CRUISE REPORT, CHAIN 116
July 22 - August 10, 1974

By
Robert H. Heinmiller, Jr., Chief Scientist

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

October 1974

TECHNICAL REPORT

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L. Valentine Worthington, Chairman
Department of Physical Oceanography
CHAIN 116
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Pre-Cruise Statement of Purpose

CHAIN 116 will be a single-leg cruise, leaving Woods Hole July 22 and returning August 10, 1974, with the following work to be carried out:

- 38° 19' N., 69° 39' W. - recovery of Station 541, armored Dacron test mooring

- Polymode pilot array - set nine moorings at sites shown on chart

- MODE area - recover two moorings

- XBT's every hour

- Continuous GDR records

- Thermosalinograph records

- A total of up to five days of CTD's including a station at each mooring setting or recovery and a forty-eight hour time-series experiment

- Setting of two magnetometer stations somewhere east of 28° N., 55° W. (Murray and Poehls)

- Bathymetric surveys before most of the Polymode settings

- Attachment of thirty to thirty-five small samples on one or more of the Polymode moorings for John Milliman

Accurate depths for most of the Polymode moorings are yet unknown and in most cases adjustments will have to be made after surveys are done.
Cruise Report

CHAIN 116

R/V CHAIN left the Woods Hole Oceanographic Institution dock at 1245Q on 22 July 1974. After a fire and boat drill in Vineyard Sound, we proceeded directly to the position of Station 541. This mooring, which was an engineering test of a length of Dacron line which had been jacketed for fishbite protection, had been set in April.

Hourly XBTs were started at 41° N. and increased to every half hour between 40° N. and 39° N. in accordance with a request from W. Redwood Wright. The run to Station 541 was uneventful. We arrived at 0845Q on the 23rd, and immediately made acoustic contact with the anchor release. The release command was sent at 0917Q and confirmed by the underwater unit. Although we initially suspected that the mooring had not actually released because the transponder range did not appear to decrease, after some maneuvering it was determined that the mooring had surfaced and it was located and recovered. A CTD had been begun as soon as the mooring recovery was well underway. The CTD was complete by 1400Q and the ship got underway for the position of Station 536.

Station 536 had also been set in April as part of a twelve-mooring array. The transponder section of the acoustic release was recorded as having been disabled after launch to avoid using up the pinger battery over the eight-month duration of the array (the array was scheduled for recovery in December, 1974). However, J. Luyten, on his cruise in May, reported that the transponder might not be disabled since he heard replies that he could attribute only to this mooring.
Arriving at Station 536 at 2350Q on 23 July, we determined that the acoustic-release transponder was indeed activated. After routine checks, we left it in a disabled condition, and proceeded south to the MODE area and Station 538.

Other than difficulties with the XBT system and the echo sounder, the run south was uneventful. We arrived at Station 538 at 2230Q on 25 July. A series of release checks indicated that while the release pinger was functioning well, the transponder apparently was not replying. Indications were that the Model 301 Acoustic Range and Bearing Receiver was also not working properly.

During the last few hours of the approach to the mooring site, a strong easterly set was observed. To insure staying clear of the site it was decided to start the first twenty-five hour CTD sequence a few miles to the east of the mooring. This sequence was begun at 0000Q 26 July and terminated at 0105Q on the 27th. Mooring work was laid out to fill the eighteen-hour gap before starting the second sequence.

At 0120Q a series of acoustic-release test lowerings was begun. Problems continued with the Model 301 receiver, and one release of eight tested did not meet the test specifications. However, at 0703Q the four release test lowerings were complete and we proceeded to the position of Station 538.

The acoustic-release command was sent at 0830Q and the last of the gear was aboard at 0948Q. The mooring was hauled upside down starting at the release end because the glass-ball clusters were not
lying properly to the wind for a normal pickup. The mooring was inspected carefully during recovery for any kinking or tangling damage which might have occurred during or after the launch in April. This had been the first attempt at setting an all-wire intermediate mooring and there was some concern that with no Dacron in the lower part of the mooring to absorb any overshoot when the anchor bottomed, kinking could occur. (The all-wire configuration is an attempt to upgrade the performance of the intermediate moorings in terms of being able to place and keep an instrument at a specified depth.) However, no damage of this sort was found on this mooring; indeed, the mooring seemed to show less of the usual tangling in the vicinity of the glass-ball clusters, which occurs during the recovery process, than usual.

CTD number 10 was carried out during the latter part of the mooring recovery. Meanwhile, preparations were started for the launch of mooring I of the Polymode pilot array. All the glass balls from Station 538 were turned around for use on the new mooring. In spite of the lack of damage on Station 538 it was decided to use approximately 100 meters of five-eighths nylon line at the bottom of the new mooring as the adjustable shot. This nylon would provide several meters of stretch compliance in the mooring in the event of an overshoot when the anchor bottomed.

Launch of Station 542 was started at 1637Q. Just above the acoustic release, the mooring was stopped off and towed at various speeds on a dynamometer for a short period in order to test calculations made of tensions vs. towing speed for a typical intermediate mooring. The anchor went over at 1913Q and after routine releases checks we proceeded
to a position chosen for the start of the second twenty-five hour CTD series.

The CTD series which started at 2055Q on 27 July included CTDs #11 through #18. The series was finished on 2315Q on the 28th, and after a final check of the acoustic release on Station 542 the ship headed for the position of Station 540 at the MODE Eastern site.

We arrived at Station 540 at 0407Q on the 29th. No contact was made with the acoustic release in any mode. At 0429Q a release command was sent, and after an uncertain wait and more attempts to contact the release, the radio came on the air at 0440Q. (It should be noted that this is the only submersible radio that worked on a mooring recovery on this cruise.) The actual hauling of the mooring took place between 0551Q and 0811Q. CTD #19 was finished by 0900Q and by 0910Q the ship was underway towards Polymode Site II.

Approaching Site II at 0300Q on the 30th a survey pattern was established. The bottom proved to be very flat and the survey was terminated at 0438Q. The top of the mooring was launched at 0546Q and the anchor dropped at 0738Q. The only incident of note was the discovery of an unbooted termination on the lower end of a wire shot. A boot was built up out of rubber and plastic tape and the launch continued (Station 543). After release checks and a CTD, the ship was underway at 1048Q.

We arrived at the site of the first magnetometer deployment at 2013Q and the launch was completed and release checks done at 2350Q, 30 July.
Another survey pattern was established upon our arrival at Polymode Site III. The topography was extremely rough and a period of about five hours, starting at 1500Q, was spent searching for a suitable mooring spot. Finally, a small flat area near the western edge of the site was identified and the mooring was launched between 2100Q and 2250Q. The site includes several peaks which extend up to depths of 4,600 meters, while the few flat areas, such as the eventual mooring location, are at depths of over 6,000 meters. The mooring depth of Station 544 was 6,043 meters, up to this point the deepest mooring of any type the Buoy Project had ever set. The ship got underway due east, towards Site IV, after release checks and the CTD, at 0330Q, on the 1st of August.

Navigation was becoming increasingly difficult: the satellite receiver, after a period of uncertainty, had ceased functioning during the 30th; Loran C was still usable, but would drop out for short periods; Omega had proven not to be useful without constant attention and frequent synchronization, which was now almost impossible with the loss of the satellite receiver.

During the 1st it was discovered that two of the wrong anchors had been loaded. The compound (IV, V, and VI) and all-Dacron (IX) moorings all required 2,500 pound anchors as opposed to the 3,500 pound anchors used on the all-wire moorings. Only two of the smaller weights were aboard, instead of the necessary four. Schemes were devised to split two of the larger anchors.
Due to the rough bottom terrain and the uncertainties in the navigation, discussions were held with scientists in Woods Hole by radio to establish tolerances on the positions of the three moorings in the coherent array comprised of moorings IV, V, and VI. At 0100Q on the 2nd of August a survey was begun while approaching Site IV to identify a flat area large enough to set the mooring. Such a spot was not located until 0700Q. The mooring, designated Station 545, was set by 0941Q, followed by routine release checks and CTD #23. The ship was underway for Site V by 1400Q.

Discussions with engineers in Woods Hole on the morning radio schedule resulted in plans for bypassing the heavy-anchor problem, eliminating the need to split two of the larger anchors.

Approaching the general area of Site V at 1700Q we found more of the same very rough bottom topography encountered at the previous two sites. A suitable mooring location was not found until 2030Q. The mooring, Station 546, was launched routinely between 2127Q and 2330Q. After completion of the release checks the plan had been to do a CTD and steam two hours to the east to find a site for the magnetometer. However, since the Loran C was not giving reliable fixes (the satellite receiver was permanently out of operation), it was decided to set the magnetometer at Site V. This would allow star sights to be taken during the launch for an accurate position fix.

The magnetometer launch was complete by 0225Q on the 3rd of August and the CTD was started a few miles away at 0310Q. CTD #23 was completed at 0530Q and the ship moved back over the magnetometer for a final release check before leaving for Site VI.
Again a bottom survey was begun some distance before reaching the center of VI in an effort to identify a suitable flat spot on the bottom for the mooring deployment. By 1200Q a very small area had been located and the launch began at 1315Q. Due to the small size of the target area the launch was started at a greater than usual distance from the drop point and the mooring was towed into position the last mile to insure that we did not overshoot the point. The anchor of Station 547 was dropped at 1534Q in the proper depth. Release checks were completed and CTD #24 finished at 1945Q on the 3rd and the ship got underway for the third magnetometer site.

During this period we began experiencing considerable difficulties with the program used to design the moorings on the Hewlett-Packard shipboard computer system. This was troublesome, since each mooring had to be modified at least to the extent of adjusting for the water depth determined in the survey, and several of the moorings needed more extensive changes. Working with the program was made more difficult by the necessity to use the computer almost continuously for calculating Loran C fixes for the routine navigation, since we did not carry Loran C charts for most of the working area.

The ship arrived at the site of the final magnetometer station at 0740Q on the 4th of August. The deployment of the magnetometer was followed by CTD #25 and by a single lowering of the acoustic wire to test the releases for the final two current-meter moorings. The ship was underway for Site VII by 1255Q.
We began the bottom survey for Site VII as we approached the center of the site at 0500Q, 5 August. A usable spot was finally located by 0800Q and the mooring prepared for launch. The launch of Station 548 was carried out between 0905Q and 1100Q, followed by the usual release checks and by CTD #26. All work at the site was complete by 1536Q.

On the way north to Site VIII, CTD #27 was done at 32°N., 60°W. and CTD #28 at 33°N., 60°W. As we approached Site VIII at 1300Q on the 6th of August we began the bottom survey. The variation in depth was not as extreme as seen at the previous stations, and a suitable mooring location was identified by 1500Q. Some time was then spent in editing the mooring-design program in accordance with suggestions from Woods Hole to eliminate the earlier problems. The program was operating by 1630Q and was used to compute the final adjusted shot for the mooring. The mooring, Station 549, was set between 1644Q and 1823Q. Release checks and CTD #29 occupied the time until 2315Q, when the ship got underway for 35°N.

From 0430Q to 0630Q we did a CTD at 35°N. before proceeding north. Approaching Site IX at 1154Q on the 7th, the bottom survey was started. The survey was completed and a mooring location picked out by 1300Q. Mooring deployment was carried out between 1424Q and 1535Q. This was Station 550, the last of the Polymode-O moorings and the last mooring on the cruise. After release checks and CTD #31, the ship headed for 37°N. at 1902Q.
CTD #32 was completed at 37° N. between 0035Q and 0215Q on the 8th of August. At 0215Q the ship got underway for Woods Hole.

Our search for a cold-core Gulf Stream ring had been so far unsuccessful. However, on the run back to Woods Hole a structure showed up on the XBT plot which was either a ring or one loop of a Gulf Stream meander. We stopped, and between 0344Q and 0515Q on 9 August took a CTD. Resuming course for Woods Hole, the ship arrived at the W.H.O.I. dock at 0915Q on 10 August, 1974.
Scientific Personnel

Robert Heinmiller, Chief Scientist
David Simoneau
Michael Kelley
Roderique LaRochelle
Harold Armstrong
Wesley Thompson
Robert Millard
Susan Tarbell
Paul Murray
Joseph Puleo
Vasili Diaconu (Guest Investigator)
Kenneth Poehls (Joint Program Student)
Menehem Cohen (Oceanographic and Limnological Research Company, Haifa, Israel)
Bruce Larson (Joint Program Student)
Richard Scabowsky (Joint Program Student)
William Grimes (Co-op Student)
Jeffrey Rubenstein (Stanford University)
Acknowledgements

I would like to acknowledge the many hours of hard work put in by everyone who participated in CHAIN 116 to make it a success, including the efforts ashore of those who did not sail on the ship but who contributed nonetheless to the success of the cruise. Thanks are particularly due to the officers and crew of R/V CHAIN.
Summary of Experiments Initiated and/or Completed

Deployment of Polymode-O pilot array: Mid-ocean current and temperature measurements (Stations 542, 543, 544, 545, 546, 547, 548, 549, and 550). Includes deployment of 33 current meters (W. Schmitz, W.H.O.I.) and 23 temperature/pressure recorders (C. Wunsch, MIT).

Deployment of 34 carbonate dissolution samples (Stations 543, 545, 548, and 550) (J. Milliman, W.H.O.I.).

Recovery of two MODE site maintenance moorings: long-term measurements of currents and temperatures (Stations 538 and 540). Includes 6 current meters (W. Schmitz, W.H.O.I.) and 18 temperature/pressure recorders (C. Wunsch, MIT).

Recovery of first all-wire intermediate mooring: 3-month engineering test (Station 538) (R. Walden, W.H.O.I.).


Recovery of Vector Averaging Current Meter with experimental bearings (V-0120 on Station 541) (J. Dean, W.H.O.I.).

Deployment of high sampling rate tensionmeters on an all-wire mooring to measure launch transients (Station 548) (R. Walden, W.H.O.I.).


32 CTDs including two 24-hour yo-yo series (T. Joyce, W.H.O.I.).

284 XBTs (G. Volkmann, W.H.O.I.).


Continuous surface temperature and salinity (G. Volkmann, W.H.O.I.).
Chronological Listing of Events

Note: All times Eastern Daylight Time

22 July, 1245 - Leave W.H.O.I. dock
   1722 - First XBT - Watches established
23 July, 0845 - Stop at position of Station 541
   0917 to 1135 - Recover Station 541
   1030 to 1234 - CTD #1
   1234 to 1357 - CTD #2
   1357 - Underway
   2350 - Stop at position of Station 536 - checked release
24 July, 0001 - Underway for Station 538
   XBT system inoperative between approximately
   1600 & 2000
   Echo sounder (GDR) inoperative between approximately
   1630 & 1900
25 July, 2230 - Stop at position of Station 538 - check acoustic release
   2252 - Underway to position of start of CTD "yo-yo" sequence
26 July, 0000 - Start CTD lowerings
   Sequence consisted of CTD Stations #3 through #9
27 July, 0105 - Finish CTDs
   0120 to 0703 - Pour release lowerings
   0710 - Underway towards position of Station 538
   0828 - Stopped over Station 538
   0830 to 1311 - Recover Station 538
   1300 - Finish CTD #10
   1311 to 1630 - Prepare for launch of Station 542
   1637 to 2020 - Launch Station 542
   2025 - Underway to position of start of second "yo-yo"
   CTD series
   Sequence included CTDs #11 through #18
Chronological Listing of Events (Contd.)

28 July, 2315   - Finish CTDs
    2340 to 2350  - Check release on Station 542
    2350         - Underway to Station 540

29 July, 0407  - Stop over Station 540
    0429 to 0811  - Recover Station 540
    0900         - Finish CTD #19
    0910         - Underway to Polymode Site II

30 July, 0250 to 0438  - Bathymetric survey of Site II
    0546 to 0900  - Set Station 543 and check release
    0928 to 1030  - CTD #20
    1048         - Underway
    2013         - Arrive magnetometer site
    2350         - Finish magnetometer launch and release checks -
                   underway to Site III

31 July, 1500 to 2000  - Bathymetric survey of Site III
    2100 to 2250  - Set Station 544

1 Aug, 0045  - Finish release checks on Station 544
    0018 to 0330  - CTD #21
    0330         - Underway to Site IV

2 Aug, 0100 to 0700  - Survey and search for mooring site at Site IV
    0746 to 1120  - Set Station 545 and check release
    1135 to 1356  - CTD #22
    1356         - Underway to Site V
    1700 to 2030  - Survey and search for mooring site at Site V
    2127 to 2400  - Set Station 546

3 Aug, 0000 to 0100  - Check release
    0100 to 0300  - Launch magnetometer
    0310 to 0530  - CTD #23
    0530 to 0558  - Check release on magnetometer
    0558         - Underway to Site VI
    0715 to 1200  - Survey and search for mooring site at Site VI
    1315 to 1534  - Set Station 547
    1534 to 1645  - Release checks
    1736 to 1945  - CTD #24
    1945         - Underway for third magnetometer site
Chronological Listing of Events (Contd.)

4 Aug, 0740 to 0850 - Launch magnetometer
   0910 to 1030 - CTD #25
   1100 to 1250 - Release test lowerings
   1255 - Underway to Site VII

5 Aug, 0500 to 0800 - Survey and search for mooring site at Site VII
   0800 to 0910 - Prepare for mooring launch
   0910 to 1100 - Launch Station 548
   1100 to 1300 - Release checks
   1305 to 1536 - CTD #26
   1536 - Underway to 32° N.
   2050 to 2349 - CTD #27
   2349 - Underway for 33° N.

6 Aug, 0500 to 0712 - CTD #28
   0712 - Underway for Site VIII
   1300 to 1500 - Survey and search for mooring site at Site VIII
   1500 to 1644 - Prepare for mooring launch
   1644 to 1823 - Launch Station 549
   1823 to 1925 - Release checks
   1954 to 2315 - CTD #29
   2315 - Underway for 35° N.

7 Aug, 0430 to 0630 - CTD #30
   0630 - Underway for 36° N.
   1154 to 1300 - Survey and search for mooring site at Site IX
   1300 to 1424 - Prepare for mooring launch
   1424 to 1535 - Set Station 550
   1535 to 1650 - Release checks
   1712 to 1900 - CTD #31
   1902 - Underway for 37° N.

8 Aug, 0035 to 0215 - CTD #32
   0215 - Underway for Woods Hole

9 Aug, 0344 to 0515 - CTD #33
   0515 - Underway for Woods Hole

10 Aug, 0915 - Arrive Woods Hole
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<thead>
<tr>
<th>Number</th>
<th>Type</th>
<th>Date</th>
<th>Equipment</th>
<th>Location</th>
<th>Duration</th>
<th>Remarks</th>
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<td>517</td>
<td>Intermediate - Radio Float</td>
<td>7-XII-73</td>
<td>2 VACMs 1 Acoustic Release</td>
<td>Site D</td>
<td>1 Year</td>
<td>Engineering evaluation of intermediate moorings</td>
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<tr>
<td>523</td>
<td>Intermediate - Radio Float</td>
<td>9-IV-74</td>
<td>3 VACMs 1 Tensiometer 1 Acoustic Release 1 DT VACM(D) 5 VACMs (1 AMF test) 1 Depth Recorder 1 Acoustic Release</td>
<td>Site D</td>
<td>8 Months</td>
<td>One of three-moorings array for R. Thompson</td>
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<td>10-IV-74</td>
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<td>1 VACM 1 Thermograph 1 Acoustic Release</td>
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<td>1 850 C.M.</td>
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<td>1 850 C.M.</td>
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<td>1 DT VACM (D)</td>
<td>1 850 C.M.</td>
<td>1 Acoustic Release</td>
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</table>
STATION 538

RADIO FLOAT WITH LIGHT
2m 1/2" CHAIN
2m 3/8" CHAIN

5 17" GLASS BALLS IN HARD HATS AND 35 16" GLASS BALLS IN HARD HATS ON 3/8" CHAIN

850 CURRENT METER

100m 3/16" WIRE
TEMP/DEPTH RECORDER
196m 3/16" WIRE
TEMP/DEPTH RECORDER
196m 3/16" WIRE
TEMP/DEPTH RECORDER

485m 3/16" WIRE

7 16" GLASS BALLS IN HARD HATS ON 7m 3/8" CHAIN

850 CURRENT METER

500m 3/16" WIRE
TEMP/DEPTH RECORDER
500m 3/16" WIRE

6 16" GLASS BALLS IN HARD HATS ON 3/8" CHAIN

(CONTINUED)
(CONTINUED)

TEMP/DEPTH RECORDER

1000m 3/16" WIRE

TEMP/DEPTH RECORDER

480m 3/16" WIRE

7 16" GLASS BALLS IN HARD HATS ON 7m 3/8"CHAIN

850 CURRENT METER

2m 3/8"CHAIN

TEMP/DEPTH RECORDER

196m 3/16"WIRE

196m 3/16"WIRE

TEMP/DEPTH RECORDER

960m 3/16"WIRE

TEMP/DEPTH RECORDER

50m 3/16"WIRE

18 16" GLASS BALLS IN HARD HATS ON 18m 3/8"CHAIN

AMF RELEASE

5m 1/2"CHAIN

20m 3/4 NYLON

3m 1/2"CHAIN

STIMSON ANCHOR, 3300 LBS (AIR WEIGHT)
STATION 540

RADIO FLOAT WITH LIGHT
2m1/2"CHAIN
2m3/8"CHAIN

20 17" GLASS BALLS IN HARD HATS ON 20m 3/8"CHAIN

850 CURRENT METER - 5401

100m 3/16"WIRE

TEMP/DEPTH RECORDER - 5402

196m 3/16"WIRE

TEMP/DEPTH RECORDER - 5403

196m 3/16"WIRE

TEMP/DEPTH RECORDER - 5404

500m 3/16"WIRE

4 17" GLASS BALLS IN HARD HATS ON 5m 3/8"CHAIN

850 CURRENT METER - 5405

500m 3/16"WIRE

TEMP/DEPTH RECORDER - 5406

475m 3/8"DACRON

TEMP/DEPTH RECORDER - 5407

950m 3/8"DACRON

TEMP/DEPTH RECORDER - 5408

470m 3/8"DACRON

(CONTINUED)
STATION 540

4 17" GLASS BALLS IN HARD HATS ON 5m 3/8" CHAIN
850 CURRENT METER - 5409
2m 3/8" CHAIN
TEMP/DEPTH RECORDER - 540,10
377m 3/8" DACRON
TEMP/DEPTH RECORDER - 540,11
630m 3/8" DACRON
90m 3/8" DACRON
TEMP/DEPTH RECORDER - 540,12
48m 3/8" DACRON
12 17" GLASS BALLS IN HARD HATS ON 15m 3/8" CHAIN

AMF RELEASE
5m 1/2" CHAIN
20m 3/4" NYLON
3m 1/2" CHAIN
STIMSON ANCHOR, 2550LBS (AIR WEIGHT)
STATION 541

ARMORED DACRON

3/16m

RADIO FLOAT WITH LIGHT
2m 1/2"CHAIN
2m 3/8"CHAIN

15 SYNTACTIC FOAM FOOTBALLS ON 23.5m 5/16"WIRE

100m

163m

137m

24 SYNTACTIC FOAM FOOTBALLS ON 23.5m 5/16"WIRE

500m 3/16"WIRE

13 SYNTACTIC FOAM FOOTBALLS ON 15m 5/16" WIRE

AMF TEST VACM-5411

AMF RELEASE

200m 3/16"WIRE

500m 3/16"WIRE

1475m 3/8"DACRON

20m 3/4"NYLON

3m 1/2"CHAIN

STIMSON ANCHOR 2500 LBS (AIRWEIGHT)
STATION 542

467 m

RADIO FLOAT
WITH LIGHT

2 m 1/2" CHAIN
2 m 3/8" CHAIN

22 16" GLASS BALLS IN HARD HATS ON 22m 3/8" CHAIN

VACM -5421

DEAN ROTOR TEST

299 m
TEMP/DEPTH RECORDER -5422

199 m
TEMP/DEPTH RECORDER -5423

471 m

30 16" GLASS BALLS IN HARD HATS ON 30m 3/8" CHAIN

CURRENT METER -5424

499 m
TEMP/DEPTH RECORDER -5425
1000 m

499 m
TEMP/DEPTH RECORDER -5426

493 m

6 16" GLASS BALLS IN HARD HATS ON 6m 3/8" CHAIN

CURRENT METER -5427

2 m 3/8" CHAIN
TEMP/DEPTH RECORDER -5428
1092 m 3/16" WIRE
200 m 3/16" WIRE

SWIVEL
95 m 5/8" NYLON

20 16" GLASS BALLS IN HARD HATS ON 20m 3/8" CHAIN

ACOUSTIC RELEASE, TRANSPONDING

5 m 1/2" CHAIN
20 m 3/4" NYLON

3 m 1/2" CHAIN
2 PARACHUTES
STIMSON ANCHOR

10 FT. CHAIN WITH
22 LB. DANFORTH
STATION 543

RADIO FLOAT WITH LIGHT
2 m 1/2" CHAIN
2 m 3/8" CHAIN

20 17" GLASS BALLS IN HARD HATS ON 20 m 3/8" CHAIN

VACM-5431

MILLIMAN SAMPLE ON 299 m
TEMP/DEPTH RECORDER -5432
198 m

VACM-5433

970 m

28 17" GLASS BALLS IN HARD HATS ON 28 m 3/8" CHAIN

VACM-5434

MILLIMAN SAMPLE ON 1000 m
MILLIMAN SAMPLE ON 992 m

7 17" GLASS BALLS IN HARD HATS ON 7 m 3/8" CHAIN

CURRENT METER -5435

MILLIMAN SAMPLE ON 2 m 3/8" CHAIN
TEMP/DEPTH RECORDER -5436
969 m 3/16" WIRE
309 m 3/16" WIRE
26 m 5/8" NYLON

14 17" GLASS BALLS IN HARD HATS ON 14 m 3/8" CHAIN

MILLIMAN SAMPLE

ACOUSTIC RELEASE, TRANSPONDING
5 m 1/2" CHAIN
20 m 3/4" NYLON
3 m 1/2" CHAIN
2 PARACHUTES
STIMSON ANCHOR

10 FT. CHAIN WITH
22 LB. DANFORTH
STATION 544

RADIO FLOAT WITH LIGHT
2 m 1/2" CHAIN
2 m 3/8" CHAIN

20 17" GLASS BALLS IN HARD HATS ON 20 m 3/8" CHAIN

VACM-5441

299 m
TEMP/DEPTH RECORDER - 5442
198 m
VACM-5443

970 m

28 17" GLASS BALLS IN HARD HATS ON 28 m 3/8" CHAIN

VACM-5444

1000 m
992 m

8 17" GLASS BALLS IN HARD HATS ON 8 m 3/8" CHAIN

CURRENT METER - 5445

2 m 3/8" CHAIN
TEMP/DEPTH RECORDER - 5446
1000 m
150 m
477 m
299 m
SWIVEL
37 m 5/8" NYLON

15 17" GLASS BALLS IN HARD HATS ON 15 m 3/8" CHAIN

ACOUSTIC RELEASE, TRANSPONDING

5 m 1/2" CHAIN
20 m 3/4" NYLON
3 m 1/2" CHAIN
2 PARACHUTES
STIMSON ANCHOR

10 FT. CHAIN WITH 22 LB. DANFORTH
STATION 545

477m

RADIO FLOAT WITH LIGHT
2 m 1/2"CHAIN
2 m 3/8"CHAIN

13" 16" GLASS BALLS IN HARD HATS ON 13m 3/8"CHAIN
VACM - 5451

MILLIMAN SAMPLE ON 299 m
TEMP/DEPTH RECORDER - 5452
198 m
VACM - 5453
977 m

21 16" GLASS BALLS IN HARD HATS ON 21m 3/8"CHAIN
VACM - 5454

MILLIMAN SAMPLE ON 2m 3/8"CHAIN
TEMP/DEPTH RECORDER - 5455

3 MILLIMAN SAMPLES ON 1892 m 3/8"DACRON

CURRENT METER - 5456
MILLIMAN SAMPLE ON 2m 3/8"CHAIN

3 MILLIMAN SAMPLES ON 1596 m 3/8"DACRON
260 m 3/8"DACRON

16 16" GLASS BALLS IN HARD HATS ON 16m 3/8"CHAIN
MILLIMAN SAMPLE

ACOUSTIC RELEASE, TRANSPONDING
5 m 1/2"CHAIN
20 m 3/4"NYLON
3 m 1/2"CHAIN

STIMSON ANCHOR
STATION 546

480 m

RADIO FLOAT WITH LIGHT
2 m 1/2" CHAIN
2 m 3/8" CHAIN

12 17" GLASS BALLS IN HARD HATS ON 12 m 3/8" CHAIN
VACM - 5461

299 m
TEMP/DEPTH RECORDER - 5462
198 m
VACM - 5463

200 m
199 m
TEMP/DEPTH RECORDER - 5464
579 m

19 17" GLASS BALLS IN HARD HATS ON 19 m 3/8" CHAIN
VACM - 5465

945 m 3/8" DACRON
TEMP/DEPTH RECORDER - 5466
946 m 3/8" DACRON

CURRENT METER - 5467
2 m 3/8" CHAIN
TEMP/DEPTH RECORDER - 5468
376 m
423 m
136 m
TEMP/DEPTH RECORDER - 5469
679 m

15 17" GLASS BALLS IN HARD HATS ON 15 m 3/8" CHAIN

ACOUSTIC RELEASE, TRANSPONDING
5 m 1/2" CHAIN
20 m 3/4" NYLON
3 m 1/2" CHAIN
1 PARACHUTE
STIMSON ANCHOR
STATION 547

RADIO FLOAT WITH LIGHT
2 m 1/2" CHAIN
2 m 3/8" CHAIN

12 17" GLASS BALLS IN HARD HATS ON 12 m 3/8" CHAIN
VACM - 5471

299 m
TEMP/DEPTH RECORDER - 5472
198 m
VACM - 5473
979 m

19 17" GLASS BALLS IN HARD HATS ON 19 m 3/8" CHAIN
VACM - 5474

1879 m 3/8" DACRON
CURRENT METER - 5475

2 m 3/8" CHAIN
TEMP/DEPTH RECORDER - 5476
843 m
91 m
TEMP/DEPTH RECORDER - 5477
693 m

19 17" GLASS BALLS IN HARD HATS ON 19 m 3/8" CHAIN
ACOUSTIC RELEASE, TRANSPONDING

5 m 1/2" CHAIN
20 m 3/4" NYLON
3 m 1/2" CHAIN
2 PARACHUTES
STIMSON ANCHOR
STATION 548

RADIO FLOAT WITH LIGHT
2 m 1/2" CHAIN
2 m 3/8" CHAIN

20 17" GLASS BALLS IN HARD HATS ON 20 m 3/8" CHAIN

VACM-5481

MILLMAN SAMPLE ON 298 m
1 m 3/8" CHAIN
TEMP/DEPTH RECORDER - 5482
198 m
VACM-5483
970 m
TENSIOMETER - 5484

28 17" GLASS BALLS IN HARD HATS ON 28 m 3/8" CHAIN

VACM-5485

3 MILLMAN SAMPLES ON 1000 m
MILLMAN SAMPLE ON 992 m

6 17" GLASS BALLS IN HARD HATS ON 6 m 3/8" CHAIN

VACM-5486

2 MILLMAN SAMPLES ON 1000 m
MILLMAN SAMPLE ON 148 m
200 m
100 m

TENSIOMETER - 5487
SWIVEL
42 m 5/8" NYLON

16 17" GLASS BALLS IN HARD HATS ON 16 m 3/8" CHAIN

ACOUSTIC RELEASE, TRANSPONDING

5 m 1/2" CHAIN
20 m 3/4" NYLON

2 PARACHUTES
STIMSON ANCHOR

10 FT. CHAIN WITH 22 LB. DANFORTH
STATION 549

476 m

RADIO FLOAT WITH LIGHT
2 m 1/2"CHAIN
2 m 3/8"CHAIN

20 17"GLASS BALLS IN HARD HATS ON 20 m 3/8"CHAIN

VACM - 5491
299 m
TEMP/DEPTH RECORDER - 5492
198 m
DT VACM (⌀) - 5493
970 m

28 17"GLASS BALLS IN HARD HATS ON 28 m 3/8"CHAIN

CURRENT METER - 5494
1000 m
992 m

6 17"GLASS BALLS IN HARD HATS ON 6 m 3/8"CHAIN

DT VACM (⌀) - 5495
424 m
150 m
SWIVEL
53 m 5/8" NYLON

14 17"GLASS BALLS IN HARD HATS ON 14 m 3/8"CHAIN

ACOUSTIC RELEASE, TRANSPONDING
5 m 1/2"CHAIN
20 m 3/4" NYLON

10 FT. CHAIN WITH 22 LB. DANFORTH

2 PARACHUTES
STIMSON ANCHOR
STATION 550

1977 m

3/8" DACRON

18 17" GLASS BALLS IN HARD HATS ON 18 m 3/8" CHAIN

CURRENT METER - 5501

MILLIMAN SAMPLE ON 474 m

TEMP/DEPTH RECORDER - 5502

MILLIMAN SAMPLE ON 1423 m

6 17" GLASS BALLS IN HARD HATS ON 6 m 3/8" CHAIN

VACM-5503

MILLIMAN SAMPLE ON 671 m

116 m

10 m

14 17" GLASS BALLS IN HARD HATS ON 14 m 3/8" CHAIN

ACOUSTIC RELEASE, TRANSPONDING

5 m 1/2" CHAIN

20 m 3/4" NYLON

3 m 1/2" CHAIN

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2. Moorings
3. Ocean Currents

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   II. N00014-66-C0241; NR 083-004

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