



Cruise Report

R/V OCEANUS
OC415-04

EDDIES Project Tracer 2 cruise Chief

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Start date: 8/29/2005

End date: 9/15/2005

This cruise report is a post-cruise compilation by the Biological and Chemical Oceanography Data Management Office of several separate documents including:

Cruise_Report_OC415-4_SeaHorse.doc

Event_Log.xls

OC415_cast_sheets.pdf

Note: Fe_Cruise_Report.doc file (9 May 2006 version) was included in the original files, but it was corrupt and could not be opened.

Fine Structure Measurements with the SeaHorse Autonomous Profiler

The purpose of this component of the field program is to add meter-scale measurements of shear and density gradient to a tracer release study of diapycnal and isopycnal mixing in the nitracline of upwelling eddies in the Sargasso Sea. These measurements were accomplished using a SeaHorse moored profiler in a drifting configuration (Figure 1) in which it sampled from 200m to within 10 m of the surface. The SeaHorse is an autonomous profiler which is comprised of a surface buoy, jacketed wire, suspended weight (or mooring anchor in moored applications) and a positively buoyant instrument package. The SeaHorse profiler ratchets down the wire using a patented one-way clamping mechanism as the buoy follows the surface waves, and then smoothly slides up the wire as its instruments make measurements. The data are stored internally in the SeaHorse microcontroller using a CompactFlash card. The data streams for all payload instruments are synchronized using the SeaHorse microcontroller clock. The payload instruments for this experiment include a Sea-Bird SBE 19plus CTD, a WetLabs WetStar fluorometer and a Nobska MAVS current meter. MAVS is a 3-axis current meter which employs a differential time travel measurement technique, taking measurements across four acoustic axes to provide a vector-averaged velocity measurement.

One deployment of this mooring was carried out from the R/V Oceanus during cruise OC415-4. The deployment was at 29° 50.24'N, 69° 13.93'W at 1526 UTC on 31 Aug 2005. This placement was within several kilometers of the center of eddy A4. This mooring drifted for 10 days in the anti-cyclonic eddy and was recovered at 1520 UTC on 10 September 2005 at 30° 00.03'N, 69° 21.04'W. During the period of this deployment to SeaHorse completed 156 profiles at one-hour intervals. Due to light wind conditions during the early part of this deployment, 29 of the 156 profiles did not go below 100 m. After profile 156 a small bolt in the clamping mechanism of the SeaHorse backed off causing a fault in the clamp. From this point on in the deployment the SeaHorse was unable to climb down the mooring wire and no profiles were recorded for the last 3.5 days of the deployment. The drift of the SeaHorse mooring during the deployment was determined by a combination of surface forcing (wind, currents) on the surface buoy and drag generated by the SeaHorse which spends most of its time at the bottom of the mooring wire. A predominantly northeast wind during the mooring period caused the mooring to gradually drift out from the eddy center. However, this was also observed to happen for the drogued drifters which have very little surface expression and, therefore, displacement from the eddy center is also related to the velocity structure of the eddy core itself.

The results from the SeaHorse Sea-Bird CTD are shown in Figure 2. The result shows a water column with a surface mixed layer of approximately 20 m. Inertial period (24 hour for latitude 30°) oscillations are evident in the upper 50 m of the water column with isopycnals being displaced vertically by as much as 20 m. A sub-surface maximum in salinity became more prominent as the SeaHorse moved further from the eddy center. This is also observed in large-scale CTD transects of the eddy. The center of this salinity maximum decreases from about 50 m near the start of the mooring period (at center) to

about 70 m at the end. A sub-surface maximum in fluorescence is also observed by the SeaHorse profiler at depths in the range of 80-120 m. Chlorophyll concentrations in this area are predominantly in the 1-2 mg/m³ range with a few profiles showing concentrations as high as 4 mg/m³.

Results from the MAVS current meter on SeaHorse indicate that most of the shear in the water column appears in the upper 100 m (Figure 3). This appears to extend a bit deeper than seen in the previous deployments of SeaHorse on Tracer 1. A downward propagation of phase is apparent in the middle panel of Figure 3 showing the direction of the current. This appears to occur at the inertial frequency. Magnitudes of the currents were measured to be as large as 0.5 m/s. However, these magnitudes are relative to the SeaHorse mooring which is drifting in the eddy. Further analysis of the trajectory of the mooring may enable us to estimate absolute velocity.

This is the first time that the SeaHorse mooring has been used in a drifting configuration. It has produced some unique data in this field program and a significant amount has been learned about using the mooring in this configuration. One of the key elements of this mooring design is that the profiler moves up the wire due to its positive buoyancy and, therefore, is much less susceptible to heave than shipboard CTDs.

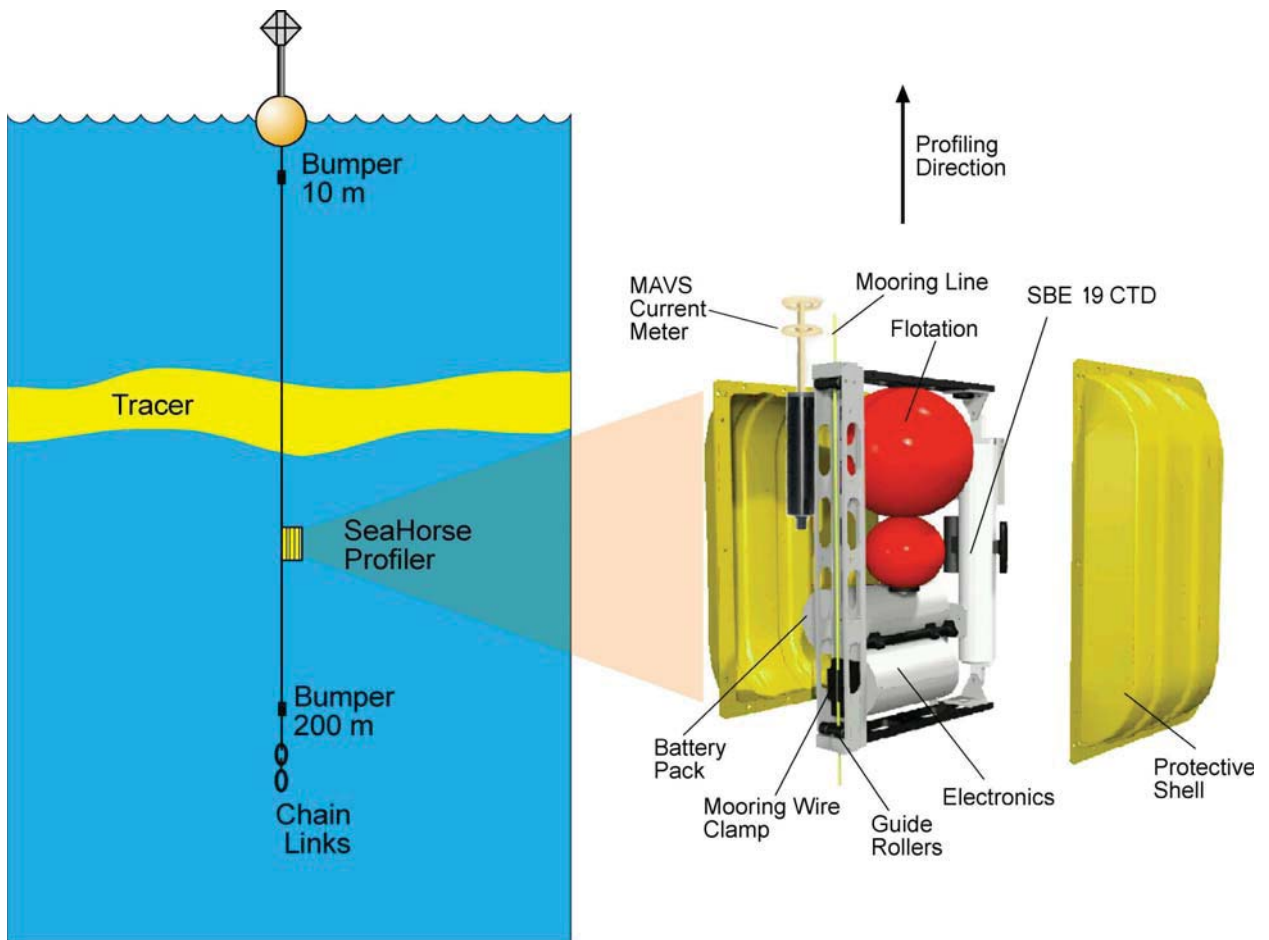


Figure 1: Configuration of the drifting SeaHorse mooring which uses the surface wave energy to climb down the mooring wire. A beacon on the surface buoy will transmit location through the Agros satellite system. Instrument payload will consist of a Sea-Bird 19+ CTD and Nobska MAVS acoustic current meter to measure ocean finestructure. The SeaHorse acts as a vane with respect to the horizontal mean flow, keeping the MAVS current meter upstream of the profiling package. SeaHorse will profile vertically upward every hour in the vicinity of the tracer patch released in the Sargasso Sea eddy.

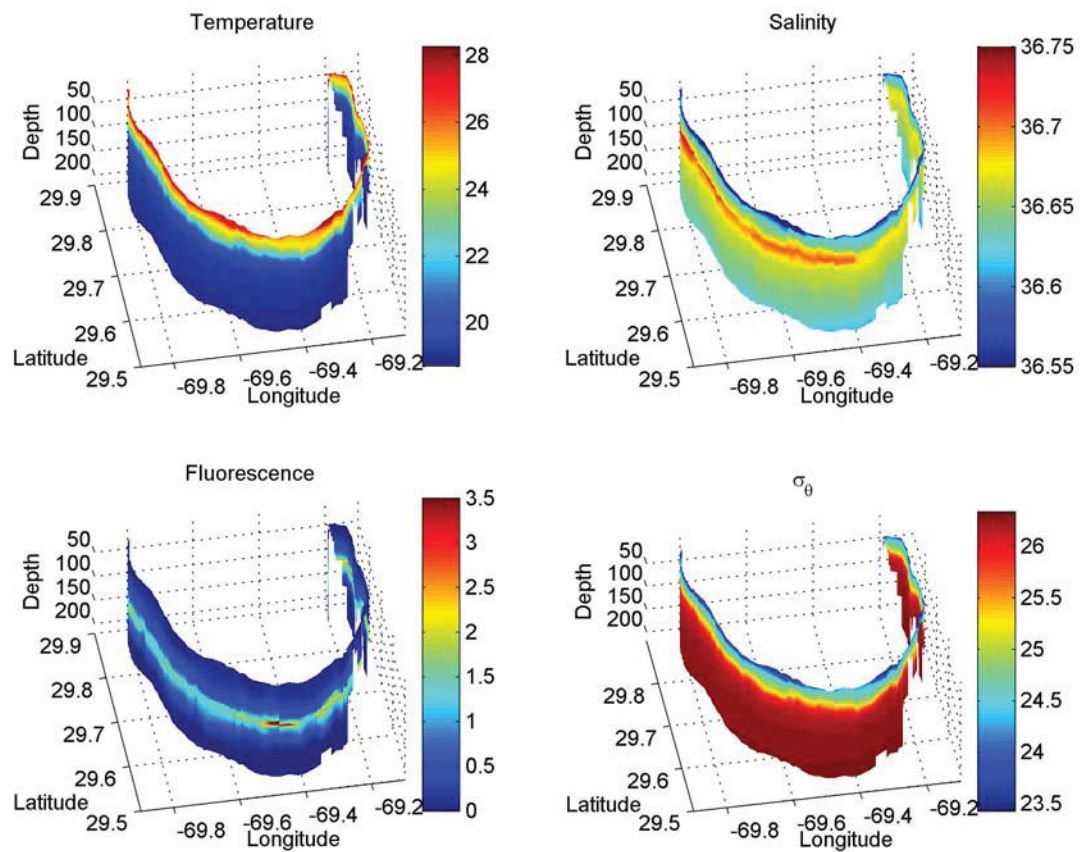


Figure 2: Data collected on SeaHorse with a Sea-Bird 19plus CTD include temperature (upper left), salinity (upper right), fluorescence (lower left) and density (sigma-theta, lower right).

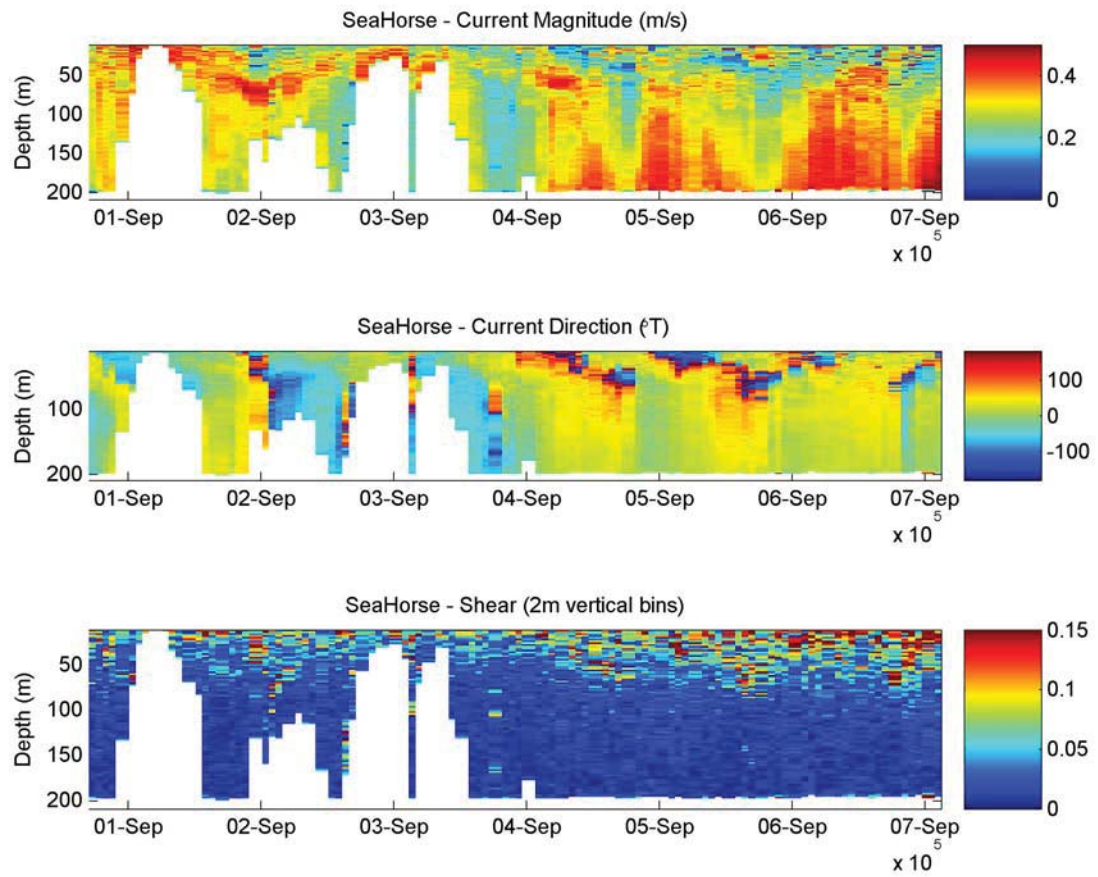


Figure 3: Current speed, direction and shear measured by the MAVS current meter during the deployment of SeaHorse in Eddy A4. The shear calculation is based on 2 m bin averages of velocity from 10 to 200 m.

EVENT LOG									
OCEANUS 415-4, EDDIES EXPERIMENT, TRACER 2, 29 August - 15 September 2005									
Event	Event	No.	Day	Time	Latitude		Longitude		Depth
Type			(UT)	(UT)	deg	min	deg	min	(m)
Oceanus	Depart St. George		29-Aug	0900					
Fe	Surface sample		30-Aug						
Sampler	Tow	1	31-Aug	0100	29	52.92	70	50.71	100
Sampler	End Tow	1	31-Aug	1230	29	42.66	69	50.71	
Seahorse	Deployment		31-Aug	1526	29	50.24	69	13.93	
Eddy Center (ADCP estimate)			31-Aug	1443	29	50.00	69	12.00	
CTD		1	31-Aug	1703	29	50.00	69	11.74	153
EM-Apex	Recovery	1636	31-Aug	2100	29	54.17	69	35.26	
Sampler	Tow	2	1-Sep	0100	29	47.43	70	47.05	107
Sampler	End Tow	2	1-Sep	1200	29	43.63	70	31.05	
Eddy Center (ADCP estimate)			1-Sep	0100	29	47.20	69	13.80	
Drogue	Deployment	52485	1-Sep	1518	29	45.80	69	14.13	
CTD	Nutrients	2	1-Sep	1529	29	45.82	69	14.82	1201
CTD	MITESS	3	1-Sep	1731	29	46.02	69	15.60	970
EM-Apex	Deployment	1636	1-Sep	2020	29	46.30	69	14.92	
Eddy Center (ADCP estimate)			1-Sep	2115	29	46.20	69	69.15	
Sampler	Tow	3	2-Sep	0100	29	48.48	70	43.38	174
Sampler	End Tow	3	2-Sep	1200	29	44.24	70	26.18	
EM-Apex		1633	2-Sep	1345	29	40.12	69	33.27	
CTD	Nutrients	5	2-Sep	1657	29	43.00	69	14.47	1200
CTD	MITESS	6	2-Sep	1923	29	43.00	69	14.47	212
Sampler	Tow	4	3-Sep	0100	29	43.58	70	43.18	182
Sampler	End Tow	4	3-Sep	1200	29	36.86	70	25.50	
CTD	Nuts & MITESS	7	3-Sep	1800	29	43.93	69	20.84	4045
Sled Cast	Calibration	5	3-Sep	2015	28	44.05	69	21.93	198
Sampler	Tow/Cast	5/6	4-Sep	0030	29	55.34	70	24.45	143
Sampler	End Tow	5/6	4-Sep	1130	30	5.71	70	11.57	
CTD	Nuts & MITESS	8	4-Sep	1550	30	27.60	70	12.90	1202
Sampler	Tow/Cast	6/7	5-Sep	0130	29	44.08	70	34.65	193
Sampler	End Tow	6/7	5-Sep	1200	29	41.08	70	17.34	
CTD	Nuts & MITESS	9	5-Sep	15.30	29	42.93	69	27.01	4530
Apex	Recovery	1636	5-Sep	2140	29	33.47	69	37.62	
Sampler	Tow/Cast	7/8	6-Sep	0100	29	49.26	70	27.17	127
Sampler	End Tow	7/8	6-Sep	1130	30	1.61	70	16.55	
Apex	Recovery	1632	6-Sep	1415	29	52.31	69	59.24	
CTD	Nutrients	10	6-Sep	1748	29	33.45	70	22.45	1202
CTD	MITESS	11	6-Sep	2051	29	36.5	70	22.94	165
Sampler	Tow/Cast	8/9	8-Sep	0230	29	49.26	70	27.17	303
Sampler	End Tow	8/9	8-Sep	1330	30	1.61	70	16.55	
CTD	Nutrients	12	8-Sep	1605	29	41.33	69	31.78	1202
CTD	MITESS	13	8-Sep	1810	29	41.82	69	31.75	415
CTD	Nutrients	14	8-Sep	2012	29	42.21	69	38.02	1202
Sampler	Tow/Cast	9/10	9-Sep	0030	29	41.75	70	32.65	105
Sampler	End Tow	9/10	9-Sep	1200	29	45.69	70	46.57	
CTD	Nutrients	15	9-Sep	1344	29	44.33	69	53.00	1203
CTD	Nutrients	16	9-Sep	1536	29	42.03	69	23.84	1202
CTD	Nutrients	17	9-Sep	1730	29	40.05	69	30.40	1203

CTD	Nuts & MITESS	18	9-Sep	1908	29	40.06	69	29.90	131
Sampler	Tow/Cast	10/11	10-Sep	0030	29	42.74	70	33.54	308
Sampler	End Tow	10/11	10-Sep	1200	29	51.20	70	55.57	
Seahorse	Recovery		10-Sep	1520	30	0.03	69	21.04	
Drogue	Search		10-Sep	1600					
Sled Cast	Background	12	10-Sep	1854	30	9.14	69	21.63	167
Sampler	Tow/Cast	11/13	11-Sep	0100	29	52.47	70	10.88	163
Sampler	Recovery	11/13	11-Sep	1230	29	43.29	70	25.26	
CTD	Nuts & MITESS	19	11-Sep	1424	29	37.51	69	37.56	1513
Eddy Center (ADCP estimate)			11-Sep	1635	29	36.98	69	37.00	
CTD	Nutrients	20	11-Sep	1759	29	37.64	69	45.51	1211
CTD	Nutrients	21	11-Sep	2029	29	37.51	69	57.45	1203
Arrive	Woods Hole		14-Sep		41	22.00	70	40.00	

Cruise: OC-415-4	Time in 1530(2)	Date in 1-Sep-05	Lat in 29° 45.906	Long In 69 14.354	Leg Tracer 2	Type CTD
Cast #: 02	Time out 1530(2) 1623	Date out 1-Sep-05	Lat out 29° 76.54	Long Out 69.24832	Depth 1200	Station OC415402
Samples: Nuthan						
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 28.3	3	X	23	OC-415-4-1		
2	20			-2		
3 23.2	40	X		-3		
4	60			-4		
5	70			-5		
6	80			-6	Sal # F21	
7	90			-7	Sal F22	
8	100			-8		
9	110			-9		
10	120			-10		
11	130			-11		
12	140			-12		
13	200			-13		
14	300			-14		
15	400			-15		
16	500			-16		
17	600			-17		
18	700			-18		
19	800			-19		
20	850			-20		
21 13.7	900	X		-21		
22	1000			-22		
23	1100			-23		
24 * 10.9	1200	X	X	-24		

* = Leak

Note - Forgot to shake & seal On After 20 mins

Cruise: 00-415-4	Time in ⁽²⁾ 1922	Date in 02-Sep-05	Lat in 29°43'22	Long In 67 14.47	Leg Trace 2	Type CTD
Cast #: 6	Time out ⁽²⁾	Date out	Lat out	Long Out	Depth 1200m	Station CTD 06
Bottle # / Draw Temp	Depth (m)	Oxygen	Oxygen Rep	Nut		
1 28.6	20 3	10	11, 12	QC-415-4-25		
2	20			-26		bottle leaking
3	40			-27		
4 22.2	60	10 13		-28		
5	70			-29		
6	80			-30		
7	90			-31		
8	100			-32		
9	110			-33		
10	120			-34		leak
11	130			-35		
12	140			-36		
13	200			-37		
14	300			-38		
15	400			-39		
16	500			-40		
17	600			-41		
18	700			-42		
19	800			-43		
20 14.7	850	15		-44		
21	900	12 15		-45		
22	1000			-46		
23	1100			-47		
24 11.2	1200	13 16		-48		

Cruise: 0045-4	Time in 1439	Date in 03 Sep 05	Lat in 29-43.93	Long In 69-20.83	Leg 4	Type ^{NUTRIENT} Tracometol
Cast #: CTD007	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD007
Bottle # / Draw Temp	Depth / Press dbar	Oxygen	Oxygen Rep	Nut		
1 29.0	3	1	2, 3	00-415-4-49		
2	20			-50	Leaky	
3 23.9	40	4		51		
4	60			52		
5	70			53		
6	80			54		
7	90			55		
8	100			56		
9	110			57		
10	120			58		
11	130			59		
12	140			60		
13	200			61		
14	300			62		
15	400			63		
16	500			64		
17	600			65		
18	700			66		
19	800			67		
20	900 800			68		
21 13.1	1000	5		69		
22	1100			70		
23	1100			71		
24 10.4	1200	6		72		

25 27 36

Cruise: 0C-415-4	(2) Time In 1548	(2) Date in 4-Sep-05	Lat in 30 27.543	Long In 70 12.843	Leg T/acc #2	Type CTD / i-ice / etc.
Cast #: 8	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD008
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	28.7 3	21	22, 23	0C-415-4-73		
2	20			-74	leaker	
3	24.7 40	24		75		
4	60			76		
5	70			77		
6	80			78		
7	90			79		
8	100			80		
9	110			81		
10	120			82	leaker	
11	130			83		
12	140			84		
13	200			85		
14	300			86	leaker	
15	400			87		
16	500			88		
17	600			89		
18	700			90		
19	14.0 800	26		91		
20	850			92		
21	900			93		
22	1000			94		
23	1100			95		
24	10.7 1200	28 27		96		

Cruise: 00-415-4	(12) Time in 1824	Date in 5-50-05	Lat in 29 24,950	Long In 69 26,947	Leg T1acord	Type CTD
Cast #: 9	Time out	Date out	Lat out	Long Out	Depth 4500	Station CTD 009
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 24.5	0	21	22, 23	00-415-04-97		
2	20			98		
3 24.5	40	24		99	Lacker	
4	60			100		
5	70			101		
6	80			102		
7	90			103		
8	100			104		
9	110			105		
10	120			106		
11	130			107		
12	140			108		
13	200			109		
14	300			110		
15	400			111		
16	500			112		
17	600			113		
18	700			114		
19	800			115		
20 14.8	850	25 26		116		
21	900			117		
22	1000			118		
23	1100			119		
24 11.4	1200	27 28		120		

Cruise: OC-415-4	Time in ⁽²⁾ 1746	Date in 6-SEP-05	Lat in 70-22-46	Long In 2953.43	Leg TAC022	Type CTD
Cast #: CTD10	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD10
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 28.5	0	29	30,31	OC-415-4-121		
2	20			122		
3 24.0	40	32		123		
4	60			124		
5	70			125		
6	80			126		
7	90			127		
8	100			128		
9	110			129		
10	120			130		
11	130			131		
12	140			132		
13	200			133		
14	300			134		
15	400			135		
16	500			136		
17	600			137		
18	700			138		
19 13.9	800	33		139		
20	850			140		
21	900			141		
22	1000			142		
23	1100			143		
24 10.6	1200	34		144		

Cruise: 00-415-4	Time in (2) 1604	Date in 8 Sep 05	Lat in 24° 41.343	Long in 69° 31.776	Leg Trace 2	Type CTD
Cast #: CTD 012	Time out	Date out	Lat out	Long Out	Depth (m)	Station 00-415-4-12
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 28.7/30.4	0	21	22, 23	00-415-04-145		
2	20			-146		
3 23.4/30.4	40	24		-147		
4	60			-148		
5	70			-149		
6	80			-150		
7	90			-151		
8	100			-152		
9	110			-153		
10	120			-154		
11	130			-155		
12	140			-156		
13	200			-157		
14	300			-158		
15	400			-159		
16	500			-160		
17	600			-161		
18	700			-162		
19 24.3	800	26		163		
20 14.3	850	26		164		
21	900	26		-165		
22	1000			-166		
23	1100			-167		
24 10.9	1200	28		-168		

UN #2 - 29, 30, 31 Draw Temp - 28.4

Cruise: 0C-415-4	Time in 2008	Date in 8-Sep-05	Lat in 29 42.008W	Long In 67 38.07W	Leg Track 2	Type CTD
Cast #: CTD 14	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD 14
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	3			0C-415-4-169		
2	20			-170		
3	40			-171		
4	60			-172		
5	70			-173		
6	80			-174		
7	90			-175		
8	100			-176		
9	110			-177		
10	120			-178		
11	130			-179		
12	140			-180		
13	200			-181		
14	300			-182		
15	400			-183		
16	500			-184		
17	600			-185		
18	700			-186		
19	800			-187		
20	850			-188		
21	900			-189		
22	1000			-190		
23	1100			-191		
24	1200			-192		

Cruise: 00-415-4	Time in 1343	Date in 9-Sept-01	Lat in 29 44.329	Long In 69 17.318	Leg Trawler 2	Type CTD
Cast #: 15	Time out	Date out	Lat out	Long Out	Depth 1200m	Station 00415415
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	3			00-415-4-193		
2	20			-194	Leaker	
3	40			-195		
4	60			-196		
5	70			197		
6	80			198		
7	90			199		
8	100			200		
9	110			201		
10	120			202		
11	130			203		
12	140			204		
13	200			205		
14	300			206		
15	400			207		
16	500			208		
17	600			209		
18	700			210		
19	800			211		
20	850			212		
21	900			213	Leaker	
22	1000			214		
23	1100			215		
24	1200			216		

Cruise: OC-415-4	(2) 01-Sep-05	Date in 1534	Lat in 29 42.041	Long In 69 23.858	Leg Tracend	Type CTD
Cast #: 16	Time out	Date out	Lat out	Long Out	Depth 1200	Station OC415-416
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	3			OC-415-4-217		
2	20			-218		
3	40			-219		
4	60			-220		
5	70			-221		
6	80			-222		
7	90			-223		
8	100			-224		
9	110			-225		
10	120			226		
11	130			227		
12	140			228		
13	200			229		
14	300			230		
15	400			231		
16	500			232		
17	600			233		
18	700			234		
19	800			235		
20	850			236		
21	900			237		
22	1000			238		
23	1100			239		
24	1200			240		

Cruise: 00-4154	Time in 1730	Date in 09-Sep-05	Lat in 29° 39.94	Long In 069° 30.51	Leg T12-2	Type CTD
Cast #: 17	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD 17
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 28.4	3	32	33, 34	00-415-04-241		
2	20			242		
3 23.9	40	35		243		
4	60			244		
5	70			245		
6	80			246		
7	90			247		
8	100			248		
9	110			249	- Leaker	
10	120			250		
11	130			251		
12	140			252		
13	200			253		
14	300			254		
15	400			255		
16	500			256		
17	600			257		
18	700			258		
19	800			259		
20 14.0	850	37		260		
21	900			261		
22	1000			262		
23	1100			263		
24 10.2	1200	38		264		

Cruise: 0415-4	(2) 1415	Date in 11-Sep-05	Lat in	Long In	Leg Tracer 2	Type CTD
Cast #: #1 #19	Time out	Date out	Lat out	Long Out	Depth 1500	Station 0415-419
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1 28.2	3	1	2, 3	04-415-4-265		
2	20			266		
3 22.5	40	4		267		
4	60			268		
5	70			269		
6	80			270		
7	90			271		
8	100			272		
9	110			273		
10	120			274		
11	130			275		
12	140			276		
13	200			277		
14	300			278		
15	400			279		
16	500			280		
17	600			281	leaking	
18	700			282		
19	800			283		
20	850			284		
21 12.9	900	5		285		
22	1000			286		
23	1100			287		
24 9.5	1200	6		288		

Cruise: 0C-415-4	Time in 1755	Date in 11-Sep-05	Lat in 29°37.56	Long In 69°47.48	Leg T/Allen	Type CTD
Cast #: 20	Time out	Date out	Lat out	Long Out	Depth 1200m	Station CTD 020
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	3			0C-415.4-289		
2	20			296		
3	40			291		
4	60			292		
5	70			293		
6	80			294		
7	90			295		
8	100			296		
9	110			297		
10	120			298		
11	130			299		
12	140			300		
13	200			301		
14	300			302		
15	400			303		
16	500			304		
17	600			305		
18	700			306		
19	800			307		
20	850			308		
21	900			309		
22	1000			310		
23	1100			311		
24	1200			312		

Cruise: 0646-4	Time in 12030	Date in 11-Sep-07	Lat in 29.37531	Long In 069°57.438	Leg Traction 2	Type CTD
Cast #: 021	Time out	Date out	Lat out	Long Out	Depth 1200	Station CTD021
Bottle # / Draw Temp	Depth	Oxygen	Oxygen Rep	Nut		
1	3			06-415.4-313		
2	20			314		
3	40			315		
4	60			316		
5	70			317		
6	80			318		
7	90			319		
8	100			320		
9	110			321		
10	120			322		
11	130			323		
12	140			324		
13	200			325		
14	300			326		
15	400			327		
16	500			328		
17	600			329		
18	700			330		
19	800			331		
20	850			332		
21	900			333		
22	1000			334		
23	1100			335		
24	1200			336		