Cruise Report: R/V Endeavor 466, T. Joyce. Ch. Sci., WHOI

Narragansett RI to Narragansett RI, 31 August to 10 September 2009

Line W: Continuing the Measurement Program as part of the US contribution to the study of the Atlantic Meridional Overturning Circulation

Background

The EN466 cruise has contributed the WHOI/LDEO research program that is investigating the characteristics and consequences of the Deep Western Boundary Current (DWBC) south of Cape Cod. Our ongoing study consists of repeated hydrographic/tracer sections across the DWBC and maintenance of a 6 element mooring array for direct measurement of the transport variability of the DWBC. This project is funded by the National Science Foundation. On the hydrographic sections, we measure temperature, salinity, and dissolved oxygen with a CTD, and collect bottle samples to calibrate the salinity and oxygen and to obtain CFC and SF6 tracer profiles across the DWBC. Selected water samples are also collected for analysis of ^{129}I concentration by Dr. John Smith (BIO, Canada). Our program, now in its 6th year of operation, currently makes yearly sections from the continental shelf out towards Bermuda. A full-depth current profile was obtained at each station using a pair of ADCPs mounted to the rosette. In addition, underway ADCP measurements to a nominal max depth of 800m were obtained with a hull-mounted, 75 kHz Ocean Surveyor from RDI.

On this cruise, additional work was done with one extra day each of support from NSF for J. Toole, and T. Duda, for shakedown tests of a new High Resolution Profiler (HRP2) for microstructure, and a shearmeter float, respectively.

Science Party

T. Joyce, J. Toole, L. St. Laurent, G. Tupper, B. Guest, J. Dunworth-Baker, C. Ahearn, R. Krishfield, E. Hobart, R. Petit (all from WHOI), W. Smethie, E. Gorman, S. Rab-Green (LDEO), K. Decotau, B. Rahter (FSU), and W. Fanning (URI Res. Tech.).

Cruise Narrative

Endeavor was loaded at URI and departed its home port at 0900 on 31 August under the direction of Captain Rett McMunn. Because the HRP work was a daylight operation that would take place throughout the cruise, we decided to form 2 watches of 12 hrs. each from 530-530, with the break occurring during dinner. A total of 26 hydrographic stations were made starting from the 90m isobath (station 1) out to Station 26, in excess of 5000m water depth over the Hatteras Abyssal Plain NW of Bermuda (Fig. 1, Table 1). In fact the southernmost stations were within the EEZ of Bermuda and clearance was obtained in advance for these stations. Station work was done from the aft hydrographic winch (#2) for stations 1-6, after which we switched to the forward traction winch for stations 7-11

while work was done on the controls for winch #2. The package had been set on the bottom on station 6 when upon command to heave in wire resulted in wire paying out. After this cast, the broadband 150 Kz ADCP on the bottom of the CTD rosette frame was found to be flooded and replaced with a backup. Beginning with station 12, we switched over to the aft winch without incident for the remainder of the cruise. On station 20, we again replaced the lower ADCP in the rosette with a 300 kHz workhorse unit, similar to that looking upward from the top of the frame. It was discovered that this 150 kHz unit replacement had also flooded – for reasons unknown at this time. We expect that stations 18 & 19 had only upward LADCP data because of this problem.

The shipboard ADCP system worked flawlessly during the cruise (Fig. 2), with consistent profiling to 800m depth. The velocity section shows a warm-core ring (distance 100:200 km) to the north of the Gulf Stream (200:300 km), with a cold core ring slightly west of our cruise track near 600:700 km distance from station 1.

CFCs and SF6 were measured with the new Lamont analytical system that measures these compounds on the same water sample. This system had been tested previously on Line W cruises, but this was the first cruise that it served as the primary analytical system. Samples were drawn into 500 cc glass bottles through a drawing tube extending to the bottom of the bottle, and the bottle was overflowed by 2 bottle volumes before capping with a ground glass stopper. The samples were then stored immersed in seawater until analysis. This eliminated the large glass syringes used on previous cruises for CFC samples and resulted in more rapid sampling. The preliminary results appear to be of excellent quality.

A total of 11 HRP stations were occupied, and a number of refinements were implemented and tested in advance of its first science mission on the upcoming DIMES cruise. The WHOI shearmeter was deployed after station 22 on the way south, and successfully recovered 64 hours after it dropped weights and surfaced on schedule near that location.

On the return track between the locations of stations 6 & 7, we broke off our ADCP line to recover an ailing Spray Glider for B. Owens (WHOI) at 1800 local time on 9 September. This glider had been deployed by another vessel and was having difficulty navigating its mission and needed to be recovered. Following the glider recovery and because of winds (25-30 kts) that were forecast to build to 40 kts overnight, we decided to head back to Narragansett where we tied up at 1200 on 10 September.

Acknowledgements

The Line W program is funded by the National Science Foundation through a grant OCE-0726720 to the Woods Hole Oceanographic Institution. We wish to thank Captain McMunn and the crew of the R/V Endeavor, and all of the shore-based personnel who assisted in making this a very successful cruise.

Table 1: EN466 Station/Event Summary

STA		Date	Time		Latitude			Longitude			Depth				#Botl
1		83109	2223	BE	40	17.78	N	70	12.62	W	89				
1		83109	2226	BO	40	17.83	N	70	12.7	W		10	82	80	6
1		83109	2234	EN	40	17.88	N	70	12.89	W					
2		90109	34	BE	40	9.1	N	70	7.26	W	114				
2		90109	37	BO	40	9.17	N	70	7.32	W		9	116	104	2
2		90109	45	EN	40	9.26	N	70	7.52	W					
3		90109	221	BE	40	0.73	N	69	59.59	W	156				
3		90109	227	BO	40	0.83	N	69	59.65	W		8	154	149	4
3		90109	236	EN	40	0.98	N	69	59.69	W					
4		90109	335	BE	39	54.34	N	69	55.61	W	644				
4		90109	352	BO	39	54.56	N	69	55.52	W		8	669	659	9
4		90109	424	EN	39	54.9	N	69	55.69	W					
5		90109	549	BE	39	51.2	N	69	53.68	W	1105				
5		90109	615	BO	39	50.94	N	69	53.47	W		10	117	1108	12
5		90109	652	EN	39	50.62	N	69	53.28	W					
6		90109	817	BE	39	47.34	N	69	50.5	W	1498				
6		90109	847	BO	39	47.46	N	69	50.03	W		9	1502	1494	13
6		90109	947	EN	39	47.11	N	69	49.91	W					
1	HRP	90109	1259	BE	39	42.2	N	69	48.2	W	2083				
1	HRP	90109	1346	EN	39	42.2	N	69	48.2	W					
7		90109	1542	BE	39	42.33	N	69	47.8	W	2077				
7		90109	1624	BO	39	42.42	N	69	47.82	W		9	2070	2078	19
7		90109	1723	EN	39	42.22	N	69	47.79	W					
8		90109	1919	BE	39	28.71	N	69	37.98	W	2350				
8		90109	2008	BO	39	29.26	N	69	36.82	W		21	2459	2365	22
8		90109	2115	EN	39	29.58	N	69	36.89	W					
9		90109	2303	BE	39	20.65	N	69	32.38	W	2493				
9		90109	2356	BO	39	21.15	N	69	32.43	W		11	2552	2512	22
9		90209	110	EN	39	22.29	N	69	31.95	W					
10		90209	441	BE	39	5.53	N	69	21.72	W	2957				
10		90209	546	BO	39	6.18	N	69	22.77	W		9	3064	2992	22
10		90209	711	EN	39	7.66	N	69	22.27	W					
11		90209	1040	BE	38	49.62	N	69	11.17	W	3240				
11		90209	1140	BO	38	49.42	N	69	11.29	W		15	3226	3265	22
11		90209	1318	EN	38	48.16	N	69	11.1	W					
2	HRP	90209	1331	BE	38	49	N	69	11.2	W	3250				
2	HRP	90209	1412	EN	38	47.71	N	69	10.7	W					
12		90209	1650	BE	38	33.66	N	68	58.24	W	3470				
12		90209	1816	BO	38	32.32	N	68	54.97	W		19	4822	3536	22
12		90209	2000	EN	38	30.67	N	68	50.99	W					
13		90209	2148	BE	38	19.02	N	68	51.98	W	3833				
13		90209	2333	BO	38	17.83	N	68	48.88	W		8	4624	3891	22
13		90309	110	EN	38	16.67	N	68	46.76	W					
14		90309	354	BE	38	5.53	N	68	40.01	W	4122				
14		90309	522	BO	38	5.21	N	68	37.65	W		10	4624	4182	22
14		90309	701	EN	38	4.98	N	68	35.61	W					

15		90309	913	BE	37	51.56	N	68	30.26	W	4354				
15		90309	1043	BO	37	51.09	N	68	27.7	W		15	4833	4446	22
15		90309	1232	EN	37	49.78	N	68	24.36	W					
3	HRP	90309	1218	BE	37	50.04	N	68	24.93	W	4365				
3	HRP	90309	1258	EN	37	49.65	N	68	23.83	W					
16		90309	1503	BE	37	37.32	N	68	22.41	W	4594				
16		90309	1625	BO	37	36.78	N	68	21.43	W		9	4632	4671	22
16		90309	1800	EN	37	36.36	N	68	21.19	W					
4	HRP	90309	1734	BE	37	36.48	N	68	21.07	W	4550				
4	HRP	90309	1815	EN	37	36.48	N	68	20.72	W					
17		90309	2136	BE	37	23	N	68	12.21	W	4738				
17		90309	2312	BO	37	23.54	N	68	10.39	W		10	5162	4815	22
17		90409	55	EN	37	23.34	N	68	7.99	W					
18		90409	336	BE	37	8.29	N	68	3.41	W	4901				
18		90409	515	BO	37	7.45	N	68	1.8	W		11	5564	4981	22
18		90409	710	EN	37	5.65	N	68	0.96	W					
19		90409	1013	BE	36	53.72	N	67	54.6	W	4930				
19		90409	1146	BO	36	53.13	N	67	54.15	W		15	5135	5009	22
19		90409	1330	EN	36	52.33	N	67	53.94	W					
20		90409	1857	BE	36	37.29	N	67	47.52	W	4831				
5	HRP	90409	2001	BE	37	22.72	N	68	12.84	W	4310				
5	HRP	90409	2112	EN	37	22.74	N	68	12.34	W					
20		90409	2051	BO	36	35.32	N	67	48.6	W		18	6110	5021	20
20		90409	2257	EN	36	32.88	N	67	49.37	W					
21		90509	353	BE	36	12	N	67	27.41	W	4978				
21		90509	526	BO	36	11.05	N	67	27.7	W		9	5717	5065	22
21		90509	720	EN	36	9.86	N	67	28.36	W					
22		90509	1253	BE	35	41.89	N	67	11.33	W	5140				
22		90509	1439	BO	35	41.53	N	67	14.31	W		18	5776	5212	22
22		90509	1656	EN	35	43.55	N	67	17.94	W					
6	HRP	90509	1638	BE	35	43.06	N	67	17.51	W	5059				
6	HRP	90509	1741	EN	35	43.29	N	67	18.35	W					
1	SHR	90509	1818	BE	35	43	N	67	19.9	W					
23		90509	2250	BE	35	13.65	N	66	52.35	W	5086				
23		90609	21	BO	35	13.75	N	66	52.72	W		6	5090	5187	22
23		90609	214	EN	35	13.46	N	66	53.21	W					
24		90609	601	BE	34	44.38	N	66	34.56	W	5163				
24		90609	740	BO	34	45.29	N	66	33.11	W		8	5542	5256	22
24		90609	956	EN	34	46.12	N	66	31.24	W					
25		90609	1324	BE	34	15.55	N	66	17.61	W	5208				
25		90609	1500	BO	34	16.13	N	66	16.91	W		8	5277	5302	22
25		90609	1659	EN	34	16.72	N	66	15.96	W					
7	HRP	90609	1625	BE	34	16.57	N	66	16.26	W	5159				
7	HRP	90609	1724	EN	34	16.83	N	66	15.81	W					
8	HRP	90609	2100	BE	33	47.04	N	65	59.74	W	5062				
8	HRP	90609	2231	EN	33	47.19	N	65	59.89	W					
26		90609	2246	BE	33	47.3	N	66	0.01	W	5110				
26		90709	19	BO	33	48.24	N	65	59.99	W		8	5247	5201	21
26		90709	210	EN	33	49.24	N	65	59.87	W					

9	HRP	90709	1312	BE	35	19.07	N	66	55.08	W	5030
9	HRP	90709	1409	EN	35	19.66	N	66	55.18	W	
10	HRP	90709	1831	BE	35	43.81	N	67	10.74	W	5069
10	HRP	90709	1923	EN	35	44.12	N	67	11.36	W	
1	BOT	90709	1940	BE	35	44.17	N	67	11.55	W	20
1	SHR	90809	1011	EN	35	48.2	N	67	46.1	W	
11	HRP	90809	1253	BE	35	44.65	N	67	17.32	W	5070
11	HRP	90809	1413	BE	35	44.76	N	67	17.48	W	
1	GLD	90909	2200	EN	39	38.7	N	70	39.5	W	

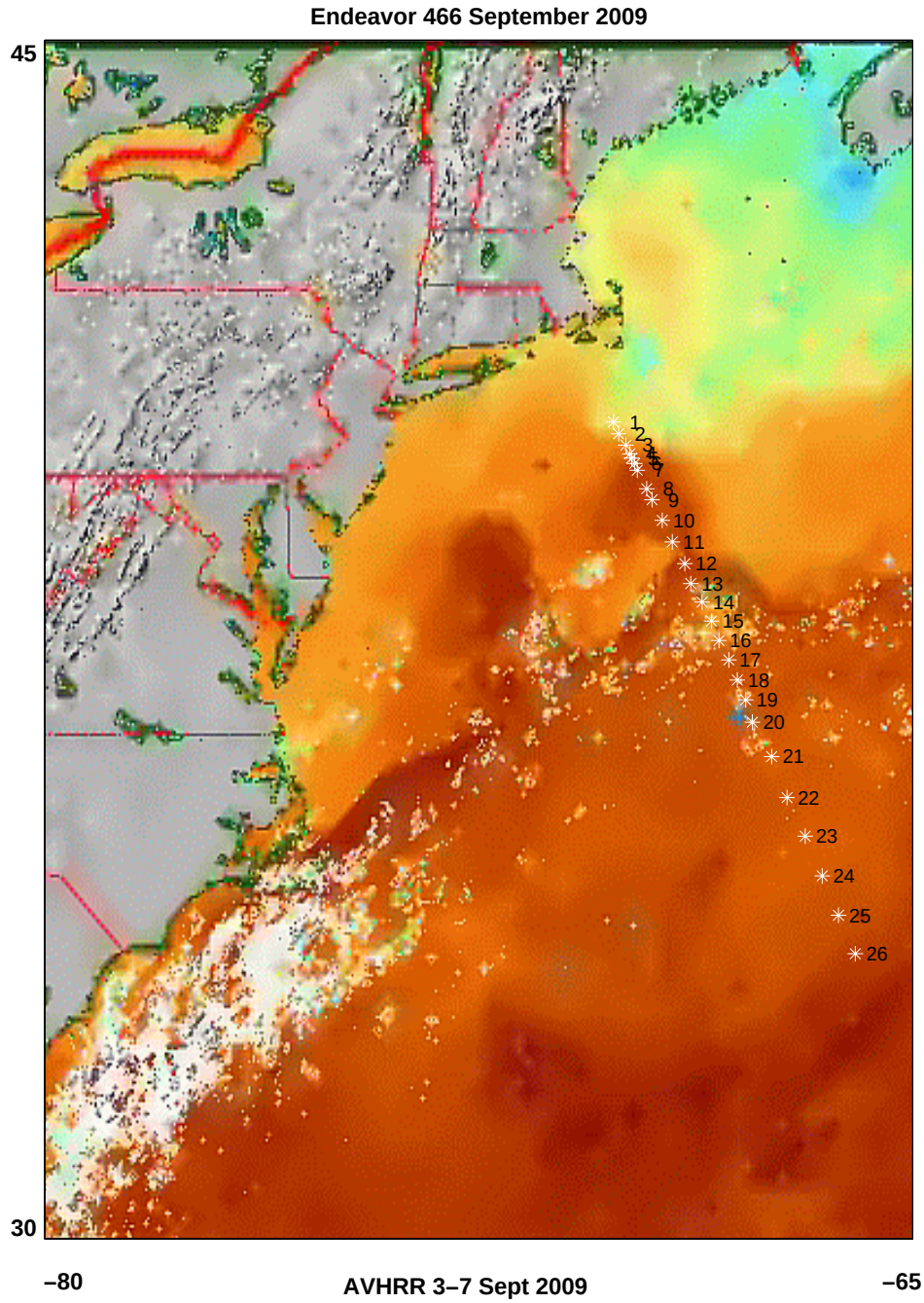

Figure 1. Composite AVHRR image of SST with staion locations for EN466.

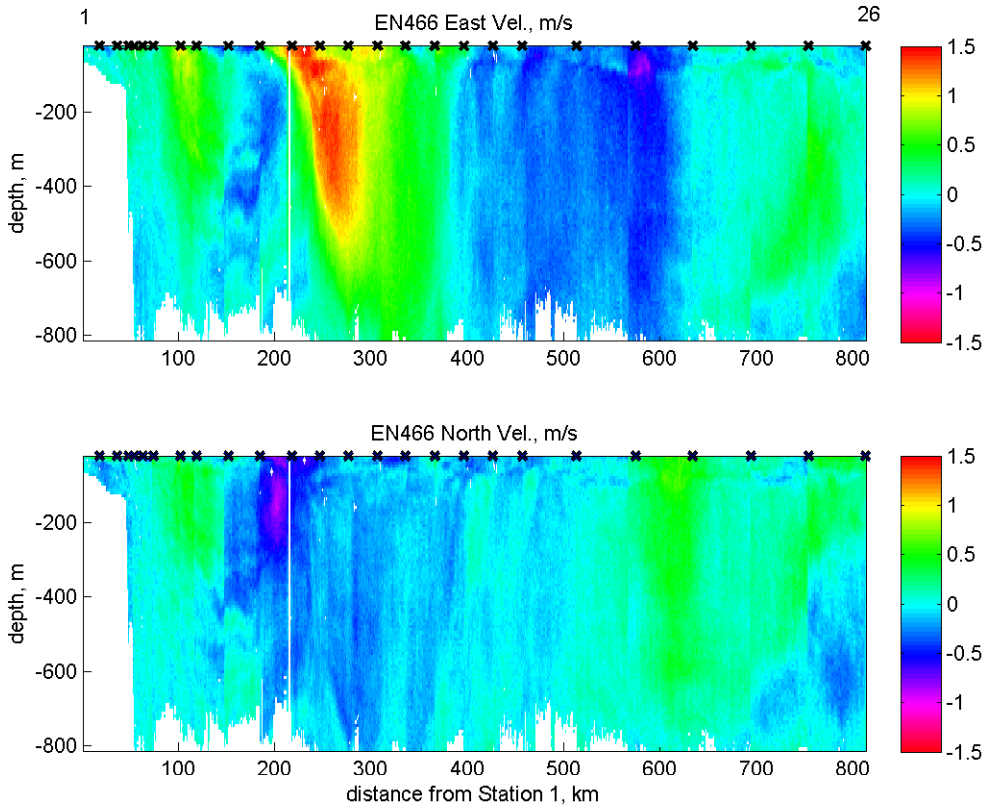

Figure 2. ADCP section along cruise track relative to the location of station 1 (left) on the continental shelf. Upper panel (east) and lower (north) are plotted in units of m/s, based on processed data from UHDAS system on the vessel.