

Cruise Report: *R/V Oceanus* 432

Woods Hole to Woods Hole

October 19 – 26, 2006

Line W: A continuing program of ocean measurements

Background

This cruise constitutes one element of an ongoing observational program – Line W – funded by the U. S. National Science Foundation to investigate the characteristics and consequences of interannual variations in the Northwest Atlantic's deep western boundary current (DWBC). This study is documenting for an initial 4-year period, the temperature, salinity, tracer and velocity variations of the DWBC upstream of its Gulf Stream crossunder point. Line W includes a 5-mooring array of instruments situated in the DWBC flow regime on the continental slope south of Woods Hole and is augmented by twice-yearly occupations of a hydrographic section along this line (Figure 1). A companion research program by U.K. investigators is sampling bottom pressure variability at each of our mooring sites (and an additional site shoreward of the shallowest mooring) plus two additional lines crossing the DWBC to the east of Line W. The moored array, which consists of 3 McLane profilers and 2 moorings of current meters plus T/C sensors, is designed to quantify changes in DWBC water properties, stratification (potential vorticity) and transport. A sixth mooring of current meters, deployed in the mean axis of the Gulf Stream along Line W was added in spring 2005 (This mooring, named GUSTO-05, is maintained by Dr. M. McCartney and funded by WHOI's Ocean and Climate Change Institute.) Shipboard observations using CTD, LADCP and discrete sampling for salinity, oxygen, CFCs, SF₆ and I¹²⁹ measure the water column properties at high spatial resolution to help verify that the array resolves interannual signals.

Cruise Summary

R/V Oceanus cruise # 432

Departed Woods Hole on 19 October 2006.

Returned to Woods Hole on 26 October 2006.

Number of CTD/LADCP/Rosette stations occupied: 21 (of 26 planned).

Science party

Chief Scientist: Ruth Curry (WHOI)

CTD operations: Margaret Cook, Beatriz Pena-Molino, Jane Dunworth-Baker (WHOI)

LADCP : Dan Torres, George Tupper (WHOI)

CFC chemistry: Bill Smethie, Eugene Gorman, Guy Mathieu, David Ho (LDEO)

Hydrography (salts and oxygens): Dave Wellwood (WHOI)

Cruise Narrative

The cruise tracked along a line between the continental shelf south of Woods Hole and Bermuda (Figure 1). Of 26 proposed stations, 21 were successfully occupied (see Table 1). Weather was a limiting factor: CTD operations were suspended by the Captain three times due to high winds and seas. A Seabird 911 CTD system equipped with dual temperature/conductivity sensors and 1- dissolved oxygen sensor was used for all casts. A rosette sampler and 21 ten-liter bottles were used to obtain water samples at discrete depths; these were subsequently analyzed for salinity, oxygen, CFC and SF₆ concentrations. Between stations 10-18, one liter samples were collected for shore-based analysis of Iodine-129 in the deep overflow waters. The LADCP consisted of one downward looking broadband ADCP and one upward looking 300 kHz (Workhorse) transducer from RDI. Between casts, data were downloaded from the instruments. Underway ADCP data were collected with an RDI 75 kHz system. Underway meteorological data included wind speed and direction, precipitation, short wave radiation, and barometric pressure. Air temperature and humidity were unavailable due to equipment problems. Sea surface temperature and salinity were collected along the cruisetrack with a SBE45 thermosalinograph. Bathymetry was logged by a Knudsen 12 kHz system.

Stations 1-3 were acquired on the continental shelf in water depths < 200 m. On **Station 4**, the rosette malfunctioned (software problem) and no water samples were collected. At **Station 6**, the secondary temperature/conductivity sensors exhibited spiky behavior below 1300 db, but primary sensors continued to work well. By **Station 10**, the chemists were backlogged with samples and requested a delay on the next cast for ~2 hours. On site at **Station 11**, the Captain shut down deck operations (wind and seas beyond limits) just as the package was to be launched (12-hour delay). CTD operations were resumed ~0800 next morning. The Gulf Stream north wall was situated between **Stations 13 and 14**. Upon arrival at **Station 14**, deck operations were suspended due to deteriorating weather conditions (~1830 local). A decision was made to run south rather than loiter in the Gulf Stream. By midnight, winds begin to drop. At 0530, southward progress was halted and ctd work was begun again at 0630 local. The next 18 hours provided an excellent weather window while the Gulf Stream stations (14 – 17) were occupied from south to north. Before **Station 15** (9016), the O₂ sensor was replaced. On **Station 17** (at Gulf Stream north wall) the LADCP (downward looking) unit would not initialize and was replaced with a Workhorse unit. This unit malfunctioned (one of 4 beams not working) likely resulting in a velocity profile of poor quality. The malfunctioning unit was replaced before the next cast with a backup Workhorse resulting in an acceptable profile. The southward transect was resumed at **Station 18**. On **Station 22**, the ctd deployment was cancelled based upon deteriorating conditions. At this time, the ship turned and headed for home.

Acknowledgements

We greatly appreciate the efforts and professionalism of Captain Diego Mello and the crew of *R/V Oceanus* in facilitating the science objectives of this cruise. The science team of Maggie Cook, Beatriz Pena-Molino, George Tupper, Jane Dunworth-Baker, Dan Torres, Dave Wellwood, Bill Smethie, Eugene Gorman, Guy Mathieu, and David Ho safely deployed, recovered, sampled the CTD/rosette package, and analysed water samples around the clock and in various weather conditions. Thanks to all for their perseverance and good humor in

completing this work. Line W is supported by the National Science Foundation (grant no. OCE-0241354) and contributes to the U.S. CLIVAR and U.K. RAPID programs.

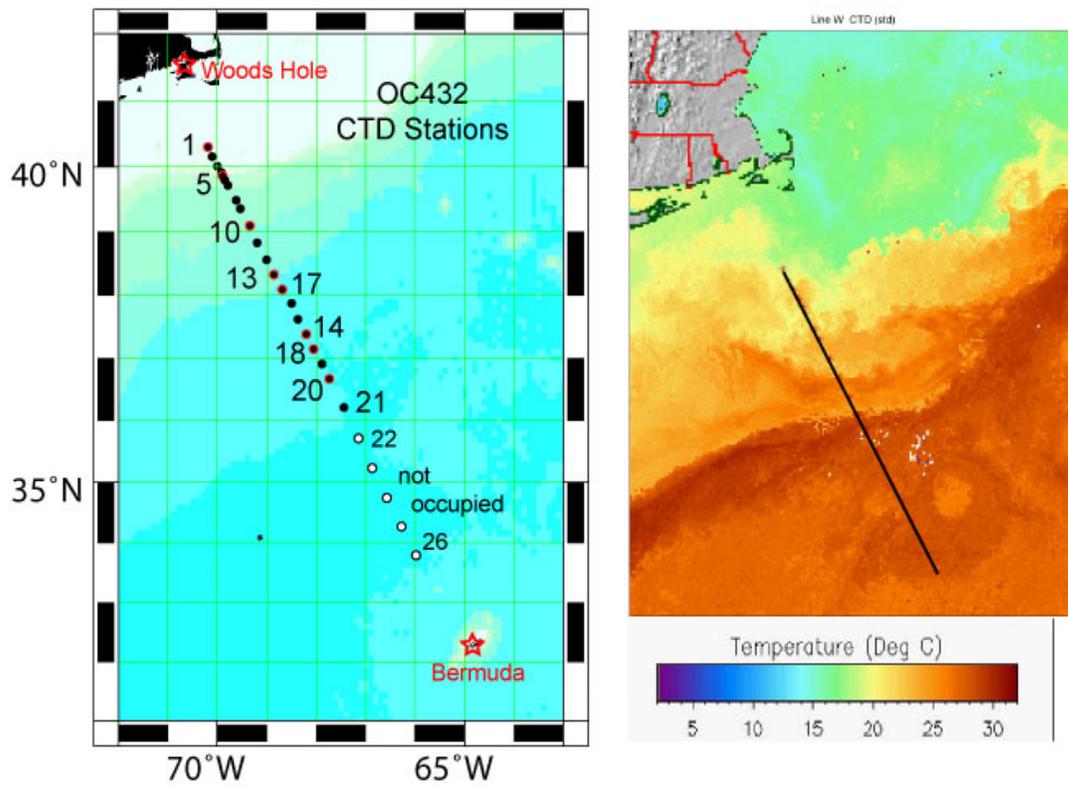


Figure 1. Left panel: locations of 21 CTD profiles acquired during OC432; background color depicts bathymetry. Right panel: cruise track overlain on sea surface temperature (source AVHRR, 6 days ending Oct 18).

Table 1. Summary of CTD station locations.

Line_W R/V Oceanus 432 October 2006							
Sta#	Cast#	Date	Time	Code	Lat	Lon	Nav Depth (m)
1	1	101906	2154	BE 40	17.35 N	070 12.07 W	91
1	1	101906	2157	BO 40	17.36 N	070 12.07 W	
1	1	101906	2202	EN 40	17.37 N	070 12.06 W	
2	1	101906	2338	BE 40	08.63 N	070 07.16 W	118
2	1	101906	2342	BO 40	08.67 N	070 07.17 W	
2	1	101906	2347	EN 40	08.71 N	070 07.18 W	
3	1	102006	0105	BE 39	59.83 N	069 59.96 W	166
3	1	102006	0109	BO 39	59.81 N	069 59.96 W	
3	1	102006	0116	EN 39	59.76 N	069 59.97 W	
4	1	102006	0209	BE 39	54.35 N	069 55.57 W	690
4	1	102006	0221	BO 39	54.31 N	069 55.45 W	
4	1	102006	0243	EN 39	54.24 N	069 55.24 W	
5	1	102006	0331	BE 39	51.43 N	069 54.27 W	1060
5	1	102006	0352	BO 39	51.24 N	069 54.34 W	
5	1	102006	0413	EN 39	51.12 N	069 54.40 W	
6	1	102006	0524	BE 39	47.07 N	069 51.61 W	1718
6	1	102006	0551	BO 39	46.95 N	069 51.79 W	
6	1	102006	0622	EN 39	46.73 N	069 52.03 W	
7	1	102006	0748	BE 39	42.16 N	069 48.04 W	2084
7	1	102006	0824	BO 39	42.27 N	069 48.31 W	
7	1	102006	0913	EN 39	42.39 N	069 48.69 W	
8	1	102006	1117	BE 39	28.57 N	069 38.49 W	2416
8	1	102006	1201	BO 39	28.36 N	069 38.84 W	
8	1	102006	1303	EN 39	28.08 N	069 39.37 W	
9	1	102006	1504	BE 39	20.99 N	069 32.27 W	2508
9	1	102006	1548	BO 39	21.02 N	069 32.30 W	
9	1	102006	1639	EN 39	21.25 N	069 32.48 W	
10	1	102006	1847	BE 39	5.17 N	069 21.12 W	3004
10	1	102006	1938	BO 39	5.29 N	069 21.35 W	
10	1	102006	2042	EN 39	5.48 N	069 21.67 W	
11	1	102106	1212	BE 38	49.55 N	069 12.97 W	3253
11	1	102106	1327	BO 38	49.25 N	069 15.83 W	
11	1	102106	1502	EN 38	49.07 N	069 18.80 W	
12	1	102106	1802	BE 38	33.99 N	068 58.59 W	3485
12	1	102106	1905	BO 38	33.67 N	068 58.86 W	
12	1	102106	2015	EN 38	33.20 N	068 59.01 W	
13	1	102106	2212	BE 38	19.43 N	068 51.74 W	3811
13	1	102106	2319	BO 38	19.62 N	068 50.85 W	
13	1	102206	0035	EN 38	19.97 N	068 50.48 W	
14	1	102206	0959	BE 37	22.59 N	068 13.27 W	4710
14	1	102206	1122	BO 37	21.91 N	068 13.93 W	
14	1	102206	1257	EN 37	21.03 N	068 14.44 W	
15	1	102206	1520	BE 37	37.14 N	068 22.41 W	4558
15	1	102206	1638	BO 37	36.72 N	068 21.16 W	
15	1	102206	1806	EN 37	36.09 N	068 20.54 W	
16	1	102206	2016	BE 37	51.39 N	068 30.77 W	4344
16	1	102206	2131	BO 37	51.21 N	068 29.14 W	
16	1	102206	2259	EN 37	50.84 N	068 27.30 W	
17	1	102306	0223	BE 38	5.29 N	068 41.88 W	4081
17	1	102306	0336	BO 38	5.96 N	068 39.40 W	
17	1	102306	0507	EN 38	6.13 N	068 37.10 W	
18	1	102306	1252	BE 37	8.25 N	068 3.74 W	4861
18	1	102306	1415	BO 37	7.63 N	068 5.04 W	
18	1	102306	1552	EN 37	6.61 N	068 6.73 W	
19	1	102306	1800	BE 36	53.46 N	067 54.18 W	4892
19	1	102306	1943	BO 36	51.19 N	067 55.06 W	
19	1	102306	2131	EN 36	48.73 N	067 56.71 W	
20	1	102306	2317	BE 36	39.39 N	067 44.82 W	4913
20	1	102406	0048	BO 36	38.25 N	067 46.62 W	
20	1	102406	0242	EN 36	38.27 N	067 47.86 W	
21	1	102406	0616	BE 36	12.50 N	067 27.01 W	4935
21	1	102406	0739	BO 36	11.74 N	067 27.58 W	
21	1	102406	0920	EN 36	10.88 N	067 28.61 W	

