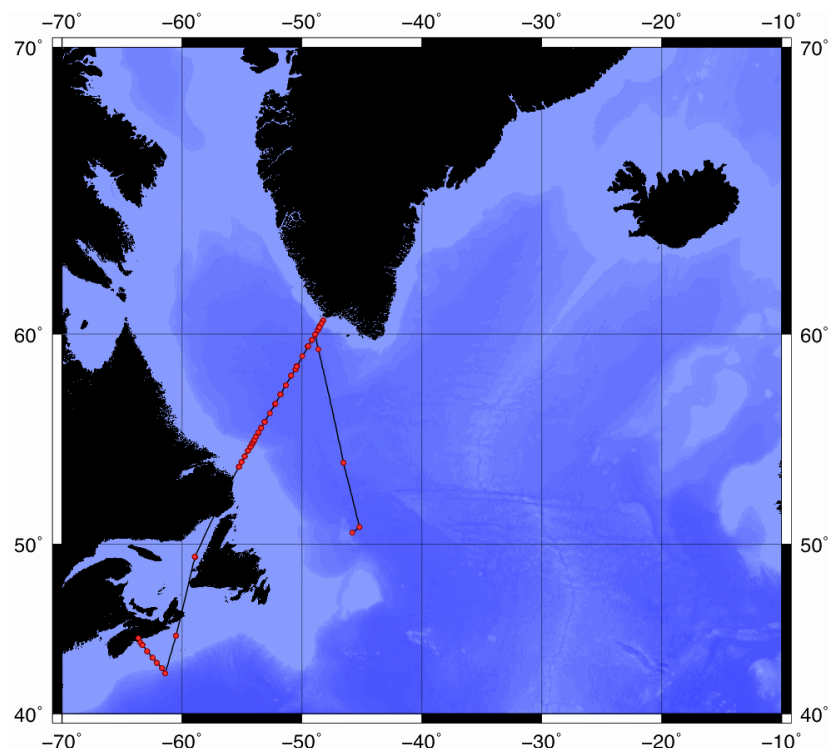


CRUISE REPORT: AR07W

(Updated NOV 2012)



Highlights

Cruise Summary Information

WOCE Section Designation	AR07W	
Expedition designation (ExpoCodes)	18HU20040515	
Chief Scientists	Glen Harrison / BIO	
Dates	2004 May 15 to 2004 May 30	
Ship	<i>CCGS Hudson</i>	
Ports of call	Dartmouth, NS, Canada - St. John's, NL, Canada	
Geographic Boundaries	60° 34.01' N	
	63° 38.20' W	45° 11.94' W
	42° 31.84' N	
Stations	27 CTD/Rosette Stations	
Floats and drifters deployed	10 PROVOR floats deployed	
Moorings deployed or recovered	1 recovery, 1 deployment	

Glen Harrison

Ocean Sciences Division • Department of Fisheries and Oceans • Bedford Institute of Oceanography

PO Box 1006 • Dartmouth, NS • Canada • B2Y 2A4

Email: harrisong@mar.dfo-mpo.gc.ca

Links To Select Topics

Shaded sections are not relevant to this cruise or were not available when this report was compiled.

Cruise Summary Information	Hydrographic Measurements
Description of Scientific Program	CTD Data:
Geographic Boundaries	Acquisition
Cruise Track (Figure): PI CCHDO	Processing
Description of Stations	Calibration
Description of Parameters Sampled	Temperature Pressure
Bottle Depth Distributions (Figure)	Salinities Oxygens
Floats and Drifters Deployed	Bottle Data
Moorings Deployed or Recovered	Salinity
	Oxygen
Principal Investigators	Nutrients
Cruise Participants	Carbon System Parameters
	CFCs
Problems and Goals Not Achieved	Helium / Tritium
Other Incidents of Note	Radiocarbon
Underway Data Information	References
Navigation Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	
Thermosalinograph	
XBT and/or XCTD	
Meteorological Observations	Acknowledgments
Atmospheric Chemistry Data	
Data Processing Notes	

CRUISE REPORT

HUDSON 2004016

LABRADOR SEA

WOCE LINE AR7W

15 May - 30 May, 2004

A. CRUISE NARRATIVE

1. Highlights

- a. WOCE Designation: WOCE Line AR7W
Atlantic Circulation Experiment
- b. Expedition Designation: Hudson 2004016
- c. Chief Scientist: Glen Harrison
Ocean Sciences Division
Department of Fisheries and Oceans
Bedford Institute of Oceanography
PO Box 1006
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Internet harrisong@mar.dfo-mpo.gc.ca
- d. Ship: CCGS Hudson
- e. Ports of Call: May 15 BIO, Dartmouth, NS, Canada
May 30 St. John's, NL, Canada
- f. Cruise Dates: May 15 to May 30, 2004

2. Cruise Summary Information

a. Cruise Track

A cruise track is shown in [Figure A.2.1](#). The ship's position at 0000Z on each day of the cruise is indicated with a date label.

The WOCE cruise station summary file (SUM) outlines the science operations conducted during the cruise. In the Comment section of the SUM file there is frequent mention of operation notes indicated by "Op Note". These notes are included in [Appendix 1](#).

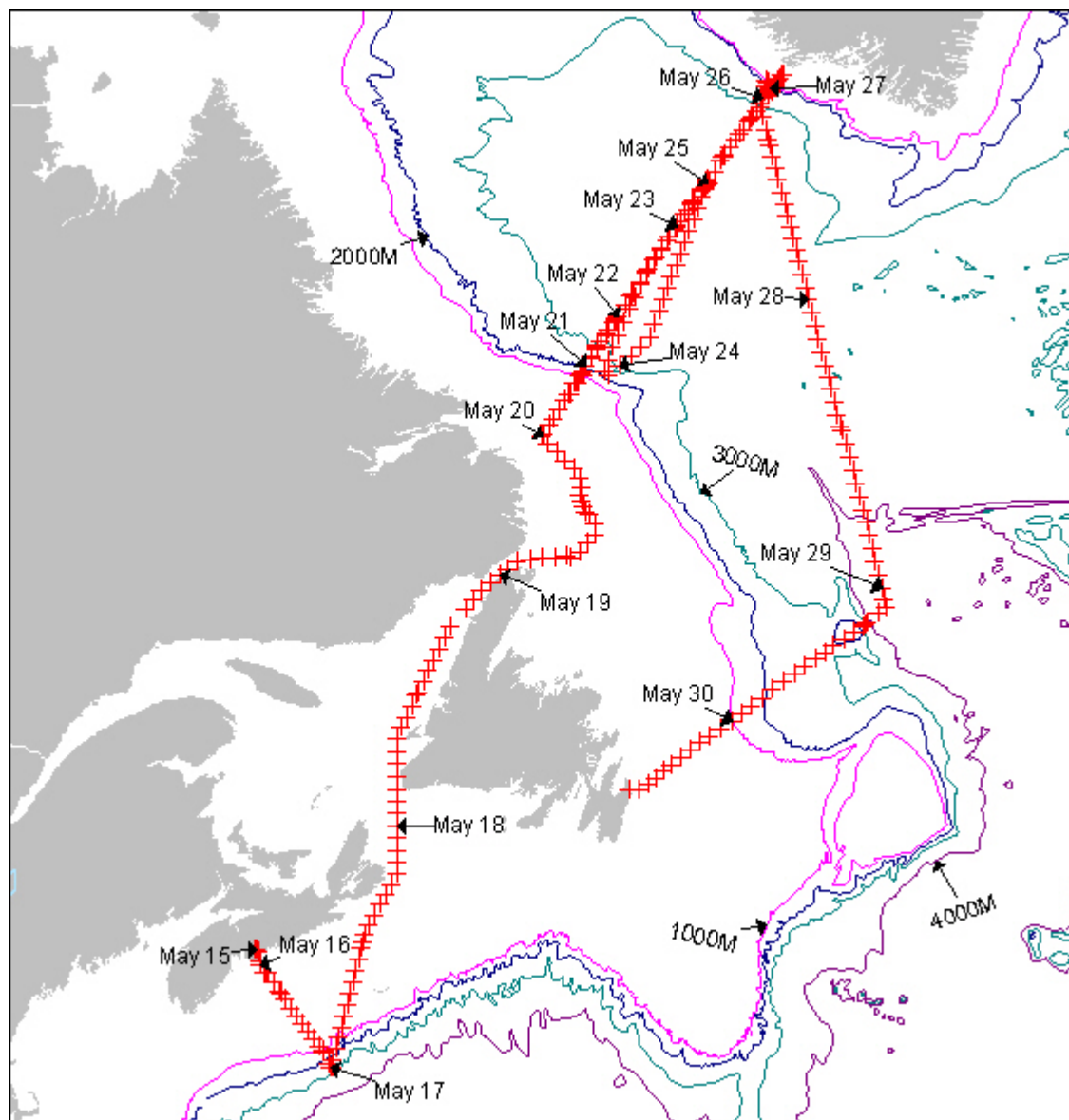


Figure A.2.1 Cruise track for 18HU2004016/1. The date labels indicate the ship's position at 0000Z.

b. Total Number of Stations Occupied

The CTD and ROS station positions are shown in [Figure A.2.2](#). The WHP stations are all contained in the box defined by 50-62°N and 40-60°W. [Table A.2.1](#) lists the science operations for 18HU2004016.

Cast Type	Number of Operations	Detailed Division	Operation Numbers
Rosette & CTD	27	26 regular AR7W Sites (L3 line) plus Sites 8.5	see Table A.2.2
	1	1 to profile warm LS Eddy	315
	7	Halifax Line Sites	See Table A.2.3
	2	Orphan Basin	287, 289
	7	Biology Casts not included in other tables	26, 27, 81, 133, 237, 280, 283
	1	Basin test	1
	1	Failed Cast	35
Moorings	2	1 recovery, 1 deployment	54, 56
	1	Release test	55
Floats	10	PROVOR floats deployed	91, 135, 214, 247, 267, 281, 282, 288, 290, 291
Biology	104	76, 200 µm net tows	3, 4, 6, 10, 11, 12, 15, 17, 18, 21, 22, 24, 25, 28, 29, 31, 32, 34, 37, 39, 41, 43, 45, 47, 49, 51, 57, 59, 61, 64, 66, 70, 72, 76, 78, 80, 87, 89, 97, 99, 118, 120, 122, 130, 132, 144, 146, 148, 160, 161, 204, 206, 209, 211, 212, 232, 234, 235, 236, 243, 244, 245, 252, 253, 255, 256, 258, 259, 261, 263, 265, 276, 278, 284, 285, 286
		28, 76 µm net tows	5, 7, 16, 23, 30, 33, 38, 42, 46, 50, 58, 60, 65, 71, 77, 79, 88, 98, 119, 121, 131, 145, 147, 205, 210, 233, 264, 277
Chemistry		¹²⁹ I surface	36, 53, 67, 90, 100, 123, 134, 162, 213, 238, 246, 254, 266, 257, 262, 260
		¹²⁹ I profile	82, 110, 149, 223, 279
Other		330 hrs Ship Board ADCP	No number assigned
		360 hrs. along-track T, S, and fluorescence	No number assigned
	127	XBT Deployments	68, 69, 74, 75, 83 – 86, 92 – 96, 101 – 109, 111 – 117, 124 – 129, 136 – 143, 150 – 159, 163 – 202, 207, 208, 215 – 222, 224 – 231, 239 – 242, 248 – 251, 268 - 275

Table A.2.1 Science operations conducted on 18HU2004016/1.

AR7W Site Number	2004016 Deep Cast Operation Number
1	-
2	-
3	36
4	40
5	44
6	48
7	53
8	62
8.5	63
9	67
10	73
11	82
12	90
13	100
14	110
15	123
16	134
17	149
18	162
19	213
20	223
21	238
22	246
23	279
24	254
25	266
25.3	-
25.7	-
26	257
27	262
28	260

Table A.2.2. AR7W sites and rosette and CTD operation numbers for 18HU2004016/1. Note that sites 1 and 2 could not be occupied due to ice and sites 25.3 and 25.7 were not occupied due to time constraints.

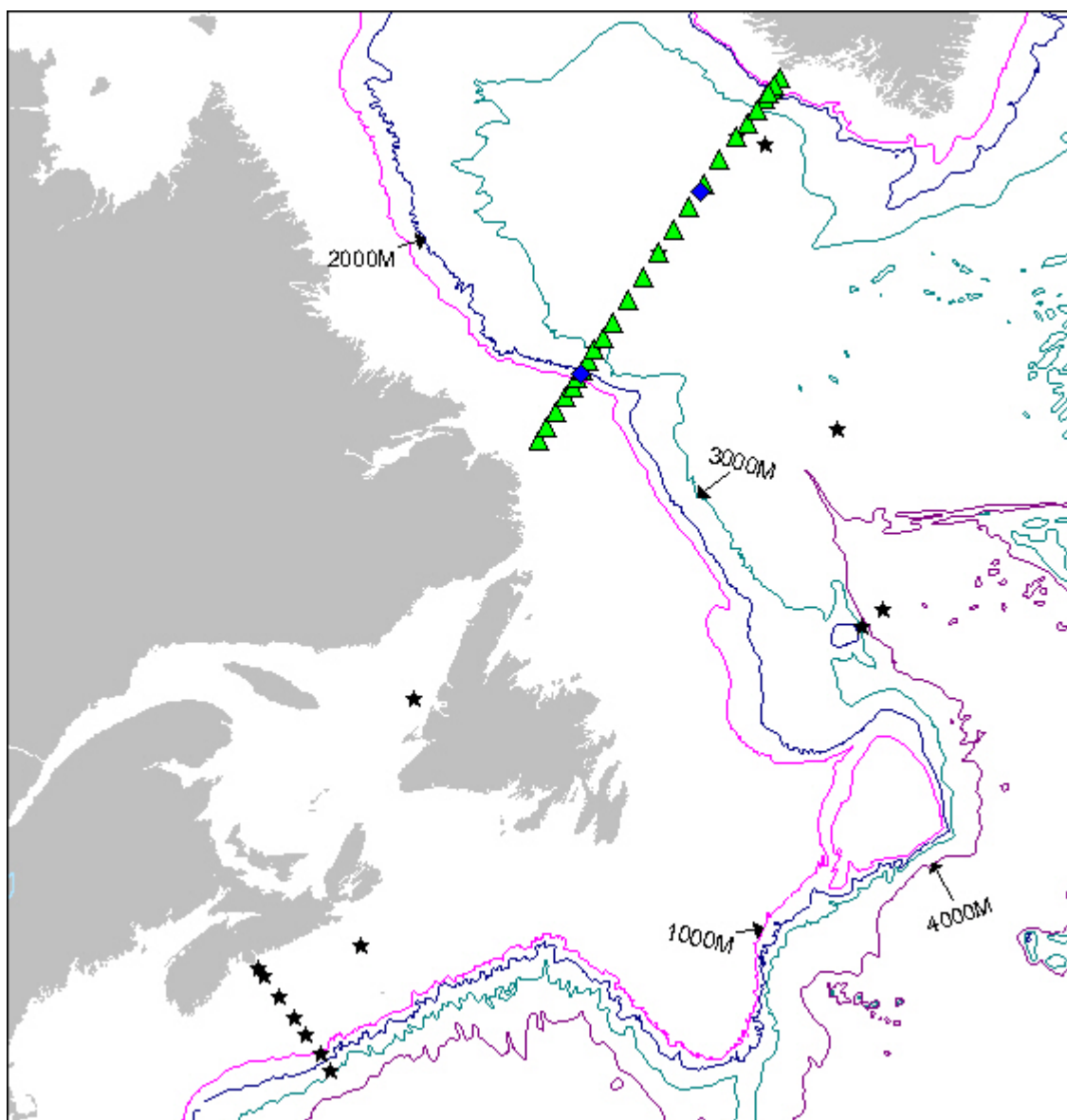


Figure A.2.2 This map shows the station positions for CTD only operations (blue solid diamonds); rosette, CTD and LADCP operations (green filled triangles); rosette and CTD operations (black star) for Hudson 18HU2004016/1.

Halifax Line Number	2004016 Deep Cast Operation Number
1	2
2	8
3	9
4	13
5	14
6	19
7	20

Table A.2.3. Halifax Line sites and rosette operation numbers for 18HU2004016/1.

Along AR7W, the stations were full-depth WHP small volume rosette casts with up to 24 rosette bottles. Water samples were analyzed for CFCs, carbon tetrachloride, total carbonate, alkalinity, oxygen, salinity, and nutrients. On some casts, samples were collected for ^{129}I (iodine-129).

c. Floats and Drifters deployed

Listed in [table A.2.5](#) are the 10 PROVOR floats that were deployed.

PROVOR Float #	WMO #	Event Number	Launch Position		Start Date / Time	Launch Date / Time
			Latitude	Longitude		
MT-157	4900528	91	55 52.3 N	53 24.0 W	21 May 2004 18:48	21 May 2004 19:32
MT-155	4900526	135	57 22.4 N	51 45.7 W	22 May 2004 17:05	22 May 2004 18:06
MT-163	4900534	214	58 34.9 N	50 24.4 W	25 May 2004 02:06	25 May 2004 02:48
APEX- 1392	4900494	247	59 45.7 N	49 06.6 W	25 May 2004 19:58	25 May 2004 21:50
APEX- 1393	4900495	267	60 18.4 N	48 37.1 W	26 May 2004 23:22	27 May 2004 01:50
MT-160	4900531	281	57 30.1 N	47 53.4 W	27 May 2004 19:05	27 May 2004 20:29
MT-168	4900539	282	54 59.7 N	46 52.0 W	28 May 2004 05:47	28 May 2004 07:21
MT-108	4900418	288	50 53.6 N	45 12.4 W	29 May 2004 04:47	29 May 2004 06:08
MT-161	4900532	290	50 35.4 N	45 48.5 W	29 May 2004 10:18	29 May 2004 11:45
MT-164	4900535	291	50 10.0 N	46 49.1 W	29 May 2004 13:54	29 May 2004 15:18

Table A.2.5 PROVOR float deployments on Hudson 2004016

d. Moorings deployed or recovered

There were two mooring related operations conducted. Mooring M1475 was recovered in the Labrador Sea and mooring M1514 was deployed in the same area. The following summarizes the mooring operations.

Deployment:

M 1514	55 07.171 N 54 05.554 W	Standard mooring consisting of one current meter positioned 20m off bottom along AR7W on the Labrador Slope (12-month deployment) at the 1032 metres.
--------	----------------------------	---

Recovery:

M 1475	56 07.171 N 54 05.554 W	Standard mooring consisting of one current meter positioned 20m off bottom along AR7W on the Labrador Slope (12-month deployment) at the 1032 metres.
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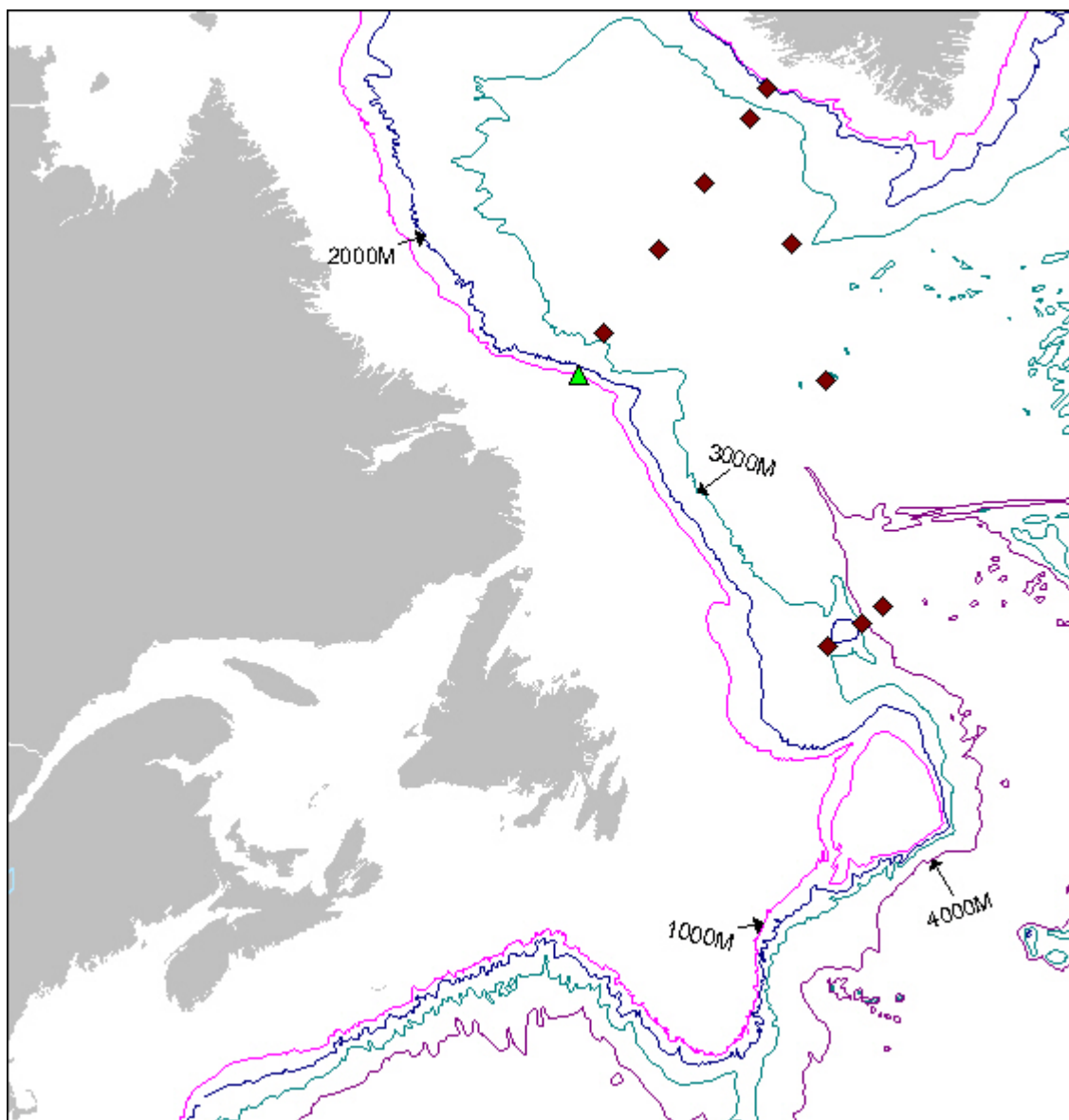


Figure A.2.3 Mooring operations (green filled triangle - a mooring was recovered and a new one deployed in the same location) and float deployment locations (burgundy filled diamonds) for Hudson 18HU2004016/1.

3. List of Principal Investigators

Name	Affiliation	Responsibility
Allyn Clarke	BIO clarkea@mar.dfo-mpo.gc.ca	Senior scientist Overall co-ordination
Bob Gershey	BDR Research rgershey@fox.nstn.ns.ca	Alkalinity, carbonate, CFCs
Glen Harrison	BIO harrisong@mar.dfo-mpo.gc.ca	Coordinator biological program nitrate and ammonium utilization by phytoplankton, sediment traps Labrador Sea.
Erica Head	BIO heade@mar.dfo-mpo.gc.ca	Macrozooplankton distribution, abundance and metabolism
Paul Kepkay	BIO kepkayp@mar.dfo-mpo.gc.ca	Dissolved organic carbon, colloid chemistry and plankton respiration
Peter Jones	BIO jonesp@mar.dfo-mpo.gc.ca	Alkalinity, carbonate, CFC's
John Lazier	BIO lazierj@mar.dfo-mpo.gc.ca	CTD data, moored instrument data
Bill Li	BIO lib@mar.dfo-mpo.gc.ca	Pico-plankton distribution and abundance, bacteria
John Loder	BIO LoderJ@mar.dfo-mpo.gc.ca	Moorings, Scotian Slope and Flemish Pass
Robert Pickart	WHOI pickart@rsp.whoi.edu	Lowered ADCP
John Smith	BIO smithjn@mar.dfo-mpo.gc.ca	Chemistry isotopes
Igor Yashayaev	BIO YashayaevI@mar.dfo-mpo.gc.ca	Hydrography and XBTs

Table A.3.1. List of Principal Investigators. See Section 7 for addresses.

4.1 Physical - Chemical Program

a. Narrative

This expedition was conducting operations in support of four ongoing scientific initiatives.

The first initiative is in support of the North Atlantic Oscillation and the Atlantic Thermohaline Circulation Principal Research Areas of the Climate Variability and Predictability (CLIVAR) project of the World Climate Research Programme (WCRP). The occupation of the Labrador Sea section and the recovery of the one Labrador Sea mooring provide a measure of the winter cooling and water mass transformations over the

winters of 2003/2004. The resetting of the mooring on the 1000 metre isobath on the Labrador slope continues a 20+ year observation program of the Labrador Current.

The second initiative is the continuation of the Labrador Sea project of the Canadian Joint Global Ocean Flux Study (JGOFS). The biological program is designed to characterize the late spring biological processes in the Labrador Sea and its shelf regions and is discussed in a later section of this document. The physical/chemical oceanographic program observes nutrients, total carbonate, alkalinity and CFCs over the entire water column in order to document the vertical transport of carbon via winter convection in the Labrador Sea as well as the changes in carbon storage in the deep waters of the North Atlantic.

The third initiative is to observe the physical and chemical parameters at the various stations of the Halifax Section in support of DFO's Atlantic Zonal Monitoring Program.

The fourth initiative was to deploy profiling floats as a Canadian contribution to the International GODAE/Argo program. Ten floats were deployed; seven in the Labrador Sea proper and three in its outflow region around Orphan Knoll.

b. Radioisotope Sampling Program

John Smith

Near surface water samples were collected for ^{129}I from a near surface rosette bottle at 16 stations on the L3 (AR7W) line. Full depth sampling for ^{129}I was carried out at 5 stations on the same section. See [table A.2.1](#) for the list of operations during which ^{129}I was sampled.

4.2 Biological Program

a. Narrative

The biological program conducted as part of cruise 2004016, with some modifications, was a continuation of studies began in 1994 to describe the large-scale (spatial and temporal) variability in plankton biomass, productivity and biogenic carbon inventories in the Labrador Sea.

The program has consisted of essentially five elements:

- 1) a phytoplankton biomass/primary productivity program conducted by Glen Harrison and Jeff Anning with assistance from Tim Perry,
- 2) a microbial program conducted by Paul Dickie (for Bill Li),
- 3) a mesozooplankton program conducted by Les Harris and Tim Perry (for Erica Head),
- 4) a dissolved organic carbon/community respiration program conducted by Jay Bugden (for Paul Kepkay), and

The ultimate aim of these studies is twofold:

- 1) to provide a description of the inventories in and export of biogenic carbon from the Labrador Sea, their turnover rates and variability in space and time as part of OSD's continuing climate-studies and
- 2) to provide a description of plankton life-cycles and productivity in the Labrador Sea and its influence or contribution to ecosystems downstream in support of OSD's fisheries-related research.

In addition to the Labrador Sea study, phytoplankton, mesozooplankton and nutrient samples were collected at the seven stations along the Halifax line in support of OSD's obligations to the Atlantic Zone Monitoring Program (AZMP).

b. Stable Isotope Studies of Carbon and Nitrogen (nitrate and ammonium) Utilization by Phytoplankton

**Glen Harrison
/ Tim Perry**

This work represents a continuation of research begun in 1994 to determine the primary productivity (in terms of carbon and nitrogen) of phytoplankton in the Labrador Sea. Carbon dioxide (CO₂), nitrate (NO₃) and ammonium (NH₄) utilization rates from eight depths in the photic zone (i.e. the 1% light level ranged from 31-71 m) were determined using stable isotope tracer (¹³C and ¹⁵N) methods. Incubations experiments were carried out in on-deck 'simulated in-situ' incubators. A total of 7 experiments were conducted (see Table A.4.2.1). In addition to isotope tracer experiments, particulate organic matter (nitrogen and carbon) were determined at the productivity depths and ammonium concentrations were measured at 11 depths in the upper 200m.

Date	Site	Event #	Photic Depth (m)	¹⁵ N/ ¹³ C	POC/ PON
20-May-04	L3_07	53	71	x	x
21-May-04	L3_11	181	68	x	x
22-May-04	L3_16	133	35	x	x
25-May-04	L3_21	237	39	x	x
26-May-04	L3_26	257	30	x	x
27-May-03	Transit	280	33	x	x
28-May-04	Transit	283	56	x	x

Table A.4.2.1. Sampling for stable isotopes.

c. Zooplankton Sampling**L. Harris / E. Head**

The zooplankton sampling is part of an ongoing program, the aim of which is to investigate the distribution, abundance and life history of the major zooplankton groups found in the Labrador Sea and its associated shelf systems. Particular emphasis is placed on the copepod species of the *Calanus* genus, which dominate the zooplankton in this region.

Vertical net tows were taken at 34 stations (7 on the Halifax Line, 2 in transit and 25 on the L3 line). At all stations, tows were made from 100 meters to the surface using a $\frac{3}{4}$ meter, 200 μ ring net. At nine of these stations an additional tow was made using a $\frac{1}{2}$ meter, 76 μ ring net. See [Figure A.4.2.1](#) below for station locations where nets were used.

d. Measurements Of Copepod Reproduction Rates**L. Harris / E. Head**

Egg production rates of *Calanus finmarchicus*, the dominant copepod species, were measured at 9 stations in the Labrador Shelf.

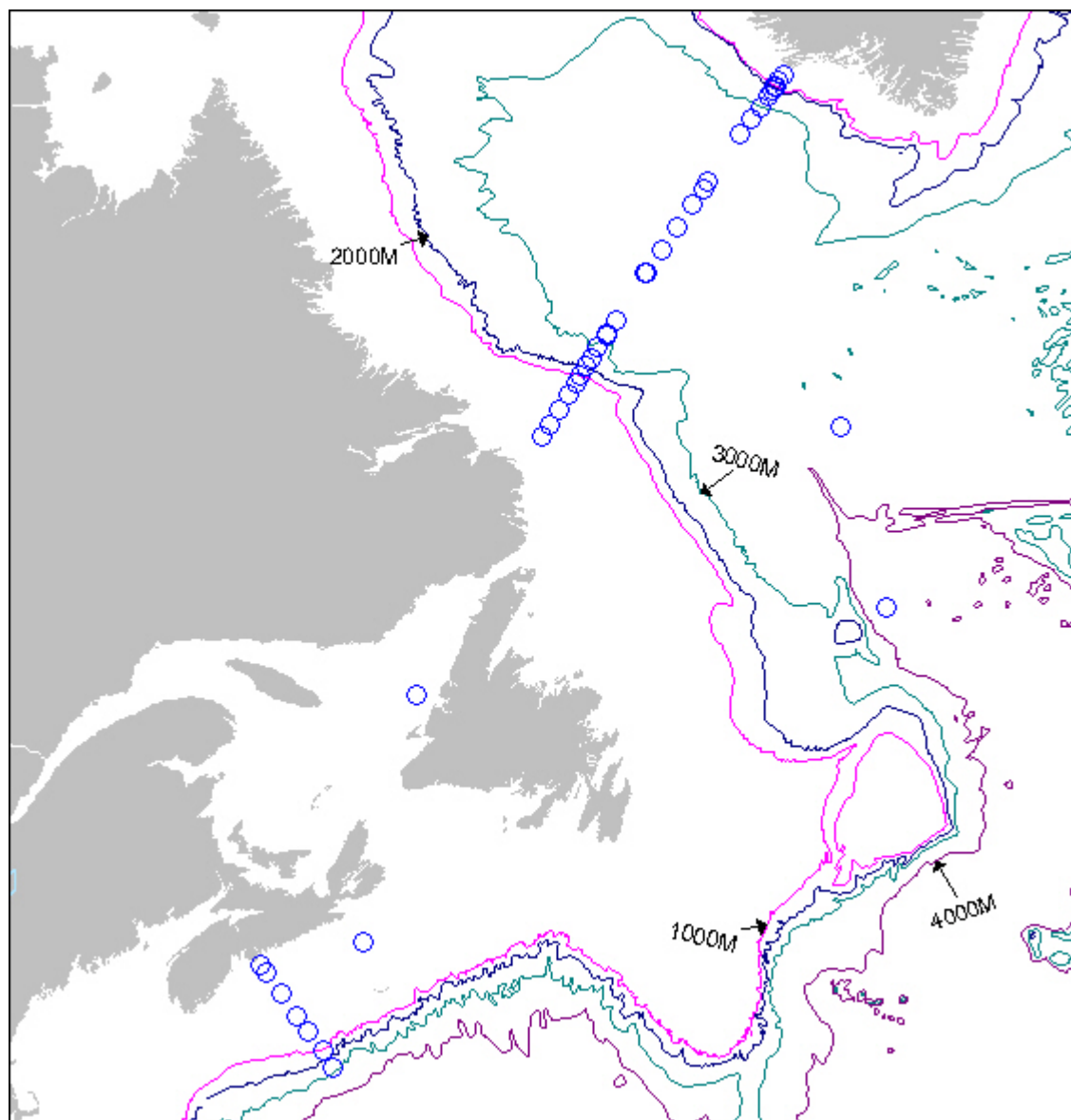


Figure A.4.2.1 Net tow (blue open circle) locations for 18HU2004016/1.

**e. Total Organic Carbon (TOC) and Microbial
Community Respiration**

Jay Bugden / Paul Kepkay

In order to better understand the cycling of carbon and the mechanisms controlling it in the Labrador Sea, it is necessary to examine the pool of total organic carbon (TOC), and look at the activity of the microbial community in the water column. By examining the rate of respiration and size fractionating the TOC, information on the fate of carbon in this marine environment may be elucidated.

During CCGS Hudson cruise 2004-016 five (5) stations were sampled at the surface and at the chlorophyll maximum (usually between 10 and 50m depth) for gross microbial

community respiration, and for the same stations only the surface was sampled for size fractionation of TOC (ultrafiltration). The stations sampled are listed below. TOC depth profiles were also collected from the stations indicated in the table below.

Station	Respiration	Ultrafiltration	TOC Profile
AR7W site 1	not sampled - ice covered		
AR7W site 2	not sampled - ice covered		
AR7W site 3			X
AR7W site 4			X
AR7W site 5			X
AR7W site 6			X
AR7W site 7	X	X	X
AR7W site 8			X
AR7W site 8.5			
AR7W site 9			X
AR7W site 10			X
AR7W site 11	X	X	X
AR7W site 12			X
AR7W site 13			X
AR7W site 14			X
AR7W site 15			X
AR7W site 16	X	X	X
AR7W site 17			X
AR7W site 18			X
AR7W site 19			X
AR7W site 20			X
AR7W site 21	X	X	X
AR7W site 22			X
AR7W site 23			X
AR7W site 24			X
AR7W site 25			X
AR7W site 26	X	X	X
AR7W site 27			X
AR7W site 28			X

Table A.4.2.2 Ultrafiltration, respiration and TOC sampling on CCGS Hudson cruise 2004016.

f. Primary Production Measurements

Jeff Anning

Water samples for primary production experiments were collected from the rosette at 10 stations. For each incubation, 33 aliquots were inoculated with ^{14}C as sodium

bicarbonate and then incubated at in situ temperatures at 30 light levels (+ 3 dark bottles) for approximately 3 hours. At the end of the incubation period the cells were harvested onto GF/F glass fibre filters for later counting in a scintillation counter. Duplicate chlorophyll, duplicate particulate organic carbon, one HPLC, and one Absorption Spectra sample were collected for each incubation.

Station	Event	Lat. (deg)	Lat. (min)	Long. (deg)	Long. (min)	Date	Time (GMT)	Depth	ID
HL5	14	43	11.16	62	5.883	16-May-04	1325	2.0	277046
BioCTD1	26	44	48.147	50	29.343	17-May-04	1250	2.0	277084
BioCTD2	27	49	17.978	58	54.749	18-May-04	1124	2.0	277098
BioCTD2	27	49	17.978	58	54.749	18-May-04	1124	50.0	277089
L3-7	53	54	57.513	54	15.112	20-May-04	1250	20.0	277154
L3-7	53	54	57.513	54	15.112	20-May-04	1250	3.0	277173
L3-11	81	55	37.455	53	38.036	21-May-04	1125	30.0	277245
L3-11	81	55	37.455	53	38.036	21-May-04	1125	3.0	277253
L3-16	133	57	22.926	51	46.329	22-May-04	1446	30.0	277385
L3-16	133	57	22.926	51	46.329	22-May-04	1446	3.0	277393
L3-21	237	59	29.695	49	29.475	25-May-04	1257	30.0	277525
L3-21	237	59	29.695	49	29.475	25-May-04	1257	3.0	277533
L3-26	257	60	22.128	48	28.663	26-May-04	1650	30.0	277621
L3-26	257	60	22.128	48	28.663	26-May-04	1650	3.0	277628
BioCTD3	280	59	21.962	48	37.902	27-May-04	1130	30.0	277706
BioCTD3	280	59	21.962	48	37.902	27-May-04	1130	3.0	277714
BioCTD4	283	54	10.721	46	32.382	28-May-04	1124	30.0	277726
BioCTD4	283	54	10.721	46	32.382	28-May-04	1124	3.0	277739

Table A.4.2.3. Photosynthesis/Irradiance incubations were conducted at the above stations.

g. Bacterial Abundance and Production of Microbial Plankton

William Li / Paul Dickie

Seawater samples were collected from the water sample bottles at all stations and all depths for subsequent Flow Cytometric analysis. They were preserved with a final concentration of 1% filtered paraformaldehyde and frozen in liquid Nitrogen. Dr. Bill Li will look at these for enumeration of pico-phytoplankton, bacteria and viruses. At 17 stations on the Labrador- Greenland transect, incubations were conducted on water from the surface to 150 meters for uptake of tritiated leucine into bacterial cells. This gave an estimate of the rate of increase of marine heterotroph biomass in the photic zone. An additional experiment was performed at station L3-21 water depths from surface to 3499 meters (24 depths). Three additional transit stations were sampled for leucine uptake.

h. Zooplankton biomass and growth**Lidia Yebra / Sergio Alvarado**

WP2 nets (76 µm and 200 µm mesh) were used to collect ZP from 0-100 m, along line L3 (see list of stations below). On board, samples were fractionated by size: 63-200, 200-450, 450-1000 and >1000 µm, and frozen in liquid Nitrogen. At PML, biomass and structural growth will be determined. Biomass will be estimated as protein content, following the method of Lowry *et al.* (1951), modified by Rutter (1967). Growth will be approached with the AARS method (Yebra & Hernández-León, 2004). Relationship between hydrography and growth will be studied and compared with previous data obtained in December 2002 along the same transect.

Calanus finmarchicus growth

Groups of 20 CV and females of *C. finmarchicus* were selected from vertical hauls inside and outside a warm eddy found next to line L3, and stored in liquid Nitrogen. At PML, biomass and growth rates of these copepods will be compared between them and also with the ones collected during the cruise HUD2002075.

On the Labrador shelf, young stages of *C. finmarchicus* (CI-III) were collected from vertical tows (0-100 m) and cultured under field Temperature and Chlorophyll concentrations to determine their growth rates (Exps. 1, 2 and 3). Growth rates assessed by individual weight increases (Heinle, 1966) and by the AARS method (Yebra & Hernández-León, 2004) will be compared at Plymouth Marine Laboratory.

Event	Station	Date	Zooplankton	CV & fem	Exps
	H1-2	15/05/04			X
	H1-5	16/05/04			X
	9-SOLAS	17/05/04			X
	18	18/05/04			X
	L3-03	19/05/04	X		
	L3-04	20/05/04	X		
	L3-05	20/05/04	X		
	L3-06	20/05/04	X		
	L3-07	20/05/04	X		
	L3-08	20/05/04	X		
	L3-09	20/05/04	X		
	L3-10	21/05/04	X		
	L3-11	21/05/04	X		
	L3-12	21/05/04	X		
	L3-13	21/05/04	X		X
	L3-15	22/05/04	X		
	L3-16	22/05/04	X		
	L3-17	22/05/04	X	X	
	L3-18	23/05/04	X		

	Eddy	24/05/04	X	X	
	L3-19	24/05/04	X	X	
	L3-21	25/05/04	X		
	L3-22	25/05/04	X		
252	L3-24	26/05/04	X		
	L3-26	26/05/04	----		
258	L3-28	26/05/04	X		
	In Transit	28/05/04			X

i. Marine Mammal Sightings

Wayne Ledwell

Method

This cruise was conducted as part of a long term project to study physical and biological parameters of the Labrador Sea by the Bedford Institute of Technology from Halifax, Nova Scotia. A member of the Whale Release and Strandings group was onboard to photo identify and biopsy the northern bottlenose whale (*Hyperoodon ampullatus*). Results would be helpful in determining population structure of this whale with reference to a much smaller population of the northern bottlenose in the Gully off the Scotian Shelf. The ship worked from the Scotian shelf through the Cabot Strait to Hamilton Bank and on to Cape Desolation, Greenland. From Greenland the ship sailed to the Orphan Basin on the Grand Banks and onto St. John's Newfoundland (see [log table](#) below). The Labrador Sea leg started at shelf edge of the Hamilton Bank to position 6033.47N 4814.18W (8 N.M. from Cape Desolation). Sighting effort was continuous from the bridge by the officers on watch. In addition approximately 6 hours of coverage each day was conducted outside on the deck. The bridge is 12m from the deck with the capability to observe 6.8 nautical miles with the naked eye on either side and in front. A Bushnell 8x42 330 feet fov (field of view) @1000 yards was used. The ship worked day and night steaming and spending from one to five hours on various previously designated stations. An additional tract of 550 nautical miles round trip was undertaken for an emergency. This began at position 58 29N 5031W on 23 May to Hamilton Bank and back to position on 24 May. From Halifax the ship covered 2,850 nautical miles. A crossbow with sampling arrows and equipment was carried for biopsies.

Results

A total of five northern bottlenose whales (*Hyperoodon ampullatus*) were sighted; one off of the Hamilton Banks and a group of four off Cape Desolation, Greenland. Both sightings occurred when the ship was stopped with instruments in the water on station. The whales were very close to the ship and swam around the hull for about 20 minutes. Ten humpback whales (*Megaptera novaengliae*), 12 fin whales (*Balaenoptera physalus*), about 70 long-finned pilot whales (*Globicephala melaena*) and one minke whale (*Balaenoptera acutostrata*) were sighted. Three large unidentified large whale spp. were observed at distances of approximately 5 nautical miles from the ship. Three other

unidentified medium sized whales were sighted. Approximately 700 seals were sighted either swimming in the Strait of Belle Isle or on pack ice in the area of the Hamilton Banks. All the medium sized and beaked whales were sighted when the ship was stopped on station. All large whales were sighted when the ship was moving between stations. Pictures were taken during both sightings of the northern bottlenose whale. No biopsies were taken.

DATE	SIGHTING POSITION	SIGHTING EFFORT	WEATHER	RESULTS
15 May Bedford Basin		N\A	N\A	N\A
16 May Scotian shelf 43 11N 62 6W		N\A	HEAVY FOG ALL DAY	NO
17 May Gulf St. Lawrence 4454N 6027W TO 4639N 5929W	4512.86N 6013.27W	0600-1930	CLEAR 10-15 KNOTS	10 HUMPBCKS 12FINS 1 MINKE 1 SMALL UNIDENTIFIE D (Canso Bank)
17 May	Gulf St. Lawrence 4533.8N 5954.12W		CLEAR	I Large whale, possible fin
18 MAY CABOT STRAIT 4901N5907W TO 5046.7N 5736.8W	5006N 5818W	ALL DAY	CLEAR	APPROX 150 SEALS SWIMMING IN HERDS
18 MAY	5006N 5818W			1 FIN OR BLUE@ 2-3MI ~400 SEALS SWIMMING IN HERDS
19 MAY BELLE ISLE	5256N 54507W	1200-1900	INTERMITTE NT FOG	141 SEALS ON HEAVY PACK ICE *5 GREYS
20 MAY HAMILTON BANK	5507.06N 5405.2W	ALL DAY	CLEAR WIND 25NW	NORTHERN BOTTLENOSE DEPTH 1050M Greenish brown, around

				ship on station for 15 min. 3 pics taken
21 MAY	5607.4N 5306.9W	ALL DAY	20-25SW ALL DAY-CLEAR	3 PILOT WHALES 1 LARGE WHALE BY RADAR
22 MAY	5658.49N 524.63W	ALL DAY	10 KNOTS WEST-CLEAR	1 small unidentified whale-200m distant
DATE	SIGHTING POSITION	SIGHTING EFFORT	CONDITIONS	RESULTS
23 MAY	5528.5N 5235.9W	ALL DAY		1 large whale spp~3 mile distant
24 MAY morning			Strong 35-40 wind	Return to Greenland line
24 May 2004 1800	5829.78N 5031.12W	1400-2100	10-30 CLEAR	~15 pilots, males, females w/calves Depth at bottom 3600m
25 May	End position		Windy-heavy seas	No effort
26 May to 6032.47 N 4814.18W surface temp 1°C	6022N 4827W	All day	35 a.m 15-20 p.m Clear	I unidentified medium sized whale spp. Depth 766m *
26 May	6018N.05N 4834.63W			4 bottlenose whales (1 large and 1 calf) Depth 2125 m-just beyond shelf. Whales circled ship twice at 2115 hours
27 May	5829.71N 4816.98W		CLEAR	1 medium sized beaked whale spp.
28 May				In transit to Orphan basin

29 May Orphan Basin	5035.24N 4548.74W		CLEAR	~50 pilot whales-mixed herd of large and small whales @ 0735. Depth 3672m
30 May				In transit St. John's, NL

*Larval squid were picked up in plankton net on three occasions on Greenland side of the shelf

Discussion

Sightings of the northern bottlenose whale occurred just beyond the shelf on both sides of the Labrador Sea. This is consistent with previous sightings of this whale by scientists and crew over the past 10 years. Sightings vary but are always found when the ship is on station. It is suspected that bottlenose whales are curious and attracted to noises generated by the ship. A dedicated effort to locate this whale should follow the Labrador shelf north into the Davis Strait and down the Greenland shelf side. Periodic stops should accompany any survey. This would allow the whale time to locate the ship.

Acknowledgements

I would like to thank the chief scientist, Glen Harrison, for having me on this cruise and to all the ships officers, crew and scientific staff of the CCGS Hudson for their generosity to me and for their assistance in locating whales.

5. Major Problems and Goals Not Achieved

Four factors contributed to the loss of station time and the inability to complete the hydrographic program as planned, (1) fuelling of the ship could not be done prior to sailing date – ca. 8h of program time were lost in fuelling, (2) heavy ice conditions on the southern Labrador coast and fog slowed progress to the inshore stations of the L3 line – ca. 6h of program time were lost and the two innermost stations were not sampled, (3) an unexpected medical evacuation required return of the ship to within 200 nautical miles of the Labrador coast (550 nautical miles round trip) – 36h of program time were lost, and (4) a storm off the Greenland coast on 25/26May with accompanying strong winds (35-50 knots) suspended over-the-side operations for ca. 9h. Thirteen stations in the Orphan Basin (42h of work) could not be sampled.

6. Other Incidents of Note

Some minor problems (software) with the CTD metering block display were encountered but correctable. Some of the elevator supports for the rosette frame were bent during operations. The plan is to weld and reattach while alongside in St John's.

7. List of Cruise Participants

Name	Responsibility	Affiliation
Sergio Alvarado	Scientist, Biologist	PML
Jeff Anning	Primary Production	BIO
Carol Anstey	Nutrients	BIO
Christine Ward-Paige	Student, CO ₂ , Alkalinity	BIO
Jay Bugden	TOC Levels, respiration rates	BIO
Rick Boyce	Salts, moorings	BIO
Derek Brittain	MVP, moorings	BIO
Paul Dickie	Bacterial activity	BIO
Bob Gershey	Scientist, CO ₂ , CFCs, Alkalinity	BDR
Les Harris	Zooplankton, Net Tows	BIO
Glen Harrison	Senior Scientist	BIO
Ross Hendry	Scientist, O ₂ , Computer Room	BIO
Jeff Jackson	Data management, Computer Room	BIO
Tim Perry	Zooplankton, vertical net hauls	BIO
Murray Scotney	Moorings, instrumentation	BIO
Igor Yashayaev	Assistant Scientist, Computer Room	BIO
Lidia Yebra Mora	Scientist, Biologist	PML
Frank Zemlyak	Technician, CO ₂ , O ₂ , CFCs, Alkalinity	BIO

BIO Bedford Institute of Oceanography
PO Box 1006
Dartmouth, NS, B2Y 2A4
Canada

BDR BDR Research Ltd.
Box 652, Station 'M'
Halifax, NS, B3J 2T3
Canada

PML Plymouth Marine Laboratory
Prospect Place, The Hoe
PL1 3DH, United Kingdom

B. UNDERWAY MEASUREMENTS

1. Navigation and Bathymetry

Jeff Jackson

The navigation system onboard CCGS Hudson consists of a differential GPS receiver and AGCNAV. The receiver is one of many NMEA feeds into a multiplexer that provides all the NMEA strings to a PC on the bridge. The PC, which is running AGCNAV software, then rebroadcasts the NMEA strings to distribution units in the computer room, which provide 16 output lines for the working labs. The resulting broadcast navigation strings are at about 1 Hz. The navigation data are then logged at specified intervals on a PC. For this cruise the navigation was logged at 1 second, 10 seconds and 1 minute intervals during the cruise due to operator oversight. It usually is logged at a 10 second interval throughout the cruise.

AGCNAV is a PC based display and waypoint setting software package, developed at the Atlantic Geoscience Centre at BIO. This software graphically displays ship position, waypoints, course, speed, etc. to the various science working areas.

The echo sounder system used for collecting bathymetric data at station locations consisted of a Raytheon Line Scan Recorder, Model LSR 1811-1 (serial number A101) connected to a 12kHz transducer. The transducer beam width is 15 degrees. The sweep rate of the record was adjusted throughout the course of data collection to aid in identifying the bottom signal. One transducer is positioned on a Ram that can be lowered or raised depending on conditions. When the ram is up, the waterline to transducer offset is 6 m. When the ram is down, the offset is 8 m.

2. Vessel Mounted Acoustic Doppler Current Profiler

Murray Scotney

The Hudson was equipped with a hull mounted RDI Acoustic Doppler Current Profiler (ADCP). The transducer (serial number 177) had VM ADCP electronics (serial number 172). Logging, using Transect software on a 486 PC, was started on May 15 at 1710 Z leaving Halifax Harbour.

The configuration used for logging resulted in 5-minute averages in 4 meter bins. The averaged data are stored to disk and backed up every few days. ADCP logging was stopped on May 30 at 11:15 Z in St. John's Harbour.

3. Continuous Flow Multisensor Package (CFMP)

Jeff Anning

Water from approximately 4m was continuously pumped to the forward lab. The temperature, conductivity and fluorescence was measured and logged every 30 seconds. The temperature and conductivity were measured with Seabird sensors and the fluorescence by a Wetlabs flow through fluorometer. Incident Photosynthetically Active

Radiation was measured with a Li-Cor Spherical Quantum Sensor and this data was merged with the sea water parameters. Exact time and positions were provided by a Northstar GPS and logged with the other data. In addition, discrete water samples were collected at regular intervals by an auto sampler for later analysis for nitrate and silicate. Time and position of these discrete samples were logged by the computer.

4. XBT and XCTD

Igor Yashayaev

Expendable Bathythermographs were routinely deployed along the AR7W line on the way from Labrador to Greenland. See [figure B.4.1](#) for a map with the XBT drops indicated. The XBTs were model T7 from Sparton of Canada. These types of probes are capable of measuring to maximum depths of 800 m (T7) at the full cruising speed 15 knots. The vertical resolution of the measurements was about 0.6-0.8 m. 127 XBTs were launched during the cruise ([Table A.2.1](#) lists the operation numbers when these were deployed).

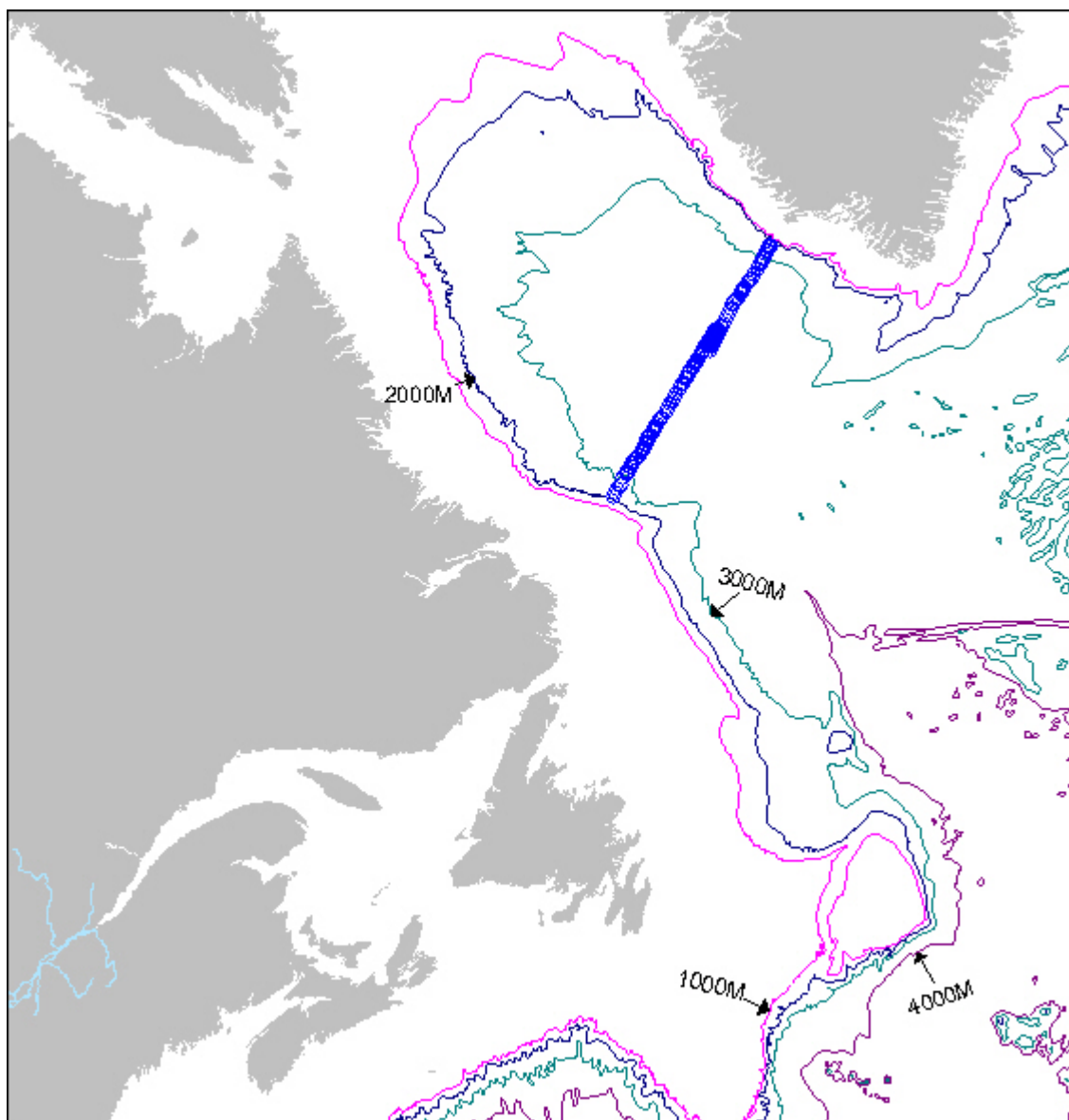


Figure B.4.1 XBT drop sites along the AR7W section (indicated by blue hollow circles).

5. Meteorological observations

The ship's crew logged routine reporting of meteorological variables.

6. Atmospheric Chemistry

There was no atmospheric chemistry program.

F. APPENDICES**Appendix 1: Operation Notes Report
(sorted by Operation ID Number)**

Note Number: 1	Entry Time: 16/May/2004 21:35:46	Note Made By: Jeff Jackson	Operation ID: 20
Sounding 2746 m			
Note Number: 2	Entry Time: 20/May/2004 1:31:16	Note Made By: Jeff Jackson	Operation ID: 35
Sent the rosette down to bottom, but there was a system malfunction which would not allow the bottles to fire. The cast was aborted and redone as operation 36.			
Note Number: 3	Entry Time: 22/May/2004 21:46:09	Note Made By: Jeff Jackson	Operation ID: 134
Igor ran into some troubles with this operation. The bottles in positions 10 - 24 were not accessible during the cast and thus were not filled in. Jeff filled in what he could from the CTD QAT file.			
Note Number: 4	Entry Time: 29/May/2004 8:43:41	Note Made By: Jeff Jackson	Operation ID: 289
For the second time on this cruise the metering sheave software is not working correctly. The CTD data line fails to show up. We are not sure if it is just a loose connection or a computer problem.			

Table F.1.1 Operation Notes

G. REFERENCES

- Carritt, D. E. and J. H. Carpenter. 1966. Comparison and evaluation of currently employed modifications of the Winkler method for determining dissolved oxygen in seawater. *Journal of Marine Research*, 24, 268-318.
- Culberson, C. H. 1991. WHP Operations and Methods. Dissolved Oxygen. (http://whpo.ucsd.edu/manuals/pdf/91_1/culber2.pdf)
- Levy, E. M., C. C. Cunningham, C. D. W. Conrad and J. D. Moffatt. 1977. The determination of dissolved oxygen in sea water. Bedford Institute of Oceanography Report Series, BI-R-77-9, August 1977.
- SIO/ODF. 2000. Oxygen titration manual. Scripps Institute of Oceanography, Ocean Data Facility. Version 22-Feb-2000.
- Strain, P.M. and P.M. Clement. 1996. Nutrient and dissolved oxygen Concentrations in the Letang inlet, New Brunswick, in the summer of 1994. *Can. Data Rep. Fish. Aquat. Sci.* 1004: iv + 33p.

CCHDO Data Processing Notes

Date	Person	Data Type	Action	Summary
2005-01-06	Jeff Jackson	SUM/CrsRpt	Submitted	None
Detailed Notes This is information regarding line: AR7W ExpoCode: 18HU2004016/1 Cruise Date: 2004/05/15 - 2004/05/30 From: JACKSON, JEFF Email address: jacksonj@mar.dfo-mpo.gc.ca Institution: BIO Country: CANADA The file: C:\Documents and Settings\JacksonJ\My Documents\Woce\2004016\docs\18HU2004016.zip - 1103580 bytes has been saved as: 20050106.055020_JACKSON_AR7W_18HU2004016.zip in the directory: 20050106.055020_JACKSON_AR7W The data disposition is: Public The file format is: WOCE Format (ASCII) The archive type is: Zip The data type(s) is: Summary (navigation) Documentation The file contains these water sample identifiers: Cast Number (CASTNO) Station Number (STATNO) JACKSON, JEFF would like the following action(s) taken on the data: Place Data Online				
2006-10-17	Danie Bartolacci	SUM	Website Update	corrected expocode, line #
Detailed Notes 20061009 DBK Reformatting sumfile for ar07w_20040515 -Changed expocode from 18HU2004016/1 to 18HU20040515 -Changed line number designation from AR7W to AR07W -Ran sumchk with no errors other than unrecognizable cast codes of BD (which is Begin Descent) and EA (End Ascent). -Renamed file ar07w_20040515su.txt and placed in parent directory.				
2011-08-23	Jeff Jackson	CTD	Submitted	To go online
2011-08-30	Carolina Berys	CTD	Website Update	Available under 'Files as received'
Detailed Notes File 18HU20040515_CTD.zip containing CTD data, submitted by Jeff Jackson on 2011-08-23, available under 'Files as received', unprocessed by CCHDO.				

2011-09-08	<i>Steve Diggs</i>	CTD	Website Update	Exchange file online
	Detailed Notes Exchange formatted CTD files for public use have been processed, validated and re-archived, and are now online for public use.			
2012-10-10	<i>CCHDO Staff</i>	BTL	Website Update	Available under 'Files as received'
	Detailed Notes The following files are now available online under 'Files as received', unprocessed by the CCHDO. AR07W_2004do.pdf 18HU20040515.exc.csv			
2012-10-10	<i>Bob Key</i>	BTL/CrsRpt	Submitted	to go online
	Detailed Notes 1. All of the data labeled NITRAT are actually NO3+NO2. This is noted in the header text, so if the column header is corrected, then the header text should be edited accordingly. 2. I ran all parameters of each cruise through QC. Many flags have been altered relative to the original submissions. In several cases I went back to the PI and got updates (mostly CTD calibrations).			
2012-11-02	<i>Jerry Kappa</i>	CrsRpt	Website Update	Final PDF version online
	Detailed Notes I've placed 1 new version of the cruise report: AR07W_18HU20040515do.pdf into the co2clivar/atlantic/ar07w/ar07w_2004a/ directory. It includes summary pages and CCHDO data processing notes as well as a linked Table of Contents and links to figures, tables and appendices.			