

Cruise Report

R/V Oceanus Cruise Oc401 April 28 – May 6, 2004

Station W: first deployment of the full array plus hydrographic sampling

Overview

As a contribution to the U.S. Clivar / U.K. Rapid study of interannual variability of the North Atlantic Ocean's meridional overturning circulation, a series of moored observations in conjunction with hydrographic sampling is being carried out along the eastern seaboard of North America. Oceanus cruise 401 constituted the first externally funded voyage to "Station W," a measurement line running from the shelf break south of Woods Hole towards Bermuda below a Jason altimeter satellite track.. A 6-element array spanning the continental slope between 1800 and 4100 m depth involving a mix of conventional current meter and Moored Profiler moorings and bottom pressure gauges will be maintained to observe the Deep Western Boundary Current, complemented by semi-annual hydrographic sampling across the slope and Gulf Stream and into the northern Sargasso Sea.

The present study along approximately 69W longitude represents a collaboration of U.S. scientists from the Woods Hole Oceanographic Institution and Lamont Doherty Earth Observatory and U.K. investigators from the Proudman Laboratory, the University of Liverpool and University of Reading. Our U.K. colleagues will additionally be deploying two cross-slope arrays off the Canadian coast; another UK/US investigator team is sampling along Lat. 26N and within Florida Straits.

Oc401 science personnel

WHOI: moorings and basic hydrography

John Toole, Scott WorriLOW, Ryan Schrawder, Brian Hogue, Marshall Swartz, Dave Wellwood, Maggie Cook, Jane Dunworth-Baker

LDEO: CFC's and I¹²⁹ sampling

Eugene Gorman, Hoyle Lee, Nicholas Santella

U.K.: bottom pressure gauges

Chris Hughes, Pete Foden, Steve Mack

Cruise Plan

Cruise Oc401 had two main objectives: deployment of the moored array and occupation of a hydrographic section spanning the array and extending south

across the Gulf Stream. Table 1 details the array while Table 2 lists the stations that were occupied.

Table 1. Locations and instrumentation of the moored array deployed during Oc401.

Mooring #	Date Deployed	Position	Ocean Depth	MMP Sampling range (db)	VACM Depths (m)	T/C Sensor Depths (m)	Bottom Pressure Sensor
0	05/02/04	39 44.3 N 69 48.8 W	1800 m				yes
1	05/02/04	39 36.1 N 69 43.0 W	2238 m	60-2145	2188	100 2186	yes
2	05/01/04	39 13.0 N 69 26.7 W	2752 m		1020 1620 2220 2670	1021 1321 1361 1920 2221P 2321 2421P ~2540 ~2600 2656	yes
3	05/01/04	38 50.7 N 69 11.3 W	3248 m	60-3150	3144	107 3145	yes
4	04/30/04	38 25.5 N 68 54.2 W	3686		1052 1652 2252 2702 3252 adcp 3652	1053 1353 1653 1953 2703 2953 3200P 3253 3303 ~3550P 3587 3651	yes
5	04/29/04	38 04.4 N 68 39.8W	4110 m	1000-4050	999 4084T/C	1000	yes

Table 2. Hydrographic station positions for Oc401

site # sequence #	Date/Time GMT	Latitude N	Longitude W	Pmax (db)
1 11	May 2, 11:09	40 0.61	70 0.35	154
2 10	May 2, 09:43	39 53.96	69 55.8	684
3 9	May 2, 08:12	39 51.51	69 54.0	1015

4 8	May 2, 05:53	39 47.45	69 51.09	1386
5 7	May 2, 02:50	39 42.08	69 48.07	2059
6 6	May 1, 16:23	39 28.52	69 38.51	2420
7 5	May 1, 12:57	39 15.54	69 29.42	2671
8 4	May 1, 09:25	39 0.94	69 19.95	3080
9 3	May 1, 05:10	38 47.47	69 11.05	3293
10 12	May 3, 05:14	38 33.52	69 1.52	3508
11 2	Apr 30, 07:05	38 19.8	68 51.64	3885
12 1	Apr 30, 01:16	38 5.42	68 41.99	4110
13 13	May 3, 13:48	37 51.01	68 32.38	4447
14 14	May 3, 21:05	37 37.28	68 22.58	4461
15 15	May 4, 02:20	37 22.93	68 12.93	4818
16 16	May 4, 10:12	37 8.34	68 3.61	4987
17 17	May 4, 16:19	36 53.91	67 53.95	5000
18 18	May 5, 00:36	36 39.5	67 44.41	4944

Cruise Narrative

The R/V Oceanus returned to the WHOI pier from its preceding cruise on Saturday April 24 and was offloaded. Loading for our cruise began on Monday morning. Owing to several ship maintenance/repair activities that also required crane access, our loading extended into April 27, causing a 1 day delay to our scheduled scaling time. Oceanus dropped dock lines at 10AM on April 28 and began heading southeast under cloudy skies and brisk winds on the starboard quarter. Transit to the work area took nearly 24 hours.

First order of business was to carry out test lowerings of the acoustic releases to be used in the moorings to insure functionality under pressure. We steamed to the site of Mooring 5 in 4100 m of water for this activity. A northward meander of the Gulf Stream placed this site in the northern flank of the Stream where the surface current was approximately 3.5 knots. Excessive wire angles experienced during the test lowering made acoustic communications difficult with 4000 m of wire out. Communications were successful at 3000 m wire out and 8 releases were confirmed to transpond and release.

After recovery of the releases, we proceeded to set up for the Mooring 5 deployment. Based on the current set observed in the morning, a starting position 9 nmi east of the target site was selected. During the release lowering, Oceanus had been carried well east of the deployment region. Thus after repositioning, it wasn't until 3PM local that the

mooring deployment began. The deployment scheme was for Oceanus to steam west through the water at approximately 1 knot within the 3 knot current to the east (giving us a speed of ~2 knots to the east over the ground). However by 3PM the surface current had slackened to around 2 knots so we were faced with a longer-than-planned drift to the deployment site. But apart from an extended towing period, the mooring went in very smoothly with anchor launch occurring at 7:30 PM. Immediately thereafter, the U.K. contingent launched a bottom pressure gauge (at 7:45). Both systems were tracked acoustically to the bottom.

Hydrographic operations then commenced with the first station at site 12 just north of the mooring, followed by a station at site 11. The vessel was positioned on mooring site #4 at 0700 on April 30 to begin that deployment. Strong current to the east/northeast was observed with winds from the southwest at 10-15 knots. When making 1-2 knots through the water on heading 260, the ship was doing 3.7 knots over the ground on course 070. The ship was thus positioned 10 nmi away from the mooring site at a bearing of 255 degrees to start the payout. The deployment went smoothly, anchor over occurred at 1832 Z followed by the bottom pressure gauge deployment. We then transited to the site of mooring #3 and proceeded to deploy that system. There was negligible current set at this site so the vessel was simply positioned 5 nmi downwind (bearing 050) of the site to begin the deployment. Anchor over occurred at 0321Z on May 1, again followed by the bottom pressure gauge deployment. CTD station work was then resumed.

Mooring 2 deployment was initiated with the vessel 4 nmi north of the target site midday on May 1. The deployment proceeded uneventfully and anchor over occurred at 2247 Z, with a bottom pressure gauge deployment immediately afterwards. Over the following evening, the shallowest hydrographic stations near the shelf break were occupied, the bottom pressure gauge at "mooring" site #0 was subsequently deployed at the 1800 m isobath. The vessel was then positioned for the final mooring deployment. The setup point for Mooring #1 was located 3 nmi downwind of the target position. Anchor over was at 1701Z on May 2, followed again by a bottom pressure gauge deployment.

R/V Oceanus was then directed to the 3000 m isobath for recovery of a Moored Profiler mooring that had been deployed in early summer 2003 with support of the WHOI Ocean and Climate Change Institute as a jump-start of the full Station W program. The mooring recovery went smoothly, however both the CTD and ACM on the Moored Profiler were found to be damaged. Looking at the acquired data, it appears that the damage occurred during recovery, probably as the backup buoyancy passed the MMP after the release was activated. Apart from the damage on recovery, the Profiler appeared to function exceptionally well throughout the deployment, occupying 269 one-way profiles between ~75 and 2900 m, with the final logged profile occurring on May 1, just prior to recovery.

Hydrographic station work was again resumed with station 10, followed next by station 13 and proceeding to the sites farther south. On May 3 the winds increased to 30 knots with gusts to 40 as we worked south across the Gulf Stream. In spite of the conditions, station work continued, though water samples had to be drawn with the ship continuing to hold station (rather than starting to transit as soon as the underwater package had been secured). Station 18 was completed early on May 5 whereupon the vessel was directed

to steam back to Woods Hole along the section to collect a synoptic shipboard acoustic Doppler current section. Arrival in Woods Hole was on May 6, as planned.

Postscript

In all aspects, the cruise was highly successful. All of the planned instrument deployments were completed, one mooring was recovered, and 18 hydrographic stations were collected. However, the good feelings were dashed two days later when one of the cruise participants, Ryan Schrawder, was killed in a motorcycle accident. Ryan was part of the WHOI mooring team and after several years of training was on the verge of assuming a leading role in the group. He will be greatly missed.

Acknowledgments

R/V Oceanus cruise number 401 was funded by grant number OCE-0241354 from the U.S. National Science Foundation to the Woods Hole Oceanographic Institution.