882	0658	236	37 59.92	-70 59.62	0100	BOPS #65 IN
240882	0733	236	37 59.92	-70 59.62	0100	BOPS #65 OUT
240882	0735	236	37 59.92	-70 59.62	1000	CTD #65 IN
240882	0938	236	37 58.64	-70 59.46	1001	CTD #65 OUT; U/W TO STATION 66
240882	1041	236	38 10.10	-70 59.59	0010	XBT #197 (G9) 10 DEG @185
240882	1138	236	38 20.03	-71 00.35	1000	CTD #66 IN
240882	1342	236	38 18.70	-71 00.54	1000	CTD #66 OUT
240882	1347	236	38 18.70	-71 00.54	0100	BOPS #66 IN
240882	1606	236	38 41.24	-71 00.28	0100	BOPS #67 IN
240882	1732	236	38 41.24	-71 00.28	0100	BOPS #67 OUT
240882	1733	236	38 41.24	-71 00.28	1000	CTD #67 IN
240882	1941	236	38 42.69	-71 00.76	1000	CTD #67 OUT
240882	1947	236	38 42.72	-71 00.80	0001	U/W TO STATION 68
240882	2119	236	39 00.12	-71 59.99	0100	BOPS #68 IN
240882	2150	236	38 59.40	-71 00.00	0100	BOPS #68 OUT
240882	2156	236	38 59.40	-71 00.00	1000	CTD #68 IN 10 DEG @220
240882	2342	236	39 00.74	-71 00.66	1000	CTD #68 OUT
240882	2344	236	39 00.74	-71 00.66	0001	U/W TO STATION 69
250882	0122	237	39 20.00	-71 00.00	1000	CTD #69 IN
250882	0310	237	39 20.74	-70 59.74	1000	CTD #69 OUT
250882	0310	237	39 20.74	-70 59.74	0100	BOPS #69 IN

TABLE 1: EVENT LOG (Continued)

250882	0340	237	39 20.00	-71 00.00	0100	BOPS #69 OUT
250882	0344	237	39 20.00	-71 00.00	0001	U/W TO STATION 70
250882	0529	237	39 40.10	-70 59.57	1000	CTD #70 IN
250882	0644	237	39 40.10	-70 59.51	1000	CTD #70 OUT
250882	0646	237	39 40.13	-70 59.49	0100	BOPS #70 IN
250882	0719	237	39 40.10	-70 59.38	0001	U/W TO STATION 71
250882	0907	237	40 00.05	-70 59.99	1000	CTD #71 IN
250882	0933	237	40 00.00	-70 59.99	1000	CTD #71 OUT
250882	0937	237	40 00.00	-70 59.99	0100	BOPS #71 IN
250882	1008	237	40 00.00	-70 59.99	0100	BOPS #71 OUT
250882	1010	237	40 00.00	-70 59.99	0001	HEADING FOR WOODS HOLE

TABLE 2: CTD STATIONS

SHIP: ENDEAVOR CRUISE: 88 DATES: AUGUST 5 - AUGUST 25, 1982

DATE DAY	DATE MOS.	GMT TIME	JULIAN DAY	LATITUDE DEG.	LATITUDE MIN.	LONGITUDE DEG.	LONGITUDE MIN.	EVENT	
6	8	1443	218	38	10.50	-72	46.90	CTD #1	TEST INST.# 98
6	8	1737	218	38	9.20	-72	46.00	CTD #2	TEST INST.# 7
8	8	1103	220	36	37.95	-73	45.71	CTD #3	
8	8	1422	220	36	38.15	-73	46.30	CTD #4	
8	8	2021	220	36	19.30	-73	12.40	CTD #5	
9	8	0143	221	36	22.90	-73	23.90	CTD #6	
9	8	0533	221	36	28.00	-73	32.00	CTD #7	
9	8	0941	221	36	33.00	-73	39.80	CTD #8	
9	8	1419	221	36	38.20	-73	46.60	CTD #9	
9	8	2043	221	36	42.79	-73	53.92	CTD #10	
10	8	0020	222	36	49.20	-74	3.80	CTD #11	
10	8	0336	222	36	53.90	-74	11.00	CTD #12	
10	8	0718	222	36	58.58	-74	19.00	CTD #13	
10	8	1043	222	37	4.32	-74	27.35	CTD #14	
10	8	1342	222	37	9.20	-74	34.20	CTD #15	
10	8	1836	222	37	8.20	-73	40.55	CTD #16	
10	8	2226	222	37	0.20	-73	40.90	CTD #17	
11	8	0230	223	36	52.74	-73	24.93	CTD #18	
11	8	1012	223	36	45.05	-73	45.99	CTD #19	
11	8	1835	223	36	38.99	-73	46.32	CTD #20	
13	8	0319	225	36	55.33	-73	30.04	CTD #21	
13	8	1249	225	37	7.02	-73	24.93	CTD #22	TOW-YO
14	8	0604	226	37	2.31	-73	46.75	CTD #23	
15	8	0048	227	37	24.85	-73	59.98	CTD #24	
15	8	0340	227	37	17.85	-73	53.56	CTD #25	
15	8	0705	227	37	11.90	-73	49.70	CTD #26	
15	8	0950	227	37	7.80	-73	47.13	CTD #27	
15	8	1337	227	37	2.64	-73	42.04	CTD #28	
15	8	1710	227	37	0.72	-73	50.90	CTD #29	
15	8	2022	227	36	55.59	-73	50.99	CTD #30	
16	8	0013	228	36	49.00	-73	51.60	CTD #31	
16	8	0325	228	36	43.67	-73	51.34	CTD #32	
16	8	0718	228	36	35.29	-73	51.42	CTD #33	
16	8	1200	228	36	45.40	-74	27.60	CTD #34	
16	8	1535	228	36	50.64	-74	16.59	CTD #35	
16	8	1856	228	36	54.05	-74	7.39	CTD #36	
16	8	2245	228	36	57.97	-73	59.76	CTD #37	
17	8	0241	229	37	6.60	-73	42.70	CTD #38	
17	8	0622	229	37	12.09	-73	30.86	CTD #39	
17	8	1220	229	36	29.30	-73	50.50	CTD #40	
17	8	1727	229	36	38.90	-73	58.00	CTD #41	
17	8	2211	229	36	45.60	-74	2.19	CTD #42	
18	8	0255	230	36	53.80	-74	8.30	CTD #43	
18	8	0645	230	37	3.39	-74	13.43	CTD #44	
18	8	0934	230	37	10.00	-74	20.25	CTD #45	
19	8	1320	231	36	39.30	-74	19.40	CTD #46	
20	8	0054	232	35	56.50	-74	47.80	CTD #47	
20	8	0347	232	35	51.06	-74	24.47	CTD #48	
20	8	0816	232	35	45.13	-74	1.60	CTD #49	
20	8	1250	232	35	39.80	-73	38.40	CTD #50	
20	8	1820	232	35	34.15	-73	14.69	CTD #51	
20	8	2316	232	35	27.56	-72	50.62	CTD #52	
21	8	0412	233	35	20.80	-72	25.50	CTD #53	
21	8	1022	233	35	15.89	-72	2.08	CTD #54	
21	8	2145	233	35	5.28	-71	36.28	CTD #55	
22	8	0618	234	35	0.18	-71	0.07	CTD #56	
22	8	1532	234	35	22.11	-70	59.90	CTD #57	
22	8	2042	234	35	39.69	-70	59.46	CTD #58	
23	8	0143	235	36	0.81	-70	59.99	CTD #59	
23	8	0607	235	36	20.19	-70	59.73	CTD #60	
23	8	1103	235	36	40.03	-70	59.59	CTD #61	
23	8	1624	235	37	0.91	-70	57.80	CTD #62	
23	8	2131	235	37	20.17	-70	57.46	CTD #63	
24	8	0203	236	37	39.93	-71	0.00	CTD #64	
24	8	0735	236	37	59.92	-70	59.62	CTD #65	
24	8	1138	236	38	20.03	-71	0.35	CTD #66	
24	8	1733	236	38	41.24	-71	0.28	CTD #67	
24	8	2156	236	38	59.40	-71	0.00	CTD #68	
25	8	0122	237	39	20.00	-71	0.00	CTD #69	
25	8	0529	237	39	40.10	-70	59.57	CTD #70	
25	8	0907	237	40	0.05	-70	59.99	CTD #71	

TABLE 3: XBT STATIONS

SHIP: ENDEAVOR CRUISE: 88 DATES: AUGUST 5 - AUGUST 25, 1982

DATE DAY	MOS.	GMT TIME	JULIAN DAY	LATITUDE DEG.	LATITUDE MIN.	LONGITUDE DEG.	LONGITUDE MIN.	EVENT		
6	8	1510	218	38	10.20	-72	46.80	XBT #1	TEST	10 DEG @248
7	8	0600	219	37	3.30	-73	37.00	XBT #2	(G1)	10 DEG @237
7	8	0630	219	36	57.20	-73	37.00	XBT #3	(G2)	10 DEG @250
7	8	0700	219	36	49.00	-73	37.00	XBT #4	(G3)	10 DEG @275
7	8	0730	219	36	42.60	-73	36.70	XBT #5	(G4)	10 DEG @328
7	8	0800	219	36	37.50	-73	36.50	XBT #6	(G5)	10 DEG @397
7	8	0830	219	36	29.90	-73	36.80	XBT #7	(G6)	10 DEG @429
7	8	0900	219	36	25.00	-73	36.90	XBT #8	(G7)	10 DEG @432
7	8	0930	219	36	18.40	-73	36.90	XBT #9	(G8)	10 DEG @408
7	8	1000	219	36	14.20	-73	36.90	XBT #10	(G9)	10 DEG @366
7	8	1030	219	36	10.50	-73	36.80	XBT #11	(G10)	10 DEG @386
7	8	1100	219	36	12.10	-73	39.60	XBT #12	(G11)	10 DEG @349
7	8	1130	219	36	17.50	-73	44.00	XBT #13	(G12)	10 DEG @320
7	8	1200	219	36	22.80	-73	49.50	XBT #14	(G13)	10 DEG @333
7	8	1230	219	36	26.00	-73	53.00	XBT #15	(G14)	10 DEG @343
7	8	1300	219	36	31.80	-73	58.30	XBT #16	(G15)	10 DEG @205
7	8	1330	219	36	37.40	-74	1.70	XBT #17	(NO GOOD)	
7	8	1330	219	36	37.40	-74	1.70	XBT #18	(G16)	10 DEG @349
7	8	1400	219	36	42.32	-74	6.00	XBT #19	(G17)	10 DEG @345
7	8	1430	219	36	47.30	-74	10.40	XBT #20	(G18)	10 DEG @315
7	8	1500	219	36	52.10	-74	14.60	XBT #21	(G19)	10 DEG @250
7	8	1530	219	36	52.10	-74	12.70	XBT #22	(G20)	10 DEG @250
7	8	1600	219	36	50.60	-74	6.40	XBT #23	(G21)	10 DEG @288
7	8	1630	219	36	48.70	-73	58.80	XBT #24	(G22)	10 DEG @347
7	8	1700	219	36	47.00	-73	51.70	XBT #25	(G23)	10 DEG @368
7	8	1730	219	36	45.50	-73	45.40	XBT #26	(G24)	10 DEG @351
7	8	1800	219	36	43.80	-73	38.30	XBT #27	(G25)	10 DEG @352
7	8	1830	219	36	41.80	-73	29.90	XBT #28	(G26)	10 DEG @315
7	8	1900	219	36	40.50	-73	24.50	XBT #29	(G27)	10 DEG @300
7	8	1930	219	36	38.40	-73	15.80	XBT #30	(G28)	10 DEG @277
7	8	2000	219	36	36.60	-73	9.10	XBT #31	(G29)	10 DEG @265
7	8	2030	219	36	34.20	-73	0.30	XBT #32	(G30)	10 DEG @295
7	8	2103	219	36	38.30	-72	57.20	XBT #33	(G31)	10 DEG @265
7	8	2130	219	36	37.30	-73	2.90	XBT #34	(G32)	10 DEG @270
7	8	2200	219	36	36.00	-73	8.30	XBT #35	(G33)	10 DEG @280
7	8	2230	219	36	34.80	-73	14.10	XBT #36	(G34)	10 DEG @298
7	8	2300	219	36	33.30	-73	20.90	XBT #37	(G35)	10 DEG @333
7	8	2330	219	36	32.10	-73	26.40	XBT #38	(G36)	10 DEG @386
8	8	0000	220	36	30.80	-73	32.60	XBT #39	(G37)	10 DEG @404
8	8	0030	220	36	29.20	-73	39.60	XBT #40	(G38)	10 DEG @395
8	8	0100	220	36	27.70	-73	46.50	XBT #41	(G39)	10 DEG @345
8	8	0130	220	36	26.20	-73	52.80	XBT #42	(G40)	10 DEG @284
8	8	0200	220	36	24.50	-74	0.10	XBT #43	(NO GOOD)	
8	8	0205	220	36	24.50	-74	0.10	XBT #44	(G1)	10 DEG @253
8	8	0230	220	36	22.90	-74	7.10	XBT #45	(G2)	10 DEG @208
8	8	0300	220	36	21.40	-74	13.90	XBT #46	(G3)	10 DEG @169
8	8	0330	220	36	24.90	-74	11.50	XBT #47		10 DEG @160
8	8	0400	220	36	28.30	-74	8.40	XBT #48	(G4)	10 DEG @220
8	8	0430	220	36	33.30	-74	3.90	XBT #49	(G5)	10 DEG @295
8	8	0500	220	36	36.70	-73	57.70	XBT #50	(G6)	10 DEG @353
8	8	0545	220	36	38.00	-73	45.70	XBT #51	(G7)	10 DEG @406
8	8	0650	220	36	47.70	-73	50.60	XBT #52	(G8)	10 DEG @364
8	8	0730	220	36	53.70	-73	44.90	XBT #53	(G9)	10 DEG @295
8	8	0800	220	36	59.30	-73	39.90	XBT #54	(G10)	10 DEG @264
8	8	0830	220	37	3.40	-73	36.40	XBT #55	(G11)	10 DEG @249 END LEG V
8	8	1700	220	36	35.70	-73	40.40	XBT #56	(G12)	10 DEG @402
8	8	1730	220	36	30.90	-73	33.30	XBT #57	(G13)	10 DEG @384
8	8	1800	220	36	27.80	-73	28.70	XBT #58	(G14)	10 DEG @380
8	8	1830	220	36	24.60	-73	23.00	XBT #59	(G15)	10 DEG @350
8	8	1850	220	36	22.00	-73	17.90	XBT #60	(G16)	10 DEG @350
10	8	1500	222	37	8.90	-74	24.40	XBT #61	(G17)	10 DEG @200
10	8	1600	222	37	8.90	-74	11.00	XBT #62	(G18)	10 DEG @250
10	8	1700	222	37	9.02	-73	52.32	XBT #63	(G19)	10 DEG @274
11	8	0153	223	36	53.50	-73	43.70	XBT #64	(G20)	10 DEG @357
11	8	1309	223	36	46.90	-73	46.20	XBT #65		10 DEG @376
11	8	1350	223	36	49.60	-73	46.60	XBT #66	(G21)	10 DEG @384
11	8	1420	223	36	53.40	-73	49.20	XBT #67	(G22)	10 DEG @375
11	8	1430	223	36	56.03	-73	51.26	XBT #68	(G23)	10 DEG @362
11	8	1450	223	36	59.90	-73	54.10	XBT #69	(G24)	10 DEG @331
11	8	1510	223	37	3.20	-73	56.70	XBT #70	(G25)	10 DEG @305
11	8	2200	223	36	34.30	-73	43.80	XBT #71	(G26)	10 DEG @367

TABLE 3: XBT STATIONS (Continued)

11	8	2230	223	36 33.50	-73 36.48	XBT #72	(NO GOOD)	
11	8	2233	223	36 32.70	-73 35.20	XBT #73	(G27)	10 DEG @430
11	8	2300	223	36 34.40	-73 29.40	XBT #74	(G28)	10 DEG @455
11	8	2330	223	36 38.90	-73 22.20	XBT #75	(G29)	10 DEG @437
12	8	0000	224	36 42.70	-73 16.50	XBT #76	(G30)	10 DEG @379
12	8	0030	224	36 49.90	-73 10.30	XBT #77	(G31)	10 DEG @315
12	8	0130	224	36 43.70	-73 15.60	XBT #78	(G32)	10 DEG @374
12	8	0158	224	36 42.30	-73 19.70	XBT #79	(NO GOOD)	
12	8	0200	224	36 41.80	-73 20.40	XBT #80	(G33)	10 DEG @443
12	8	0238	224	36 36.20	-73 25.70	XBT #81	(G34)	10 DEG @437
12	8	0300	224	36 40.30	-73 22.00	XBT #82	(G35)	10 DEG @442
12	8	0330	224	36 46.00	-73 18.00	XBT #83	(G36)	
12	8	0400	224	36 45.24	-73 21.24	XBT #84	(G37)	10 DEG @393
12	8	0430	224	36 42.90	-73 26.10	XBT #85	(G38)	10 DEG @433
12	8	0500	224	36 41.46	-73 31.86	XBT #86	(G39)	10 DEG @420
12	8	0530	224	36 45.80	-73 29.70	XBT #87	(G40)	10 DEG @433
12	8	0602	224	36 51.05	-73 25.23	XBT #88	(G1)	10 DEG @400
12	8	0740	224	36 41.20	-73 39.60	XBT #89	(G2)	10 DEG @350
12	8	0800	224	36 43.80	-73 42.70	XBT #90	(G3)	10 DEG @350
12	8	0830	224	36 48.50	-73 49.09	XBT #91	(G4)	10 DEG @335
12	8	0900	224	36 52.29	-73 54.83	XBT #92	(G5)	10 DEG @291
12	8	0930	224	36 55.86	-74 1.05	XBT #93	(G6)	10 DEG @265
12	8	1000	224	36 56.70	-73 54.20	XBT #94	(G7)	10 DEG @312
12	8	1030	224	36 56.32	-73 46.50	XBT #95	(G8)	10 DEG @358
12	8	1100	224	36 55.52	-73 38.59	XBT #96	(G9)	10 DEG @405
12	8	1130	224	36 55.20	-73 30.80	XBT #97	(G10)	10 DEG @404
12	8	1200	224	35 54.50	-73 22.20	XBT #98	(G11)	10 DEG @367
12	8	1230	224	36 55.10	-73 12.20	XBT #99	(G12)	10 DEG @361
12	8	1300	224	36 55.20	-73 4.60	XBT #100	(G13)	10 DEG @336
12	8	1330	224	36 53.00	-73 8.20	XBT #101	(G14)	10 DEG @344
12	8	1400	224	36 50.40	-73 14.40	XBT #102	(G15)	10 DEG @398
12	8	1430	224	36 49.00	-73 18.00	XBT #103	(G16)	10 DEG @415
12	8	1500	224	36 45.56	-73 25.80	XBT #104	(G17)	10 DEG @415
12	8	1530	224	36 43.50	-73 32.00	XBT #105	(G18)	10 DEG @389
12	8	1600	224	36 41.10	-73 38.30	XBT #106	(G19)	10 DEG @328
12	8	1630	224	36 39.80	-73 46.90	XBT #107		10 DEG @270
12	8	1700	224	36 36.40	-73 50.60	XBT #108	(H1)	10 DEG @235
12	8	1730	224	36 59.00	-73 50.10	XBT #109	(H2)	10 DEG @226
12	8	1800	224	36 41.30	-73 50.80	XBT #110	(H3)	10 DEG @287
12	8	1830	224	36 49.15	-73 47.50	XBT #111	(H4)	10 DEG @306
12	8	1900	224	36 51.80	-73 42.40	XBT #112	(H5)	10 DEG @358
12	8	1930	224	36 56.50	-73 39.50	XBT #113	(H6)	10 DEG @380
12	8	2000	224	37 1.72	-73 37.95	XBT #114	(H7)	10 DEG @380
12	8	2030	224	37 7.06	-73 37.81	XBT #115	(H8)	10 DEG @339
12	8	2100	224	37 12.90	-73 37.80	XBT #116	(H9)	10 DEG @284
12	8	2130	224	37 8.67	-73 36.06	XBT #117	(H10)	10 DEG @318
12	8	2200	224	37 4.34	-73 34.44	XBT #118	(H11)	10 DEG @360
12	8	2230	224	36 57.88	-73 32.15	XBT #119	(H12)	10 DEG @402
13	8	0700	225	37 3.40	-73 27.00	XBT #120	(H13)	10 DEG @365
13	8	0730	225	37 8.50	-73 23.20	XBT #121	(H14)	10 DEG @315
13	8	0800	225	37 14.00	-73 19.40	XBT #122	(H15)	10 DEG @296
13	8	0830	225	37 18.80	-73 15.90	XBT #123	(H16)	10 DEG @275
13	8	1000	225	37 15.31	-73 18.39	XBT #124	(H17)	10 DEG @302
13	8	1030	225	37 12.00	-73 20.70	XBT #125	(H18)	10 DEG @307
13	8	1120	225	37 5.30	-73 25.60	XBT #126	(H19)	10 DEG @337
14	8	1015	226	37 0.04	-73 41.65	XBT #127	(G1)	10 DEG @317
14	8	1045	226	37 5.10	-73 42.80	XBT #128	(G2)	10 DEG @330
14	8	1115	226	37 11.50	-73 44.50	XBT #129	(G3)	10 DEG @320
14	8	1145	226	37 8.22	-73 40.39	XBT #130	(G4)	10 DEG @325
14	8	1215	226	37 3.20	-73 33.90	XBT #131	(G5)	10 DEG @324
14	8	1245	226	37 4.60	-73 28.60	XBT #132	(G6)	10 DEG @324
14	8	1315	226	37 8.30	-73 22.30	XBT #133	(G7)	10 DEG @329
14	8	1345	226	37 5.70	-73 23.50	XBT #134	(G8)	10 DEG @326
14	8	1415	226	36 59.90	-73 27.40	XBT #135	(G9)	10 DEG @301
14	8	1445	226	36 55.50	-73 23.80	XBT #136	(G10)	10 DEG @233
14	8	1515	226	36 51.80	-73 21.50	XBT #137	(NO GOOD)	
14	8	1517	226	36 51.80	-73 21.50	XBT #138	(G11)	10 DEG @202
14	8	1545	226	36 52.11	-73 26.30	XBT #139	(NO GOOD)	
14	8	1550	226	36 52.20	-73 27.40	XBT #140	(G12)	10 DEG @225
14	8	1615	226	36 52.30	-73 33.00	XBT #141	(G13)	10 DEG @240
14	8	1645	226	36 45.20	-73 36.80	XBT #142	(G14)	10 DEG @205
14	8	1715	226	36 45.40	-73 38.70	XBT #143	(G15)	10 DEG @200

TABLE 3: XBT STATIONS (Continued)

14	8	1745	226	36 51.10	-73 40.10	XBT #144	(G16)	10 DEG @243
14	8	1815	226	36 54.90	-73 44.30	XBT #145	(G17)	10 DEG @285
14	8	1845	226	36 56.20	-73 52.16	XBT #146	(G18)	10 DEG @305
14	8	2200	226	37 6.17	-73 48.13	XBT #147	(G19)	10 DEG @333
14	8	2300	226	37 14.01	-73 52.35	XBT #148	(G20)	10 DEG @290
18	8	1700	230	36 9.90	-74 40.60	XBT #149	(G1)	10 DEG @218
18	8	1730	230	36 14.80	-74 35.80	XBT #150	(G2)	10 DEG @215
18	8	1800	230	36 19.80	-74 31.80	XBT #151	(G3)	10 DEG @250
18	8	1830	230	36 24.50	-74 27.00	XBT #152	(G4)	10 DEG @303
18	8	1900	230	36 29.40	-74 22.60	XBT #153	(NO GOOD)	
18	8	1903	230	36 29.90	-74 22.00	XBT #154	(G5)	10 DEG @330
18	8	1930	230	36 33.90	-74 18.20	XBT #155	(G6)	10 DEG @315
18	8	2000	230	36 38.62	-74 13.76	XBT #156	(G7)	10 DEG @320
18	8	2030	230	36 43.76	-74 8.91	XBT #157	(NO GOOD)	
18	8	2030	230	36 43.76	-74 8.91	XBT #158	(G8)	10 DEG @306
18	8	2100	230	36 47.94	-74 5.34	XBT #159	(G9)	10 DEG @296
18	8	2130	230	36 41.98	-74 4.53	XBT #160	(G10)	10 DEG @306
18	8	2200	230	36 36.72	-74 4.46	XBT #161	(G11)	10 DEG @307
18	8	2230	230	36 29.51	-74 4.39	XBT #162	(G12)	10 DEG @285
18	8	2300	230	36 23.35	-74 4.34	XBT #163	(G13)	10 DEG @270
18	8	2330	230	36 17.10	-74 4.26	XBT #164	(G14)	10 DEG @290
19	8	0028	231	36 14.93	-74 15.20	XBT #165	(G15)	10 DEG @246
19	8	0100	231	36 18.90	-74 21.80	XBT #166	(G16)	10 DEG @245
19	8	0200	231	36 29.13	-74 26.84	XBT #167	(G17)	10 DEG @287
19	8	0230	231	36 35.73	-74 26.87	XBT #168	(G18)	10 DEG @305
19	8	0300	231	36 41.90	-74 26.68	XBT #169	(G19)	10 DEG @293
19	8	0330	231	36 48.82	-74 26.59	XBT #170	(G20)	10 DEG @265
19	8	0400	231	36 55.10	-74 26.70	XBT #171	(G21)	10 DEG @246
19	8	0430	231	36 51.80	-74 23.10	XBT #172	(G22)	10 DEG @279
19	8	0500	231	36 46.20	-74 18.60	XBT #173	(G23)	10 DEG @325
19	8	0530	231	36 41.30	-74 14.60	XBT #174	(G24)	10 DEG @329
19	8	0600	231	36 35.70	-74 10.00	XBT #175	(G25)	10 DEG @313
19	8	0630	231	36 30.50	-74 5.60	XBT #176	(G26)	10 DEG @280
19	8	0700	231	36 30.50	-74 10.30	XBT #177	(G27)	10 DEG @315
19	8	0730	231	36 32.80	-74 17.40	XBT #178	(G28)	10 DEG @324
19	8	0830	231	36 37.40	-74 32.10	XBT #179	(G29)	10 DEG @299
19	8	0900	231	36 39.30	-74 38.60	XBT #180	(G30)	10 DEG @248
19	8	0930	231	36 41.20	-74 37.00	XBT #181		10 DEG @268
19	8	1000	231	36 42.60	-74 29.20	XBT #182	(G32)	10 DEG @311
19	8	1045	231	36 39.20	-74 19.40	XBT #183	(G34)	10 DEG @350
19	8	1130	231	36 45.30	-74 14.40	XBT #184	(G36)	10 DEG @330
19	8	1200	231	36 47.07	-74 8.05	XBT #185	(G37)	10 DEG @320
20	8	0250	232	35 53.40	-74 35.70	XBT #186	(G38)	10 DEG @171
20	8	0725	232	35 48.44	-74 11.06	XBT #187	(G39)	10 DEG @350
20	8	1156	232	35 44.70	-73 48.90	XBT #188	(G40)	10 DEG @578
20	8	1650	232	35 37.60	-73 25.30	XBT #189	(G1)	10 DEG >750
20	8	2150	232	35 31.22	-73 2.33	XBT #190	(G2)	10 DEG >750
21	8	0315	233	35 24.88	-72 38.84	XBT #191	(G3)	10 DEG >750
21	8	0922	233	35 17.70	-72 15.60	XBT #192	(G4)	10 DEG >750
23	8	1501	235	36 51.88	-70 58.99	XBT #193	(G5)	10 DEG >750
23	8	2033	235	37 16.66	-70 59.29	XBT #194	(G6)	10 DEG @474
24	8	0106	236	37 30.00	-70 55.60	XBT #195	(G7)	10 DEG @294
24	8	0555	236	37 49.60	-70 59.80	XBT #196	(G3)	10 DEG @206
24	8	1041	236	38 10.10	-70 59.59	XBT #197	(G9)	10 DEG @185

TABLE 4: BOPS STATIONS

SHIP: ENDEAVOR   CRUISE: 88   DATES: AUGUST 5 - AUGUST 25, 1982

DATE DAY	DATE MOS.	GMT TIME	JULIAN DAY	LATITUDE DEG.	LATITUDE MIN.	LONGITUDE DEG.	LONGITUDE MIN.	EVENT
6	8	1641	218	38	9.40	-72	46.60	BOPS #1
8	8	1305	220	36	38.00	-73	45.76	BOPS #3
8	8	1939	220	36	18.80	-73	12.50	BOPS #5
9	8	0041	221	36	22.80	-73	22.60	BOPS #6
9	8	0806	221	36	28.10	-73	31.65	BOPS #7
9	8	1205	221	36	32.40	-73	41.00	BOPS #8
9	8	1341	221	36	37.90	-73	45.90	BOPS #9
9	8	2007	221	36	42.90	-73	54.00	BOPS #10
9	8	2337	221	36	49.10	-74	3.60	BOPS #11
10	8	0535	222	36	53.30	-74	11.30	BOPS #12
10	8	0912	222	36	57.94	-74	20.00	BOPS #13
10	8	1206	222	37	3.47	-74	28.64	BOPS #14
10	8	1358	222	37	09.21	-74	33.97	BOPS #15
10	8	1804	222	37	8.90	-73	40.70	BOPS #16
10	8	2130	222	37	0.50	-73	41.20	BOPS #17
11	8	0145	223	36	53.07	-73	43.84	BOPS #18
11	8	1230	223	36	46.00	-73	47.20	BOPS #19
11	8	1755	223	36	38.41	-73	47.29	BOPS #20
13	8	0548	225	36	58.06	-73	30.33	BOPS #21
13	8	1204	225	37	6.90	-73	24.80	BOPS #22A
13	8	1441	225	37	5.20	-73	25.60	BOPS #22B
14	8	0514	226	37	2.29	-73	46.03	BOPS #23
14	8	2030	226	37	05.23	-73	43.30	BOPS #24A
15	8	0008	227	37	25.05	-73	59.86	BOPS #24B
15	8	0305	227	37	18.04	-73	54.14	BOPS #25
15	8	0615	227	37	12.50	-73	50.50	BOPS #26
15	8	1150	227	37	07.86	-73	47.94	BOPS #27
15	8	1625	227	37	01.58	-73	50.69	BOPS #29
15	8	1930	227	36	55.83	-73	50.65	BOPS #30
15	8	2332	227	36	49.92	-73	50.58	BOPS #31
16	8	0245	228	36	43.99	-73	50.64	BOPS #32
16	8	0640	228	36	35.93	-73	50.93	BOPS #33
16	8	1317	228	36	46.22	-74	27.53	BOPS #34
16	8	1500	228	36	50.50	-74	16.50	BOPS #35
16	8	1819	228	36	54.07	-74	07.53	BOPS #36
16	8	2151	228	36	58.05	-73	59.93	BOPS #37
17	8	0203	229	37	6.90	-73	43.00	BOPS #38
17	8	0544	229	37	12.00	-73	30.90	BOPS #39
17	8	1429	229	36	28.40	-73	49.28	BOPS #40
17	8	1635	229	36	38.93	-73	57.20	BOPS #41
17	8	2130	229	36	46.44	-74	2.56	BOPS #42
18	8	0212	230	36	53.80	-74	8.30	BOPS #43
18	8	0602	230	37	2.68	-74	13.28	BOPS #44
18	8	1110	230	37	9.08	-74	21.66	BOPS #45
19	8	1456	231	36	39.30	-74	19.34	BOPS #46
20	8	0120	232	35	56.18	-74	48.13	BOPS #47
20	8	0550	232	35	52.03	-70	22.97	BOPS #48
20	8	1035	232	35	47.40	-73	59.51	BOPS #49
20	8	1525	232	35	41.04	-73	36.67	BOPS #50
20	8	1742	232	35	33.84	-73	14.64	BOPS #51
20	8	2242	232	35	27.71	-72	50.72	BOPS #52
21	8	0728	233	35	18.20	-72	26.40	BOPS #53
21	8	1326	233	35	16.23	-72	5.91	BOPS #54
21	8	1706	233	35	9.69	-71	38.89	BOPS #55
22	8	1000	234	35	6.90	-71	3.90	BOPS #56
22	8	1410	234	35	20.16	-70	54.80	BOPS #57
22	8	2003	234	35	40.68	-71	1.56	BOPS #58
23	8	0110	235	36	1.00	-71	1.53	BOPS #59
23	8	0903	235	36	23.31	-70	59.34	BOPS #60
23	8	1340	235	36	41.51	-70	57.96	BOPS #61
23	8	1542	235	36	59.97	-71	0.82	BOPS #62
23	8	2054	235	37	20.00	-70	59.53	BOPS #63
24	8	0429	236	37	40.43	-70	59.87	BOPS #64
24	8	0658	236	37	59.92	-70	59.62	BOPS #65
24	8	1347	236	38	18.70	-71	0.54	BOPS #66
24	8	1606	236	38	41.24	-71	00.28	BOPS #67
24	8	2119	236	39	0.17	-71	59.99	BOPS #68
25	8	0310	237	39	20.74	-70	59.74	BOPS #69
25	8	0646	237	39	40.13	-70	59.49	BOPS #70
25	8	0937	237	40	0.00	-70	59.99	BOPS #71

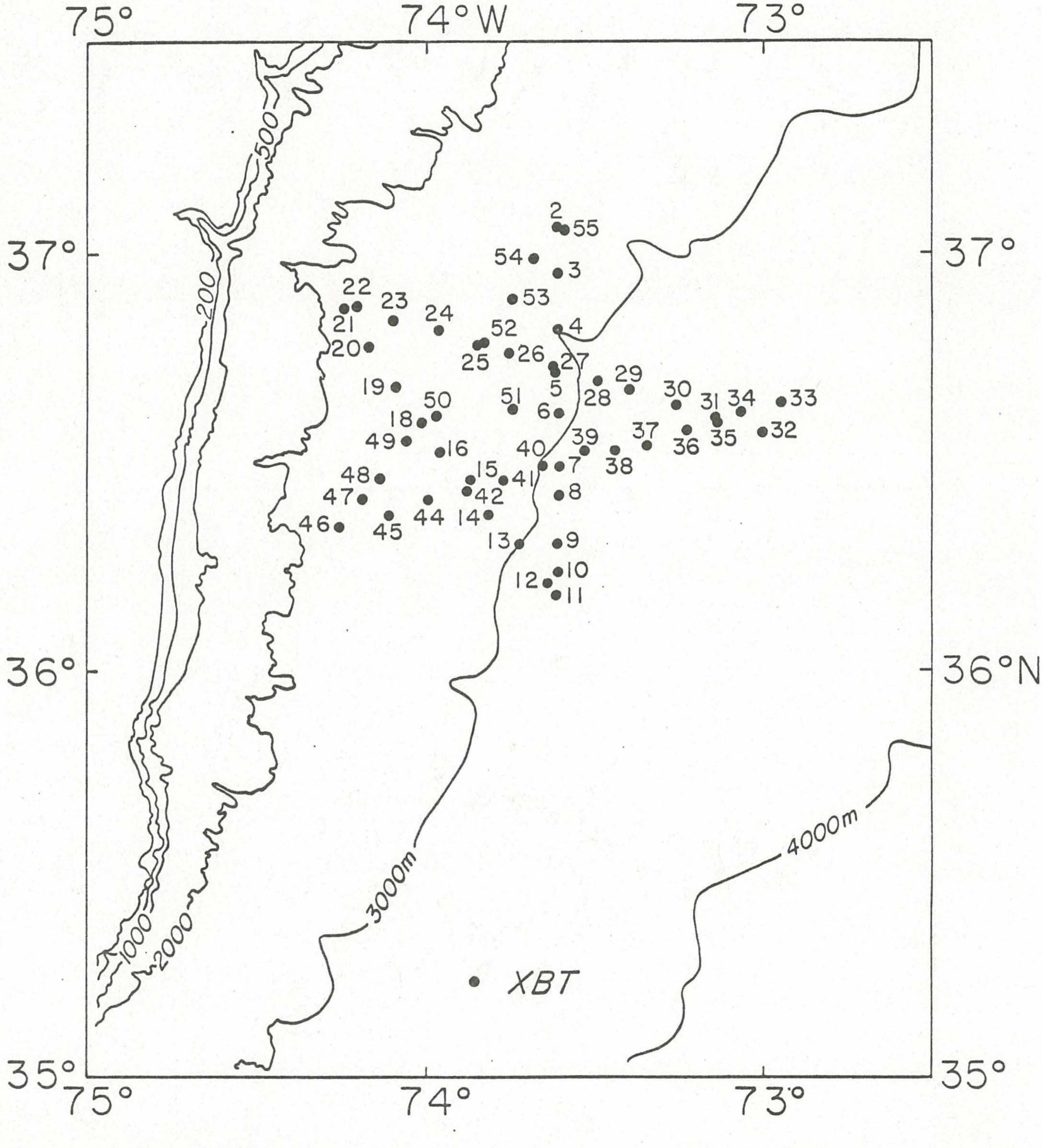


Figure 1: XBT locations for the first star.

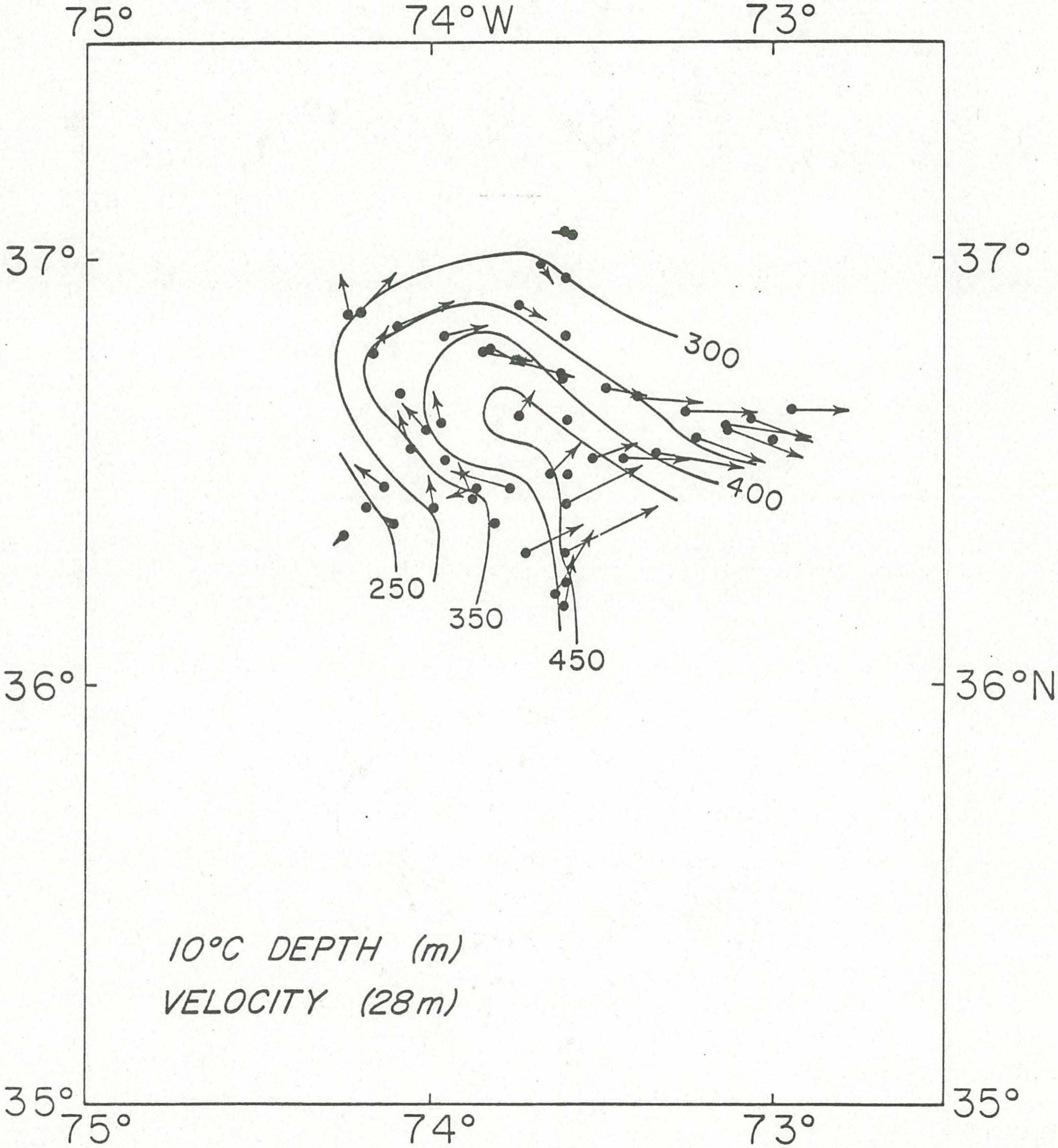


Figure 2: Depth of the 10°C isotherm and APOC vectors for the first star.

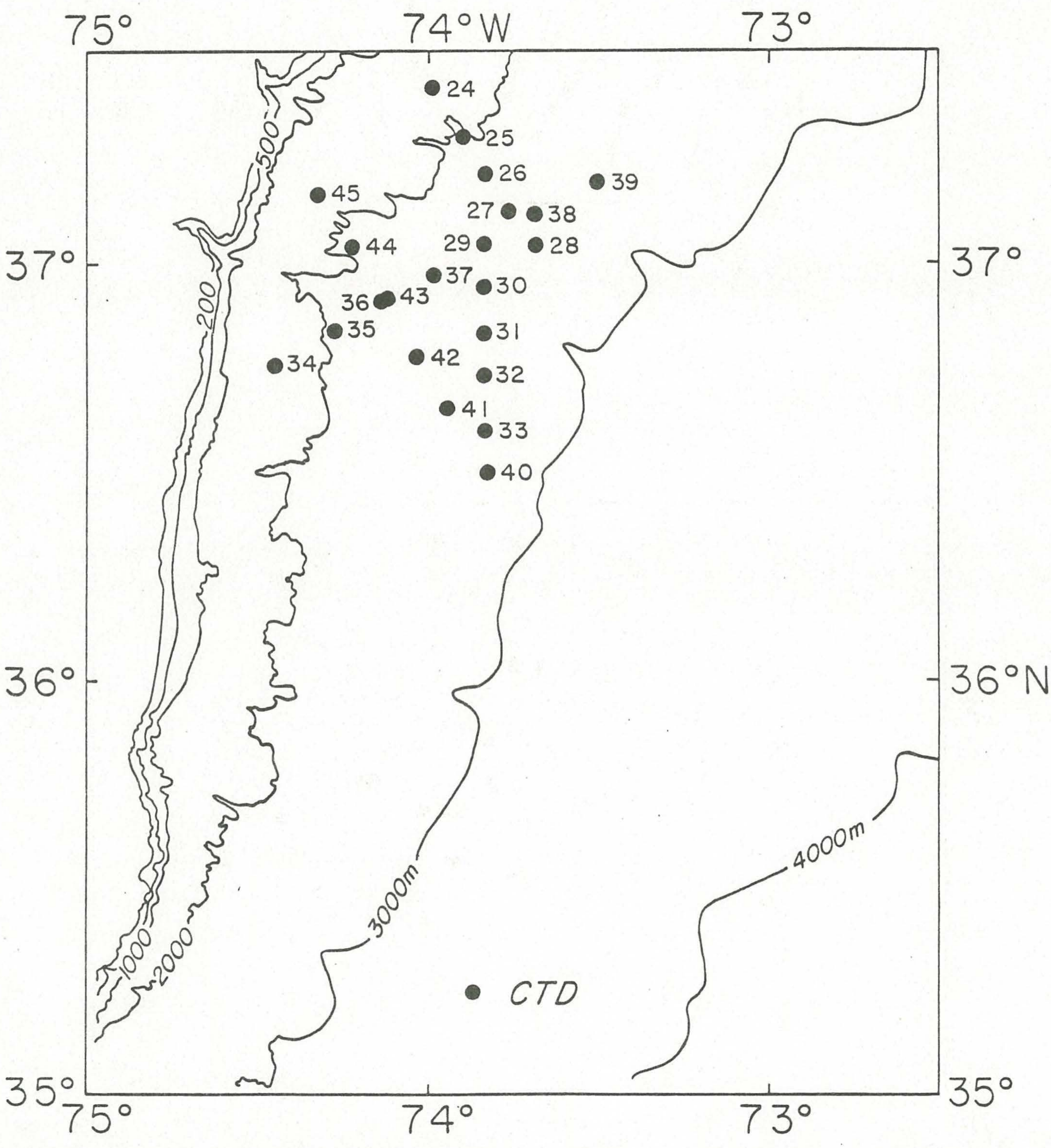


Figure 3: Station locations for the second CTD survey, Stations 24 to 45.

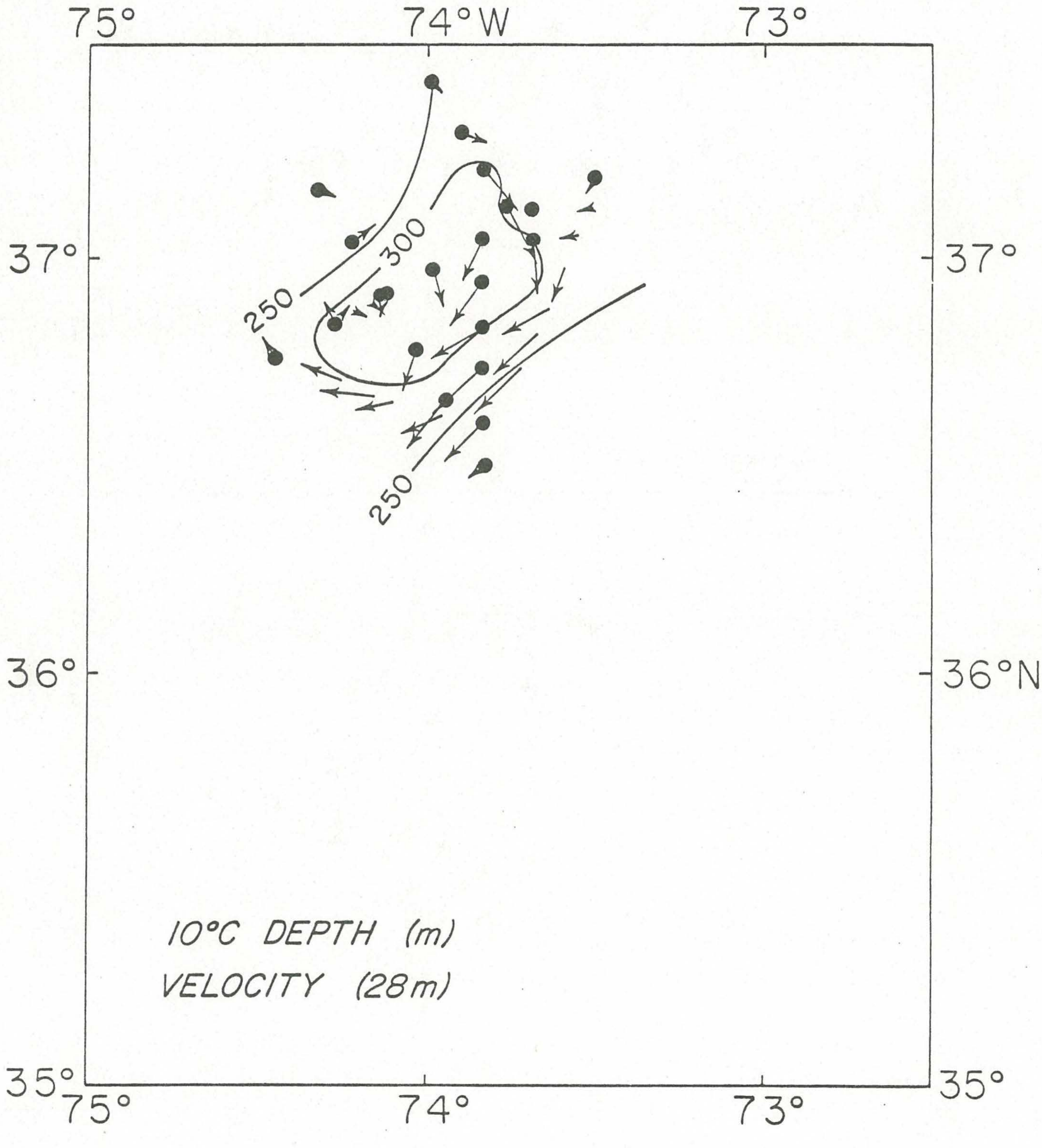


Figure 4: The 10°C isotherm depths and APOC vectors for the second CTD survey.

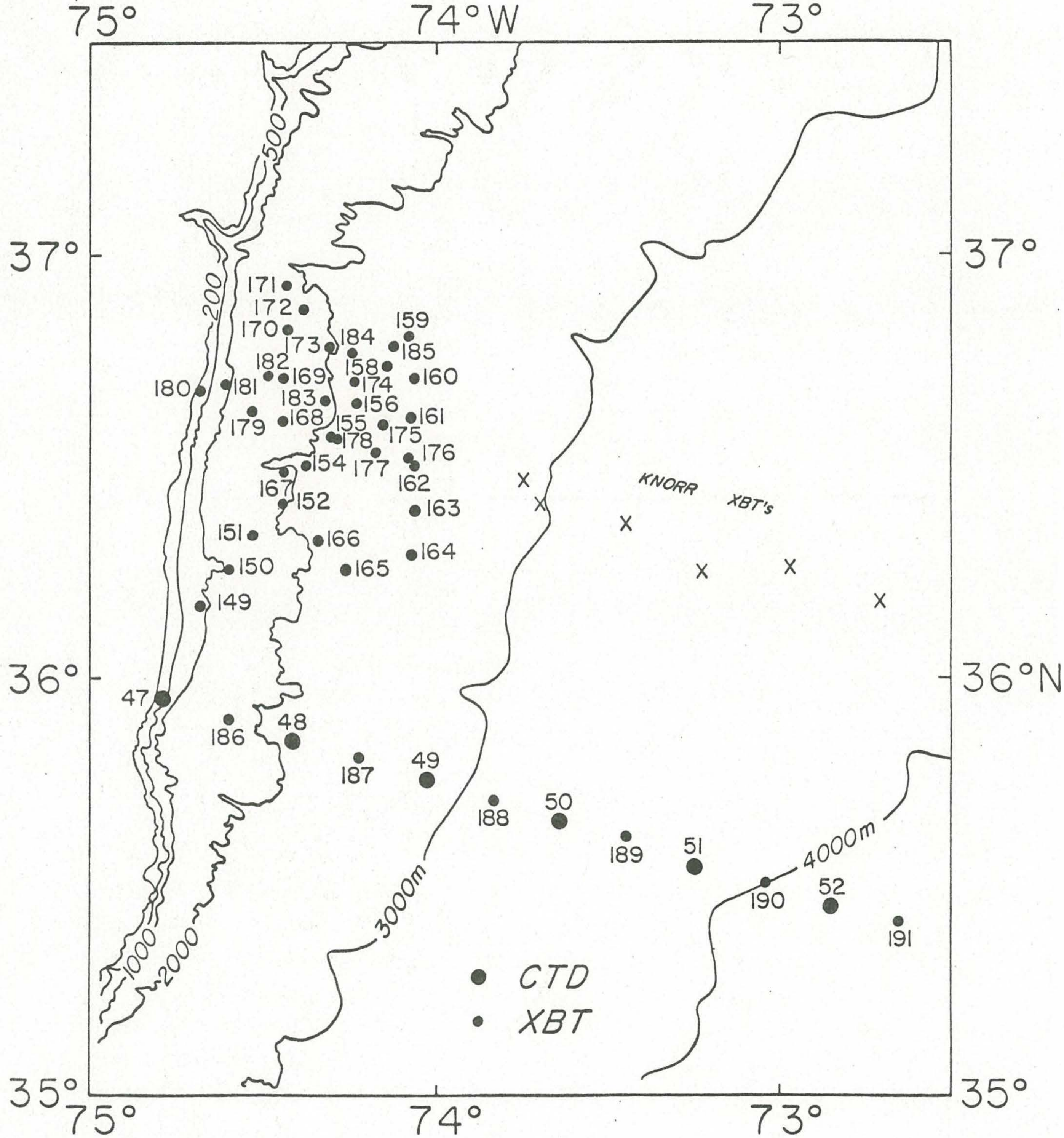


Figure 5: XBT locations for the final survey of 82B.

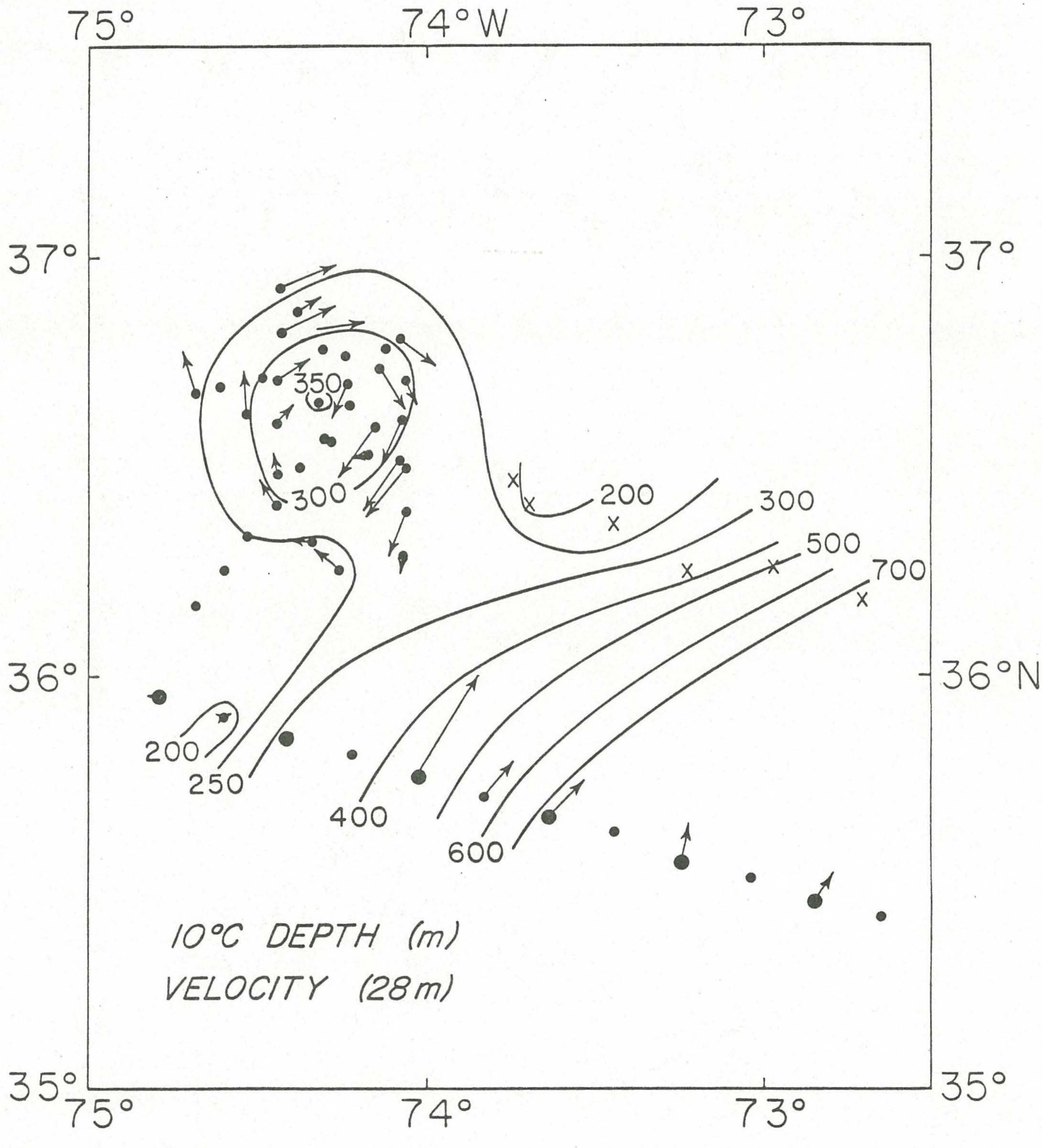


Figure 6: The 10°C isotherm depths and APOC vectors for the final XBT survey.

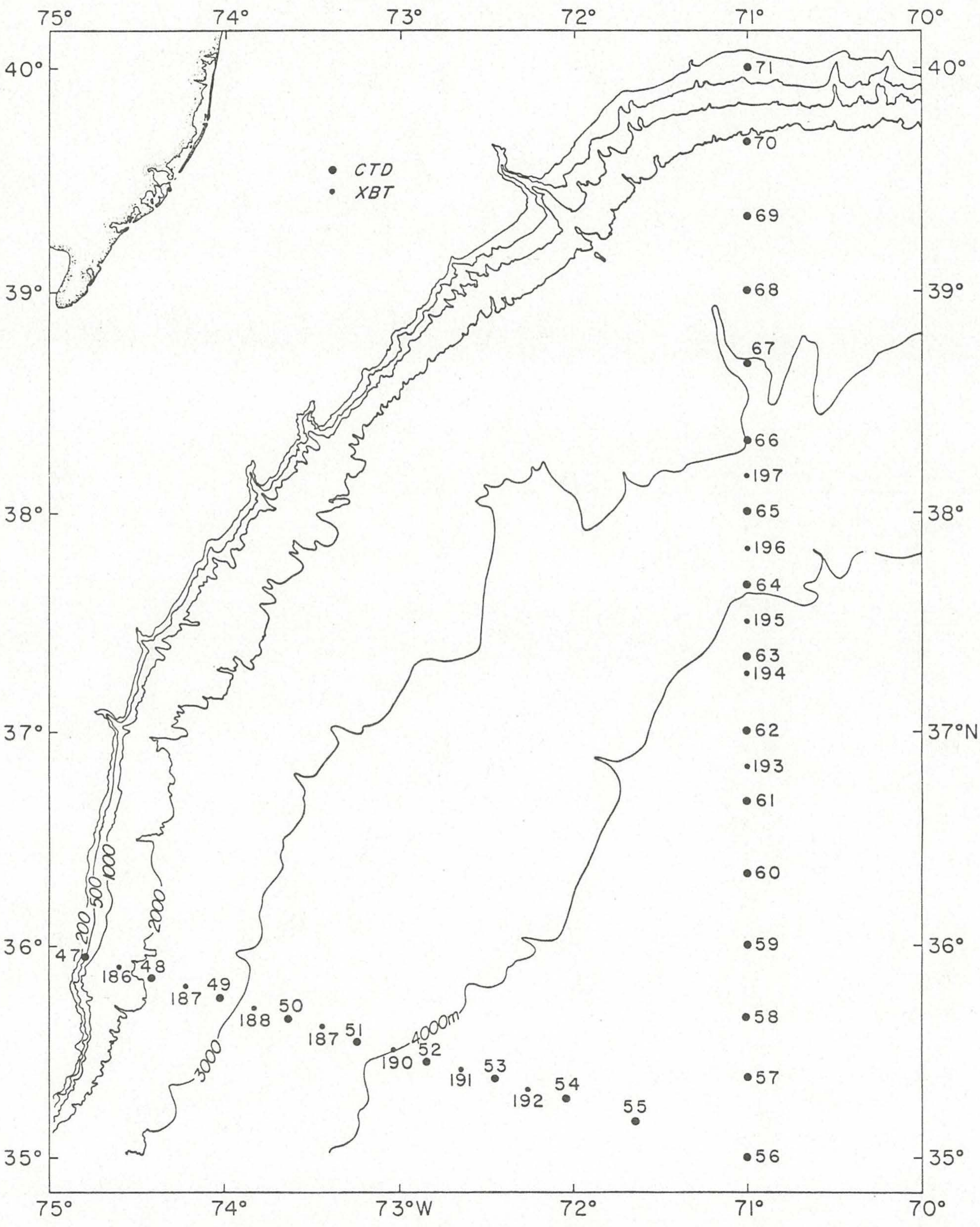
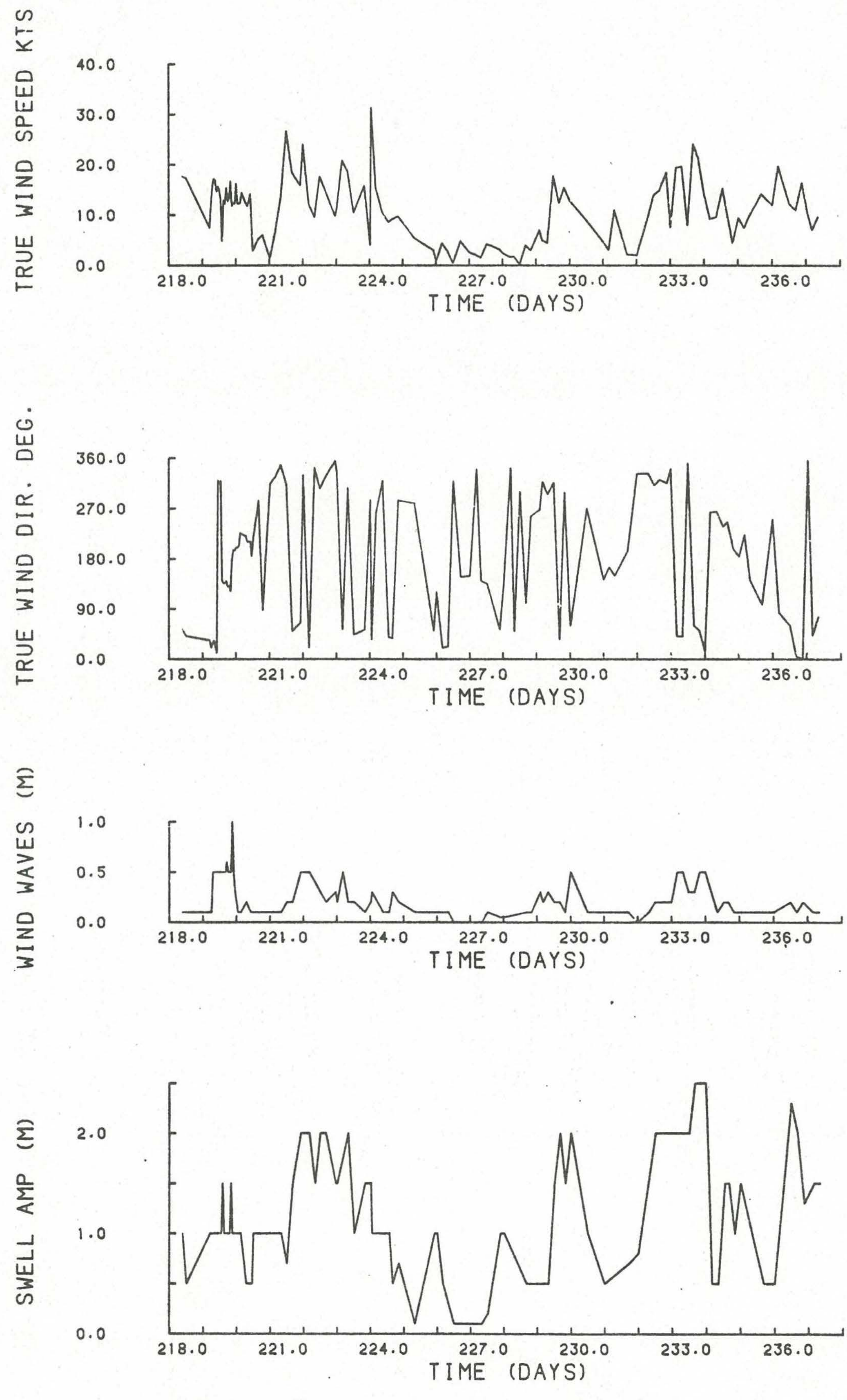


Figure 7: CTD and XBT station locations for the Slope-Sargasso section and the 71°W section.

Figure 8: Meteorological variables observed during EN-088.



CRUISE REPORT

KNORR CRUISE NO. 97, 8/7/82 - 8/24/82

James J. McCarthy

Harvard University

Cambridge, Massachusetts

KN 097 CRUISE REPORT

I. Objective of the Cruise

KNORR 097 was the third in a series of four cruises scheduled in 1982 for the purpose of invesitgating the evolution of warm core rings. The scientists aboard this vessel are responsible for most of the experimental biological and some of the chemical studies that constitute the Warm Core Ring Program. Other components of the program were accommodated by the research vessels OCEANUS and ENDEAVOR. A portion of this work is supported by NASA, but principal support comes from NSF.

Prior to our departure it was decided that the initial effort of all three vessels would be directed towards Ring 82-B. If this ring deteriorated to the point that we no longer found it useful to study, another ring, such as 81-G, or 82-E would then be chosen. Shortly after arriving in the vicinity of Ring 82-B it became apparent that the few tens of meters of water overlying the remnant of the ring core were being influenced primarily by horizontal processes, and that this water was probably a mixture of Stream, and shelf waters. The scientists aboard the KNORR decided to spend the balance of their cruise period in another ring, and Ring 82-B, although farther east than 81-G, seemed to offer the most interesting prospects.

Enroute to Ring 82-E stations were made in both the Sargasso Sea and the Gulf Stream. The initial work in the ring indicated that its structure was relatively symmetrical, but just prior to the completion of our work an intrusion of warm water, perhaps a Gulf Stream streamer, moved into the area peviously occupied by ring center. The ring appeared to have moved to the east with the advance of a Gulf Stream meander just west of the ring.

II. Cruise Itinerary

7 August	Depart Woods Hole, MA at 1900 hr. and steam to Ring 82-B
9-11 August	Ring 82-B Center Station
12 August	Steam to Sargasso Sea Station
13 August	Sargasso Sea Station
15 August	Gulf Stream Station
16-17 August	Ring 82-E Center Station
18-19 August	Ring 82-E Cross Section
20-22 August	Ring 82-E Center Station
24 August	Arrive in Woods Hole, MA at 0900 hr.

III. Summary of Funded Investigations

Investigator	Agency Grant
Cowles	NSF OCE-80-17271
Ducklow	NSF OCE-81-17713
Fryxell	NSF OCE-81-01785
Hanson/Kester	NSF OCE-81-17848
Kester/Brown	NSF OCE-80-22989
McCarthy	NSF OCE-80-22990
Nelson	NSF OCE-80-17269-01
Roman	NSF OCE-81-17562
Smayda/Hitchcock	NSF OCE-80-17272
Yentsch	NASA grant NAG 6-17, Suppl. 1 from Wallops Flight Center

IV. Scientific Party

Dr.	James J. McCarthy	Chief Scientist, Harvard University
Mr.	Mark Altabet	Harvard University
Mr.	Joseph Montoya	Harvard University
Ms.	Cara Adler	Harvard University
Dr.	Dana Kester	University of Rhode Island
Dr.	Alfred Hanson	University of Rhode Island
Dr.	Mary Brown	University of Rhode Island
Dr.	Richard Zuehlke	University of Rhode Island
Mr.	Peter Bates	University of Rhode Island
Ms.	Carole Sakamoto-Arnold	University of Rhode Island
Mr.	Jan Szelag	University of Rhode Island
Dr.	Tim Cowles	Woods Hole Oceanographic Institution
Ms.	Nancy Copley	Woods Hole Oceanographic Institution
Dr.	Gary Hitchcock	University of Rhode Island
Mr.	Christopher Langdon	University of Rhode Island
Mr.	Tracy Villareal	University of Rhode Island
Dr.	Hugh Ducklow	Lamont
Ms.	Sue Hill	Lamont
Dr.	Mike Roman	University of Maryland
Ms.	Sarah Libourel	University of Maryland
Mr.	Dave Phinney	Bigelow Laboratory
Mr.	Jack Laird	Bigelow Laboratory
Dr.	Dave Nelson	Oregon State University
Mr.	Mark Brzezinski	Oregon State University
Mr.	Rick Gould	Texas A and M
Mr.	Dana Wiese	WHOI computer tech

V. Ship's Officers and Crew

Emerson H. Hiller	Master
David F. Castles	Chief Mate
John E. Sweet, Jr.	2nd Mate
David H. Megathlin	3rd Mate
Ernest G. Smith	Radio Officer
Frank D. Tibbetts	Boan
Edward R. Broderick	A.B.
Peter M. Flaherty	A.B.
Wayne A. Bailey	A.B.
Edward F. Graham	O.S.
Thomas M. Macedo	O.S.
Stephen W. Cotter	O.S. (Dayman)
Joseph A. Nickowal	O.S.
Emelio Soto	Chief Engineer
Harry E. Oakes	1st Asst Engineer
David L. Hayden	2nd Asst Engineer
John S. Hurder	3rd Asst Engineer
Harry Rougas	Electrician
Harry F. Clinton	Oiler
Herman Wagner	Oiler
Peter P. Reilly	Oiler
John M. Gassart	Steward
Gilberto R. Garcia	Cook
Stephen S. Bates	Messman
Robert P. Martin	Messman

VI. Scientific Narrative

During the 18 days of KNORR 097 we occupied 16 stations. The policy of station designation and the coding of operation numbers followed the procedure established during KNORR 093. A station number was assigned for each location during continuous station work. For some stations the locations were fixed geographic positions, while for others they changed in time as we maneuvered to track a drogued buoy. Operation numbers took the form KNmmdd.ss, where KN is an abbreviation for KNORR, mm designates month, dd is for day, and ss indicates the sequence of the operations for any day beginning with 01 at 0000 hr. each day. All operations are listed chronologically in Table 1.

Station position abbreviations are as follows: SLOPE= Slope Water, DRFTR= Loran or Satellite drifter, SECTN= series of stations along a cross section of the ring, SGASO= Sargasso Sea, GSTRM= Gulf Stream, RNGCT= ring center position determined without the benefit of drifter position, and ENTRN= western entrainment feature. The descriptors, the names of operations, are self-explanatory.

XBT's were taken during several periods of the cruise to define the temperature structure of the Ring. These are summarized in Table 2. All XBT's were Sippican T-7's giving profiles to greater than 750 meters. Table 2 gives the time, month and day (GMT) position, surface bucket temperature, and the depths in meters of three selected isotherms, 15, 10 and 6 degrees Celcius. The surface salinity data for XBTs are given in Table 3.

Cowles: Zooplankton Feeding and Reproduction. Work was done in four major hydrographic regimes - Slope Water, Sargasso Sea, Gulf Stream, and within warm core rings 82-B and 82-E. The experiments with macrozooplankton focussed on the feeding and egg production rates of the dominant copepods. Additional experiments were done to estimate the grazing rates of microzooplankton.

The distribution of particulate matter in the upper 100 m was determined at most stations with an electronic particle counter.

The vertical distribution of small zooplankton was determined using the 1/4 m MOCNESS, in collaboration with M. Roman.

The following table provides a summary of the work completed during KNORR 97.

Activity	SLOPE	SARGASSO	G.S.	82-B	82-E
Feeding Expts	-	-	1	4	8
Egg Prod Expts	-	-	-	5	6
Part. Profiles	1	1	-	2	8
Microzoo Expts	1	-	-	2	8
MOC 1/4 Tows	1	1	-	3	5

General Comments: The macrozooplankton in the upper 100 meters of ring 82-B had changed considerably since our June visit to this ring. The composition of the plankton resembled that found in the Gulf Stream, with few species present which had dominated during the June cruise. The rapidly changing hydrographic structure of ring 82-B made it difficult to acquire consistent rate measurements with the macrozooplankton.

In contrast, the macrozooplankton in ring 82-E resembled the plankton community seen earlier in ring 82-B and in ring 81-D, with the copepods Eucalanus elongatus, Nannocalanus minor, and Scolecithrix danae quite abundant in the upper 100 m. Unlike the early months of 82-B, 82-E does not seem to have a substantial number of cold-water species present in the ring center plankton community. This could be a consequence of season of formation, as the summer Slope Water plankton community does differ from the winter populations which are entrained in 82-B.

Ducklow: On KN097, most of our work was concentrated in Ring 82E, with other experiments in 82B, and cooperative work in the Sargasso Sea. During this cruise we extended our ^{3}H-thymidine incorporation studies to include all SI DEEP casts, with the objective of examining bacterial production around the O_2 minimum. As in previous cruises we collected bacterial abundance and production data on all productivity casts.

Other experiments performed included our continuing studies of factors influencing bacterial growth in unamended seawater; several investigations of ^{3}H-thymidine incorporation associated with Trichodesmium, and our participation in the copper addition experiments. We also tried to complete an experiment designed to examine coupling among phytoplankton, bacteria, microzooplankton grazers, and ammonia regenerators, but CID problems aborted the effort. We hope to try again next time.

On the radial section study of 82-E we again collected a full set of abundance and rate data for the shallow casts, and in addition collected abundance data for the entire deep series of casts.

<u>Gould</u> (Fryxell): Quantitative samples were collected from twelve stations - seven during a complete transect of ring 82-E, two ring center stations in 82-B, one Gulf Stream station, one Sargasso Sea station, and two 82-E ring center stations. Water was collected from six depths at the transect stations, and from generally nine depths elsewhere. This yields a total of 144 discrete samples, with duplicates of most. One hundred fifty nine filtered samples were collected from nine stations for a scanning electron microscope study of the nanoplankton. Eighty isolations of diatoms and dinoflagellates were made from the twenty net hauls. The preserved material from these net hauls will be used to create permanent light and scanning electron microscope mounts to aid in the identification of the phytoplankton species. The 1/4-MOCNESS samples were collected at six stations in an attempt to describe and enumerate the phytoplankton in the chlorophyll maximum and surface layers.

Several general comments can be made from the preliminary microscope work performed during the cruise. In ring 82-B in June, a common constituent of the flora was <u>Dinophysis tripos</u>, a dinoflagellate. This species was very rare in 82-B, or at any station, during this cruise. Diatoms of the genus <u>Rhizosoleria</u> and chain-forming diatoms of the genera <u>Nitzschia</u>, <u>Chaetoceros</u>, and <u>Hemiaulus</u> were common in ring 82-B, and in the Sargasso Sea and Gulf Stream as well. During the June occupation of 82-E ring center, <u>Thalassiosira</u> colonies were extremely abundant, particularly below 20 meters or so in the water column. These mucous colonies were still present upon our return to 82-E ring center following our transect, but there was a decrease in abundance.

<u>Kester and Hanson</u>: A series of chemical investigations were carried out in Warm Core Rings 82-B, 82-E, the Slope Water, the Gulf Stream, and the Sargasso Sea. Nutrient samples were obtained during 41 operations at each major station. Approximately 475 samples were analyzed onboard for nitrate, nitrite, phosphate, and silicate. These results provided information for the nutrient concentrations at the productivity casts, the deep CTD casts, the silica deep casts, and the radial transect stations. About 30% of the nutrient data were processed into tabular and graphical form for initial interpretations of the results.

Oxygen measurements were made on selected samples from the CTD casts to provide calibration data for the <u>in situ</u> oxygen sensors. A microcomputer-controlled Winkler titration system was used for these analyses. Salinity samples were also processed on the AutoSal for calibration of the <u>in situ</u> conductivity sensor and for the surface salinity samples collected in association with the XBT data.

The automated trace metal preconcentration system and shipboard atomic absorption spectroscopy analyses yielded a substantial amount of information. The emphasis during this cruise for the automated preconcentrator was placed on extractions and analyses of dissolved manganese in ocean water. This work complements other studies on copper concentrations and speciation and the response of phytoplankton and bacteria to trace metals.

The second aspect of the trace metal studies was concerned with several operationally defined measurements of copper species concentrations. Dissolved copper was partitioned into organically bound (retained by C_{18} reverse phase liquid chromatography, C_{18}-RPLC, and eluted with methanol), 'silica labile' (retained by C_{18}-RPLC and eluted with an aqueous acid), electrochemically labile (anodic stripping voltommetry at pH 8). Total dissolved copper samples were also collected for analysis offshore. The samples processed by C_{18}-RPLC were analyzed using the onboard atomic absorption spectrophotometer. Approximately 250 samples were collected for copper measurements from the deep CTD, the productivity and the radial section casts.

Dissolved organic matter was isolated by C_{18}-RPLC from large volumes of seawater (approx. 50 l) collected from ring center waters (three from the chlorophyll maximum and one from the O_2 minimum, approx. 550 m). This organic matter will be further characterized by high performance liquid chromatography and employed in laboratory experiments on copper complexation by organic ligands.

Two experiments were conducted to evaluate the sensitivity of Sargasso Sea and warm core ring center phyto-, bacterio- plankton to dissolved copper. Seawater collected from the chlorophyll maximum was incubated with increasing levels (1-130 nmole/kg) of added dissolved copper in each of these experiments. Various biological rate and biomass measurements (^{14}C productivity, silica uptake, ammonia uptake, thymidine uptake, ATP and chlorophyll) were carried out by other WCR program investigators. Copper speciation measurements (ASU, C_{18}-RPLC) were made on similarly incubated samples. A time series experiment at natural and one higher copper addition level (approx. 8 nmole Cu/kg) was also conducted.

Surface water samples were collected from the Zodiac at locations away from the ship in order to evaluate the cleanliness of the Rosette-Go-Flo bottle sampling systems for trace metals.

These chemical studies were carried out by Peter Bates, Mary Brown, Alfred Hanson, Dana Kester, Carole Sakamoto-Arnold, and Richard Zuehlke.

McCarthy: The primary objective of this work was to elucidate the role that nitrogenous nutrition of the phytoplankton plays in the evolution of the populations contained within warm core rings. At all of the productivity stations we sampled six depths within the euphotic zone at three times during the day: first light, midday, and late night, to determine water column properties and collect material for experiments. We measured the concentrations of ammonium and urea, and held additional samples for eventual determination of particulate carbon, nitrogen, and phosphorus. Nitrogen-15 labelled ammonium, urea, and nitrate and phosphorus-33 labelled phosphate were added to samples from each of these depths, which were subsequently incubated under simulated *in situ* conditions on deck, for the determination of nutrient uptake rates. On the ring transect stations we collected samples from 12 depths for particulate carbon, nitrogen, and phosphorus determinations. At several stations we collected samples for eventual determination of nitrogen-15 natural abundance. We participated in the copper addition experiment described by Hanson and the *Trichodesmium* experiments described by Roman.

Nelson: Silicon cycling studies. In the Gulf Stream water overlying the remnants of ring 82-B we measured the concentration of biogenic and mineral particulate silica and production and dissolution rates of biogenic silica. Biogenic and mineral particulate silica concentrations and biogenic silica dissolution rates were measured at 15 depths from the surface to 600 m (i.e. into the ring thermostad). Production rates were measured at 9 depths in the upper 100 m. Concentrations and production rates were measured day and night. We also performed biogenic silica size fractionation experiments (concentration and production rate; <10μ, 10-64μ and >64μ size fractions) and joined Hanson, Hitchcock, McCarthy and Ducklow in an experiment on the effects of copper on rates of phytoplankton and microbial processes (this last experiment performed in the Sargasso Sea).

We then proceeded to ring 82-E, a young and clearly defined warm core ring. We again made day and night measurements of biogenic silica production rates and concentrations of mineral and biogenic particulate silica in the upper waters (to 100 m) plus a single profile of concentration and dissolution rates from the surface to 700 m at ring center. We repeated this full suite of observtions four days later, just before departing from the ring.

During the intervening four days we conducted a cross section of the ring similar to those done in ring 82-B in June. We measured concentrations of mineral and biogenic particulate silica at 17 depths in the upper 800 m at 7 stations in a NW to SE transect of the ring. A considerable number of other hydrographic, nutrient and biomass parameters were measured along this same transect. We also conducted size-fractionation studies at the center of ring 82-E similar to those in the Gulf Stream water overlying the sparse remnants of what once was ring 82-B, and copper addition experiments similar to that performed with others in the Sargasso Sea.

Approximately 80 clones of various diatom species were isolated from ring center in the upper 20 m mixed layer of ring 82-B. An additional 200 clones were isolated from the mixed layer in the center of ring 82-E. Studies concerning the nutrient physiology of these clones will be performed in the laboratory.

Enrichment experiments to ascertain whether various nutrients were limiting diatom growth in 82-E and 82-B were conducted. Subsamples collected from the various treatments were preserved for cell counts.

Phinney and Laird (Yentsch): A total of 23 operations were completed to characterize bio-optical properties of seawater in Ring 82-B, Sargasso Sea, Gulf Stream, Ring 82-E and Slope water. These operations break down to:

- 13 vertical pump profiles of chlorophyll, fucoxanthin and phycoerythrin fluorescence; temperature and salinity to 110 meters.
- 5 Four channel photometer profiles to determine K_T, the total attenuation coefficient, at 440,520,550 and 670 nm.
- 4 Spectral transmissometer profiles to 75 m to determine alpha, the inherent property of seawater representing scattering and absorption, at 450,491,550,585 and 631 nm.
- 1 Total scalar inadiance profile. Flooding of the remote sensor for total scalar inadiance prohibited its further use.

Fifty fluorescence excitation/emission spectra were produced to evaluate spectral signatures of the particulate material for eleven pump profiles.

Underway data of pigment fluorescence, temperature, salinity and transmission of surface water and incident solar inadiance were collected continuously from +2 hours Woods Hole departure 7 August 1982 to Vineyard Sound 24 August 1982, constituting approximately 385 hours of data logged on the Woods Hole SAIL system at 5 minute intervals. Two hundred and fifty chlorophyll calibration samples were collected, with duplicate samples exhibiting +/- 1.0% precision.

Roman: WCR 82-B. General impressions: Gulf Stream zooplankton were overlying Slope and Sargasso Sea plankton. Variability in water column characteristics was greater than in previous rings. MOC-1/4 night tow caught greater than 50% more zooplankton in surface 100 m than the day tow, however it is just as likely to be a different water mass as a consequence of vertical migration. Gelatinous zooplankton which were so abundant in 82-B during the June cruise were few or absent.

Work done: We took MOC-1/4 day/night tows (0 to 200 m in 25 m increments) and a tow-yo from 0 to 50 m (8 replicates). Zooplankton were collected by pump from 100-70, 70-50, 50-30, 30-10, 10-0 m.

Shipboard grazing experiments, day/night, were conducted for >333μm; <333μm; >64μm fractions. Samples were collected for POC, PON, protein, carbohydrate, lipid, chlorophyll (>3μm; >0.22μm), analyses and bacteria counts (free and attached). Three in situ zooplankton grazing experiments were conducted.

In the Sargasso Sea we collected samples with the MOC-1/4 (0 to 200 m; 25 m increments), conducted in situ incubations (0,11,22,33,35,76 m), and collected zooplankton by pump from 110-70, 70-50, 50-30, 30-10, 10-0.

We conducted *Trichodesmium* experiments to compare glass vs. polycarbonate incubations flasks with 6 each at 60% light (8/10; 8/12). We also looked at the effect of different concentrations of phosphate additions and ammonium additions.

WCR 82-E. General impressions: The zooplankton were most like those in 82-B in April. Much *Trichodesmium* was present at both the surface and at 70 m. Protozoa were abundant (forams, radiolarians, tintinids). The greatest number and biomass of zooplankton was between 50 to 25 m, and were dominated by calanoid copepods. The copepods collected from this depth had full guts and those species which carried eggs had them.

Work done: 8/16-8/17/82 Ring Center: Zooplankton were collected by pump (110-70, 70-50, 50-30, 30-10, 10-0 m) and we took MOC-1/4, day/night tows, and a tow-yo (0-80 m, 8 replicates). Shipboard feeding experiments were conducted, day/night, with water collected from 30 m for POC, PON, protein, carbohydrate, lipid, bacteria (free/attached), and chlorophyll (>3μm, >0.22μm). In situ grazing experiments were conducted (0,12,24,35,59,81 m).

8/20-8/21/82 Ring Center: Zooplankton were collected by pump (radial station #7) and we took MOC-1/4, day/night tows (200 m to 0 m with 25 m increments). Shipboard feeding experiments were conducted as on 8/16. In situ grazing experiments were conducted (0,7,15,22,36,50 m). Biochemical fractionation of ^{14}C into phytoplankton (30 m) and zooplankton (>333 μm, >64 μm) was conducted for protein, carbohydrate, lipid, and low molecular weight fractions over time.

On radial transect stations zooplankton were collected from Yentsch's pump from 110-70, 70-50, 50-30, 30-10, 10-0 m for biomass and species enumeration.

Smayda and Hitchcock: On KNORR 97 our component was represented by Hitchcock, Langdon and Villareal. Our primary work was to determine rates of primary production and the biomass, as chlorophyll *a* and ATP, for phytoplankton between the 100% and 0.1% isolume depths. In addition to the three regular productivity stations (one at 82-B, two at 82-E) occupied, we conducted two productivity stations on size-fractionated material with D. Nelson to establish rates of net- and nannoplankton C and Si-uptake. One of these stations was at 82-B and the other at the Sargasso Sea. Langdon did ATP analyses on material collected from the 'deep Si' cast (to 700 m) for estimates of sub-euphotic zone microplankton biomass. Chris also routinely measured dissolved O_2 profiles from the euphotic zone and deep water casts; an attempt was made to measure respiration in water collected from the O_2 minimum. Langdon and Villareal conducted dilution growth-rate experiments with T. Cowles at each of the seven stations occupied during the radial transect of 82-E. Additional measurements made by our group during the 82-E transect were 'potential productivity' (^{14}C-based production measurements for the 4 shallowest depths); chlorophyll a and ATP biomass on net- and nannoplankton (<10μ) samples from the shallowest 6 depths. Villareal analyzed chlorophyll a from the 1/4 MOCNESS tows of Cowles and Roman to establish netplankton (>64μ) chlorophyll abundance in the upper 200 m. Preliminary analysis shows marked differences in day-night tows from the same location. He made 3 growth rate measurements on natural populations incubated in diffusion chambers and dialysis sacs (on-deck growth chambers). He attempted 127 isolations of diatoms (57 isolates in 82-E, 24 in the Sargasso Sea and 46 in 82-B). Hitchcock conducted five experiments to determine the linear rate of ^{14}C uptake in natural phytoplankton; two of these rate experiments provided material to be analyzed ashore for a measure of solvent-extracted polymers (lipids, polysaccharides and proteins). One experiment was done in conjunction with Ducklow and Roman to estimate carbon-based rates of production for bacteria, phytoplankton and micro-zooplankton. Two series of incubations were done with Roman (one in slope water, one at 82-E) to determine the diel variation in ^{14}C-labelled polymers (lipids, polysaccharides, proteins) in phytoplankton and micro-zooplankton. A series of Cu addition-experiments was done with Hauson to assess the potential susceptability of Sargasso Sea and 'ring center' (82-E) phytoplankton to Cu toxicity.

WARM CORE RING CRUISE 0807-0824 1982

TABLE 1 KN-097 OPERATION LOG

OP. NO.	TIME	STA	LOCAT.	LAT.	LONG.	INVESTGR	DESCRIPT	CTD #
KN0809.01	0405	1	RNGCT	36 37.2	73 47.5	KESTER	5L CTD	1
KN0809.02	0730	1	RNGCT	36 37.2	73 47.5	COWLES	30L NISKIN	
KN0809.03	0735	1	RNGCT	36 37.2	73 47.5	ROMAN	LIVE TOW	
KN0809.04	0830	1	RNGCT	36 37.2	73 47.5	HITCHCOCK	30L NISKIN	
KN0809.05	1000	1	RNGCT	36 37.0	73 48.1	PHINNEY	TOT IRRAD	
KN0809.06	1102	1	RNGCT	36 37.1	73 48.5	PHINNEY	4 CHAN LT	
KN0809.07	1220	1	RNGCT	36 37.4	73 49.1	PHINNEY	PUMP PROFL	2
KN0809.08	1400	1	RNGCT	36 37.3	73 49.2	COWLES	1/4 MOC	
KN0809.09	1546	1	RNGCT	36 35.7	73 41.1	GOULD	1/4 MOC	
KN0809.10	1636	1	RNGCT	36 34.9	73 47.0	GOULD	LIVE TOW	
KN0809.11	2045	1	RNGCT	36 38.4	73 48.1	ROMAN	30L NISKIN	
KN0809.12	2100	1	RNGCT	36 38.4	73 48.1	ROMAN	LIVE TOW	
KN0809.13	2215	1	RNGCT	36 38.5	73 48.1	DUCKLOW	NT PROD I	4
KN0809.14	2307	1	RNGCT	36 38.6	73 48.1	DUCKLOW	NT PROD II	5
KN0809.15	2345	1	RNGCT	36 38.6	73 48.1	GOULD	1/4 MOC	
KN0810.01	0010	1	RNGCT	36 38.6	73 48.1	COWLES	1/4 MOC	
KN0810.02	0505	1	RNGCT	36 36.5	73 48.6	HITCHCOCK	FL PROD I	6
KN0810.03	0553	1	RNGCT	36 35.4	73 48.5	HITCHCOCK	FL PROD II	7
KN0810.04	0735	1	RNGCT	36 36.9	73 48.3	NELSON	SI DEEP	8
KN0810.05	0930	1	RNGCT	36 38.1	73 48.2	PHINNEY	ALPHA MTR	
KN0810.06	1114	1	RNGCT	36 39.2	73 47.8	DUCKLOW	MD PROD I	9
KN0810.07	1209	1	RNGCT	36 39.6	73 47.6	HITCHCOCK	MD PROD II	10
KN0810.08	1245	1	RNGCT	36 39.6	73 47.6	ROMAN	IN SIT GRZ	
KN0810.09	1400	1	RNGCT	36 40.4	73 47.6	GOULD	VERT TOW	
KN0810.10	1446	1	RNGCT	36 40.8	73 47.7	BRZEZINSKI	VERT TOW	
KN0810.11	1605	1	RNGCT	36 38.1	73 47.4	HANSON	5L CTD	11
KN0810.12	1950	1	RNGCT	36 39.2	73 46.8	GOULD	HORIZ TOW	
KN0810.13	2051	1	RNGCT	36 40.2	73 47.0	ROMAN	VERT TOW	
KN0810.14	2104	1	RNGCT	36 40.2	73 47.2	COWLES	30L NISKIN	
KN0810.15	2114	1	RNGCT	36 40.5	73 47.2	COWLES	VERT TOW	
KN0810.16	2212	1	RNGCT	36 40.4	73 47.3	COWLES	1/4 MOC	
KN0811.01	0609	2	RNGCT	36 38.4	73 47.7	HITCHCOCK	FL PROD	12
KN0811.02	1400	3	RNGCT	36 55.1	73 42.8	BRZEZINSKI	VERT TOW	
KN0811.03	1424	3	RNGCT	36 55.3	73 42.2	COWLES	30L NISKIN	
KN0811.04	1432	3	RNGCT	36 55.4	73 42.0	COWLES	VERT TOW	
KN0811.05	1550	3	RNGCT	36 55.4	73 42.0	VILLAREAL	HORIZ TOW	
KN0811.06	1555	3	RNGCT	36 55.1	73 41.3	GOULD	1/4 MOC	
KN0811.07	1630	3	RNGCT	36 55.1	73 41.3	BROWN	30L CTD	13
KN0811.08	2052	3	RNGCT	36 55.1	73 42.4	COWLES	30L NISKIN	
KN0811.09	2104	3	RNGCT	36 55.1	73 42.5	COWLES	VERT TOW	

TABLE 1 (contimed) KN-097 OPERATION LOG

OP. NO.	TIME	STA	LOCAT.	LAT.	LONG.	INVESTGR	DESCRIPT	CTD #
KN0812.01	0609	4	RNGCT	36 55.6	73 43.0	HITCHCOCK	FL PROD/PUMP	14
KN0812.02	0715	4	RNGCT	36 55.6	73 43.0	ROMAN	IN SITU GRZ	
KN0812.03	0847	4	RNGCT	36 58.1	73 40.9	NELSON	30L CTD	
KN0812.04	0913	4	RNGCT	36 58.5	73 40.7	GOULD	HORIZ TOW	
KN0812.05	1003	4	RNGCT	37 00.4	73 40.5	COWLES	30L NISKIN	
KN0813.06	1010	4	RNGCT	37 00.1	73 40.5	COWLES	VERT TOW	
KN0812.07	1044	4	RNGCT	37 00.5	73 40.5	ALTABET	VERT TOW	
KN0812.08	1200	4	RNGCT	36 55.0	73 42.2	PHINNEY	PUMP PROFL	
KN0812.09	1400	4	RNGCT	36 54.9	73 42.3	ROMAN	IN SITU GRZ	
KN0812.10	1400	4	RNGCT	36 54.9	73 42.3	PHINNEY	4 CHAN LT	
KN0813.01	0643	5	SGASO	35 44.3	71 51.5	HITCHCOCK	FL PROD I	15
KN0813.02	0843	5	SGASO	35 44.2	71 51.9	HITCHCOCK	FL PROD II	16
KN0813.03	0915	5	SGASO	35 44.0	71 51.9	GOULD	1/4 MOC	
KN0813.04	1000	5	SGASO	35 42.4	71 54.7	COWLES	VERT TOW	
KN0813.05	1108	5	SGASO	35 40.7	71 54.9	GOULD	VERT TOW	
KN0813.06	1155	5	SGASO	35 40.7	71 54.9	ALTABET	VERT TOW	
KN0813.07	1200	5	SGASO	35 40.7	71 54.2	PHINNEY	4 CHAN LT	
KN0813.08	1221	5	SGASO	35 40.7	71 54.2	ROMAN	IN SITU GRZ	
KN0813.09	1330	5	SGASO	35 40.7	71 54.2	HANSON	ZODIAC SMPL	
KN0813.10	1430	5	SGASO	35 40.0	71 53.0	BROWN	30L ROSETTE	17
KN0813.11	1540	5	SGASO	35 39.9	71 53.3	KESTER	5L CTD	18
KN0814.01	1032	6	SGASO	37 03.2	68 51.4	ROMAN	30L NISKIN	
KN0814.02	1040	6	SGASO	37 03.2	68 51.4	ROMAN	VERT TOW	
KN0815.01	0933	7	GSTRM	38 32.0	64 04.5	GOULD	OBLQ TOW	
KN0815.02	1010	7	GSTRM	38 34.1	62 02.7	COWLES	30L NISKIN	
KN0815.03	1031	7	GSTRM	38 35.1	64 02.0	COWLES	1/4 MOC	
KN0815.04	1130	7	GSTRM	38 41.8	64 00.4	PHINNEY	ALPHA MTR	
KN0815.05	1225	7	GSTRM	38 45.8	63 58.5	COWLES	1/4 MOC	
KN0815.06	1400	7	GSTRM	38 54.7	63 56.0	KESTER	5L CTD	19
KN0815.07	1820	7	GSTRM	39 04.5	63 52.3	GOULD	VERT TOW	
KN0816.01	0950	8	RNGCT	40 17.5	61 06.2	COWLES	VERT TOW	
KN0816.02	1015	8	RNGCT	40 16.7	61 06.9	COWLES	30L NISKIN	
KN0816.03	1028	8	RNGCT	40 17.2	61 04.3	PHINNEY	30L CTD PMP	20
KN0816.04	1157	8	RNGCT	40 15.2	61 08.6	PHINNEY	4 CHAN LT	
KN0816.05	1235	8	RNGCT	40 15.2	61 08.6	PHINNEY	ALPHA MTR	
KN0816.06	1325	8	RNGCT	40 15.2	61 10.6	COWLES	1/4 MOC	
KN0816.07	1415	8	RNGCT	40 16.5	61 09.5	BRZEZINSKI	VERT TOW	
KN0816.08	1510	8	RNGCT	40 16.5	61 08.5	VILLAREAL	VERT TOW	
KN0816.09	1540	8	RNGCT	40 16.5	61 08.4	PHINNEY	4 CHAN LT	
KN0816.10	1620	8	RNGCT	40 15.4	61 08.4	COWLES	1/4 MOC	
KN0816.11	1730	8	RNGCT	40 14.5	61 12.0	GOULD	1/4 MOC	
KN0816.12	1800	8	RNGCT	40 14.5	61 12.0	KESTER	5L CTD	21
KN0816.13	2054	8	RNGCT	40 14.8	61 14.5	ROMAN	30L NISKIN	
KN0816.14	2102	8	RNGCT	40 15.0	61 14.8	COWLES	VERT TOW	
KN0816.15	2200	8	RNGCT	40 15.1	61 15.6	DUCKLOW	NT PROD I	22
KN0816.16	2257	8	RNGCT	40 15.0	61 15.1	DUCKLOW	NT PROD II	23

TABLE 1 (continued) KN-097 OPERATION LOG

OP. NO.	TIME	STA	LOCAT.	LAT.	LONG.	INVESTGR	DESCRIPT	CTD #
KN0817.01	0501	8	RNGCT	40 12.3	61 17.1	HITCHCOCK	FL PROD 0	24
KN0817.02	0548	8	RNGCT	40 12.3	61 17.1	HITCHCOCK	FL PROD I	25
KN0817.03	0630	8	RNGCT	40 12.3	61 17.1	HITCHCOCK	FL PROD II	26
KN0817.04	0720	8	RNGCT	40 10.6	61 19.1	NELSON	SI DEEP	27
KN0817.05	0851	8	RNGCT	40 10.8	61 20.6	COWLES	30L NISKIN	
KN0817.06	0902	8	RNGCT	40 10.7	61 21.2	COWLES	VERT TOW	
KN0817.07	0958	8	RNGCT	40 10.7	61 21.2	ROMAN	IN SITU GRZ	
KN0817.08	1000	8	RNGCT	40 10.7	61 21.2	PHINNEY	4 CHAN LT	
KN0817.09	1123	8	RNGCT	40 12.0	61 23.2	HITCHCOCK	MD PROD I	28
KN0817.10	1223	8	RNGCT	40 12.5	61 23.7	HITCHCOCK	MD PROD II	29
KN0817.11	1315	8	RNGCT	40 12.5	61 23.7	PHINNEY	4 CHAN LT	
KN0818.01	0007	9	SLOPE	40 94.9	61 49.9	ROMAN	1/4 MOC	
KN0818.02	0108	9	SLOPE	40 50.0	61 49.5	GOULD	1/4 MOC	
KN0818.03	0145	9	SLOPE	40 49.3	61 49.2	KESTER	5L CTD	30
KN0818.04	0600	9	SECTN	40 50.2	61 49.6	PHINNEY	PUMP PROFL	31
KN0818.05	0725	9	SECTN	40 50.2	61 49.6	GOULD	VERT TOW	
KN0818.06	0743	9	SECTN	40 50.2	61 49.8	DUCKLOW	30L CTD	32
KN0818.07	1104	10	SECTN	40 34.2	61 34.3	PHINNEY	PUMP PROFL	33
KN0818.08	1236	10	SECTN	40 37.0	61 28.6	GOULD	VERT TOW	
KN0818.09	1309	10	SECTN	40 37.0	61 27.0	NELSON	30L CTD	34
KN0818.10	1604	11	SECTN	40 25.0	61 27.1	PHINNEY	PUMP PROFL	35
KN0818.11	1746	11	SECTN	40 25.8	61 24.5	GOULD	VERT TOW	
KN0818.12	1847	11	SECTN	40 26.5	61 22.5	NELSON	30L CTD	36
KN0819.01	0713	12	SECTN	39 42.5	60 53.9	PHINNEY	PUMP PROFL	37
KN0819.02	0858	12	SECTN	39 41.2	60 56.6	GOULD	VERT TOW	
KN0819.03	0926	12	SECTN	39 41.1	60 57.2	NELSON	30L CTD	38
KN0819.04	1202	13	SECTN	39 48.9	61 04.7	HITCHCOCK	30L CTD	39
KN0819.05	1316	13	SECTN	39 47.4	61 07.5	GOULD	VERT TOW	
KN0819.06	1349	13	SECTN	39 46.9	61 08.9	PHINNEY	PUMP PROFL	40
KN0819.07	1617	14	SECTN	39 53.3	61 12.7	DUCKLOW	30L CTD	41
KN0819.08	1712	14	SECTN	39 52.5	61 13.9	GOULD	VERT TOW	
KN0819.09	1756	14	SECTN	39 51.7	61 15.2	PHINNEY	PUMP PROFL	42
KN0820.01	0625	15	SECTN	40 17.8	61 20.9	DUCKLOW	30L CTD	43
KN0820.02	0722	15	SECTN	40 17.8	61 20.2	GOULD	VERT TOW	
KN0820.03	0838	15	SECTN	40 17.7	61 20.2	PHINNEY	PUMP PROFL	44
KN0820.04	1008	15	RNGCT	40 17.2	61 18.4	ROMAN	30L NISKIN	
KN0820.05	1016	15	RNGCT	40 17.1	61 18.6	COWLES	VERT TOW	
KN0820.06	1050	15	RNGCT	40 17.0	61 19.0	HANSON	30L CTD	45
KN0820.07	1130	15	RNGCT	40 17.1	61 19.4	PHINNEY	ALPHA MTR	
KN0820.08	1353	15	RNGCT	40 18.6	61 18.0	PHINNEY	4 CHAN LT	
KN0820.09	1447	15	RNGCT	40 18.8	61 17.0	GOULD	MOC 1/4	
KN0820.10	1515	15	RNGCT	40 18.0	61 16.3	COWLES	MOC 1/4	
KN0820.11	1640	15	RNGCT	40 11.3	61 20.5	KESTER	CTD YOYO	46
KN0820.12	2116	15	RNGCT	40 09.0	61 19.8	COWLES	30L NISKIN	
KN0820.13	2140	15	RNGCT	40 09.0	61 18.9	COWLES	VERT TOW	

TABLE 1 (contimmed) KN-097 OPERATION LOG

OP. NO.	TIME	STA	LOCAT.	LAT.	LONG.	INVESTGR	DESCRIPT	CTD #
KN0820.14	2208	15	RNGCT	40 09.3	61 20.6	ROMAN	MOC 1/4	
KN0820.15	2328	15	RNGCT	40 06.5	61 21.0	GOULD	MOC 1/4	
KN0821.01	0000	15	RNGCT	40 05.5	61 20.9	COWLES	VERT TOW	
KN0821.02	0148	15	RNGCT	40 06.0	61 22.3	BROWN	5L CTD	47
KN0821.03	0519	15	RNGCT	40 05.8	61 23.8	DUCKLOW	FL PROD I	48
KN0821.04	0610	15	RNGCT	40 05.9	61 23.7	DUCKLOW	FL PROD II	49
KN0821.05	0700	15	RNGCT	40 06.2	61 23.6	ROMAN	30L NISKIN	
KN0821.06	0714	15	RNGCT	40 06.2	61 23.6	NELSON	SI DEEP	50
KN0821.07	0949	15	RNGCT	40 06.7	61 22.1	GOULD	HORIZ TOW	
KN0821.08	1128	15	RNGCT	40 06.7	61 22.1	NELSON	MD PROD I	*
KN0821.09	1224	15	RNGCT	40 08.5	61 20.4	HITCHCOCK	MD PROD II	51
KN0821.10	1310	15	RNGCT	40 08.5	61 20.4	ROMAN	IN SITU GRZ	
KN0821.11	1415	15	RNGCT	40 08.5	61 20.3	ROMAN	OBLIQUE TOW	
KN0821.12	1524	15	RNGCT	40 08.3	61 16.9	HANSON	30L CTD	52
KN0821.13	2231	16	RNGCT	39 35.5	61 11.3	HITCHCOCK	NT PROD I	53
KN0821.14	2318	16	RNGCT	39 31.3	61 13.9	HITCHCOCK	NT PROD II	54
KN0821.15	2338	16	RNGCT	39 33.4	61 14.7	COWLES	30L NISKIN	
KN0821.16	2344	16	RNGCT	39 33.1	61 15.2	COWLES	VERT TOW	

* FOR OPERATION KN0821.08 THE AQUI SYSTEM WAS NOT RUNNING. JAN HAS A CASSETTE RECORDING FOR THE CTD INFORMATION FROM THIS CAST, BUT HE DID NOT LOG IT AS A REGULAR CTD #. IN THE BRIDGE RECORDS THIS CAST WAS LABELLED AS CTD #52, AND SUBSEQUENT CTD CASTS ARE +1. WHEN THIS TAPE IS PROCESSED, IT WILL BE LABELLED AS CTD #55.

KN-097 XBT SUMMARY

TABLE 2

PAGE # 1

XBT#	TIME-GMT	DA/MO	LATTITUDE	LONGITUDE	BUCKET T	Z-15	Z-10	Z-06
001	1247	08/08	39 26.23	72 05.16	23.8	60	235	—
002	1600	08/08	38 57.90	72 24.00	23.4	80	250	480
003	2000	08/08	39 21.00	72 47.00	24.2	56	235	455
004	0000	09/08	37 43.98	73 06.66	25.0	60	259	497
005	0400	09/08	37 06.90	73 29.90	25.7	39/165	282	460
006	1600	09/08	36 37.38	73 48.94	28.0	288	395	580
007	2018	09/08	36 34.70	73 47.38	28.7	285	387	602
008	2400	09/08	36 38.19	73 47.42	28.2	190	302	505
009	0402	10/08	36 38.08	73 47.92	27.3	255	355	490
010	0750	10/08	36 37.80	73 48.03	27.4	278	381	560
011	1638	10/08	36 39.58	73 47.87	27.5	—	—	—
(skipped 12-19 due to improper XBT digitizer setting) (next setting after 11 was 20)								
020	1823	10/08	36 40.65	73 47.63	27.5	280	380	560
021	0400	11/08	36 38.50	73 47.64	—	109/112-118/127/234	370	553-565
022	0500	11/08	86 49.00	73 47.92	27.0	62	354	494
023	0605	11/08	36 59.83	73 48.26	26.4	200	340	540
024	0710	11/08	36 54.10	73 58.11	26.7	238	358	535
025	0805	11/08	36 49.50	74 06.46	26.5	72	249	460
026	0905	11/08	36 43.66	73 57.71	27.0	95	305	525
027	1000	11/08	36 38.37	73 47.68	27.8	168	350	550
028	1110	11/08	36 39.04	73 46.62	28.9	157	330	540
029	1212	11/08	36 42.38	75 45.75	27.6	228	338	517
030	1234	11/08	36 42.56	73 45.55	27.6	228	340	515
031	1250	11/08	36 44.66	73 44.25	27.4	284	375	545
032	1310	11/08	36 47.91	73 41.67	27.2	310	392	562
033	1330	11/08	36 51.10	73 38.91	27.2	287	387	545
034	1350	11/08	36 54.10	73 36.27	27.3	238	378	542
035	1400	11/08	36 55.60	73 35.03	26.7	193	338	524
036	1410	11/08	36 57.07	73 33.73	26.7	57	340	575
037	1420	11/08	36 58.61	73 32.42	26.7	40/85/208	353	515
038	1430	11/08	37 00.11	73 31.23	25.7	42/55/228	340	510
039	1440	11/08	ABORTED					
040	1444	11/08	37 02.46	73 29.37	25.8	232	345	505
041		DUD						
042	1514	11/08	37 06.89	73 26.15	25.5	210	324	517
043	1615	11/08	36 58.91	73 32.37	26.2	50/84/192	338	510
044	1625	11/08	36 57.53	73 33.39	26.8	72/88/94	347	517
045	1638	11/08	36 55.82	73 34.71	26.7	210	353	535
046	1714	11/08	36 51.13	73 38.93	27.2	290	345	570
047	1735	11/08	36 52.20	73 40.01	27.1	290	394	560
048	1753	11/08	36 55.12	73 42.80	27.2	270	370	537
049	2021	11/08	36 53.71	73 46.15	27.1	292	390	560
050	0153	12/08	36 54.50	73 42.64	27.3	230	315	490

KN-097 XBT SUMMARY

TABLE 2 (continued)

PAGE # 2

XBT#	TIME-GMT	DA/MO	LATTITUDE	LONGITUDE	BUCKET T	Z-15	Z-10	Z-06
051	0230	12/08	36 49.46	73 41.93	27.6	292	383	560
052	0300	12/08	36 45.00	73 41.87	27.4	180/235	365	540
053	0330	12/08	36 40.56	73 41.89	27.5	210	340	540
054	0400	12/08	36 35.77	73 42.00	28.1	212	355	510
055	0430	12/08	36 31.41	73 42.04	28.2	205	340	480
056	0500	12/08	36 27.13	73 41.70	28.2	210	305	440
057	0530	12/08	36 26.48	73 38.88	28.3	248	350	465
058	0600	12/08	36 29.44	73 32.64	28.7	311	433/438	566
059	ABORTED							
060	0630	12/08	36 32.73	73 24.57	28.2	351	493	547
061	MALFUNCTION							
062	MALFUNCTION							
063	0730	12/08	36 38.65	73 24.30	27.9	310	455	619
064	0800	12/08	36 42.46	73 28.92	28.3	280	441	613
065	0830	12/08	36 46.31	73 33.80	28.3	198/310	198/310	594
066	0900	12/08	36 50.06	73 38.56	27.4	276	383	554-8
067	0930	12/08	36 53.80	73 41.10	27.3	284	385	559
068	1003	12/08	36 55.45	73 42.94	27.4	285	375	545
069	1233	12/08	36 57.99	73 41.01	27.3	290	395	550
070	1634	12/08	36 55.05	73 42.19	28.0	280	375	545
071	2000	12/08	36 54.72	73 43.42	27.9	249	370	570
072	0000	13/08	36 57.15	73 30.72	27.5	308	390	521/523/549
073	0400	13/08	36 37.62	73 02.88	28.2	358	515	670
074	0604	13/08	36 21.37	72 38.31	28.0	410	687	—
075	0702	13/08	36 13.65	72 27.33	27.5	500	735	—
076	0800	13/08	36 05.11	72 16.13	27.2	580	—	—
077	0900	13/08	35 56.45	72 05.60	27.0	610	—	—
078	1000	13/08	35 48.26	71 55.65	27.0	650	—	—
079	1035	13/08	35 44.32	71 51.52	27.4	650	—	—
080	1235	13/08	35 44.19	71 51.91	27.4	685	—	—
081	1608	13/08	35 39.91	71 53.06	27.8	655	—	—
082	0800	15/08	37 54.84	65 02.32	23.7	110	330	530
083	ABORTED							
084	0905	15/08	32 59.31	64 48.90	24.0	120	345	600
085	1000	15/08	38 01.30	64 36.80	23.4	112	350	600
086	1100	15/08	38 06.01	64 22.00	26.8	254	453	684
087	1124	15/08	38 10.05	64 16.00	27.0	318	520	760
088	1158	15/08	38 14.50	64 04.20	27.3	435	595	—
089	1220	15/08	38 17.06	64 03.38	27.0	440	606	800(?)
090	1240	15/08	38 21.80	64 03.20	27.0	405	570	—
091	1300	15/08	38 26.30	64 03.00	27.0	422	580	—
092	1321	15/08	38 30.20	64 04.39	27.0	364	565	775
093	1606	15/08	38 44.93	63 58.85	27.0	382	550	753
094	ABORTED							

KN-097 XBT SUMMARY

TABLE 2 (continued)

PAGE # 3

XBT#	TIME-GMT	DA/MO	LATTITUDE	LONGITUDE	BUCKET T	Z-15	Z-10	Z-06
095	0358	16/08	39 29.33	62 55.39	26.7	625	—	—
096	0759	16/08	39 48.74	62 05.61	26.6	170	420	725
097	0900	16/08	39 55.50	61 55.14	24.4	170/190	395	676
098	1000	16/08	40 02.00	61 44.90	23.5	325	501	727
099	1100	16/08	40 09.50	61 34.50	25.0	370	557	—
100	1200	16/08	40 16.10	61 24.00	24.5	405	593	—
101	1300	16/08	40 17.40	61 12.20	24.0	419	600	—
102	1400	16/08	40 17.02	61 06.75	24.9	412	580	—
103	0410	17/08	40 13.84	61 17.04	25.0	430	615	—
104	0800	17/08	40 13.90	61 14.30	24.7	405	615	800
105	1600	17/08	40 12.16	61 23.70	25.0	395	590	—
106	2000	17/08	40 17.80	61 27.04	25.1	410	594	—
107	2100	17/08	40 28.98	61 24.57	25.4	278	348	—
108	2200	17/08	40 39.17	61 23.04	26.0	297	450	698
109	2300	17/08	40 43.15	61 19.85	25.0	298	253	303
110	0000	18/08	40 35.48	61 08.71	23.7	330	505	703
111	0100	18/08	40 37.35	61 17.46	25.3	306	480	710
112	0200	18/08	40 41.68	61 28.34	25.1	218	400	657
113	0303	18/08	40 46.09	61 39.55	23.7	131	330	610
114	0402	18/08	40 49.95	61 50.00	23.9	36	289	595
115	1330	18/08	40 45.00	61 43.53	22.7	109	325	590
116	1400	18/08	40 41.12	61 40.14	22.7	60	214/215/335	611
117	1430	18/08	40 37.01	61 36.09	23.6	235	400	650
118	1445	18/08	40 34.86	61 34.97	24.9	280	465	690
119	0103	19/08	40 24.19	61 05.15	25.0	382	557	755
120	0200	19/08	40 22.97	60 51.58	24.5	360	520	680
121	0300	19/08	40 21.62	60 38.56	25.2	255	418	640
122	SKIPPED							
123	0400	19/08	40 20.38	60 23.37	25.4	120	330(-10)*	590(-10)*
124	0419	19/08	40 20.21	60 20.00	—	108	340	585
125	0500	19/08	40 17.40	60 27.33	25	145	375	625
126	ABORTED							
127	0606	19/08	40 20.86	60 40.12	—	280	440(-7)*	700(-7)*
128	0702	19/08	40 08.97	60 50.38	—	355	512	725
129	0800	19/08	39 57.29	60 50.56	—	270	453(+20)**	700(+20)**
130	0900	19/08	39 48.10	60 51.40	—	120	363(+20)**	645(+20)**
131	1000	19/08	39 44.06	60 52.36	—	104	370(+20)**	610(+20)**
132	1455	19/08	39 42.60	61 00.58	25.6	138	382	644
133	1515	19/08	39 45.62	61 02.36	25.6	182	400	660

*See XBT Log: (-10M and -7M, respectively)
**NOTE: Add 20M respectively

KN-097 XBT SUMMARY

TABLE 2 (continued)

XBT#	TIME-GMT	DA/MO	LATTITUDE	LONGITUDE	BUCKET T	Z-15	Z-10	Z-06
134	1535	19/08	39 48.60	61 03.82	25.1	255	465	690
135	1940	19/08	39 49.86	61.13.00	25.2	313	509	730
136	2000	19/08	39 53.08	61 12.52	25.3	348	540	748
137	2400	19/08	39 56.44	61 12.95	25.0	375	570	760
138	0103	20/08	40 05.43	61 04.65	24.9	372	575	765
139	0209	20/08	40 14.78	60 56.17	24.8	366	557	720
140	0300	20/08	40 21.77	60 50.21	24.8	310	495	700
141	0400	20/08	40 29.87	60 43.38	24.8	250	435	660
142	0513	20/08	40 40.82	60 35.06	23.6	70/95/120	330	580
143	0600	20/08	40 37.10	60 41.80	23.4	89	357	623
144	0700	20/08	40 31.20	60 51.30	24.9	295	479	670
145	0800	20/08	40 25.80	61 01.10	24.8	360	532	713
146		20/08	DUD					
147	0908	20/08	40 20.50	61 11.90	24.8	373	548	755
148	0957	20/08	40 16.58	61 20.76	24.2	384	575	—
149	1016	20/08	40 17.84	61 20.85	24.4	380	576	—
150	2000	20/08	40 16.58	61 15.41	24.8	320	540	723
151	2040	20/08	40 12.02	61 20.05	25.7	400	556	—
152	0906	21/08	40 05.76	61 23.76	25.8	367	514	742
153	1723	21/08	40 08.21	61 19.11	26.4	372	531	722
154	2001	21/08	40 08.11	61 16.78	26.3	349	537	700
155	2300	21/08	40 01.81	61 20.37	26.5	360	538	740
156	2328	21/08	39 58.45	61 23.46	26.9	363	530	730
157	0011	22/08	39 53.79	61 29.19	25.7	355	550	—
158	0109	22/08	39 46.20	61 21.11	—	415	565	—
159	0212	22/08	39 36.84	61 12.35	—	337	500	735
160	0459	22/08	39 37.30	61 16.20	—	380	553	780
161	0557	22/08	39 45.00	61 14.50	25.5	400	563	792
162	0657	22/08	39 53.22	61 11.76	25.5	410	558	820
163	0759	22/08	40 02.45	61 08.28	25.5	395	540	735
164	0858	22/08	40 12.43	61 04.12	—	340	500	680
165	1000	22/08	40 22.57	61 01.00	25.2	283	461	678
166	1100	22/08	40 32.88	61 00.00	25.2	131	367	585
167	1200	22/08	40 26.74	61 06.97	25.1	238	426	650
168	1300	22/08	40 19.95	61 14.64	25.6	228	429	671
169	DUD							
170	1400	22/08	40 13.77	61 22.24	23.8	181	418	650
171	1515	22/08	40 16.12	61 37.89	23.5	74/85/100	355-347	515
172	1600	22/08	40 17.00	61 46.70	23.5	79/112/118	345	600
173	1700	22/08	40 17.38	61 56.96	21.5	25/36/72/105/113	365	600
174	1820	22/08	40 17.44	62 05.86	23.5	180	410	660

KN-097 XBT SURFACE SALINITY DATA

TABLE 3

XBT#	SALINITY PPT
029	34.382
030	34.736
032	34.368
033	34.423
035	33.409
036	33.664
037	32.897
040	33.306
045	33.118
049	34.095
050	34.774
051	35.588
053	35.964
054	36.057
055	35.992
056	35.644
057	35.969
058	35.246
060	35.179
063	35.934
064	36.028
065	36.023
066	35.554
067	35.263
068	35.282
069	35.420
070	35.758
071	35.606
072	35.422
073	36.047
074	35.818
075	36.055
076	35.920
077	36.141
078	36.107
079	35.955
080	36.178
081	36.102
084	34.900
085	34.913
086	35.923
087	35.954
088	36.009
089	35.976

KN-097 XBT SURFACE SALINITY DATA

TABLE 3 (contimed)

090	36.022
091	36.031
092	36.100
093	36.110
095	36.075
096	35.871
097	35.223
098	35.834
099	35.712
100	35.890
101	35.994
102	34.940
104	36.055
105	35.962
106	35.998
107	35.699
108	35.796
109	35.352
110	35.690
111	35.550
112	35.358
113	34.306
114	34.976
115	33.412
116	33.520
117	34.328
118	35.962
132	35.546
133	35.546
134	35.837
135	35.688
136	35.539
137	35.581
138	35.870
139	35.890
140	35.610
141	35.321
142	34.092
148	34.794
149	34.975
150	35.354
151	35.282
152	35.357
153	35.634

CRUISE REPORT

OCEANUS CRUISE NO. 125, 8/6/82 - 8/23/82

Peter H. Wiebe

Woods Hole Oceanographic Institution

Woods Hole, Massachusetts 02543

Contents

I. CRUISE NARRATIVE

OCEANUS Cruise No. 125, 8/6/82 - 8/23/82

Peter H. Wiebe
Woods Hole Oceanographic Institution

R/V OCEANUS left port on 6 August as one of three ships participating in the third cruise of a time-series study of Gulf Stream warm core ring 82-B. The other ships in this coordinated study were R/V ENDEAVOR, and R/V KNORR. KNORR's studies of 82-B were completed during the first week, and it went to the newly formed warm core ring 82-E for work during the latter portion the cruise. The R/V ALBATROSS IV was also out during this period, but warm core ring 81-G was the focus of their studies. A NASA P-3 aircraft made one overflight of ring 82-B while the OCEANUS and ENDEAVOR were in the ring environs, and a second flight over a larger ocean area including the Sargasso Sea and Gulf Stream after these two ships had left the ring area and were in the Gulf Stream and Sargasso Sea respectively.

The overall objective of the scientific research aboard the OCEANUS was to map the ring's horizontal and vertical distributions of zooplankton and micronekton, and to study the vertical distribution of size fractionated particulate matter, chlorophyll a, radon, radium ^{228}, and radium ^{226}. We also studied volume reverberation of sound scatters throughout the region using 12khz and 50khz echo-sounders.

We left Woods Hole at 1600 and commenced our now customary XBT transect across the continental shelf just south of the entrance to Vineyard Sound. Our first station was in the Slope Water free of warm core rings around 38.55°N; 71.40°W. This station permitted us to check equipment out and to gather data to serve as one reference against which changes in ring properties could be compared. Two test lowerings were made with the Multiple Large Volume Filtration System (MULVFS) to determine the soundness of the electrical conductors which were rebuilt during the last period in port. A day/night pair of MOCNESS-20 (with 20-m^2 nets) tows, a nighttime neuston tow, a shallow radon cast, a chlorophyll cast, and a test lowering of the double MOCNESS-1 (with 1-m^2 nets) were made during a 24 hour period.

This station was cut short by the need to return to shore to seek medical assistance for scientist Stephen Brandt who had contracted a serious infection of the throat and seaman Peter Hoar who had injured his hand. We returned to Woods Hole on the evening of the 8th, and after a 2-hour stay in port awaiting the return of seaman Hoar (S. Brandt's condition was serious enough to require hospitalization), we again set sail, this time on a direct course for ring 82-B (36.40°N; 73.40°W).

We arrived at ring center on 10 August and commenced a long station during which we obtained 4 shallow radon casts, 3 double MOCNESS tows, 3 MOCNESS-20 tows, 1 neuston tow, 2 chlorophyll casts, and 2 MULVFS casts. Warm core ring 82-B, which was approximately 6 months old, had become very much smaller since June. At the time of our entry into this ring, it was undergoing a very strong interaction with the Gulf Stream. The southern half of the surface (upper 50 to 100 m) of the ring was in the process of being overwashed by the Gulf Stream, and currents, which in this portion of the ring generally run from east to west, were running from southwest to northeast at 2.5 knots or better at the surface. During the latter portion of station 2, it became apparent that the ring was moving to the north and east apparently in reaction to the force of the Gulf Stream. Scientists on the RV/KNORR, who had run a trianglular XBT pattern on the evening of 10 August to define the thermostad (15 to 16 C) region of the ring, found that they were unable to locate ring center where they had left it 6 to 12 hours earlier. As a result, a short (3 hr) 3 ship (KNORR, OCEANUS, ENDEAVOR) XBT survey was undertaken on the morning of the 11th to again define the position and limits of the ring thermostad region. OCEANUS was, at the time, in a portion of the thermostad doing a MULVFS pump cast, and our contribution to the survey was to drop XBT's at 20-minute intervals while steaming on station. The other ships moved to the north-northwest (ENDEAVOR) and to the north-northeast(KNORR).

The next several stations taken on the 12th to 14th of August were abbreviated because of the difficulty of remaining in a given hydrographic portion of the ring as it continued to move away from the Gulf Stream. Thus, stations 3, 4, 5, and 6 were scattered across the ring area, and this reflects the fact that instruments were put over the side of the vessel when the wire became available rather than wasting time trying to navigate back to some specific hydrographic point. There was, however, some continuity to the placement of the observations: net towing was done principally on the western edge of the ring (a day/night pair of double MOCNESS and MOCNESS-20 tows and 1 neuston tow); most of the pumping and water catching was done in ring center (a MULVFS, six-shooter, and chlorophyll cast). Furthermore, during the course of our station work on the 13th at the ring center, ENDEAVOR passed within a mile while conducting a toyo CTD section across the ring. Later, for the evening double MOCNESS tow (no. 198), we steamed over to the ENDEAVOR and paralleled her course during the tow.

By the 14th of August, ring surface velocity vectors had returned to a more normal circular configuration, and the northward trending meander of the Gulf Stream which had been overriding the ring, moved to the east leaving the ring separated from the stream albeit strongly modified. Station 7 (14 and 15 August) was located in ring center in order to document changes that resulted from the Gulf Stream ring interaction. Three double MOCNESS tows, 3 MOCNESS-20 tows, 1 neuston tow, a chlorophyll cast, and a shallow and deep radon cast were made at this station. The MULVFS system was also deployed at this station in order to test repairs made to the cable; several breaks in the electrical conductors occurred during the previous cast. No samples were obtained. Two of the MOCNESS-20 tows were long horizontal sections. The first was taken during daylight from the ring center to outside the eastern side of the ring with the net centered at 625 m. The second was intended to be a shallow (upper 100 m) nighttime tow back into the ring center on a reciprocal course, but the ring had moved far enough to the west in the intervening period that the tow never penetrated the ring substantially.

Following a MULVFS and a six-shooter cast on the southeastern edge of the ring (station 8), we steamed to the northwest to a Slope Water location a bare 10 miles from the ring edge. At this station, a complete complement of observations was obtained including day/night pairs of MOCNESS tows, a neuston tow, and chlorophyll, MULVFS, and six-shooter casts.

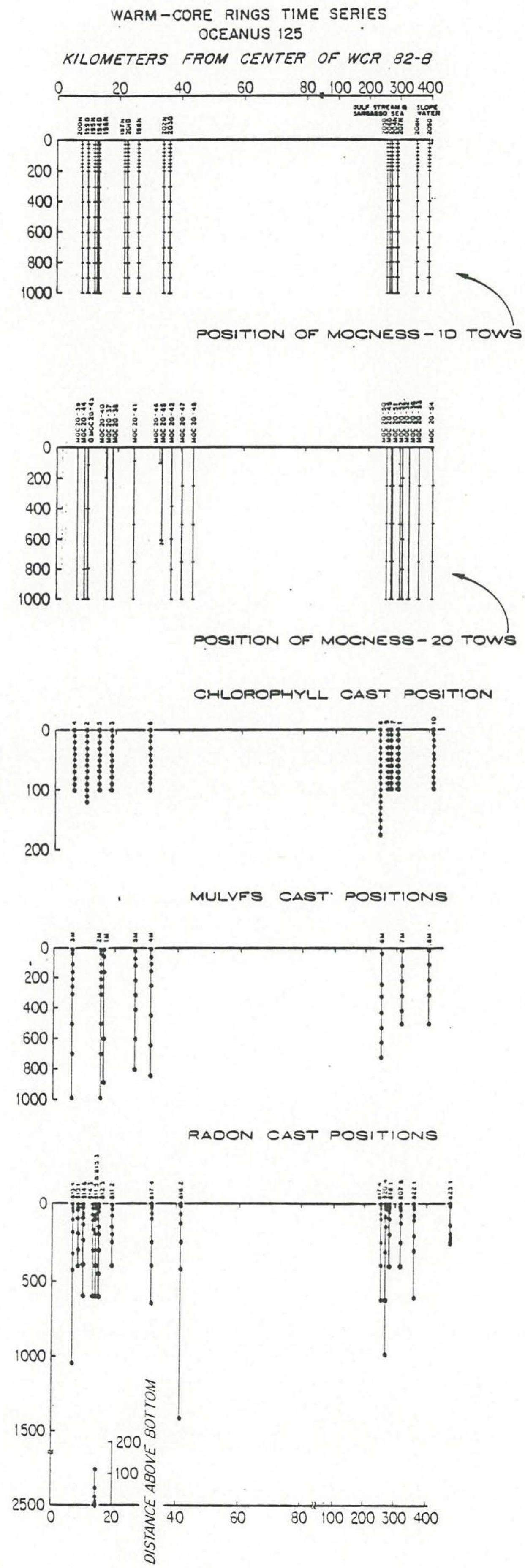
The last 5 days of the cruise were spent making a series of two reference stations and 1 series of observations along a section line: one in the Sargasso Sea at 36°N; 71°W; the second in the Gulf Stream at approximately 37°N; 71°W; and the section in the Slope Water along longitude 71°W. At each station a complete complement of observations was obtained. While working in the Gulf Stream, the NASA P-3 made 3 overflights of the OCEANUS at which time we collected surface temperature, salinity, and chlorophyll samples for comparison with their remote sensor recordings. Lack of time prevented our working a single geographic location in the Slope Water; instead, observations were alternated with periods of steaming north along 71°W. At the shelf/slope break (approximately 200 m), a single shallow radon cast was made using 30 liter bottles deployed on the six-shooter during our transit into Woods Hole on the 23rd of August. XBT's were taken at most of the usual places along this course.

A summary of the placement of the net tows and radon, chlorophyll, MULVFS, and six-shooter casts are graphically presented in Figure 1. Table 1 gives the ring center positions used to calculate distances of individual observations from the ring center. A summary of events is given in Section 3; XBT data are given in Section 4. Individual principal investigator reports follow.

This cruise, as the last two, can be characterized as quite successful; a nearly complete set of data was obtained at the various locations around the ring. Only the repeated breakdown of the six-shooter electronics caused the near total failure to acquire samples for radium^{228}analysis. The MULVFS system provided more particulate organic matter samples than had ever previously been obtained on a cruise in spite of several serious failures in the MULVFS electrical conductors. The system has proven to be repairable at sea. The MOCNESS systems' electronics packages experienced few problems, and those that did occur were related to poor cable connections. The MOCNESS-20 had difficulties releasing nets on several tows which were ultimately corrected by fine tuning the frame. It is clear that improvement to the motor/toggle release system is needed before the last of the time-series cruises. This trawl system was successfully deployed more times than on any previous cruise.

Dramatic changes in the biological as well as physical structure of ring 82-B had taken place since June. Many of these changes will almost certainly be ascribed to the very intense interactions between the ring and the Gulf Stream that occur when warm core rings reach the Cape Hatteras cul-de-sac, as we witnessed on this cruise. For the zooplankton, the ring was still a hybrid mix of warm and cold water species with the cold species dominating the deeper

Wiebe et al., Figure 1.



portions of the ring and the warm dominating the surface waters. Most of the warm water species were probably introduced with the Gulf Stream overwash observed during the first part of the cruise.

Our success in gathering data on this third warm core ring cruise is due once again in large part to the full and friendly cooperation of the officers and crew of the OCEANUS. Without the OCEANUS deck crew's willingness to put in long hours in getting our equipment over the side and back on deck, our list of accomplishments would be much shorter. We also must again express our appreciation to Woods Hole's Marine Facility and Shops Services personnel for the tremendous amount of work they accomplished in helping to ready the OCEANUS for this cruise.

Wiebe, et al

Table 1. Ring Center Positions Estimated From ENDEAVOR XBT Star Surveys

	Julian Day	Calendar Day	Latitude	Longitude
(a)	219	7 August	36 38	73 50
(a)	220	8 August	36 38	73 41
(b)	221	9 August	36 40	73 38
(b)	222	10 August	36 43	73 36
(b)	223	11 August	36 47	73 34
(a)	224	12 August	36 52	73 33
(a)	225	13 August	36 58	73 32
(a)	226	14 August	37 05	73 34
(b)	227	15 August	37 08	73 44
(b)	228	16 August	37 07	73 52
(c)	229	17 August	37 02	74 01
(b)	230	18 August	36 45	74 14
(c)	231	19 August	36 39	74 18
(c)	232	20 August	36 39	74 18
(c)	233	21 August	36 39	74 18
(c)	234	21 August	36 39	74 18

(a) Ring center estimates derived from XBT data collected by RV/ ENDEAVOR using a center algorithm based on the intersection of perpendicular bisectors constructed between adjacent data point pairs of a particular isotherm at a particular depth. Information sent by Stan Hooker on the RV/ENDEAVOR.

(b) Interpolated by J.Bishop RV/OCEANUS

(c) Position based on satellite-tracked drogue.

II. INDIVIDUAL REPORTS

PARTICULATE MATTER AND 12 KHZ ECHO SOUNDING STUDIES

Principal Investigator: James K. B. Bishop
Cruise Participants: Maureen Conte, Dan Schupack, James Bishop
Lamont-Doherty Geological Observatory

The purpose of this program is to understand the factors governing the distributions and sedimentation of oceanic particulate matter in ring 82-B. During this third visit to 82-B, we deployed the Multiple Unit Large Volume *In Situ* Filtration System (MULVFS) and collected 59 samples of size fractionated particulate matter for subsequent laboratory analysis (Table 1). Sediment traps were deployed for approximately 6 hours, attached to these two systems (Table 2).

Additional activities aboard R/V Endeavor were the deployment of sediment traps attached to the Loran drifters and the collection of transmissometer data during CTD casts.

There were visable differences between samples collected from ring 82-B during this cruise and the April and June cruises. We had previously concluded that intensive biological filtering of the upper 600 m had taken place between April and June. Since June, the ring had decreased in size substantially and had been overridden by a 50 to 100 m thick layer of Gulf Stream water. Visual examination of the >53 μm filters from the MULVFS indicated that more large aggregate material was present in the water column compared to June. The change observed was much less dramatic compared to that found between April and June.

Comparisons of aggregate material abundances in ring environs, Slope Water, Sargasso Sea, and Gulf Stream suggest that sedimentation was least in the Sargasso and Gulf Stream, intermediate in ring 82-B and highest in Slope Water.

1. MULVFS OPERATIONS

(a) System Performance

This cruise was the second sea trial of the complete MULVFS and the first time that it was the core of our sampling program. The Large Volume *In Situ* Filtration System was aboard but was never used.

The MULVFS, which is powered by 480 VAC 3-phase ship's power, consists of a drum winch, level wind, electromechanical cable, twelve pump units, and an Apple II control computer. The electromechanical cable is radically different from that used with the Large Volume *In Situ* Filtration System (LVFS) in that it is composed of a KEVLAR strength member mated in parallel to the electrical cable. This arrangement permits us to mechanically and electrically attach twelve pump/filter units at any of the fifteen electrical "pigtails" distributed along its 1000 m length. The numbering of pigtails ran from 1 (near surface) to 15 at the end of the cable. Pigtail spacing varied from 25 m near the surface to 100 m at the end of the cable. The performance of the major components of the system was excellent with the exception of the electro-mechanical cable.

Table 1. MULVFS Cast Summary: Oceanus 125

Date	Day	Cast	Sta.	Time (Local)			Depths Sampled	Mean Position °N	°W	Dist.
82/08/07.01	219	1T	1	+4	0900	1219	rewind cable	38.53.1	71.47.8	*
08/02/08.01	220	2T	1	+4	0322	0906	test cable	38.53.7	71.32.2	*
08/08/10.05	222	3T	2	+4	1913	2035	rewind cable	36.40.5	73.43.3	*
82/08/11.03	223	1M	2	+4	0740	1517	10,60,158,597 890 blank	36.43.7	73.44.0	16.1
82/08/12.03	224	2M	2	+4	0530	1226	15,39,112,162 211,260,308,505 699,992	35.55.6	73.41.9	14.8
82/08/13.02	225	3M	4	+4	0751	1510	15,39,112,162 211,260,308,505 699,992	37.00.4	73.29.3	6.0
82/08/15.07	227	4T	7	+4	2015	2200	rewind cable	36.50.4	73.40.1	*
82/08/16.01	228	4M	8	+4	0404	1044	10,59,108,156 255,450,645,840	36.51.6	74.00.3	31.1
82/08/17.01	229	5M	9	+4	0415	0937	20,69,117,215 314,411,606,801	37.12.1	74.13.3	26.1
82/08/18.07	230	5T	10	+4	1528	2120	repair cable	36.00.2	71.13.9	*
82/08/19.07	231	6T	10	+4	1607	2150	aborted cast	36.00.9	71.31.9	*
82/08/19.08	231	6M	10	+4	2150	0440	40,237,334,431 529,626,724	36.03.6	71.32.0	253.5
82/08/21.03	233	7M	11	+4	0511	1238	25,122,219,317 414,512	37.05.2	70.41.7	316.7
82/08/22.04	234	8M	12	+4	1640	2208	20,117,214,312 507	39.17.7	70.59.1	401.0

Elapsed wire time = 17.3 hours testing; 59.9 hours sampling = 77.2 hours

1 - Slope Water
2 - Ring Center, 82-B
3 - Western Edge, 82-B
4 - Ring Center, 82-B
5 - Western Edge, 82-B
6 - Southeast Edge, 82-B
7 - Ring Center, 82-B
8 - Southeast Edge, 82-B
9 - Slope Water North of 82-B
10 - Sargasso Sea reference station
11 - Gulf Stream reference station
12 - Slope Water reference station
13 - Upper Slope, 250 m

Table 2. MULVFS Sediment Trap Summary

Sta.	Depth	Trap. No.	Filt.	Hrs.	Sta.	Depth	Trap No.	Filt.	Hrs.
1M	60	31		4.77	6T	69	16 (No. 2)	r0093	0.67
	304	30		1.58		117	17 (No. 2)	r0089	1.97
	890	29		7.60		314	18 (No. 2)	r0090	3.10
						314	14 blk	r0086	3.10
2M	39	19		4.50		606	20 (No. 2)	r0091	4.18
	112	33		4.88		801	21 (No. 2)	r0092	4.75
	211	32		5.30					
	505	26		6.03	6M	40	17 (No. 2)	same	4.93
	992	25		6.80		237	28 (No. 2)	same	5.27
						237	14 blk	same	5.27
3M	39	22		4.60		529	20 (No. 2)	same	6.18
	162	24		5.43		724	21 (No. 2)	same	6.57
	308	23		6.02					
	699	27		6.65	7M	25	15 (No. 2)	r0096	5.97
	699	28 blk		6.65		122	16 (No. 3)	r0097	6.20
						219	17 (No. 3)	r0098	6.45
4M	59	19		4.73		219	14 blk	r0095	6.45
	156	17		5.20		317	18 (No. 3)	r0099	6.83
	156	18 blk		5.20		414	20 (No. 3)	r0100	7.15
	450	20		5.87		512	21 (No. 3)	r0101	7.45
	840	21		6.58					
					8M	20	15 (No. 3)	r0103	4.20
						117	16 (No. 4)	r0104	4.58
						214	18 (No. 4)	r0105	4.83
						214	14 blk	r0102	4.83
						312	20 (No. 4)	r0106	5.03
						507	21 (No. 4)	r0107	5.38

Traps 14-18 were 18" high; traps 19-33 were 15" high.
They were deployed strapped to vertical members on the MULVFS.
Blank traps were covered with millipore filter holder covers and drained about as fast as regular traps.

The cable had been repaired at L-DGO following a serious failure during the June cruise. This was due to the failure of the KEVLAR strength member to support the conducting cable. We repaired cable by using new clamps to hold the cables together. It became apparent during this cruise that we had solved our problems only partially.

Our first test on August 7 involved placing one pump at pigtail number 15 at the end of the cable, spooling all the cable off the winch, test running the pump at a 1500 m depth, and respooling the cable under tension. The single pump ran 16 seconds prior to a short circuit. A second test of the cable continuity showed that one or more dummy connectors had been damaged due to crushing on the winch and that the repaired pigtail no. 3 was faulty. We unspooled the cable onto the LVFS winch and figure eighted the remaining cable on the deck for repairs as the OCEANUS returned to WHOI to drop off Stephen Brandt who had a throat infection. The cable was respooled onto the winch after pigtail no. 3 was replaced with a straight splice and dummy connectors repaired.

The third test on August 10 was necessary to respool the cable under tension. A continuity test afterwards showed that the twisted shielded conductors used for data communications had been open circuited at the splice replacing pigtail no. 3. MULVFS cast 1 on August 11 was the first attempt at filtering water with 6 pumps on line. This station was completed but only after pigtail no. 9 was capped after its connector shorted out. This failure was caused by a faulty male plug on the pump attached to that termination.

MULVFS casts 2 and 3 on August 12 and 13 near the center of 82-B were the first full-scale stations with ten pumps on line simultaneously. The system performed beautifully and returned excellent samples.

A cable continuity test after the third MULVFS cast showed that the main power conductors were broken in the spliced portion of the cable at no. 3. Furthermore, it was apparent that the electrical cable was not being supported adequately by the KEVLAR cable. We once again unspooled the cable from the winch for repairs on August 14. We respliced the cable at no. 3, capped no. 4, which was faulty, and repaired pigtail no. 9. The cable was respooled on August 15 by hand during which time additional clamps and brown friction tape were added to the portions of the cable showing wear. The cable was respooled under tension during test 4.

MULVFS station 4 on August 16 at the edge of 82-B went well with eight excellent samples being collected. Station 5 on August 17, just outside of the ring, ran well until a short circuit terminated the cast after 30 minutes. Test 5 showed that pigtail no. 9 was faulty, pigtail no. 4 had been crushed, necessitating us to cut the cable between no. 4 and 5, and that a bad dummy connector at no. 11 was the cause of the short. These repairs were carried out with the MULVFS cable deployed over the side.

MULVFS station 6 on the 19th of August in the Sargasso Sea was marred by the necessity to cut the conducting cable again, this time between pigtail 6 and 7. The system was powered through pigtail no. 7, and 7 samples were collected. Station 7 in the Gulf Stream ran well until a short circuit terminated the cast 5 minutes before its scheduled end. This short was traced to pigtail no. 14, where a burned out pigtail connector was found. Station 8 on August 22 in the Slope Water was delayed due to a shorted cable harness in one of the pump units but was successfully completed as planned.

We have learned a great deal about the performance of the MULVFS and collected an excellent series of samples. This has been at the expense of the electromechanical cable which has worn during this cruise. Many of our problems are related to the fact that we are handling the cable with a drum winch and storing it under full tension and compression by overlying layers of cable on the drum. This problem would be minimized with a traction/spooling winch. A second major class of difficulties was due to our inability to make reliable flexible splices which would withstand passing over the sheave and being stored under tension on the winch. We intend to return the cable to L-DGO for repairs and should be in a strong position for the KNORR cruise in late September. We will have to have the LVFS system at sea for that cruise as a backup.

(b) Sampling Program Modifications

Approximately 60 samples of size fractionated particulate matter were collected during this cruise with the MULVFS system. Subsamples were taken from both 1-53 and <1 μm microquartz filter size fractions for combined organic analyses. These samples were placed in chloroform:methanol (2:1) and frozen and will be analyzed for total lipid and fatty acid composition. In addition, filter sets using 53 μm stainless steel prefilters in lieu of the regularly used 53 μm Nitex were loaded in several casts. These samples will be analyzed for total lipids and lipid classes for each of the >53, 1-53, and <1 μm size fractions. These analyses will provide information on particulate matter sources, aging, recycling and decomposition in the water column.

Integrated zooplankton samples from 0-1000 m were obtained from Peter Wiebe's MOC-1D tows. A portion of these samples was placed in chloroform: methanol for analysis of the lipid fraction in living zooplankton; a second portion was preserved in 5 percent formalin for identification of the contributing plankton. Several plankters were separated from the remaining portion of the sample (e.g., cyclothone, euphausids, chaetognaths) to be analyzed separately. These samples will allow comparison between the lipid fraction in living and particulate organic material.

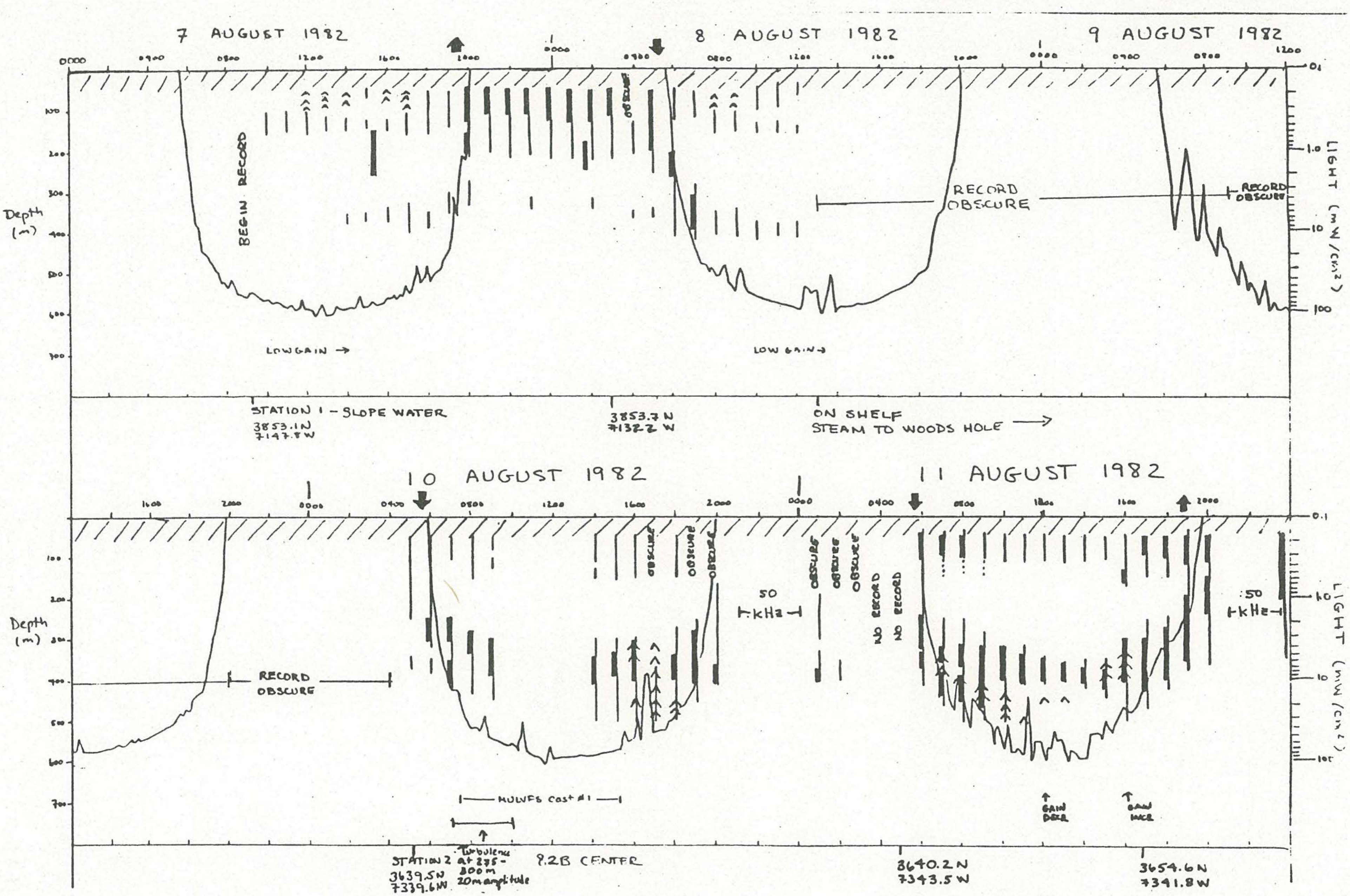
The workup of these samples is not supported under this grant.

2. R/V ENDEAVOR PROGRAM

The R/V ENDEAVOR work apparently went very well. The transmissometer, which had performed well in June, was working on all CTD casts including the "tow-yo" series. The sediment trap frames and deployment strategy were modified to compensate for mooring motion which had damaged samples in June. Two deployments for 24 hours and 3 days were made on the Loran drifters in ring 82-B.

3. 12 KHZ ECHO SOUDING:

Twelve KHz echo sounding records to 750 m (Figure 1) were taken continuously during the cruise except during MOC-1D tows (when a 50 KHz echo



Bishop

Figure 1.

Page 1 of 4

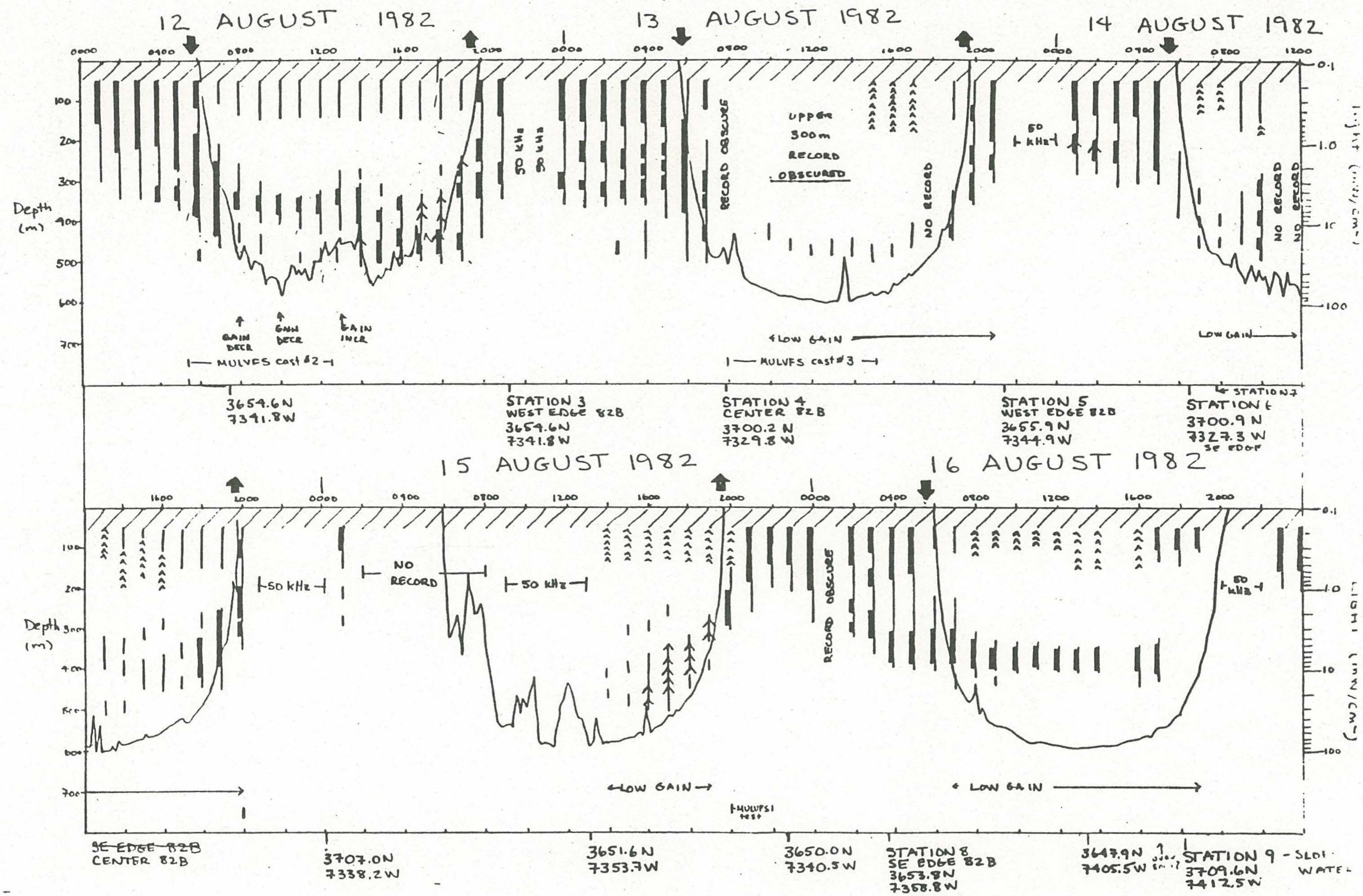


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Figure 1 cont.

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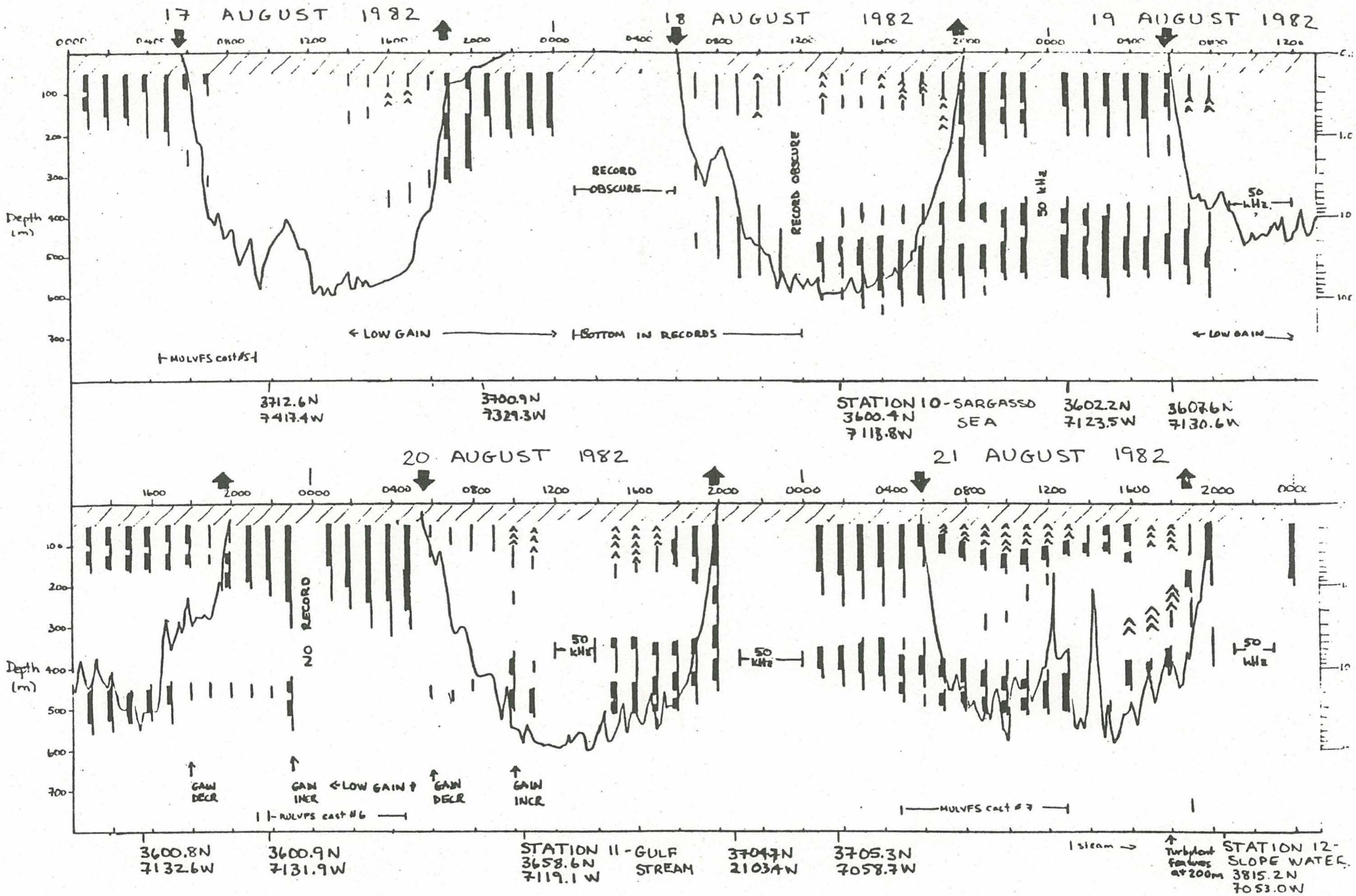

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Figure 1 cont.

Page 3 of 4

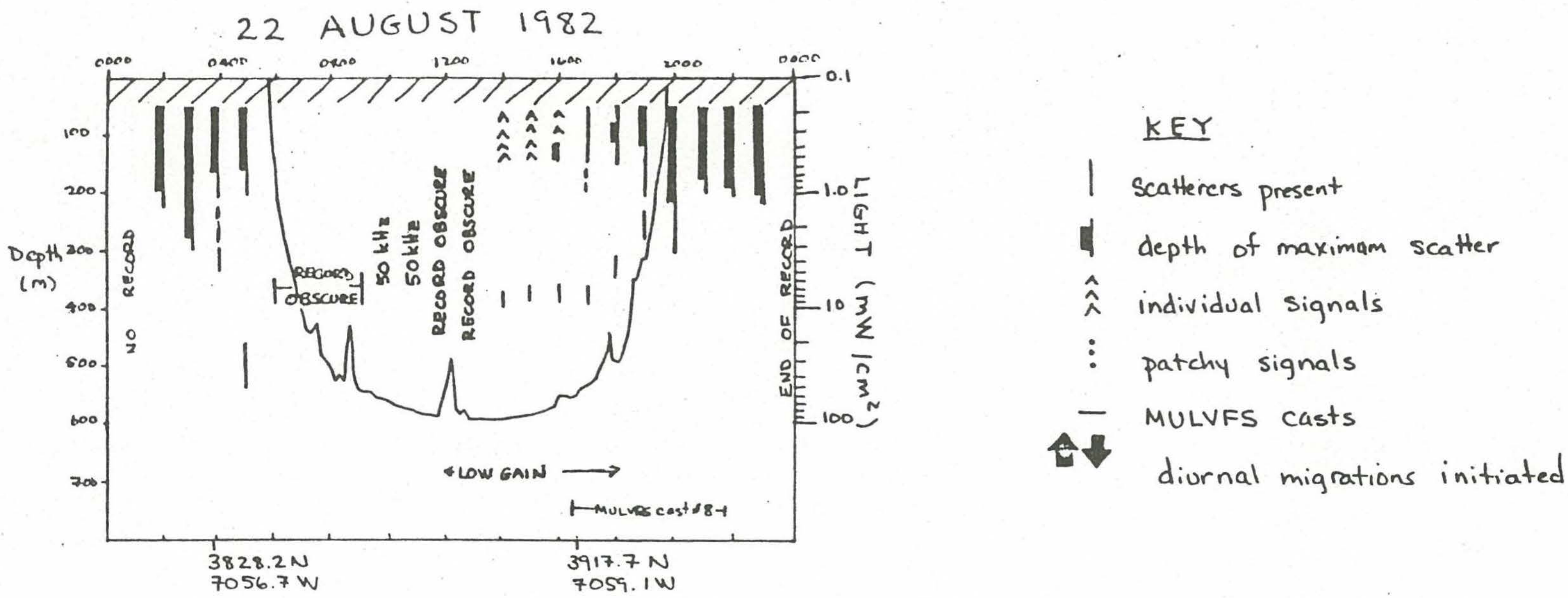

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Figure 1 cont.

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sounder was deployed) and during deep radon casts. These records provide a qualitative idea of the behavior of the animals comprising the scattering layers. The echo sounder gain controls were unreliable and frequently the upper 50 m was obscure.

Several differences in 12 KHz scattering were noted among Slope Water, ring environs, Sargasso Sea and Gulf Stream stations. The two Slope Water stations (1 and 9) both showed a weak deep sattering maximum during the day between 300-400 m and significant scattering primarily in the upper 200 m during the night. In contrast, ring center stations showed several strong scattering layers at 325-375 m, 400-450 m, and 500 m during the day, and a strong non-migrating layer between 350-400 m at night. In addition, large individual signals, probably tightly packed schools were seen to migrate with the deep scattering maximum from 500-300 m. Maximum scattering was observed in the upper 200 m at night. Significant scattering compared with the Slope Water was observed in the upper 200 m during the day in ring 82-B. Western and Southeast edges of 82-B tended to resemble ring center stations.

Both the Sargasso Sea and Gulf Stream station exhibited very strong non-migrating deep scattering layers between 400 and 550 m which were not present in either Slope Water or ring stations. Non-migratory scatterers in the Sargasso Sea were present at 350-450 m and 450-550 m. Strong scattering was also present in the upper 250 m at night and in the upper 150 m during the day with a distinct layer centered on 125 m. The Gulf Stream sttion also showed a strong non-migratory layer at 400-450 m and strong scattering in the upper 200 m at night. Three distinct scattering layers were present during the day at 150-200, 300-350, 400-450, and centered on 500 m. In addition, large individual signals were seen to migrate from 350 to shallower than 250 m at night.

Vertical migrations closely followed light intensity. Records suggest that the depth of migrating scatterers during the day is inversely proportional to light intensity.

RADON AND RADIUM IN WARM CORE RINGS

Principal Investigators: David R. Schink and Norman L. Guinasso
Cruise Participants: Kathleen Cole, Ken Bottom and James Orr
Texas A&M University

Our participation in this cruise has been focused on characterizing mixing processes in and around the ring. we are using three radioactive isotopes, radium ^{228}, radium^{226}, and radon^{222}, to understand both vertical and horizontal ring water transfer.

If there are no sources or sinks, radon^{222} should be in radioactive secular equilibrium with its parent, radium^{226}. however, normal oceanic profiles for radon^{222} and radium^{226} show deficiencies of radon in the surface layer and surpluses of radon in the near bottom water. The magnitude of the surface deficiency is related to the amount of recent air-sea gas exchange because of the relatively short half life of radon^{222} (4 days). Likewise, bottom water radon ^{222} surplus is affected by sediment type and near bottom mixing regimes.

All radium^{226} and radon^{222} samples were collected using 30-liter Niskins which were tripped on the hydrowire or by Rosette sampling. Radon^{222} was stripped and counted aboard ship while radium^{226} was extracted on manganese-coated acrylic fiber for future laboratory analysis. All bottles were sampled for shipboard determination of salinity and oxygen. Nutrient samples were taken and immediately frozen for on-shore analyis. Hydrowire casts were preceeded by an XBT just prior to the cast to aid in depth selection. Reversing thermometers were also used on each bottle. To the Rosette was attached a Nel Brown CTD which gave a simultaneous record with each cast.

Radium^{228} has been shown to be a good indicator of horizontal mixing. Continental shelf sediments provide the major source of radium^{228}. Because of this reason and because of the relatively short half life of radium^{228} (6 years), noticeable gradients are found when moving toward the open ocean from the shelf region. The analytical problem with radium^{228} lies in the fact that it requires large volumes of water on the order of 1000 liters to achieve meaningful numbers. This has encouraged us to build a large volume radium extraction system which we have labelled the "six shooter". The six shooter attaches to the base of the 30-liter Rosette/Neil Brown CTD system and consists of a battery-operated pump which diverts water individually to one of six channels upon commands sent from a deck unit to the pump and six solenoid values. Each channel contains two wound acrylic cartridges which have been impregnated with manganese dioxide. These cartridges effectively remove about 93 percent of the radium.

The six shooter was effective only on one cast during the entire cruise, mainly due to electronic problems encountered after severe modifications had been made on the underwater electrical package. The successful cast was achieved in approximate ring center of 82-B. On casts where the six shooter could not be used, the Rosette-CTD system was used for measurements of radium^{226} and radon^{222}. Problems with the six shooter seem relatively minor and should be alleviated by the September cruise aboard the KNORR.

Throughout the observed history of warm core ring 82-B, we have seen some rather dramatic changes in the characteristics of the center core itself. In April, rather typical surface radon profiles were observed in ring center. As we have progressed through the June and August cruises, we have seen substantial changes in the amount of surface radon present. Radon surpluses (i.e., values in excess of the equilibrium values) have been observed with the slightly higher surpluses seen in August. With our profiles taken in the Sargasso Sea, Gulf Stream, Slope, and Shelf Water, we can verify that the excess radon is derived from infiltration of Slope and Shelf waters. The radon surpluses observed in the later 82-B cruises correspond to those seen in 81-D in September and October of 1981. A cruise aboard the Texas A M, R/V Gyre in July, 1982, showed no excess radon in the ring core of ring 81-G. This seems to suggest that $radon^{222}$ and $radium^{226}$ measurements provide a mechanism whereby one can map the influence of Slope and Shelf waters upon a ring. Further mreasurements in the lab with the collected $radium^{228}$ samples will provide an opportunity to more elaborately evaluate the system.

As on all of the warm core rings cruises aboard the OCEANUS, our group has provided the surface salinity measurements for all of the XBT's and the weather observations. The following table is a summary of the data collected on this cruise.

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Table 1.

Day	Cast	Type	Station Position °N	°W	Sta. Type	Depth of Ring	Dist. from RC
219	1-807.3	SR	38.56.7	71.43.7	Slope Water	0-400 m	317 km
222	2-810.1	SR	36.39.5	73.39.6	Ring Center	10-400	8
223	2-811.2	SR	36.40.2	73.43.5	Ring Center	10-400	19
223	2-811.5	SR	36.53.3	73.38.8	Ring Center	0-600	14
224	2-812.3	SR	36.54.5	73.42.6	Ring Center	1-600	15
225	4-813.4	SS	37.00.3	73.28.6	Ring Center	7-1016	7
226	6-814.3	SR	37 00.9	73.27.3	SE Ring Edge	1-600	13
226	7-814.6	SR	37.01.3	73.40.6	Ring Center	0-600	10
227	7-815.3	DR	37.01.3	73.48.2	Ring Center	2255-2500	14
228	8-816.2	RR	36.47.9	74.05.5	SE Ring Edge	1-1414	41
229	9-817.4	RR	37.13.4	74.17.0	Slope Water	0.5-639	47
230	10-818.1	RR	36.00.4	71.13.8	Sargasso Sea	0-400	281
231	10-819.2	RR	36.07.6	71.30.6	Sargasso Sea	1-620	256
232	11-820.4	RR	37.04.2	71.12.4	Gulf Stream	5-984	279
234	12-822.1	RR	38.28.2	70.56.7	Slope Water	0-608	358
235	13-823.1	RR	40.02.7	70.59.7	Shelf Water	0.5-238	475

MESOPELAGIC FISHES

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Cruise Participants: Richard Backus and Mary Ann Daher
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Hauls of the MOCNESS-20 were made at nineteen locations (Table 1). Neuston tows were made at some stations. After some initial trouble with net tripping, the MOC-20 worked very well. Five nets were fished on most lowerings, and a total of 83 collections were made. Little can be told from a superficial examination of these collections, but it appears that ring 82-B has been thoroughly invaded by certain cold-water animals such as the myctophid fish Benthosema glaciale. Cetaceans and pelagic birds were much more abundant in and immediately around 82-B than they were at the reference Slope Water stations.

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Table 1. WARM CORE GULF STREAM RING TIME SERIES CRUISE
Oceanus Cruise No. 125, 8/6/82 - 8/23/82

MOCNESS TOW NO.	LAT °N	LONG °W	DATE	TIME START	TIME UP	STATION AREA DEPTH INTERVAL, REMARKS
MOC-20-35	38.53.3 38.56.4	71.47.6 71.42.1	7 August	1419	1720	Slope Water; 0-992 992-800, 800-601 601-402, 402-201 201-0
MOC-20-36	38.56.3 38.54.5	71.39.8 71.32.0	7-8 Aug	2334	0248	Slope Water; 0-964-0
MOC-20-37	36.37.8 36.34.6	73.44.7 73.45.4	10 August	1355	1714	Center 82-B; 0-998 998-0
MOC-20-38	36.40.9 36.38.2	73.43.3 73.46.9	11 August	0125	0414	Center 82-B; 0-1000 1000-0
MOC-20-39	36.52.9 36.51.0	73.37.4 73.43.8	12 August	0042	0408	Center 82-B; 0-1000 1000-0
MOC-20-40	TEST					
MOC-20-41	37.01.0 37.07.3	73.48.2 73.47.7	13 August	0113	0446	West edge 82-B; 0-1004,1004-750 750-500,500-137 137-0
MOC-20-42	36.54.3 36.58.0	73.54.7 73.50.9	14 August	0105	0441	West edge 82-B; 0-1069-1000 1000-800,800-601 601-383,383-0

MOCNESS TOW NO.	LAT °N	LONG °W	DATE	TIME START	TIME UP	STATION AREA DEPTH INTERVAL, REMARKS
MOC-20-43	37.07.7 37.00.3	73.39.9 73.39.9	14 August	1332	1654	Center 82-B; 0-1037-994,994-797 797-597,597-399 399-115,115-0
MOC-20-44	37.07.0 37.04.3	73.38.2 73.48.2	15 August	0008	0402	Center 82-B;0-1001 1001-797,797-598 598-0
MOC-20-45	36.51.6 36.50.5	73.53.7 73.40.4	15 August	1304	1949	Horizontal tow from 82-B center out at 625m with 5 nets
MOC-20-46	36.50.0 36.50.8	73.40.5 73.49.8	15-16 Aug	2239	0204	Aborted horizontal tow; 0-101,101-30 30-101,101-29,50-0
MOC-20-47	37.12.3 37.15.5	74.18.1 74.25.5	16-17 Aug	2253	0242	Slope Water; 0-1000 1000-751,751-500 500-249,249-0
MOC-20-48	37.15.6 37.11.9	74.24.9 74.17.3	17 August	1424	1747	Slope Water; 0-1000 1000-748,748-500 500-250,250-0
MOC-20-49	36.02.2 36.05.6	71.23.5 71.31.4	19 August	0102	0431	Sargasso Sea; 0-1000 1000-749,749-500 500-250,250-0
MOC-20-50	36.04.4 36.00.6	71.29.7 71.32.8	19 August	1229	1519	Sargasso Sea; 0-1001 1001-746,746-499 499-250,250-0
MOC-20-51	37.00.9 37.03.7	71.15.3 71.16.8	20 August	1403	1711	Gulf Stream; 0-1001 1001-750,750-500 500-251,251-0
MOC-20-52	37.05.3 37.04.6	70.58.8 70.57.3	21 August	0135	0425	Gulf Stream; 0-1000 1000-750,750-496 496-251,251-0
MOC-20-53	38.22.0 38.28.5	70.52.7 70.55.5	21-22 Aug	2346	0308	Slope Water; 0-1002 1002-751,751-500 500-250,250-0
MOC-20-54	39.11.4 39.17.5	70.59.1 70.58.8	22 August	1235	1556	Slope Water; 0-1001 1001-750,750-500 500-251,251-0

ZOOPLANKTON SPATIAL PATTERNS

Principal Investigator: Peter H. Wiebe
Cruise Participants: Steven Boyd, Alfred Morton, Valerie Barber, and Peter Wiebe
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Our objectives for this third of four time-series crusies to Gulf Stream warm core rings were to sample the macro-zooplankton at station locations placed from the center of ring 82-B out into the adjacent Slope Water in order to provide a picture of the vertical structure in the upper 1000 meters across the ring for a variety of species, especially the euphausiids, and to characterize the diel vertical movements of these species as well as the total zooplankton biomass. We also set out to sample the Northern Sargasso Sea and the Gulf Stream near the ring in order to compare evolution of the ring core plankton population structure with populations in waters giving rise to the ring core. In addition, we intended to collect individuals of a number of euphausiid species for biochemical analysis in order to study the effects of spatial and time-course changes in rings on their physiological and biochemical properties. As part of our program, Stephen Brandt was to have conducted a volume reverberation study of the ring survey area using a 50khz transducer mounted in a towed fish. His illness, however, (see narrative) forced us to put him ashore after only 2 days at sea. In spite of his absence, 50 khz recordings were made during each of the double MOCNESS tows.

We used a double MOCNESS-1 (1 m^2 nets) equipped with SEABIRD temperature and conductivity probes to sample the zooplankton in the upper 1000 meters. On each 3- to 3-1/2-hour haul, we generally obtained 8 samples integrating 100 meter intervals from 1000 to 200 meters, and 8 samples integrating 25 meter intervals from 200 to 0 meters. Sixteen hauls were made: 10 in the vicinity of 82-B; 2 in the Northern Sargasso Sea; 2 in the Gulf Stream; and 2 in the Slope Water far from the influence of 82-B or other rings (Table 1). Distances of each tow from the ring center were calculated using positions listed in narrative Table 1 and are given in Table 2.

To help correlate our zooplankton data with the findings of phytoplankton investigators on ENDEAVOR and KNORR, we made 10, 1.7-liter Nansen bottle casts in the upper 100 to 200 meters for analysis of chlorophyll a and phaeophytin (Table 3). Samples were taken at ten-meter intervals from the surface to at least 100 m on most occasions. In the Sargasso Sea and Gulf Stream, depths between 100 and 200 m were also sampled. In general, chlorophyll cast positions bracketed double MOCNESS tows (see Narrative, Figure 1). This chlorophyll data will also be used in conjunction with pyranometer data collected by us on the OCEANUS to calculate downwelling light levels in the upper 1000 meters. These light data were collected at 10-minute intervals for the duration of the cruise with an MR-5 pyranometer (Hollis Observatory product). The light data are also being used by Maureen Conte (LDGO) for comparison with the movements of the scattering layers observed with the 12khz echo sounder (see Bishop report).

Table 1. Summary of Double MOCNESS-1 Tow Statistics

WARM CORE

GULF STREAM RING TIME SERIES CRUISE

OCEANUS Cruise No. 125, 8/6/82-8/23/82

MOCNESS #	Lat. °N	Long. °W	Local Date (Start Down)	Local Time Start Up	Local Time Up	GMT Date (Start Down)	GMT Time Start Up	GMT Time Up	Isotherm Depths 15°C	Isotherm Depths 10°C	Station Area Depth Interval, Remark
MOC-1D-194	36.37.72 36.37.60	73.38.25 73.44.69	10 August (0815)	0920	1143	10 August (1215)	1320	1543	290	414	Ring 82-B; 1000-200 @ 100m inter;200-0 @ 25m inter;w/T & Sal.
MOC-1D-195	36.41.00 36.37.34	73.43.30 73.40.74	10 August (2028)	2208	0000	11 August (0028)	0208	0400	289	400	Ring 82-B; 100-200 @ 100m inter;200-0 @ 25m inter except 0-25; w/T & Sal.
MOC-1D-196	36.52.96 36.50.15	73.37.48 73.42.55	11 August (2041)	2144	2344	12 August (0041)	0144	0344	300	403	Ring 82-B RC; 1000-200 @ 100m inter;200-0 @ 25m inter; w/T & Sal.
MOC-1D-197	36.53.90 36.59.91	73.45.16 73.48.04	12 August (2113)	2220	0028	13 August (0113)	0220	0428	148	345	Ring 82-B WE; 1000-200 @100m inter;200-0 @ 25m inter; w/T & Sal.
MOC-1D-198	36.55.92 36.54.27	73.44.90 73.53.60	13 August (2130)	2226	0003	14 August (0130)	0226	0403	142	283	Ring 82-B WE; 1000-200 @ 100m inter;200-0 @ 25m inter; w/T & Sal.
MOC-1D-199	37.05.15 37.09.89	73.39.81 73.39.70	14 August (0941)	1045	1250	14 August (1341)	1445	1650	242	334	Ring 82-B RC; 1000-200 @ 100m inter; 200-0 @ 25m inter; w/T & Sal.
MOC-1D-200	37.04.06 37.07.20	73.41.00 73.37.17	14 August (2022)	2126	2319	15 August (0022)	0126	0319	182	325	Ring 82-B RC; 1000-200 @ 100m inter; 200-0 @ 25m inter; w/T & Sal.

WARM CORE

GULF STREAM RING TIME SERIES CRUISE

OCEANUS Cruise No. 125, 8/6/82-8/23/82

MOCNESS #	Lat. °N	Long. °W	Local			GMT			Isotherm Depths		Station Area Depth Interval, Remark
			Date (Start Down)	Time Start Up	Time Up	Date (Start Down)	Time Start Up	Time Up	15°C	10°C	
MOC-1D-201	37.00.47 36.52.78	73.48.06 73.50.90	15 August (0900)	1000	1204	15 August (1300)	1400	1604	242	322	Ring 82-B RC;1000-200 @ 100m inter; 200-0 @ 25m inter; w/T & Sal.
MOC-1D-202	37.09.94 37.11.71	74.11.10 74.17.60	16 August (1922)	2025	2213	16 August (2322)	0025	0213	78	248	Ring 82-B NE;1000-200 @ 100m inter; 200-0 @ 25m inter;w/T & Sal
MOC-1D-203	37.12.56 37.13.60	74.17.40 74.24.60	17 August (0958)	1103	1302	17 August (1358)	1503	1702	64	216	Ring 82-B NE;1000-200 @ 100m inter;200-0 @ 25m inter;w/T & Sal
MOC-1D-204	36.01.61 36.01.96	71.15.84 71.22.95	18 August (2135)	2232	0028	19 August (0135)	0232	0428	733	982	Sargasso Sea; 1000-100 @ 100m inter; 200-0 @ 25m inter; w/T & Sal
MOC-1D-205	36.09.14 36.04.92	71.29.63 72.29.55	19 August (0831)	0935	1142	19 August (1231)	1335	1542	696	929	Sargasso Sea;1000-200 @ 100m inter; 200-0 @ 25m inter;w/T & Sal
MOC-1D-206	36.58.56 37.00.39	71.19.06 71.18.61	20 August (1020)	1130	1335	20 August (1420)	1530	1735	457	635	Gulf Stream;1000-200 @ 100m inter; 200-0 @ 25m inter; w/T & Sal
MOC-1D-207	37.04.65 37.04.63	71.03.35 71.01.31	20 August (2045)	2208	0019	21 August (0045)	0208	0419	447	619	Gulf Stream;1000-200 @ 100m inter;200-0 @ 25m inter;w/T & Sal

WARM CORE

GULF STREAM RING TIME SERIES CRUISE

OCEANUS Cruise No. 125, 8/6/82-8/23/82

MOCNESS #	Lat. °N	Long. °W	Local			GMT			Isotherm Depths		Station Area Depth Interval, Remarl
			Date (Start Down)	Time Start Up	Time Up	Date (Start Down)	Time Start Up	Time Up	15°C	10°C	
MOC-1D-208	38.15.15	70.52.98	21 August (2013)	2115	2313	22 August (0013)	0115	0313	52	188	Slope Water;1000-200 @ 100m inter;200-0 @ 25m inter; poor T & Sal.
MOC-1D-209	39.03.63 39.09.81	71.00.16 71.59.52	22 August (0857)	0955	1140	22 August (1257)	1355	1540	48	228	Slope Water;1000-200 @ 100m inter;200-0 @ 25m inter; w/T & Sal

Euphausiids from 7 MOCNESS-20 trawls were preserved for carbon, nitrogen, and hydrogen analysis, lipid fractionation or chlorophyll pigment levels. A total of 9 species were processed with emphasis being place on Euphausia krohnii and nematoscelis megalops (Table 4).

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Table 2. Distance of double MOCNESS tows to ring 82-B center

MOC-1D		Dist. to Ring Center NM	Dist. to Ring Center KM
194	S	5.6	10.3
	F	8.8	16.3
195	S	6.2	11.5
	F	6.8	12.6
196	S	6.6	12.2
	F	7.5	14.0
197	S	9.9	18.4
	F	14.4	26.7
198	S	10.5	19.5
	F	17.7	32.7
199	S	4.6	8.6
	F	6.7	12.4
200	S	5.7	10.5
	F	3.4	6.2
201	S	8.2	15.2
	F	16.2	30.0
202	S	15.5	28.7
	F	20.9	38.8
203	S	16.8	31.1
	F	22.1	41.0
204	S	147.8	277.7
	F	144.3	267.3
205	S	138.8	257.1
	F	139.9	259.2

MOC-1D	Dist. to Ring Center NM	Dist. to Ring Center KM
206 S	144.6	267.9
F	145.2	269.0
207 S	157.8	292.5
F	159.4	295.4
208 S	189.0	350.3
F	192.4	356.5
209 S	212.9	394.4
F	217.4	402.8

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Table 3. Analysis of Chlorophyll and Phaeophytin

Cast No.	Date	Time	Region	Lat °N	Lon °W	Distance from ring center km/nm	Depth of cast
1	7 August	1300	SW	38.53.2	71.47.7	308/166.2	100A
2	10 August	0707	RC	36.37.9	73.39.2	10.6/5.7	120D
3	11 August	1650	RC	36.54.6	73.41.8	18.3/9.9	100A
4	13 August	1535	RC	37.00.0	73.28.5	6.4/3.5	100A
5	15 August	0815	RC	37.01.3	73.48.2	14.3/7.7	100A
6	16 August	1800	RE	37.09.6	74.12.5	30.7/16.5	100A
7	18 August	1454	SS	36.00.2	71.13.6	281.6/151.9	100A
8	19 August	1535	SS	36.00.8	71.32.6	256.8/138.6	200C
9	20 August	1720	GS	37.04.1	71.17.9	271.0/146.3	150B
10	22 August	1614	SW	39.17.59	70.58.7	413.6/223.2	100A

A = 10 m intervals to 100 m
B = 20 m intervals to 60 m; 10 m intervals to 150 m
C = 10 m intervals from 70 to 150 m; 25 m intervals from 150 to 200 m
D = 10 m intervals to 120 m

Table 4. Number of Individuals Collected For Biochemical Analysis According to Intended Treatment

Tow/Area	Species	CHN	Chlor-Meth	Acetone	Frozen
MOC-20-35day-SW	E. krohnii	10	10	6	12
	P. norvegica	4	5		
	N. microps		1		
	N. flexipes		1		
MOC-testday-RC	S. abbreviatum	3	2		
	N. megalops		2		
MOC-20-42nite-RE	E. krohnii	5	5		6
	N .megalops	5	3		2
	S. abbreviatum		1		
	E. brevis		1		
	N. microps				2
	E. tenera				2
MOC-20-43day-RC	E. krohnii	8	8		7
	N. megalops	1	2		
	S. abbreviatum				3
	N. microps				1
	E. gibboides				1
MOC-20-47nite-SW	E. krohnii	6	8		15
	N. megalops	8	5		15
MOC-20-48day-SW	E. krohnii	6	4		
	N. megalops	10	5		40
MOC-20-54day-SW	M. norvegica		4		
	E. krohnii	7	10		
	N. megalops	7	3		
	N. microps	3			

III. SCIENTIFIC OBSERVATION LOG

Sta.	Op. No.	Start Time	Latitude °N	Longitude °W	Descriptor	Invest.
			SLOPE WATER			
1	0807.1	0920	38.53.10	71.47.80	MULVFS test no. 1	Bishop
1	0807.2	1300	38.53.20	71.47.70	Chlorophyll cast no. 1	Boyd
1	0807.3	1315	38.53.3	71.47.30	MOC-20-35	Backus
1	0807.4	1849	38.56.70	71.43.70	Shallow radon cast no. 1	Orr
1	0807.5	1955	38.56.81	71.44.60	MOC-1D-test	Wiebe
1	0807.6	2334	38.56.33	71.39.80	MOC-20-36	Backus
1	0807.7	2355	38.57.00	71.39.00	Neuston tow no. 1	Backus
1	0808.1	0300	38.53.70	71.32.20	MULVFS test no. 2	Bishop
			WARM CORE RING 82-B			
2	0810.1	0604	36.39.50	73.39.60	Shallow radon cast no. 2	Orr
2	0810.2	0707	36.37.88	73.39.15	Chlorophyll cast no. 2	Boyd
2	0810.3	0815	36.37.72	73.38.25	MOC-1D-194	Wiebe
2	0810.4	1353	36.38.70	73.43.30	MOC-20-37	Backus
2	0810.5	1913	36.40.50	73.43.40	MULVFS test no. 3	Bishop
2	0810.6	2028	36.41.00	71.43.30	MOC-1D-195	Wiebe
2	0811.1	0125	36.40.90	73.43.30	MOC-20-38	Backus
2	0811.2	0600	36.40.20	73.43.50	Shallow radon cast no.3	Orr
2	0811.3	0740	36.41.40	73.44.00	MULVFS cast no. 1	Bishop
2	0811.4	1650	36.54.60	73.41.80	Chlorophyll cast no. 3	Boyd
2	0811.5	1936	36.53.30	73.38.80	Shallow radon cast no. 4	Orr
2	0811.6	2040	36.52.96	73.37.48	MOC-1D-196	Wiebe
2	0812.1	0042	36.52.88	73.37.40	MOC-20-39	Backus
2	0812.2	0200	36.41.00	73.44.00	Neuston tow no. 2	Backus
2	0812.3	0530	36.54.60	73.41.80	MULVFS cast no. 2	Bishop
2	0812.4	1758	36.54.50	73.42.60	Shallow radon cast no. 5	Orr
			RING 82-B WESTERN EDGE			
3	0812.5	2113	36.53.90	73.45.16	MOC-1D-197	Wiebe
3	0813.1	0113	37.01.20	73.48.20	MOC-20-41	Backus
			RING 82-B CENTER			
4	0813.2	0751	37.00.20	73.29.80	MULVFS cast no. 3	Bishop
4	0813.3	1535	37.00.01	73.28.46	Chlorophyll cast no. 4	Boyd
4	0813.4	1706	37.00.30	73.28.60	Six-shooter cast no. 1	Orr

Sta.	Op. No.	Start Time	Latitude °N	Longitude °W	Descriptor	Invest.
			RING 82-B WESTERN EDGE			
5	0813.5	2130	36.55.92	73.44.90	MOC-1D-198	Wiebe
5	0814.1	0105	36.54.30	73.54.70	MOC-20-42	Backus
5	0814.2	0105	36.54.30	73.54.70	Neuston tow no. 3	Backus
			RING 82-B SOUTHEAST EDGE			
6	0814.3	0721	37.00.90	73.27.30	Shallow radon cast no. 6	Orr
			RING 82-B CENTER			
7	0814.4	0941	37.05.15	73.39.81	MOC-1D-199	Wiebe
7	0814.5	1332	37.07.72	73.39.92	MOC-20-43	Backus
7	0814.6	1900	37.04.30	73.40.60	Shallow radon cast no. 7	Orr
7	0814.7	2023	37.04.06	73.41.04	MOC-1D-200	Wiebe
7	0815.1	0008	37.07.02	73.38.18	MOC-20-44	Backus
7	0815.2	0045	37.07.02	73.38.18	Neuston tow no. 4	Backus
7	0815.3	0600	37.03.52	73.48 34	Deep radon cast no. 1	Orr
7	0815.4	0815	37.01.25	73.48.16	Chlorophyll cast no. 5	Boyd
7	0815.5	0900	36.00.47	73.48.06	MOC-1D-201	Wiebe
7	0815.6	1304	36.51.59	73.53.72	MOC-20-45	Backus
7	0815.7	2000	36.50.4	73.40.1	MULVFS test no. 4	Bishop
7	0815.8	2239	36.50.02	73.40.46	MOC-20-46	Backus
			SOUTHEASTERN EDGE OF 82-B			
8	0816.1	0340	36.53.80	73.58.80	MULVFS cast no. 4	Bishop
8	0816.2	1330	36.47.90	74.05.50	Six-shooter cast no. 2	Orr
			SLOPE WATER NORTH OF 82-B			
9	0816.3	1800	37.09.56	74.12.50	Chlorophyll cast no. 6	Boyd
9	0816.4	1922	37.09.94	74.11.10	MOC-1D-202	Wiebe
9	0816.5	2253	37.12.33	74.18.13	MOC-20-47	Backus
9	0816.6	2309	37.12.30	74.18.00	Neuston tow no. 5	Backus
9	0817.1	0420	37.11.90	74.17.40	MULVFS cast no. 5	Bishop
9	0817.2	0958	37.12.56	74.17.40	MOC-1D-203	Wiebe
9	0817.3	1424	37.15.64	74.24.90	MOC-20-48	Backus
9	0817.4	2022	37.00.9	73.29.30	Six-shooter cast no. 3	Orr
			SARAGASSO SEA REFERENCE STATION			
10	0818.1	1358	36.00.40	71.13.80	Shallow radon cast no. 8	Orr
10	0818.2	1454	36.00.18	71.13.61	Chlorophyll cast no. 7	Boyd
10	0818.3	1528	36.00.20	71.13.89	MULVFS test no. 5	Bishop
10	0818.4	2135	36.01.61	71.15.84	MOC-1D-204	Wiebe
10	0819.1	0102	36.02.18	71.23.52	MOC-20-49	Backus
10	0819.2	0125	36.02.20	71.23.50	Neuston tow no. 6	Backus

Sta.	Op. No.	Start Time	Latitude °N	Longitude °W	Descriptor	Invest.
10	0819.3	0600	36.07.60	71.30.60	Six-shooter cast no. 4	Orr
10	0819.4	0831	36.09.14	71.29.63	MOC-1D-205	Wiebe
10	0819.5	1229	36.04.41	71.29.72	MOC-20-50	Backus
10	0819.6	1535	36.00.82	71.32.56	Chlorophyll cast no. 8	Boyd
10	0819.7	1607	36.00.89	71.31.91	MULVFS test no. 6	Bishop
10	0819.8	2150	36.01.37	71.30.92	MULVFS cast no. 6	Bishop
			GULF STREAM REFERENCE STATION			
11	0820.1	1020	36.58.56	71.19.05	MOC-1D-206	Wiebe
11	0820.2	1403	37.00.86	71.17.53	MOC-20-51	Backus
11	0820.3	1720	37.04.1	71.17.9	Chlorophyll cast no. 9	Boyd
11	0820.4	1805	37.04.02	71.12.44	Six-shooter cast no. 5	Orr
11	0820.5	2040	37.04.76	71.03.50	MOC-1D-207	Wiebe
11	0821.1	0135	37.05.30	70.58.84	MOC-20-52	Backus
11	0821.2	0145	37.05.30	70.58.70	Neuston tow no. 7	Backus
11	0821.3	0446	37.04.70	70.55.9	MULVFS cast no. 7	Bishop
			SLOPE WATER REFERENCE SECTION			
12	0821.4	2013	38.15.15	70.52.98	MOC-1D-208	Wiebe
12	0821.5	2346	38.22.00	70.52.70	MOC-20-53	Backus
12	0822.1	0357	38.28.20	70.56.70	Six-shooter cast no. 6	orr
12	0822.2	0857	39.03.63	71.00.16	MOC-1D-209	Wiebe
12	0822.3	1235	39.11.40	70.59.10	MOC-20-54	Backus
12	0822.4	1640	39.17.7	70.59.1	MULVFS cast no. 8	Bishop
12	0823.5	0147	40.02.54	70.59.85	Six-shooter cast no. 7	Orr

IV. XBT DIGITIZING LOG

XBT No.	Date	Time (Local)	Latitude °N	Longitude °W	XBT Surface Temp. (°C)	Depth (M) 15	10
13	08/09/82	0308	39.45.0	71.00.0	23.6	54	249
14	08/09/82	0340	39 40.0	71.00.0	22.8	70	260
15	08/09/82	0444	39.30.9	71.09.2	NR	78	262
16	08/09/82	0600	39.19.5	71.21.3	NR	70	265
17	08/09/82	0705	39.10.1	71.30.5	23.8	70	272
18	08/09/82	0800	39.01.4	71.38.4	24.4	69	240
19	08/09/82	0900	38.52.2	71.47.4	24.7	57	245
20	08/09/82	1500	38.48.8	72.24.0	24.4	65	245
21	08/09/82	1630	38.33.5	72.33.2	24.4	54	270
22	08/09/82	1810	38.15.9	72.43.7	24.5	52	253
23	08/09/82	1941	38.00.2	72.53.0	24.8	61	249
24	08/09/82	2103	37.46.1	73.01.5	25.3	61	251
25	08/09/82	2230	37.31.7	73.09.8	25.4	58	250
26	08/09/82	2300	37.22.6	73.15.0	25.5	58	263
27	08/10/82	0030	37.13.72	73.20.25	NR	51	258
28	08/10/82	0130	37.06.2	73.24.8	25.3	41,100,140	288
29	08/10/82	0230	36.58.76	73.28.76	25.6	53	274
30	08/10/82	0330	36.50.14	73.33.25	26.0	38	262
31	08/10/82	0451	36.39.9	73.39.8	28.0	43,50,274	390
32	08/10/82	1756	36.38.0	73.46.2	25.5	59	342
33	08/10/82	2005	36.41.0	73.44.2	27.4	308	395
34	08/11/82	0436	36.38.7	73.46.0	27.8	143,168,220	362
35	08/11/82	0637	36.40.5	73.43.6	27.5	123,129,265	380
36	08/11/82	0755	36.41.6	73.44.0	27.4	105,111,251	356
37	08/11/82	0840	36.41.9	73.44.1	27.6	106,112,251	366
38	08/11/82	0906	36.42.1	73.44.1	27.5	110,116,258	373
39	08/11/82	0932	36.42.5	73.44.1	27.3	108,115,255	359
40	08/11/82	1000	36.42.8	73.44.1	27.6	269	371
41	08/11/82	1030	36.43.8	73.44.1	27.8	115,121,275	382
42	08/11/82	1100	36.43.5	73.44.1	27.9	112,118,277	378
43	08/11/82	1156	36.44.0	73.44.1	27.8	110,115,284	395
44	08/11/82	1301	36.44.6	73.44.0	27.9	114,120,295	394
45	08/11/82	1410	36.45.1	73.44.0	27.5	115,119,280	392
46	08/11/82	1509	36.45.7	73.43.8	27.9	287	388
47	08/11/82	1550	36.50.2	73.41.9	27.8	312	393
48	08/11/82	1624	36.55.0	73.42.4	27.4	279	372
49	08/11/82	1830	36.53.6	73.39.2	27.2	286	388
50	08/12/82	0516	36.54.9	73.41.9	27.4	278	388
51	08/12/82	0723	36.55.6	73.41.6	27.2	292	376
52	08/12/82	1140	36.56.5	73.42.0	27.3	295	393
53	08/12/82	1702	36.54.3	73.41.8	28.0	246	362
54	08/13/82	0501	37.07.4	73.47.9	26.7	225	347
55	08/13/82	0551	37.04.0	73.47.0	27.3	245	355
56	08/13/82	0609	37.00.6	73.45.0	27.3	250	352
57	08/13/82	0632	36.59.96	73.40.9	27.3	270	350

XBT No.	Date	Time (Local)	Latitude °N	Longitude °W	XBT Surface Temp. (°C)	Depth (M) 15	10
58	NG						
59	08/13/82	0716	36.59.8	73.32.0	27.2	307	382
60	08/13/82	0728	36.59.8	73.29.8	27.4	310	392
61	08/13/82	1201	37.00.6	73.29.1	28.1	315	380
62	NG						
63	08/13/82	1515	37.00.1	73.28.7	28.5	271	334
64	08/14/82	0525	36.58.3	73.45.7	NR	225	313
65	08/14/82	0615	36.59.4	73.35.4	28.5	115,138,178	296
66	08/14/82	0653	37.00.7	73.28.1	28.2	181	294
67	08/14/82	0900	37.01.4	73.32.8	27.3	82,140,150	310
68	08/14/82	0922	37.04.4	73.38.9	27.2	251	332
69	08/14/82	2010	37.04.10	73.40.96	27.4	231	310
70	08/15/82	0643	37.02.8	73.48.4	27.2	202	311
71	08/15/82	1314	36.52.0	73.54.0	NR	234	312
72	08/15/82	1413	36.51.2	73.52.2	NR	220	307
73	08/15/82	1500	36.51.2	73.50.6	NR	200	287
74	08/15/82	1601	36.51.32	73.48.45	NR	170	284
75	08/15/82	1700	36.51.35	73.46.19	NR	112	268
76	08/15/82	1759	36.51.16	73.43.68	NR	110	246
77	08/15/82	1904	36.50.71	73.41.65	NR	56,57,94	224
78	08/15/82	2241	36.50.02	73.40.46	NR	116	256
79	08/15/82	2314	36.50.0	73.42.0	NR	152	254
80	08/15/82	2343	36.50.2	73.43.4	NR	68,82,105	265
81	08/16/82	0010	36.50.2	73.44.6	NR	118	262
82	08/16/82	0105	36.50.4	73.47.1	NR	127	275
83	08/16/82	0130	36.50.5	73.48.4	NR	141	271
84	08/16/82	0155	36.50.7	73.49.5	NR	147	275
85	08/16/82	0257	36.51.1	73.52.6	26.2	152	281
86	08/16/82	0312	36.52.5	73.55.4	26.5	207	313
87	08/16/82	0330	36.53.9	73.58.5	27.7	242	327
88	08/16/82	0504	36.52.6	73.59.7	27.8	237	323
89	08/16/82	0630	36.51.8	74.00.4	27.8	240	320
90	08/16/82	0820	36.50.9	74.01.6	27.8	242	325
91	08/16/82	1530	36.47.82	74.06.45	NR	246	332
92	08/16/82	1638	36.54.3	74.08.6	27.7	231	325
93	08/16/82	1704	36.58.9	74.09.6	27.7	104	304
94	08/16/82	1730	37.03.8	74.11.0	27.7	135,137,170	272
95	08/16/82	1800	37.09.6	74.12.5	27.7	120	249
96	08/17/82	0352	37.12.2	74.17.8	25.5	69	225
97	08/17/82	0606	37.12.2	74.17.4	26.3	68	230
98	NG						
99	08/17/82	1948	37.14.0	74.17.0	25.4	58	225
100	08/17/82	2230	37.11.5	74.17.1	25.0	50,66,71	232
101	08/17/82	2330	37.00.3	74.11.7	24.5	128	257
102	08/18/82	0030	36.49.77	74.05.06	26.2	79,112,135	291
103	08/18/82	0130	36.37.90	74.02.16	NR	130	276
104	08/18/82	0235	36.28.0	73.55.0	25.7	75	248
105	08/18/82	0330	36.24.6	73.42.0	25.5	51	158

XBT No.	Date	Time (Local)	Latitude °N	Longitude °W	XBT Surface Temp. (°C)	Depth (M) 15	10
106	08/18/82	0430	36.22.0	73.27.0	26.7	101	208
107	08/18/82	0530	36.20.2	73.13.8	24.4	68,105,175	82, 88,305
108	08/18/82	0628	36.16.1	72.58.8	28.4	352	500
109	08/18/82	0731	36.11.1	72.43.0	27.7	518	715
110	08/18/82	0832	36.06.75	72.26.64	27.2	592	NP

NG = no good
NR = not recorded
NP = not present