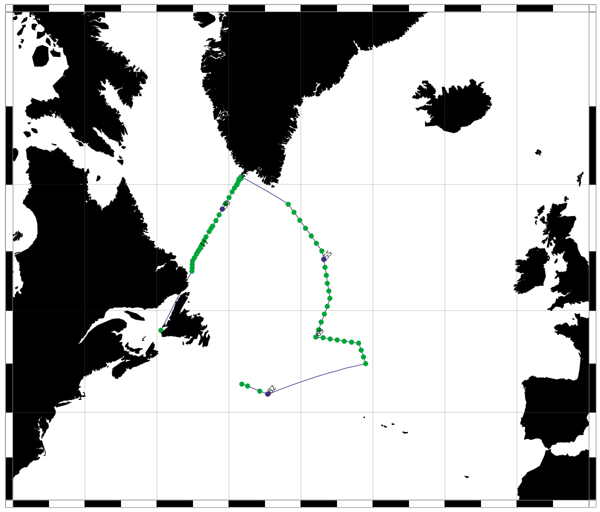


A01W, AR05, AR13
18HU95011_1

WHP Cruise Summary Information

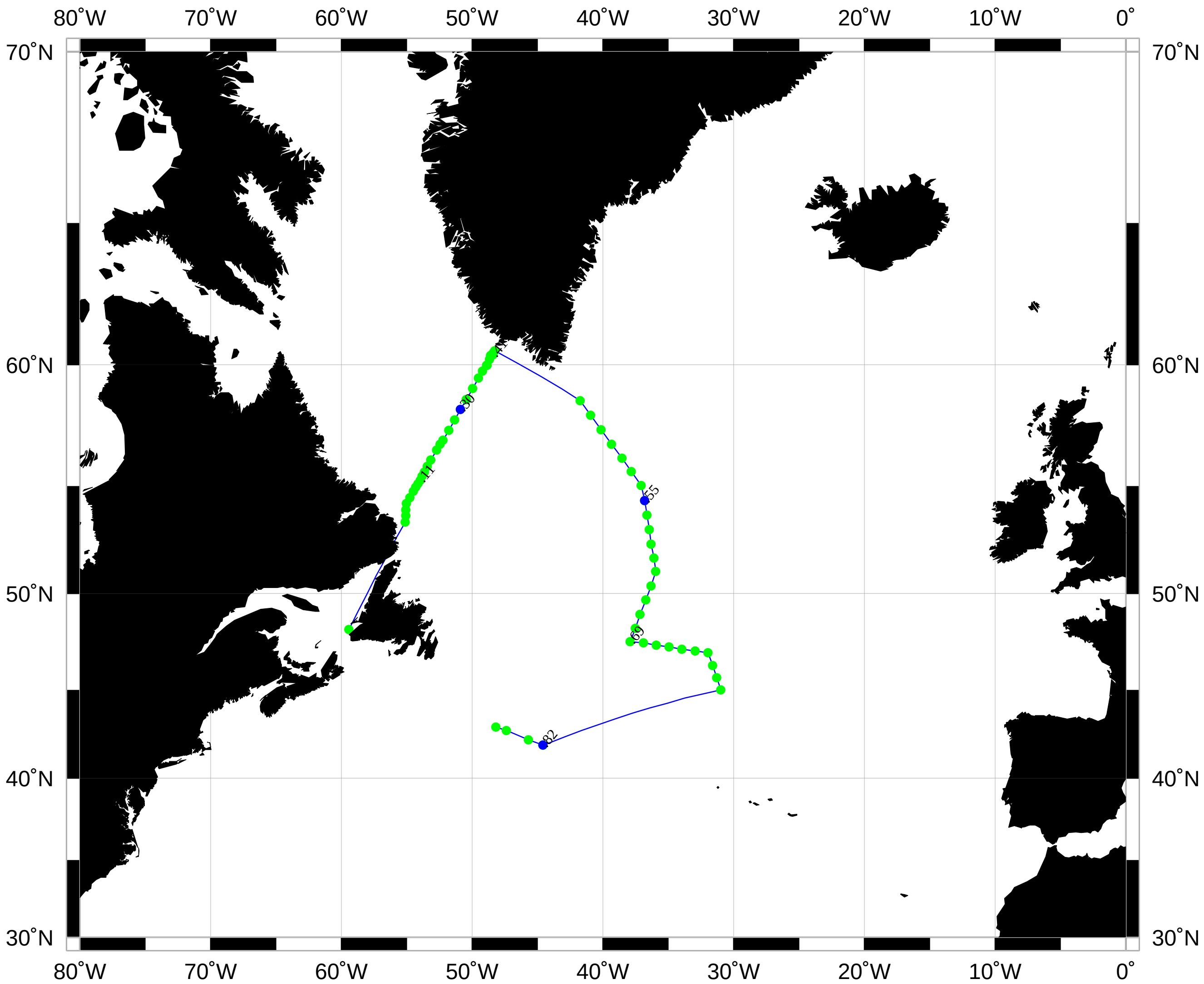
WOCE section designation	**A01W, AR05, AR13**
Expedition designation (EXPOCODE)	**18HU95011_1**
Chief Scientist(s) and their affiliation	John Lazier, BIO
Dates	1995.06.07 — 1995.07.05
Ship	HUDSON
Ports of call	Nova Scotia, Canada to Newfoundland, Canada
Number of stations	88
Geographic boundaries of the stations	60°30.93 N; 59°25.40 W; 30°58.70 W; 41°46.02 N
Floats and drifters deployed	6 Floats
Moorings deployed or recovered	see below
Contributing Authors (In order of appearance)	A. Isenor M. Scotney P. Clement B. Gershey F. Zemlyak M. Hingston J. Lazier R. Watts

WHP Cruise and Data Information

Instructions: Click on items below to locate primary reference(s) or use navigation tools above.

Cruise Summary Information	Hydrographic Measurements
Description of scientific program	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	CTD - conductivity/salinity
Description of stations	CTD - oxygen calibration
Description of parameters sampled	
	Salinity
Floats and drifters deployed	Oxygen
Moorings deployed or recovered	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
	Dissolved Inorganic Carbon
Problems and goals not achieved	CO2 system parameters
Other incidents of note	Other parameters
Underway Data Information	
Navigation	**References**
Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	
Thermosalinograph and related measurements	
XBT and/or XCTD	
Meteorological observations	
Atmospheric chemistry data	
	Data Processing History

Station locations for A01W : LAZIER



Produced from .sum file by WHPO-SIO

A. CRUISE NARRATIVE

1. Highlights

a. WOCE Designation:	Line:	**A01W**
	Expocode:	**18HU95011_1**
b. Expedition Designation:	**Hudson 95011**	
c. Chief Scientist:	**John R. N. Lazier** Ocean Circulation Division Physical and Chemical Sciences Branch Department of Fisheries and Oceans Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, NS, Canada B2Y 2A4	
	FAX	902 426 7827
	Internet	LazierJ@mar.dfo-mpo.gc.ca
d. Ship:	CSS Hudson	
e. Ports of Call:	June 8	BIO, Dartmouth, NS, Canada
	July 4	St. John's, Newfoundland, Canada
f. Cruise Dates:	June 8, 1995 to July 4, 1995	

2. Cruise Summary Information

a. Cruise Track

A cruise track is shown in Figure 1. Ship position at midnight on each day of the cruise is indicated with an asterisk.

The station positions are shown in Figures 2 and 3. Figure 2 shows the stations occupied along A1W while Figure 3 shows stations along the southerly line from Greenland that approximately follows AR5. Some station numbers are indicated for clarity. The various types of stations are also indicated.

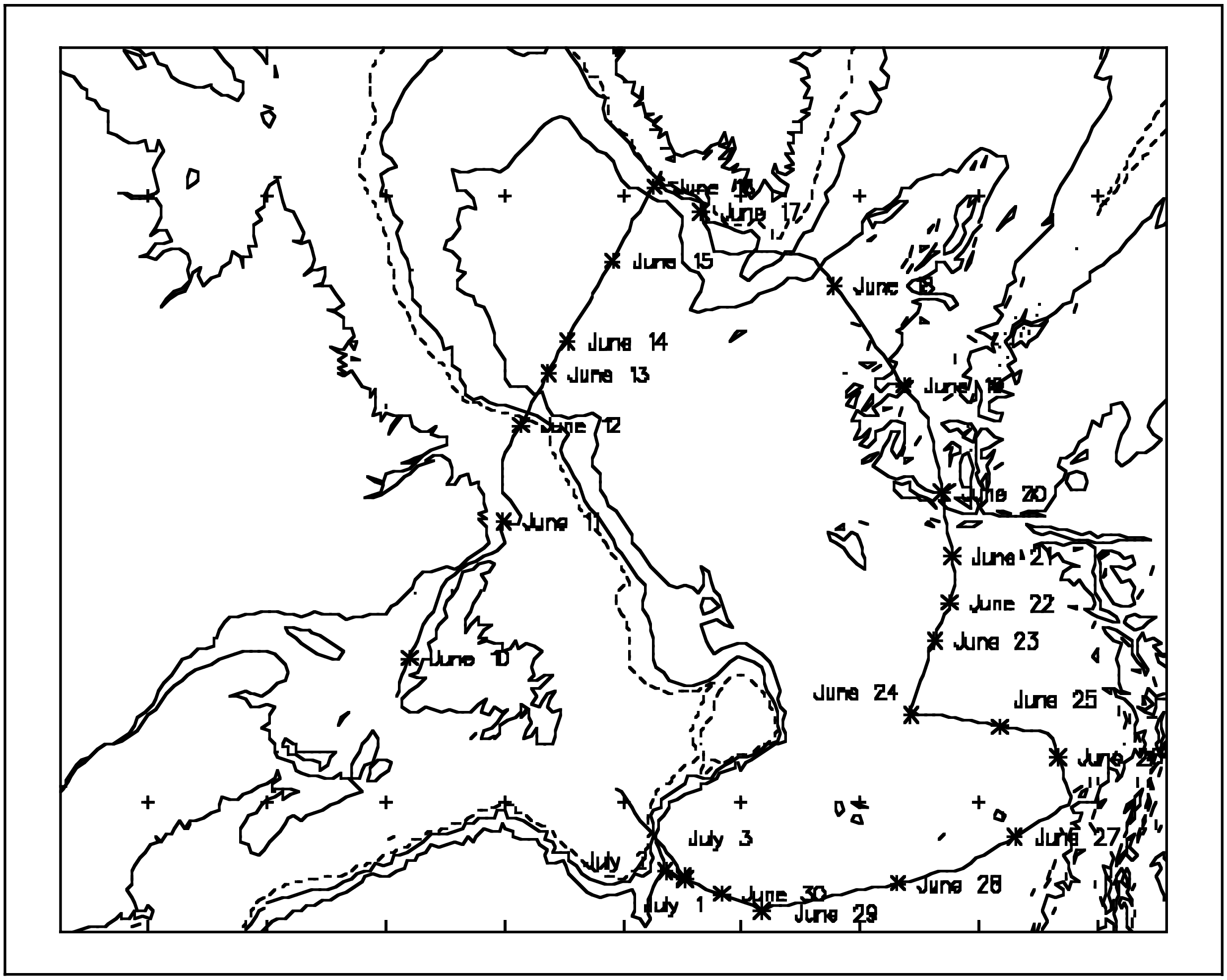


Figure 1. Cruise Track for 95011. Asterisks indicate a time of 0000 Z on the day indicated.

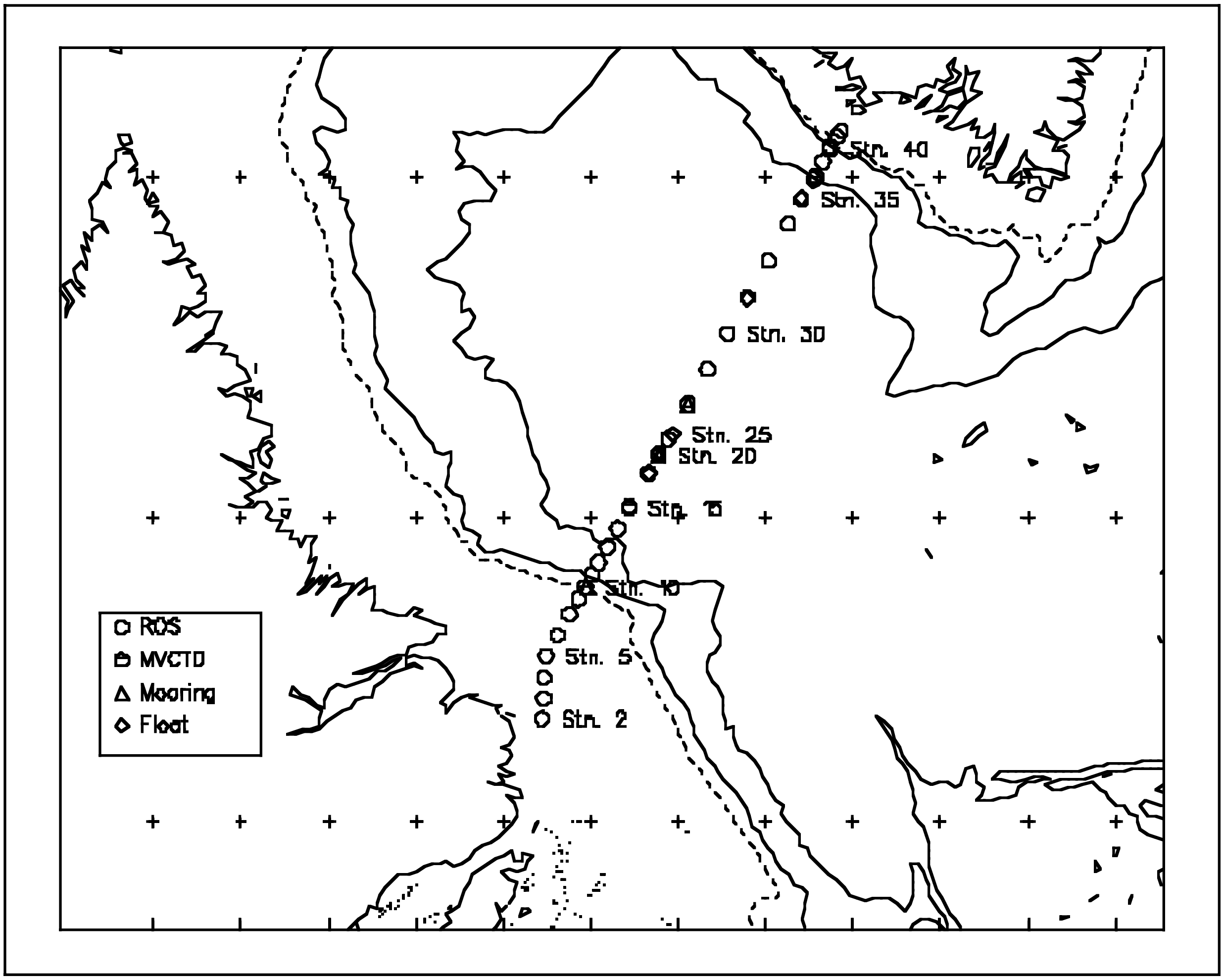


Figure 2. The type and location of stations occupied along A1W.

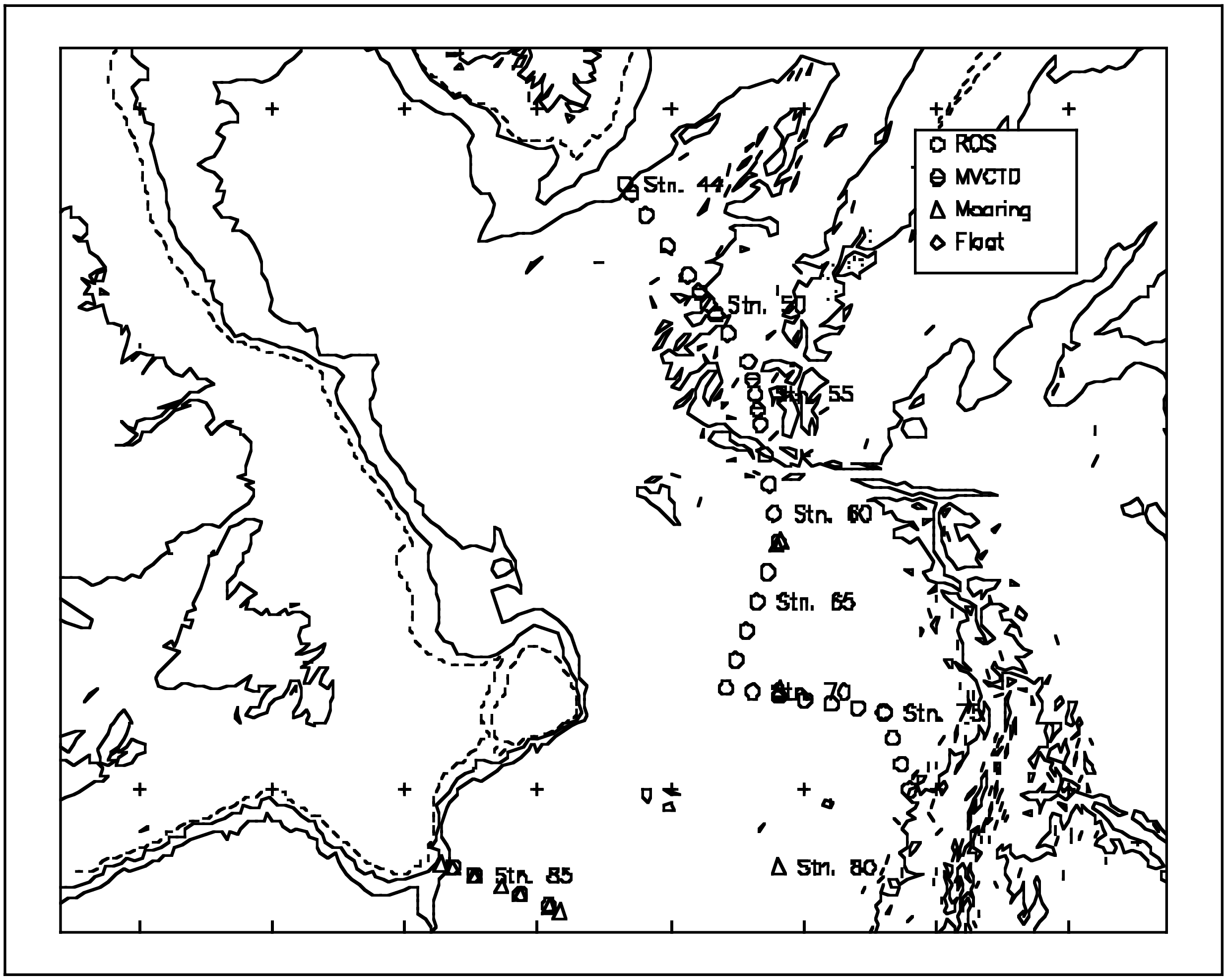


Figure 3. Stations along the southerly line from Greenland that approximately follows AR5.

b. *Total Number of Stations Occupied*

61 Full depth WHP small volume CTD stations with up to 23 rosette bottles. Depending on the station, water samples were analyzed for CFC's, carbon tetrachloride, methyl chloroform, total carbonate, alkalinity, oxygen, salinity, nutrients, tritium, helium, and oxygen isotopes.
3 CTD casts with no water samples
8 MVCTD casts, with an additional cast with MVCTD attached to CTD rosette frame
59 Full depth velocity profiles using a lowered ADCP attached to the CTD/rosette
6 Float deployments
4 IES Mooring Recoveries (2 unsuccessful attempts)
4 Sound source mooring recoveries
1 IES mooring deployed
2 Current meter moorings deployed
3 Current meter moorings recovered (2 through dragging)

c. *Floats and Drifters Deployed*

A total of six floats were launched during the cruise, all on the A1W line. Of the six, three were ALACE (Autonomous Lagrangian Circulation Explorer) floats launched for Ray Schmitt of WHOI (1 float) and Russ Davis of SIO (2 floats). The remaining three were deep lagrangian floats launched for Eric d'Asaro of APL/UW.

d. *Moorings Deployed or Recovered*

The multi-instrument mooring deployed during the BIO cruise to AR7W in 1994 (WOCE Expocode 18HU94008, mooring number 1168) was recovered and a duplicate mooring was deployed (mooring number 1194) in the same location. The deployed mooring consisted of 6 Seacat temperature/conductivity recorders, 6 Aanderaa current meters, 1 Acoustic Doppler Current Profiler (ADCP), 1 WOTAN (weather observations through ambient noise) and 1 CTD with a device for measuring the total partial pressure of dissolved gas in the water.

A current meter mooring consisting of one current meter positioned 15 m off the bottom was deployed along the 1000 m isobath on the Labrador side of A1W (mooring number 1200). This mooring was deployed for Peter Rhines of the University of Washington.

A total of four RAFOS Sound Source moorings were recovered. The R/V Oceanus deployed these moorings in August 1993. The Sound Sources were used in a RAFOS float program lead by Tom Rossby of the University of Rhode Island. Over the past 2 years, floats have been set in and near the North Atlantic Current in order to map the lagrangian velocity fields on isopycnal surfaces in the upper pycnocline throughout the Newfoundland Basin. The Sound Sources are used to spatially locate the floats during the program.

Four of a total of six Inverted Echo Sounders (IES) were recovered from the area of the ACM6 mooring line. The Echo Sounders measured the travel time of an acoustic signal between the instrument and the surface. The data can be used to determine the vertical density field and dynamic height. Randy Watts of the University of Rhode Island led this program.

During the Clarke 95003 cruise (WOCE Expocode 18HU95003), two planned recoveries of moorings could not be completed due to release problems. During this cruise, Hudson dragged the area hoping to recover these 2 moorings. The operation was successful, as all current meters on mooring 1124 on the 3900 m isobath and 3 of the 4 current meters on mooring 1122 on the 2500 m isobath were recovered.

3. List of Principal Investigators

Name	Affiliation	Responsibility
John R. N. Lazier LazierJ@mar.dfo-mpo.gc.ca	BIO	CTD data, shipboard ADCP data, moored instrument data, salinity
Robert Houghton houghton@ldeo.columbia.edu	LDEO	oxygen ratio
Peter Jones JonesP@mar.dfo-mpo.gc.ca	BIO	oxygen, alkalinity, carbonate, CFC s
Robert Pickart pickart@rsp.whoi.edu	WHOI	lowered ADCP
Peter Rhines rhines@killer.ocean.washington.edu	UW	moored instrument data
Peter Schlosser peters@ldeo.columbia.edu	LDEO	tritium, helium data
Peter Strain StrainP@mar.dfo-mpo.gc.ca	BIO	nutrients
Randy Watts randy@drw.gso.uri.edu	URI	IES, sound sources, current meter data

See Section 7 for addresses.

4. Scientific Programme and Methods

a. Narrative

One of the aims of the annual occupation of the WOCE AR7W (or A1W) line across the Labrador Sea is to monitor the water mass properties in the region especially the Labrador Sea Water (LSW) which is renewed by deep convection in winter to as much as 2300 m. The temperature and salinity of this water mass changes by varying amounts each winter depending on the severity of the winter and the temperature and salinity of the waters that are mixed up by the convection. Estimates of its average temperature and salinity for the years 1990-1995, except 1991, are shown in Figure 4.

Between 1990 and 1993 the temperature decreased by =0.1 °C while the salinity increased by =0.009 resulting in an increase in density (=σ+1000 kg m^{-3}) of =0.02 kg m^{-3}. The temperature decrease is due to large heat losses to the atmosphere in the two abnormally severe winters. The increase in salinity results from the convection penetrating deeper than in previous years into layers of higher salinity. Some of the higher salinity water becomes incorporated in the convecting layer and raises its salinity.

Between 1993 and 1994 the estimates in Figure 4 show the average temperature and salinity decreased and between 1994 and 1995 the averages increased. Over both winters these changes where such that no significant change in σ resulted.

The temperature vs salinity curves in Figure 5 and 6 give a more detailed view of the LSW properties in 1994 and 1995. In the core of the water mass, where 34.682 < σ< 34.687 kg m^{-3}, the temperature and salinity variation along σ surfaces is significantly greater in 1994. In 1995 the temperature and salinity gradients along σ surfaces over 7 of the 9 stations is less than half the range in 1994. This difference seems to be an effect of the convection process and possibly an important clue to how convection works but as of now the connection is not understood.

The 2nd objective of the Labrador Sea part of the program was to replace the NOAA/ACCP funded mooring in the centre of the central gyre. The purpose of the mooring is to obtain data throughout the year to better understand the formation of the LSW and the variability in its properties induced by interannual variations in the heat and salt fluxes. The mooring placed in May 1994 was recovered intact yielding 6 complete Seacat records and almost 6 complete current meter records.

In the Labrador Sea we also successfully launched three "Deep Lagrangian Floats" for Eric d'Asaro of the Applied Physics Laboratory, University of Washington, Seattle; one ALACE float for Ray Schmitt of the Woods Hole Oceanographic Institution and two ALACE floats for Russ Davis of the Scripps Institution of Oceanography.

On the original plan was the requirement to recover 4 sound source moorings for Tom Rossby of the University of Rhode Island and 6 inverted echo sounders for Randy Watts also of the University of Rhode Island. But following the failure to recover 2 moorings in the Newfoundland Basin on cruise 95003 the plan was altered to include dragging for these.

All the sound sources were recovered intact, however, only 4 of the IES s. The dragging was successful in recovering all the current meters on mooring 1124 on the 3900 m isobath and 3 of the 4 current meters on mooring 1122. Two attempts were made to get mooring 1124. The first on June 30 recovered 4 current meters and the second on July 2 recovered the rest of the mooring including two current meters and the release.

On the way between the sound source moorings and between Cape Farewell and the northern most sound source mooring we obtained CTD and chemistry data at roughly 40 mile spacings. The motivation for these stations was to observe the characteristics of the LSW across the entrance to the Irminger Sea and between 48 and 52°N west of the Mid Atlantic Ridge along roughly 37°W. The latter section crosses the path of the LSW that flows from the western into the eastern basin of the North Atlantic.

Figure 7 shows one comparison from these two sections constructed from the CTD data. Shown are estimates of the layer thickness between σ surfaces 0.002 kg m^{-3} apart. Since LSW is formed by convection the water mass is nearly homogeneous in the Labrador Sea. As it flows away from the Labrador Sea the thickness of the layer is an indicator of its presence. The higher thick curve in Figure 7 is from four of the stations southeast of Cape Farewell at the entrance to the Irminger Sea. The other thick curve is the average from the stations south of the Charlie Gibbs Fracture Zone representing the water flowing into the eastern basin. The layer thickness across the entrance to the Irminger Sea is about 4 times that of the other curve and is centred on a σ of =34.687. The peak in the other curve is centred at σ = 34.665 kg m^{-3}. The peak at the higher σ value represents Labrador Sea Water formed in 1993, 94 or 95 as it closely matches the σ for those years shown in Figure 4 for the Labrador Sea. The lower σ peak for the water passing through to the eastern basin suggests a source that is of a lower density than any of the values plotted on Figure 4. In 1990, for example, the Labrador Sea Water was at σ = 34.672 kg m^{-3} that is slightly higher than the peak in Figure 6. This suggests the water passing through to the eastern basin was probably formed before 1990.

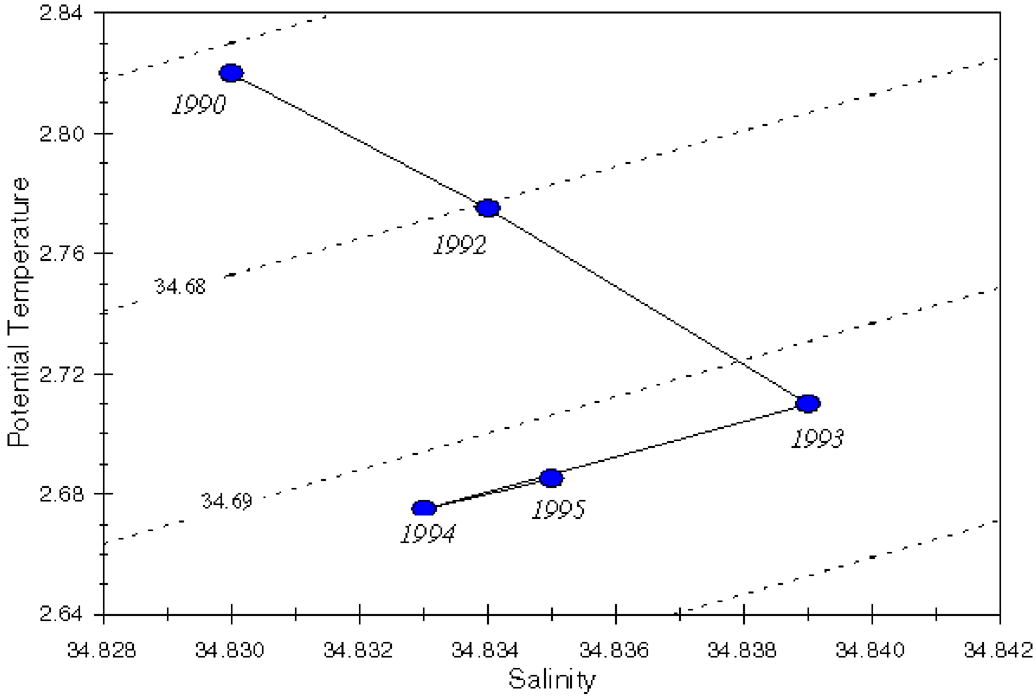


Figure 4. The average temperature and salinity of the Labrador Sea Water in 1990, 1992, 1993, 1994 and 1995. The dotted curves are lines of constant •1.5 (= density referenced to 1500 db minus 1000 kg m-3.

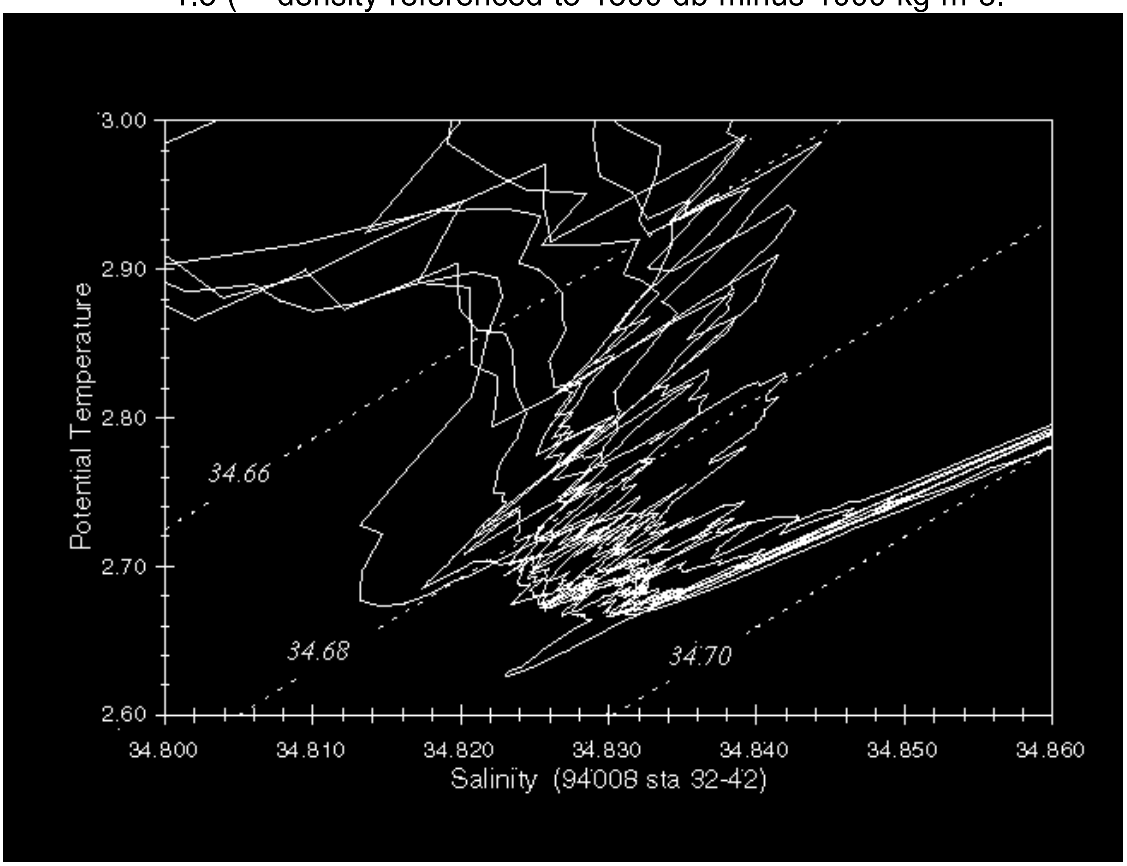


Figure 5. Temperature vs. salinity curves for stations 32 to 42 (sites 13 to 21) obtained in May 1994. Dotted curves as in Figure 4.

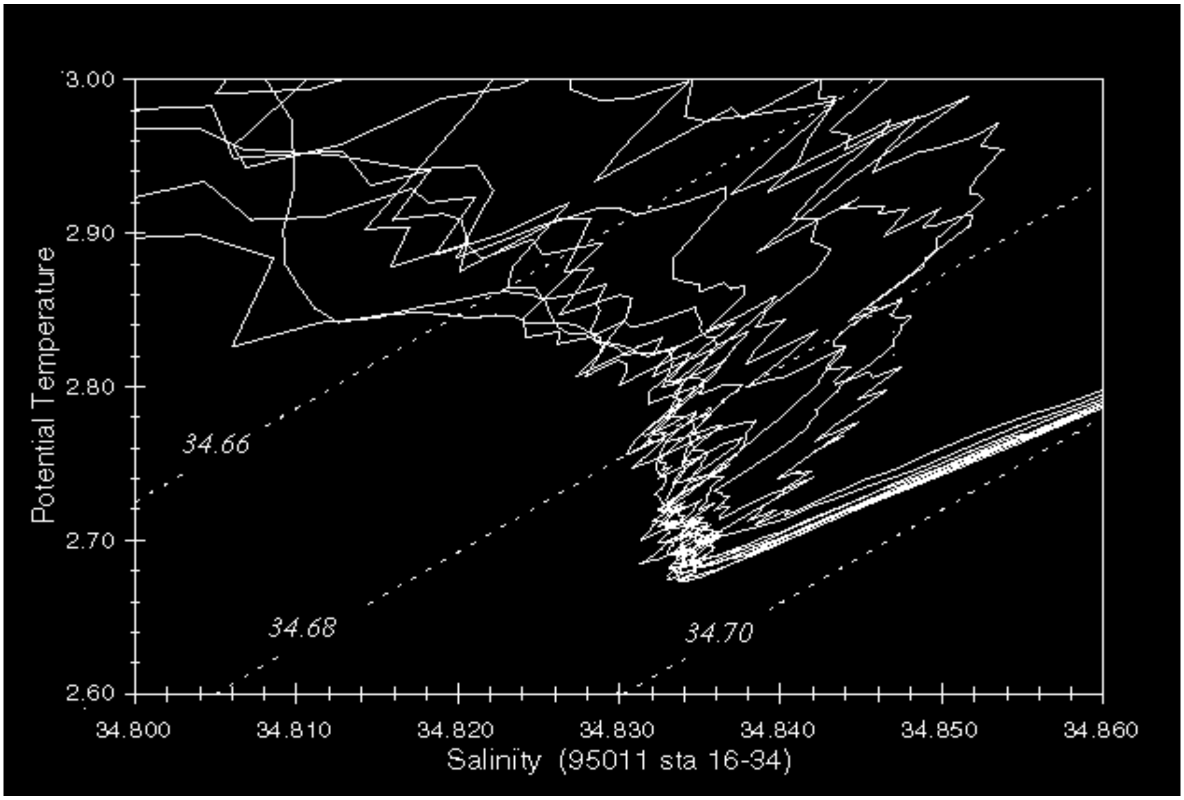


Figure 6. Temperature vs. salinity curves for stations 16 to 34 (sites 13 to 21) obtained in June 1995. Dotted curves as in Figure 4.

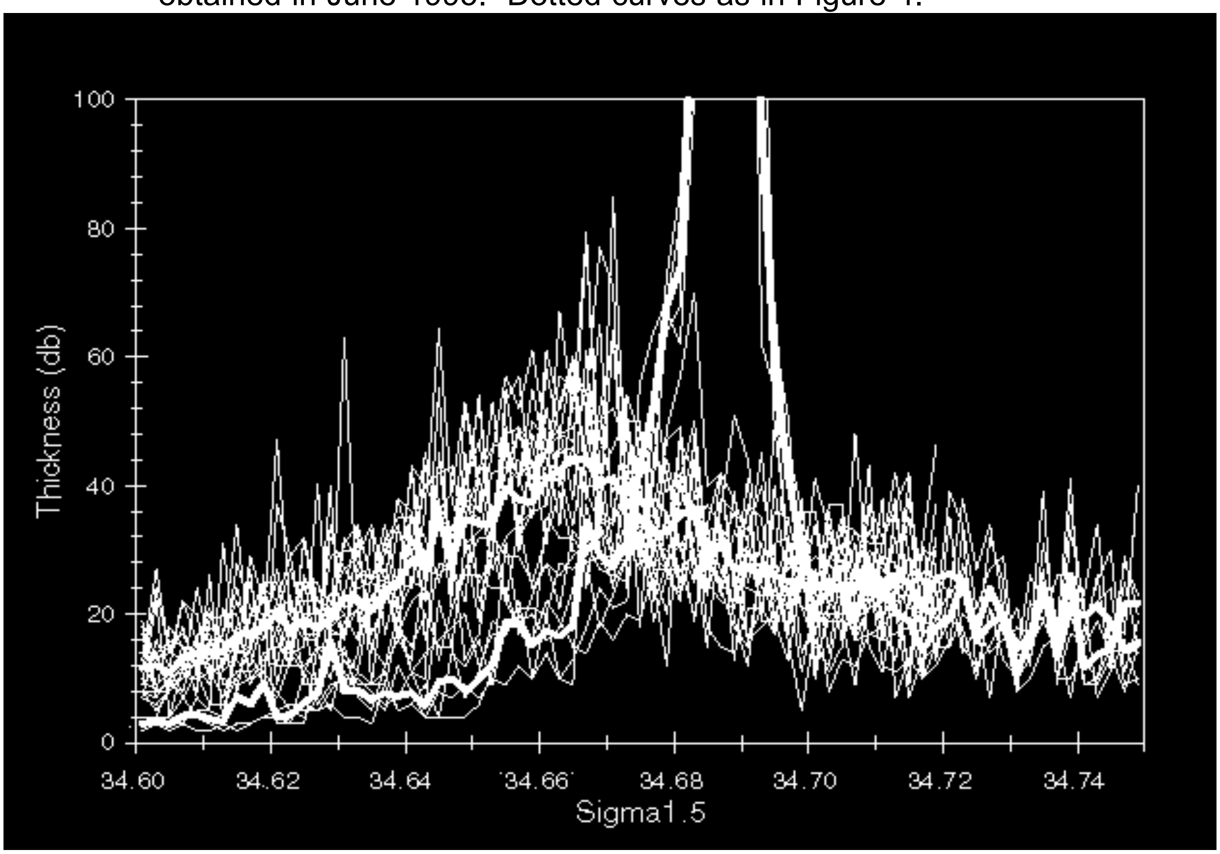


Figure 7. Estimates of layer thickness in decibars (db) every 0.002 kg m-3 in •1.5 and their averages at two sets of stations. The higher peak centred at 34.687 kg m-3 is from stations 45 to 48 southeast of Cape Farewell. The peak at 34.665 is from stations 59 to 79.

5. Major Problems and Goals Not Achieved

Unfortunately, ice prevented the occupation of four CTD stations on the Cape Farewell Shelf at the northern extension of the AR5 line. Therefore the first station on AR5 was in about 3000 m of water.

Also, two inverted echo sounders were not recovered due to release problems.

6. Other Incidents of Note

The MVCTD is a profiling CTD system that can be deployed when a ship is steaming at 10 knots. The system has been tested on a previous cruise to the Newfoundland Basin (Clarke, WOCE Expocode 18HU94030) and further testing was conducted during this cruise. A total of eight casts were completed using the MVCTD and winch gear (one cast was performed with the MVCTD attached to the CTD rosette frame) during this cruise. Sadly, however, at Station 56 the instrument was lost during recovery.

A rack containing three digital thermometers was lost on Station 41, cast 2. A setscrew holds the rack to the SIO bottle, but allows the rack to rotate about the attachment to the bottle. Speculation is that the setscrew became loose and when the bottle was fired, the rack fell off the bottle.

On Station 65 the CTD was brought back onboard with a kink in the winch/conducting wire. The kink was located about 5 m from the CTD. A splice and retermination was carried out. The probable cause of the kink was a lowering of the CTD on the upcast at about 3500 m that resulted in slack wire.

The heave compensation winch was also tested on this cruise. This system was designed to modulate the speed of the winch to compensate for the heaving motion of the ship. It was first tested on the Clarke 95003 (WOCE Expocode 18HU95003) cruise and found to make the motion of the CTD worse. The electronics were then adjusted to reduce to zero the component of acceleration fed to the control amplifier. The controller was tried on two stations during this cruise with major reduction of the variations of the CTD speed. Unfortunately (!!) the weather was always good and the heave motion was less than – 1 m/s. We cannot say what the performance will be in rough seas.

On station 37 the watchkeepers noted that a group of sample ID numbers ranging from 155601 to 155700 were missing. To keep the ID numbers consecutive for each cast, the watchkeepers decided to skip ID numbers 155590 to 155700. Thus, station 35 ends with ID number 155589 and station 37 starts with ID number 155701.

7. List of Cruise Participants

Name	Responsibility	Affiliation
Larry Bellefontaine	Salinometer/Watchkeeper	BIO
Brian Beanlands	MVCTD	BIO
Gerry Boudreau	Computers/Watchkeeper	BIO
Pierre Clement	Nutrients/Oxygens	BIO
Jean-Guy Dessureault	MVCTD	BIO
Bob Gershey	CFC/Alkalinity/Carbonate	BDR Research
Mike Hingston	CFC/Alkalinity/Carbonate	BDR Research
Anthony Isenor	Data Quality/Watchkeeper	BIO
Peter Jones	Assistant Scientist	BIO
John Lazier	Chief Scientist	BIO
Jonathon Lilly	Watchkeeper	UW
Christopher Meinen	Sound Sources/IES/Watchkeeper	URI
Mike Mulroney	Sound Sources/IES/Watchkeeper	URI
Maureen Noonan	Helium/Tritium Sampling	LDEO
Patrick Roussel	Watchkeeper	Dal
Murray Scotney	Moorings/CTD/Watchkeeper	BIO
Randy Watts	Sound Sources/IES	URI
Frank Zemlyak	CFC/Alkalinity/Carbonate	BIO

BIO	Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, NS, CANADA B2Y 2A4
BDR	BDR Research Ltd. Box 652, Station 'M' Halifax, N.S., Canada, B3J 2T3
Dal	Dalhousie University Halifax, Nova Scotia
LDEO	Lamont-Doherty Earth Observatory of Columbia University Palisades, NY, 10964, USA
URI	University of Rhode Island Narraganset Marine Lab South Ferry Road, Narragansett Rhode Island 02882
UW	University of Washington Seattle, WA, USA
WHOI	Woods Hole Oceanographic Institution Woods Hole, MA 02543, USA

B. UNDERWAY MEASUREMENTS

1. Navigation and Bathymetry
(Anthony W. Isenor)

The navigation system onboard CSS Hudson consisted of a Trimble Navigation Loran-GPS 10X decoder and AGCNAV. The decoder received the satellite fixes and decoded the signals to obtain latitude, longitude and time. The decoder signals were about 1 Hz. The navigation data were logged at one minute intervals on a PC. This PC was running the AGCNAV software package; a PC based display, and waypoint setting software package developed at the Atlantic Geoscience Centre at BIO. This software graphically displayed ship position, waypoints, course, speed, etc. to the various science working areas.

The echo sounder system used for collecting bathymetric data consisted of a Raytheon Line Scan Recorder, Model LSR˚1811-1 (serial number A105) connected to a hull mounted 12kHz transducer. The transducer beam width was 15 degrees. The sweep rate of the record was adjusted throughout the course of data collection to aid in identifying the bottom signal. The recorder was also linked to a clock, and thus could indicate 5 minute intervals on the sounder paper. The system was used to collect bathymetric soundings at 5 minute intervals while underway between stations on A1W and AR5.

Sounding data collection started on June 11, 1995 13:55 Z at the southwest end of line A1W. In total there were 1448 soundings collected, 442 soundings along A1W and 1006 along AR5. No soundings were collected while steaming between A1W and AR5. The sounding data collection stopped on June 26, 1995 at 11:25 Z, position 45.0006 N and 30.9984 W.

2. Acoustic Doppler Current Profiler
(Murray Scotney)

The CSS Hudson was equipped with a hull mounted RDI acoustic doppler current profiler. The transducer (serial number 177) had SC ADCP electronics (serial number 607) converted for shipboard use. Logging, using Transect software on a 386 PC, was started on June 8, 1995 at 1908Z along the Scotian Shelf. The configuration of the equipment resulted in a bin length of 8 metres and a total of 50 bins. The raw data were stored to disk and backed up every few days. The data were also averaged in real-time over 10 minute intervals. ADCP logging was stopped on July 3, 1995 on the Grand Banks.

3. Thermosalinograph
(Anthony W. Isenor)

An experimental alongtrack measuring system developed by the Biological Sciences Branch at BIO was used for the first time on this cruise. The system consisted of a Seabird Model 25 CTD equipped with a Syphalitic Nepelometer (fluorometer) and a ship board mounted irradiance meter.

The Seabird was placed in a 200 litre container and seawater was pumped into the container from the ships seawater lines collected at a depth of about 5 m below the surface. The container had a discharge line positioned such that the volume in the container was approximately 140 litres. The flow rate into the container was about 45 litres per minute.

A total of three computers were used to produce the final data file. One computer received navigation data from the Bridge navigation computer. The navigation data was logged and then rebroadcast to a Seabird deckunit, where it was merged with the CTD signal. The merged signal was then sent to a second computer where a real-time display of position, time, temperature, salinity , chlorophyll and irradiance was shown. This computer rebroadcasted a one second ASCII representation of the merged signal to a third computer where the data were stored to hard disk. The logging computer's Seabird processing coefficients are given in Appendix 1.

4. XBT and XCTD

No probes were used

5. Meteorological observations

The ship s crew carried out routine reporting of meteorological variables.

6. Atmospheric Chemistry

There was no atmospheric chemistry programme.

7. Moving Vessel CTD

(Anthony W. Isenor)

The MVCTD (described in Clarke et al., 1995) was an instrument development project lead by Jean-Guy Dessureault. This device consisted of a special winch, power block, launch and recovery chute, a heavy brass body containing a Falmouth Scientific Instruments CTD, Onset Tattletail 8 computer and radio modem. The system was capable of obtaining profiles at a depth greater than 1000 m while steaming at 10 knots. A profile was obtained by turning on the CTD by sending a signal to the fish via the radio modem. The operator then entered the target depth and the ships speed into the PC computer that controlled the winch and power block and initiated the profile. The entire operation of deploying and recovering the fish was completely under computer control. The radio modem was then used to download the data from the fish when recovery was complete.

The MVCTD was used successfully on seven casts. At Station 1, The MVCTD was attached to the rosette frame carrying the Seabird CTD. This will allow a comparison of the MVCTD and Seabird CTD datasets.

C. HYDROGRAPHIC MEASUREMENTS - DESCRIPTIONS, TECHNIQUES AND CALIBRATIONS

1. CTD Measurements

(Anthony W. Isenor)

a. Description of the Equipment and technique

The CTD measurements were made with a standard SEABIRD model 9Plus CTD (S/N 09P 7356-0299, BIO System #4, deck unit S/N 11P9984-0353). This unit was equipped with a model 3-02/F temperature sensor (S/N 031422), a model 4-02/0 conductivity sensor (S/N 041124), a paroscientific digiquartz model 410K-105 pressure sensor (S/N 53355) and a model 13-02 dissolved oxygen sensor (S/N 130284). All but the pressure sensor were mounted in a duct through which a pump pulls sea water. Hence the water flow past the actual sensors was independent of the lowering rate; this simplified the data processing considerably.

The Seabird CTD was mounted vertically within a custom designed and built CTD/Rosette frame. This frame was square rather than round to better accommodate the restricted space of Hudson’s winch room and winch room door. All the pressure cases as well as the sample bottles were mounted vertically to improve the package’s stability as in descended through the water column. In the centre of the frame was a 10 inch diameter aluminum tube that contained at its upper end a General Oceanics Model 1015-24 bottle rosette unit (BIO rosette #3, S/N 1185). The bottom of this tube was designed to hold an RDI 150 khz Broadband ADCP in a shortened pressure case. On this cruise, the short pressure case RDI was not available; instead a full length RDI pressure case was clamped vertically down one side of the central tube. On another side was clamped the pressure case for the Seabird CTD. The CTD sensors and pump were mounted on the third side and on the fourth was clamped a rechargeable battery pack for the RDI and below it a General Oceanics model 6000 12 kHz pinger unit.

The rosette bottles were made by the Physical and Chemical Oceanographic Data Facility of the Scripps Institution of Oceanography. The bottles were mounted six to each side of the rosette frame. Each bottle collected 10 litres of water.

b. Sampling Procedure and data processing techniques

The CTD was deployed with a lowering rate of 60 metres/min (40 metres/min in the upper 200 metres or deeper if the conditions were rough). It was recovered at a rate of 75 metres/min (60 metres/min when deeper than 4000 metres or when conditions were rough).

The CTD data was recorded onto disk by a 486 computer using SEABIRD SEASOFT Version 4.205 software. A screen display of temperature, oxygen and salinity profiles vs pressure were used to decide the depths at which bottles were to be tripped on the up cast. The bottles were tripped using the enable and fire buttons on the SEABIRD deck unit.

At the end of each station, the SEASAVE software was used to create 1 and 2 dbar processed data files, an IGOSS TESAC message and a processed rosette trip file. All the raw and processed data files associated with the station were then transferred to the ship's MicroVAX computer for archive and subsequent access and distribution to various users on the vessel.

The data processing used the following steps:

DATCNV	Converted the raw data to physical parameters.
SPLIT	Split the data into DOWN and UP cast.
WILDEDIT	For every block of 12 scans, flagged all scans whose pressure, temperature, conductivity and oxygen values differed from the mean by more than 2 standard deviations. Recomputed the mean and standard deviation from unflagged data then marked as bad all scans exceeding 4 standard deviations from these new values.
FILTER	Low pass filtered pressure and conductivity channels. Time constant used for conductivity was 0.045 seconds, for pressure 0.150 seconds.
LOOPEDIT	Marked as bad, all cycles on the down trace for which the vertical velocity of the CTD unit was less than 0.1 metres/sec.
ALIGNCTD	Aligned the temperature, conductivity and oxygen values relative to the pressure values accounting for the time delays in the system. Time offsets of 0.010 secs for conductivity, 0.000 secs for temperature and 3.000 secs for oxygen were used.
CELLTM	A recursive filter used to remove the thermal mass effects from the conductivity data. Thermal anomaly amplitude and time constants of 0.0300 and 9.0000 were used.
DERIVE	Computed oxygen values.
BINAVG	Averaged the down cast into 1 and 2 dbar pressure bins. (Note: The procedure to produce the 2 dbar averages takes about 5% of the total processing time).
DERIVE	Computed salinity, potential temperature and $sigma_{theta.}$
ROSSUM	Averaged 3 seconds of CTD data after every bottle trip. Used in comparison with water sample data.

c. Calibration data

The CTD calibrations used during this cruise were supplied by Seabird Electronics. The slope and offset applied to the conductivity sensor was based on data from the BIO Cruise 95003 (WOCE Expocode 18HU95003, see below). The applied calibrations were as follows:

BIO SEABIRD CTD System # 4

Temperature Sensor (#031422)

$$\text{Temperature} = 1/\{a + b[\ln(f_o/f)] + c[\ln^2[f_o/f] + d[\ln^3(f_o/f)]\} - 273.15$$

where ln indicates a natural logarithm,
f is the frequency
a = 3.68096068 E-03
b = 5.98528033 E-04
c = 1.47933699 E-05
d = 2.18572143 E-06
f_o = 6142.890
slope = 1, offset = 0 (Seabird calibration dated July 6, 1994)

Pressure Sensor (#53355)

$$\text{Pressure} = c\,(1 - T_o^2/T^2)\,(1 - d[1 - T_o^2/T^2])$$

where T is the pressure period (μsec)
$c = c_1 + c_2\,U + c_3\,U^2$
$d = d_1 + d_2\,U$
$T_o = T_1 + T_2\,U + T_3\,U^2 + T_4\,U^3 + T_5\,U^4$
U is the temperature (°C)
c_1 = -4.290243 E+04 psia
c_2 = 5.137240 E-01 psia/°C
c_3 = 1.334070 E-02 psia/°C^2
d_1 = 4.039500 E-02
d_2 = 0
T_1 = 2.993058 E+01 μsec
T_2 = -8.855370 E-05 μsec/°C
T_3 = 3.597730 E-06 μsec/°C^2
T_4 = 5.583850 E-09 μsec/°C^3
T_5 = 0
AD590M = 1.146000 E-02
AD590B = -8.11354 E+00
slope = 1, offset = 0 (Seabird calibration, February 2, 1993)

Conductivity Sensor (#041124)

$$\text{Conductivity} = (af^m + bf^2 + c + dt)/[10(1\text{-}9.57(10^{-8})p)]$$

where f is the frequency
p is pressure (dbars)
t is the temperature (°C)
m = 4.2
a = 1.35924955 E-05
b = 4.87959496 E-01
c = -4.19483432 E+00
d = -1.04684736 E-04
Slope = 1.00039254 E+00
Offset = -5.400 E-04

Oxygen Sensor (#130284)

$$\text{Oxygen} = \text{Soc} \times (\text{oc} + \text{tau} \times \frac{doc}{dt}) + \text{Boc}] \times \text{OXSAT}(T,S) \times e^{\{\text{tcor} \times [T + \text{wt} \times \{T0 — T)] + \text{pcor} \times P\}}$$

where Soc = 2.5328
oc is the oxygen sensor current (μamps)
oc = mV + b
m = 2.4528 E-07
V is the oxygen temperature sensor voltage signal
b = -3.9245 E-09
tau = 2.0
$\frac{doc}{dt}$ is the time derivative of oc
Boc = -0.0322
OXSAT is the oxygen saturation value dependent on T and S
T is the water temperature (°C)
S is salinity (psu)
e is natural log base
tcor = -0.033
wt = 0.670
T_o oxygen sensor internal temperature (°C)
T_o = kV + c
k = 8.9625
c = -6.9161
pcor = 1.5 E-04
P is the pressure (psia)

A previous cruise in April/May 1995 (see Clarke, WOCE Expocode 18HU95003) to the Newfoundland Basin used the same CTD and sensors as this cruise. Fortunately, preliminary analyses of the 95003 dataset were complete on our departure. Clarke and Yashayeav determined that no temperature calibration of the CTD was necessary. However, a conductivity calibration was necessary. Based on the work of Clarke and Yashayeav, the conductivity calibration applied to the CTD data during collection of this dataset was as follows:

$$\text{Conductivity}_{CTD} = -0.00054 + 1.00039254 * \text{Conductivity}_{CTD}$$

Subsequent analysis of the CTD salinities as compared to the water samples salinities was carried out using a total of 1102 comparison data points. The median salinity difference was found to be:

$$\text{Salinity}_{\text{Water Sample}} - \text{SalinityCTD} = 0.0005$$

The duplicate water sample salinity analysis (see Salinity Replicate Analysis section) indicated that the median difference between water sample salinities was also 0.0005. This indicated no significant difference between our ability to compare duplicate water sample salinities and our ability to compare the water sample salinities with the CTD. Thus, no pressure independent offset in salinity will be applied.

However, the CTD salinities were found to have a pressure dependent offset relative to the water sample salinities. To remove this offset, we first defined the interquartile range (IQR) in 3 layers in the water column, 0 to <1500 dbars, 1500 to <3000 dbars and =>3000 dbars. The IQR is defined using the difference between values at the 25 and 75 percentile, Q_1 and Q_3 respectively (note that Q_2 would be the 50 percentile, or the median). In each layer, we neglect all differences outside of the range

$$\text{difference} < Q_2 - 1.5 * (Q_3 - Q_1) \text{ and}$$
$$\text{difference} > Q_3 + 1.5 * (Q_3 - Q_1)$$

$$\text{where difference} = \text{Salinity}_{\text{Water sample}} - \text{Salinity}_{CTD}$$

Using the valid points from all layers (a total of 931 points), we fit a 3rd order polynomial to the differences. The fitted equation is:

$$\text{difference} = 0.00122 + 3.47869*10^{-7}*P - 4.96435*10^{-10}*P^2 + 6.48289*10^{-14}*P^3$$

This equation produces an offset of about 0.0012 in the surface and -0.0012 at 4000 dbar.

Considering the CTD temperature measurements as compared to the digital thermometers (see Reversing Thermometer Replicate Analysis section) we note that the interthermometer comparison indicated differences of 0.002_C. The difference between the thermometers and the CTD were also about 0.002_C. Thus, we will not apply any temperature calibration to the CTD.

The CTD oxygen data was calibrated using a combination of upcast water sample data and downcast CTD profile data. No CTD data were obtained for the following stations: 9, 15, 17, 18, 20, 21, 22, 25, 26, 27, 31, 36, 38, 45, 49, 51, 54, 56, 62, 64, 68, 75, 80, 81, 84, 87 and 88. The details of the calibration procedure and results are given in Appendix 2. Note that the WOCE SEA file column CTDOXY contains the down cast CTD oxygen data used in the calibration as opposed to the discrete CTD oxygen data obtained at the time of bottle trip.

2. Salinity

(Anthony W. Isenor)

a. *Description* of Equipment and Technique

Salinity samples were analyzed on a Guildline Autosal model 8400 salinometer, Ocean Circ Unit B. Samples were drawn into medicine bottles. New caps, equipped with plastic liners, were placed on the sample bottles for each use.

The salinometer cell was filled and rinsed three times with sample water before readings were recorded. Three readings of the salinometer were recorded for every sample and standardization. The last two readings were averaged and entered into the water sample database as the conductivity of the water sample.

b. Sampling Procedure and Data Processing Technique

Salinity samples were drawn into medicine bottles after three rinses. The bottles were filled up to the shoulders and then capped with new caps with plastic liners.

One conductivity file for the entire cruise was prepared. The file consisted of a sequential record number, the bath temperature, sample ID number, average conductivity ratio and a quality flag. A PC based program running under a commercial DBMS computed the salinity using the average conductivity ratio and the standard IAPSO formula. Any changes in the salinometer readings between successive standardizations were assumed to have occurred as a linear drift of the instrument. Thus, the program applied a correction to the ratios, which varied linearly with the samples analyzed. The salinity data was then placed in the water sample database.

c. Laboratory and Sample Temperatures

Full cases of samples were taken from the winch room to the GP lab where they were left for a period of at least 10 hours to equilibrate to laboratory temperature before being analyzed.

The baths in the salinometer were kept at 21°C for the first 79 stations and thereafter at 24°C. The change in operating temperature was due to our inability to hold the laboratory at about 21°C in the southern, warmer region of operation.

d. Replicate Analysis

A duplicate salinity sample was drawn from one of the rosette bottles on every cast.

A total of 58 duplicate salinity samples were drawn and statistically analyzed. Statistics of the duplicate differences follow. All replicate values and their quality flags are shown in Table C.1 below.

Statistic	Value
Number of Duplicate Differences	58
Minimum	0
Maximum	0.0059
Mean	0.0009
Median	0.0004
Standard Deviation	0.0011

e. Standards Used

The salinometer was standardized on June 12, 1995 using IAPSO standard water, Batch P126, prepared on November 24, 1994. A check on the standardization using a new ampoule was carried out at the beginning and end of every 32 bottle case and at intermediate points during a case if instrument drift was suspected. A restandardization was conducted on June 20, 1995.

Table C.1 Replicate water sample salinity values with their quality flags.

Sample ID Number	Salinity	WOCE QF
155204	32.4623	2
155204	32.4618	2
155227	31.7400	2
155227	31.7384	2
155228	34.1117	2
155228	34.1118	2
155237	32.8259	2
155237	32.8263	2
155243	31.7877	2
155243	31.7862	2
155247	33.2100	2
155247	33.2092	2
155254	32.7362	2
155254	32.7389	2
155256	34.6949	2
155256	34.6951	2
155267	34.8148	2
155267	34.8175	2
155279	34.8650	2
155279	34.8642	2
155298	34.8797	2
155298	34.8795	2
155316	34.8800	2
155316	34.8797	2
155339	34.9005	2
155339	34.9007	2
155356	34.8762	2
155356	34.8794	2
155378	34.8701	2
155378	34.8693	2
155418	34.8358	2
155418	34.8356	2
155442	34.8340	2
155442	34.8340	2
155457	34.9102	2
155457	34.9098	2
155487	34.8336	2
155487	34.8344	2
155503	34.9078	2
155503	34.9068	2
155537	34.8415	2
155537	34.8411	2
155588	34.3154	2
155588	34.3154	2
155714	34.8611	2
155714	34.8617	2
155731	34.8905	2
155731	34.8911	2
155759	34.8952	2
155759	34.8244	4
155776	34.7804	2
155776	34.7806	2
155778	34.5600	2
155778	34.5604	2
155782	34.3570	2
155782	34.3576	2
155808	34.7382	2
155808	34.7358	2
155821	34.8450	2
155821	34.8454	2
155838	34.9286	2
155838	34.9290	2
155866	34.8528	2
155866	34.8524	2
155882	34.9389	2
155882	34.9380	2
155920	34.8129	2
155920	34.8121	2
155940	34.9044	2
155940	34.9050	2
155954	34.8654	2
155954	34.8705	2
155975	34.8797	2
155975	34.8805	2
155994	34.8943	2
155994	34.8964	2
156009	34.9496	2
156009	34.9494	2
156038	34.8752	2
156038	34.8693	2
156059	34.8762	2
156059	34.8780	2
156072	34.9135	2
156072	34.9117	2

Table C.1 Replicate water sample salinity values with their quality flags.

Sample ID Number	Salinity	WOCE QF
156096	34.9093	2
156096	34.9095	2
156139	35.3421	2
156139	35.3415	2
156141	34.8995	2
156141	34.8999	2
156164	34.8996	2
156164	34.8994	2
156199	34.9347	2
156199	34.9347	2
156210	34.9002	2
156210	34.8994	2
156233	34.9055	2
156233	34.9055	2
156275	35.5071	2
156275	35.5067	2
156280	34.9141	2
156280	34.9145	2
156302	34.9117	2
156302	34.9117	2
156340	34.9416	2
156340	34.9412	2
156365	35.6322	2
156365	35.6322	2
156370	34.9306	2
156370	34.9304	2
156395	34.9263	2
156395	34.9259	2
156399	34.9031	2
156399	34.9035	2
156403	34.8968	2
156403	34.8972	2
156410	34.9237	2
156410	34.9241	2

Sample ID Number	Salinity	WOCE QF

3. Oxygen

(Pierre Clement)

a. Description of Equipment and Technique

The oxygen samples wee analyzed using an automated procedure developed by the Physical and Chemical Services Branch (PCS) of the Bedford Institute of Oceanography (BIO) from a manual titration system (Levy et al. 1977). The PCS procedure is a modified Winkler titration from Carritt and Carpenter (1966), using a whole bottle titration. In this method there is no starch indicator and a wetting agent (Wetting Agent A, BDR) is introduced to reduce bubble formation. The automated titration system consists of an IBM PC linked to a Brinkmann PC800 colorimeter and a Metrohm 665 Multi-Dosimat Automatic Titrator. A full description of the system and method can be found in Jones, et al. (1992) with the following exception: Page 2-4, section 2.3 Method - Sample titration should read, 'The stopper is not replaced and the acid rinsed down the stopper's end into the flask. The end is then rinsed into the flask with deionized water. One drop of wetting agent and the magnetic stirring bar are then added.'

b. Sampling Procedure and Data Processing Technique

The sampling bottles were 125ml Iodine flasks with custom ground stoppers (Levy et al. 1977). The flask volumes were determined gravimetrically. The matched flasks and stoppers were etched with Identification numbers and entered into the Oxygen program database.

For this cruise 10 litre rosette bottles were used to obtain the original sample. The oxygen subsamples were drawn immediately following the drawing of the CFC and helium subsamples. The oxygen subsamples were drawn through the bottles spigot with a latex or silicone tube attached so as to introduce the water to the bottom of the flask. The flask and its stopper were thoroughly rinsed and filled to overflowing. The flow was allowed to continue until at least two to three flask volumes overflowed. The flask was then slowly retracted with continuous low flow to ensure that no air was trapped in the flask. The flask was then brought to the reagent station and one ml each of the Alkaline Iodide and Manganous Chloride Reagents were added and the stoppers carefully inserted, again ensuring that no air was entering into the flasks. The flasks were thoroughly shaken then carried to the lab for analysis.

c. Replicate Analysis

There were 1212 unique sample id numbers that were analyzed for dissolved oxygen, of which 1130 had one sample value, 79 had two sample values and 3 had three sample values. A duplicate oxygen sample was drawn from one of the rosette bottles on every cast. On one cast, duplicate samples were drawn from all the rosette bottles.

Statistics of the replicate differences follow. Only acceptable values were used in calculating the replicate differences. The calculated replicate statistics used the absolute value of the replicate differences. Of the 79 unique ids that had one replicate sample, the replicate difference was not calculated for five sample id numbers (155248, 155251, 155260, 155785 and 155786) because one of the sample values was unacceptable. All of the replicate sample values and their quality flags are listed in Table C.2 below.

Number of replicate differences
= (79 - 5) sample id numbers having one replicate * 1 possible difference
+ (3) sample id numbers having two replicates * 3 possible differences
= 83

Median of [(absolute difference/sample mean concentration of all samples) * 100%]
= 0.22 %

Statistic	Value (µmoles/kg)
Minimum	0.0
Maximum	40.8
Mean	2.2
Median	0.6
Standard Deviation	5.6

Cumulative Frequency	Oxygen Difference (µmoles/kg)
50 %	≤ 0.6
68 %	≤ 1.3
95 %	≤ 6.9

Table C.2 Replicate water sample oxygen values in moles/kg, along with their quality flags.

Sample ID Number	Oxygen	WOCE QF
155219	304.4	2
155219	303.0	2
155226	327.4	2
155226	327.4	2
155231	320.6	2
155231	320.9	2
155236	323.9	2
155236	323.9	2
155239	305.3	2
155239	306.2	2
155248	343.8	3
155248	330.5	2
155251	311.2	3
155251	315.3	2
155260	308.8	2
155260	309.1	3
155271	294.3	2
155271	295.1	2
155283	295.8	2
155283	298.2	2
155294	287.0	2
155294	286.6	2
155312	296.0	2
155312	295.9	2
155343	300.5	2
155343	300.9	2
155367	299.3	2
155367	299.6	2
155380	291.4	2
155380	291.5	2
155401	301.7	2
155401	330.0	2
155402	302.4	2
155402	302.8	2
155403	310.7	2
155403	310.7	2
155404	317.1	2
155404	319.1	2
155405	326.6	2
155405	327.3	2
155413	277.6	2
155413	277.3	2
155430	300.7	2
155430	293.8	2
155453	299.1	2
155453	301.0	2
155485	298.2	2
155485	299.1	2
155499	299.2	2
155499	299.4	2
155516	300.8	2
155516	301.1	2
155525	280.9	2
155525	285.0	2
155535	298.8	2
155535	298.2	2
155537	301.3	2
155537	301.8	2
155547	290.4	2
155547	291.0	2
155547	291.0	2
155556	298.3	2
155556	298.3	2
155556	297.2	2
155580	299.3	2
155580	299.3	2
155712	292.5	2
155712	298.0	2
155725	297.3	2
155725	299.8	2
155757	295.9	2
155757	295.9	2
155757	296.1	2
155777	364.8	2
155777	365.7	2
155779	322.0	2
155779	321.9	2
155781	391.5	2
155781	393.0	2
155785	385.8	3
155785	388.7	2
155786	305.9	2
155786	311.6	3
155817	286.3	2
155817	286.0	2
155847	283.0	2

Table C.2 Replicate water sample oxygen values in moles/kg, along with their quality flags.

Sample ID Number	Oxygen	WOCE QF
155847	292.6	2
155858	278.1	2
155858	281.7	2
155910	281.7	2
155910	282.0	2
155929	271.6	2
155929	271.7	2
155951	278.7	2
155951	276.2	2
155969	274.6	2
155969	275.0	2
155988	273.4	2
155988	273.7	2
156020	280.6	2
156020	281.7	2
156037	288.9	2
156037	294.1	2
156063	273.9	2
156063	270.9	2
156071	279.4	2
156071	276.9	2
156072	275.9	2
156072	276.1	2
156073	275.4	2
156073	275.9	2
156074	275.4	2
156074	275.8	2
156075	269.2	2
156075	275.5	2
156076	274.9	2
156076	275.2	2
156077	275.0	2
156077	274.8	2
156078	275.1	2
156078	275.7	2
156079	280.5	2
156079	282.3	2
156080	281.1	2
156080	285.5	2
156081	284.6	2
156081	285.9	2
156082	282.3	2
156082	282.3	2
156083	274.1	2
156083	276.5	2
156084	268.8	2

Sample ID Number	Oxygen	WOCE QF
156084	269.4	2
156085	250.3	2
156085	256.7	2
156086	229.1	2
156086	228.9	2
156087	223.1	2
156087	224.1	2
156097	274.2	2
156097	274.3	2
156130	274.7	2
156130	275.1	2
156140	281.5	2
156140	281.5	2
156163	280.5	2
156163	279.2	2
156200	265.0	2
156200	264.2	2
156211	277.7	2
156211	277.8	2
156232	275.5	2
156232	275.6	2
156270	242.4	2
156270	243.2	2
156278	274.9	2
156278	275.0	2
156303	273.9	2
156303	274.6	2
156333	286.2	2
156333	279.3	2
156334	242.9	2
156334	283.7	2
156347	271.7	2
156347	272.5	2
156371	271.0	2
156371	265.7	2

4. Nutrients

(Pierre Clement)

a. Description of Equipment and Technique

Nutrient concentrations were determined using a Technicon Autoanalyser II. The chemistries were standard Technicon (Silicate 186-72W, Phosphate 155-71W, Nitrate/Nitrite 158-71W) except for Phosphate which was modified by separating the Ascorbic Acid (4.0 gms/l) from the Mixed Reagent. This alteration was achieved by introducing the modified Mixed Reagent instead of water at the start of the sample stream at 0.23 ml/min and the Ascorbic Acid was pumped into the stream between the two mixing coils at 0.32 ml/min.

b. Sampling Procedure and Data Processing Technique

Duplicate nutrient subsamples were drawn into 30 ml HDPE (Nalge) wide mouth sample bottles from 10 litre Niskins. The bottles were 10% HCl washed, rinsed once with tap water, three times with Super-Q and oven dried at >100 °F.

A sample run included six Working Standards run at the beginning and end. Duplicate Check Standards were run every 16 samples followed by blanks as a Baseline Check. These Standards were made up in 33 ppt NaCl (VWR,Analar grade) as is the wash water. The Standards were tested against CSK Solution Standards (Sagami Chemical Center, Japan).

Analog data was converted to digital, processed and statistics calculated by a Pascal 6.0 in house program (Logger) on a PC. Chart recordings, hard copy and disk copies of the data were kept for reference.

c. Replicate Analysis

A total of 2068 seawater samples were analyzed for silicate, phosphate and NO_2+NO_3. Included in these samples were a total of 1030 duplicate samples and 2 quadruplicate samples. Statistics relating to the precision of the sample values follow. All values are given in µmoles/kg. Only the samples that had acceptable replicate values were included in the statistics. All replicate values and their quality flags are given in Table C.3.

Precision is a measure of the variability of individual measurements and in the following analysis two categories of precision were determined: field and analytical precision. Analytical precision is based on the pooled estimate of the standard deviation of the check standards over the course of a complete autoanalyzer run and is a measure of the greatest precision possible for a particular analysis. Field precision is based on the analysis of two or more water samples taken from a single Niskin sampling bottle and has an added component of variance due to subsampling, storage and natural sample variability.

Both categories of precision were determined by computing the variance, σ_i^2, of each replicate set, where "i" is the index of the replicate set. In the case of analytical (field) precision, a replicate set consisted of all the check standards (duplicate samples). Given p replicate sets and n samples within any replicate set, the mean standard deviation, $\bar{\sigma}$, was determined from

$$\bar{\sigma} = \sqrt{\frac{\sum_{i=1}^{p}(n-1)_i \sigma_i^2}{\sum_{i=1}^{p}(n-1)_i}}$$

The precision expressed in percent was based on the mean concentration (M) of the check standards (analytical precision) or water samples (field precision) and was given by

$$P_{\%} = \frac{\bar{\sigma}}{\bar{M}} \times 100\%$$

The following table indicates the analytical and field precision obtained for this cruise.

Statistic	Silicate	Phosphate	NO2+NO3
Number of Samples	2068	2068	2068
Number of Replicates	1036	1036	1036
Mean concentration (μmoles/kg)	10.48	1.01	14.86
Field Precision (μmoles/kg)	0.11	0.03	0.16
Field Precision (%)	1.07	2.70	1.08
Analytical Precision (μmoles/kg)	0.69	0.03	0.31
Analytical Precision (%)	2.06	2.84	1.86
Detection Limit (μmoles/kg)	0.20	0.06	0.19

The laboratory temperature during all analyses was between 21 and 23 °C.

The conversion to mass units for the analytical precision and detection limits used a standard density of 1.02443 kg/liter corresponding to 33 ppt and 15°C. The conversion of individual sample values from volume to mass units used a potential density with a fixed temperature of 15°C.

Duplicate samples were drawn from each rosette bottle for the determination of silicate, phosphate and nitrate concentrations.

The nutrient detection limits noted in the above table were applied to the dataset. All values at or below the detection limits were set to zero.

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155201	8.80	0.98	7.90	2 2 2
155201	8.75	0.99	7.81	2 2 2
155202	8.88	1.01	8.20	2 2 2
155202	8.96	1.00	8.22	2 2 2
155203	8.92	1.04	8.10	2 2 2
155203	9.01	1.02	8.33	2 2 2
155204	8.82	1.26	7.98	2 2 2
155204	8.82	1.07	7.98	2 2 2
155205	8.95	1.08	8.09	2 2 2
155205	8.89	1.07	8.00	2 2 2
155206	8.79	1.07	8.09	2 2 2
155206	8.87	1.07	8.14	2 2 2
155207	8.80	1.07	7.91	2 2 2
155207	8.81	1.08	8.14	2 2 2
155209	8.51	1.05	7.81	2 2 2
155209	8.61	1.05	7.81	2 2 2
155210	8.51	0.98	7.76	2 2 2
155210	8.47	0.99	7.78	2 2 2
155211	8.82	1.00	7.94	2 2 2
155211	8.63	1.00	7.85	2 2 2
155212	8.74	1.00	8.08	2 2 2
155212	8.89	1.00	7.97	2 2 2
155213	8.77	1.01	8.04	2 2 2
155213	8.87	1.00	8.15	2 2 2
155214	8.57	1.02	7.96	2 2 2
155214	8.67	1.01	7.81	2 2 2
155215	8.79	1.02	8.03	2 2 2
155215	8.92	1.02	7.99	2 2 2
155216	8.76	1.02	8.12	2 2 2
155216	8.72	1.02	8.15	2 2 2
155217	8.79	1.01	8.10	2 2 2
155217	8.81	1.00	7.97	2 2 2
155219	8.61	0.97	7.87	2 2 2
155219	8.37	0.99	7.89	2 2 2
155220	8.46	0.99	7.84	2 2 2
155220	8.34	1.00	7.75	2 2 2
155221	8.25	1.01	7.80	2 2 2
155221	8.37	1.01	7.71	2 2 2
155222	8.33	1.02	7.80	2 2 2
155222	8.44	1.00	7.86	2 2 2
155223	8.41	1.01	7.81	2 2 2
155223	8.44	1.02	7.84	2 2 2
155224	11.15	1.04	9.99	2 2 2
155224	11.41	1.03	10.19	2 2 2
155225	12.18	1.04	9.45	2 2 2
155225	12.09	1.05	9.39	2 2 2
155226	11.56	1.04	8.19	2 2 2
155226	11.75	1.03	8.47	2 2 2
155227	1.11	0.50	0.00	2 2 2
155227	1.15	0.47	0.23	2 2 2
155228	12.06	1.03	13.15	2 2 2
155228	12.26	1.01	12.86	2 2 2
155229	11.90	1.02	12.32	2 2 2
155229	11.95	1.01	12.38	2 2 2
155230	10.97	1.03	11.32	2 2 2
155230	11.07	0.99	11.39	2 2 2
155231	10.50	1.02	10.32	2 2 2
155231	10.54	1.02	10.22	2 2 2
155232	11.59	1.04	9.07	2 2 2
155232	11.45	1.05	8.92	2 2 2
155233	11.13	1.02	7.90	2 2 2
155233	11.29	1.04	8.06	2 2 2
155234	1.02	0.51	0.00	2 2 2
155234	1.06	0.47	0.00	2 2 2
155235	12.45	1.04	11.28	2 2 2
155235	12.62	1.07	11.23	2 2 2
155236	11.62	1.03	9.03	2 2 2
155236	11.79	1.05	9.14	2 2 2
155237	11.31	1.04	8.14	2 2 2
155237	11.51	1.05	8.23	2 2 2
155238	0.90	0.52	0.00	2 2 2
155238	0.97	0.50	0.00	2 2 2
155239	10.99	1.02	12.52	2 2 2
155239	11.19	1.01	12.97	2 2 2
155240	8.04	0.91	8.69	2 2 2
155240	7.93	0.90	8.67	2 2 2
155241	11.17	1.04	8.52	2 2 2
155241	11.34	1.03	8.65	2 2 2
155242	10.97	1.03	7.77	2 2 2
155242	11.08	1.02	7.74	2 2 2
155243	0.42	0.45	0.00	2 2 2
155243	0.49	0.44	0.00	2 2 2
155244	9.68	0.95	12.75	2 2 2
155244	9.51	0.95	12.49	2 2 2
155245	10.13	1.01	12.54	2 2 2
155245	9.76	0.98	12.19	2 2 2
155246	9.96	0.98	9.36	2 2 2
155246	10.04	0.96	9.48	2 2 2
155247	11.51	1.02	9.26	2 2 2
155247	11.74	1.03	9.11	2 2 2
155248	10.38	1.03	7.34	2 2 2
155248	10.76	1.01	7.58	2 2 2
155249	0.38	0.50	0.00	2 2 2
155249	0.38	0.46	0.00	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155250	9.01	1.03	15.02	2 2 2
155250	8.85	1.03	15.03	2 2 2
155251	9.23	0.92	12.11	2 2 2
155251	9.29	0.93	12.24	2 2 2
155252	11.14	1.00	11.45	2 2 2
155252	10.74	1.00	11.26	2 2 2
155253	11.78	1.03	9.57	2 2 2
155253	11.58	1.04	9.42	2 2 2
155254	10.77	1.00	7.56	2 2 2
155254	10.81	1.00	7.70	2 2 2
155255	0.73	0.48	0.00	2 2 2
155255	0.80	0.47	0.00	2 2 2
155256	8.96	1.03	14.88	2 2 2
155256	9.19	1.01	14.97	2 2 2
155257	8.43	1.00	14.49	2 2 2
155257	8.48	1.01	14.61	2 2 2
155258	8.89	1.01	14.45	2 2 2
155258	8.88	0.99	14.54	2 2 2
155259	8.78	0.99	13.68	2 2 2
155259	9.00	1.00	13.99	2 2 2
155260	8.47	0.96	12.63	2 2 2
155260	8.49	0.94	12.84	2 2 2
155261	9.42	0.95	11.56	2 2 2
155261	9.47	0.99	11.37	2 2 2
155262	10.08	0.98	10.30	2 2 2
155262	10.03	0.99	10.26	2 2 2
155263	4.61	0.77	4.98	2 2 2
155263	4.65	0.75	4.78	2 2 2
155264	0.36	0.37	0.00	2 2 2
155264	0.40	0.42	0.00	2 2 2
155265	8.67	1.07	15.71	2 2 2
155265	8.85	1.03	16.03	2 2 2
155266	8.86	1.05	15.64	2 2 2
155266	9.05	1.04	15.73	2 2 2
155267	8.78	1.04	16.05	2 2 2
155267	8.79	1.06	15.79	2 2 2
155268	8.58	1.05	15.53	2 2 2
155268	8.56	1.04	15.66	2 2 2
155269	8.87	1.06	15.84	2 2 2
155269	8.79	1.07	15.84	2 2 2
155270	8.82	1.04	15.54	2 2 2
155270	8.89	1.04	15.97	2 2 2
155271	8.51	1.04	15.58	2 2 2
155271	8.59	1.04	15.77	2 2 2
155272	8.58	1.06	15.57	2 2 2
155272	8.72	1.04	15.66	2 2 2
155273	9.10	1.02	15.09	2 2 2
155273	8.88	1.02	15.18	2 2 2
155274	8.34	0.99	14.33	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155274	8.42	0.99	14.46	2 2 2
155277	10.50	1.06	16.19	2 2 2
155277	10.58	1.07	16.11	2 2 2
155278	10.27	1.08	16.34	2 2 2
155278	10.38	1.08	16.43	2 2 2
155279	10.04	1.07	16.10	2 2 2
155279	9.99	1.08	16.66	2 2 2
155280	9.24	1.08	16.32	2 2 2
155280	9.22	1.06	16.02	2 2 2
155281	9.23	1.08	16.48	2 2 2
155281	9.25	1.07	16.29	2 2 2
155282	9.17	1.07	15.95	2 2 2
155282	9.42	1.08	16.01	2 2 2
155283	9.25	1.08	16.25	2 2 2
155283	9.42	1.10	16.62	2 2 2
155284	9.50	1.06	16.10	2 2 2
155284	9.53	1.08	16.41	2 2 2
155285	9.27	1.08	16.22	2 2 2
155285	9.19	1.07	16.13	2 2 2
155286	8.84	1.07	16.15	2 2 2
155286	8.86	1.04	15.57	2 2 2
155287	8.44	1.04	15.44	2 2 2
155287	8.40	1.05	15.64	2 2 2
155288	8.56	1.06	15.66	2 2 2
155288	8.48	1.06	15.84	2 2 2
155289	6.66	0.84	11.26	2 2 2
155289	6.76	0.83	11.26	2 2 2
155290	8.11	1.00	14.10	2 2 2
155290	8.49	1.00	14.32	2 2 2
155291	4.51	0.60	7.86	2 2 2
155291	4.51	0.60	8.07	2 2 2
155293	11.59	1.03	15.36	2 2 2
155293	11.60	1.05	15.23	2 2 2
155294	11.61	1.05	15.47	2 2 2
155294	11.54	1.03	15.27	2 2 2
155295	11.40	1.06	15.66	2 2 2
155295	11.47	1.05	15.24	2 2 2
155296	11.33	1.07	15.67	2 2 2
155296	11.34	1.08	15.70	2 2 2
155297	10.71	1.07	15.82	2 2 2
155297	10.75	1.07	15.48	2 2 2
155298	10.38	1.09	16.17	2 2 2
155298	10.34	1.08	16.47	2 2 2
155299	9.16	1.11	16.07	2 2 2
155299	9.42	1.09	15.82	2 2 2
155300	9.31	1.08	16.27	2 2 2
155300	9.41	1.08	16.12	2 2 2
155301	9.21	1.07	16.21	2 2 2
155301	9.24	1.10	16.41	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155302	8.98	1.09	16.20	2 2 2
155302	9.08	1.10	15.91	2 2 2
155303	8.97	1.09	16.35	2 2 2
155303	9.14	1.10	16.46	2 2 2
155304	9.21	1.09	16.01	2 2 2
155304	9.19	1.09	15.73	2 2 2
155305	9.00	1.08	15.84	2 2 2
155305	8.87	1.07	15.84	2 2 2
155306	8.32	1.05	15.52	2 2 2
155306	8.56	1.06	15.59	2 2 2
155307	8.57	1.07	15.29	2 2 2
155307	8.59	1.06	15.31	2 2 2
155308	8.51	1.04	15.48	2 2 2
155308	8.67	1.06	15.42	2 2 2
155309	8.21	1.02	15.05	2 2 2
155309	8.32	1.04	15.20	2 2 2
155310	7.17	0.92	12.53	2 2 2
155310	7.09	0.89	12.51	2 2 2
155311	3.92	0.51	7.19	2 2 2
155311	4.00	0.52	7.10	2 2 2
155312	10.66	1.00	14.16	2 2 2
155312	10.77	1.00	14.22	2 2 2
155313	10.91	1.02	14.71	2 2 2
155313	10.93	1.03	14.49	2 2 2
155314	11.75	1.05	15.23	2 2 2
155314	11.83	1.06	15.31	2 2 2
155315	11.25	1.10	15.72	2 2 2
155315	11.33	1.08	15.55	2 2 2
155316	10.57	1.11	15.98	2 2 2
155316	10.64	1.11	15.86	2 2 2
155317	9.58	1.11	15.96	2 2 2
155317	9.42	1.09	15.86	2 2 2
155318	9.26	1.09	16.18	2 2 2
155318	9.30	1.09	16.02	2 2 2
155319	9.31	1.08	16.23	2 2 2
155319	9.36	1.10	16.43	2 2 2
155320	9.44	1.10	16.35	2 2 2
155320	9.49	1.12	16.07	2 2 2
155321	9.30	1.09	16.15	2 2 2
155321	9.51	1.10	15.88	2 2 2
155322	9.28	1.10	15.75	2 2 2
155322	9.38	1.08	15.58	2 2 2
155323	9.15	1.10	15.94	2 2 2
155323	9.29	1.08	15.90	2 2 2
155324	9.63	1.11	15.85	2 2 2
155324	9.65	1.10	15.76	2 2 2
155325	9.55	1.09	15.65	2 2 2
155325	9.41	1.10	15.68	2 2 2
155326	8.97	1.10	15.67	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155326	9.15	1.09	15.46	2 2 2
155327	8.83	1.07	15.70	2 2 2
155327	8.90	1.08	15.63	2 2 2
155328	8.84	1.08	15.87	2 2 2
155328	8.91	1.06	15.80	2 2 2
155329	8.60	1.05	15.26	2 2 2
155329	8.65	1.04	15.04	2 2 2
155330	7.00	0.64	7.27	2 2 2
155330	6.98	0.64	7.31	2 2 2
155331	6.12	0.56	6.80	2 2 2
155331	6.14	0.55	6.81	2 2 2
155332	10.93	1.00	14.24	2 2 2
155332	11.10	0.99	14.10	2 2 2
155333	11.04	0.98	14.41	2 2 2
155333	11.15	0.99	14.56	2 2 2
155335	11.78	1.03	14.79	2 2 2
155335	12.01	1.02	15.02	2 2 2
155336	12.27	1.06	15.72	2 2 2
155336	12.49	1.05	15.54	2 2 2
155337	12.25	1.05	15.54	2 2 2
155337	12.20	1.06	15.39	2 2 2
155338	12.06	1.12	15.91	2 2 2
155338	11.99	1.08	16.14	2 2 2
155339	11.40	1.09	15.87	2 2 2
155339	11.44	1.07	15.83	2 2 2
155340	11.24	1.10	16.39	2 2 2
155340	11.41	1.08	16.64	2 2 2
155341	9.88	1.09	16.04	2 2 2
155341	10.03	1.06	16.35	2 2 2
155342	10.02	1.08	16.50	2 2 2
155342	9.71	1.08	16.33	2 2 2
155343	9.55	1.08	16.04	2 2 2
155343	9.66	1.06	16.25	2 2 2
155344	9.80	1.08	16.46	2 2 2
155344	9.86	1.08	16.59	2 2 2
155345	9.70	1.07	16.00	2 2 2
155345	9.75	1.10	16.21	2 2 2
155346	9.89	1.07	16.52	2 2 2
155346	9.80	1.10	16.59	2 2 2
155347	9.93	1.10	16.42	2 2 2
155347	9.76	1.11	16.21	2 2 2
155348	9.79	1.09	16.46	2 2 2
155348	9.80	1.08	16.55	2 2 2
155349	9.48	1.10	16.11	2 2 2
155349	9.50	1.06	16.19	2 2 2
155350	9.30	1.10	16.20	2 2 2
155350	9.37	1.08	16.34	2 2 2
155351	9.11	1.08	15.90	2 2 2
155351	9.44	1.07	16.09	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155352	8.92	1.04	15.69	2 2 2
155352	8.91	1.05	15.74	2 2 2
155353	8.78	1.07	14.81	2 2 2
155353	8.83	1.06	14.98	2 2 2
155354	6.94	0.62	8.18	2 2 2
155354	6.92	0.62	8.18	2 2 2
155355	11.03	1.00	14.43	2 2 2
155355	11.01	1.00	14.35	2 2 2
155356	10.97	1.02	14.87	2 2 2
155356	11.14	1.02	14.98	2 2 2
155357	11.49	1.01	15.00	2 2 2
155357	11.72	1.02	15.07	2 2 2
155358	12.32	1.05	15.36	2 2 2
155358	12.40	1.05	15.36	2 2 2
155359	12.45	1.07	15.76	2 2 2
155359	12.50	1.06	15.93	2 2 2
155360	12.34	1.06	16.25	2 2 2
155360	12.34	1.08	15.99	2 2 2
155361	11.62	1.09	16.02	2 2 2
155361	11.63	1.10	15.93	2 2 2
155362	11.44	1.10	16.40	2 2 2
155362	11.55	1.08	16.42	2 2 2
155363	10.82	1.09	16.38	2 2 2
155363	11.74	1.10	16.29	2 2 2
155364	9.83	1.09	16.36	2 2 2
155364	9.71	1.09	16.52	2 2 2
155365	9.55	1.09	16.19	2 2 2
155365	9.60	1.08	16.38	2 2 2
155366	9.46	1.09	16.13	2 2 2
155366	9.68	1.08	16.04	2 2 2
155367	9.66	1.09	16.34	2 2 2
155367	9.71	1.09	16.47	2 2 2
155368	9.52	1.08	16.09	2 2 2
155368	9.65	1.07	16.59	2 2 2
155369	9.33	1.09	16.28	2 2 2
155369	10.19	1.09	16.38	2 2 2
155370	9.73	1.09	16.72	2 2 2
155370	9.70	1.10	16.68	2 2 2
155371	9.63	1.07	16.13	2 2 2
155371	9.41	1.08	16.13	2 2 2
155372	9.19	1.07	16.21	2 2 2
155372	9.24	1.08	16.37	2 2 2
155373	9.16	1.08	16.26	2 2 2
155373	9.38	1.08	16.07	2 2 2
155374	9.09	1.08	15.65	2 2 2
155374	9.10	1.08	16.11	2 2 2
155375	8.72	1.07	15.45	2 2 2
155375	8.77	1.06	15.62	2 2 2
155376	7.61	0.76	9.72	2 2 2
155376	7.53	0.77	9.77	2 2 2
155377	6.40	0.57	6.87	2 2 2
155377	6.53	0.56	6.85	2 2 2
155378	10.86	1.00	14.43	2 2 2
155378	10.98	1.00	14.71	2 2 2
155379	11.14	1.01	14.37	2 2 2
155379	11.24	1.02	14.88	2 2 2
155380	11.18	1.01	14.91	2 2 2
155380	11.19	1.01	14.75	2 2 2
155381	12.28	1.05	15.33	2 2 2
155381	12.60	1.05	15.68	2 2 2
155382	13.33	1.06	15.68	2 2 2
155382	13.34	1.08	16.10	2 2 2
155383	12.55	1.07	15.82	2 2 2
155383	12.42	1.09	15.89	2 2 2
155384	11.93	1.10	16.38	2 2 2
155384	11.98	1.10	16.44	2 2 2
155385	11.55	1.07	16.02	2 2 2
155385	11.61	1.09	16.42	2 2 2
155386	10.57	1.11	16.45	2 2 2
155386	10.67	1.11	16.27	2 2 2
155387	9.66	1.10	16.57	2 2 2
155387	9.80	1.10	16.32	2 2 2
155389	9.76	1.11	16.21	2 2 2
155389	9.77	1.11	16.15	2 2 2
155390	9.56	1.08	16.21	2 2 2
155390	9.60	1.07	16.02	2 2 2
155391	9.46	1.09	16.30	2 2 2
155391	9.51	1.10	16.13	2 2 2
155392	9.66	1.09	15.96	2 2 2
155392	9.59	1.08	16.15	2 2 2
155393	9.55	1.09	16.32	2 2 2
155393	9.60	1.09	16.37	2 2 2
155394	9.53	1.08	15.77	2 2 2
155394	9.59	1.10	16.43	2 2 2
155395	9.18	1.09	16.00	2 2 2
155395	9.28	1.08	15.83	2 2 2
155396	9.25	1.09	16.22	2 2 2
155396	9.17	1.08	16.16	2 2 2
155397	9.13	1.10	15.86	2 2 2
155397	9.21	1.10	15.66	2 2 2
155398	8.77	1.05	15.79	2 2 2
155398	9.02	1.07	15.54	2 2 2
155399	8.25	0.89	11.34	2 2 2
155399	8.29	0.89	11.25	2 2 2
155400	7.14	0.68	8.24	2 2 2
155400	7.31	0.69	8.28	2 2 2
155407	10.84	1.02	14.16	2 2 2
155407	10.87	0.98	14.44	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155408	10.98	0.99	14.39	2 2 2
155408	11.16	0.98	14.53	2 2 2
155409	12.94	1.02	15.37	2 2 2
155409	13.06	1.02	15.21	2 2 2
155410	13.36	1.05	15.77	2 2 2
155410	14.27	1.05	15.31	2 2 2
155411	12.42	1.05	15.34	2 2 2
155411	12.76	1.05	15.48	2 2 2
155412	12.14	1.06	15.78	2 2 2
155412	12.26	1.07	15.58	2 2 2
155413	12.44	1.09	16.23	2 2 2
155413	12.56	1.08	16.45	2 2 2
155414	12.85	1.09	16.25	2 2 2
155414	11.88	1.08	16.45	2 2 2
155415	10.90	1.09	16.30	2 2 2
155415	11.08	1.06	16.55	2 2 2
155416	9.60	1.05	16.23	2 2 2
155416	9.79	1.07	16.39	2 2 2
155417	9.63	1.04	16.11	2 2 2
155417	9.75	1.04	16.17	2 2 2
155418	9.92	1.04	16.12	2 2 2
155418	9.86	1.03	16.08	2 2 2
155419	9.61	1.05	16.10	2 2 2
155419	9.48	1.08	16.18	2 2 2
155420	9.66	1.09	16.49	2 2 2
155420	10.36	1.09	16.69	2 2 2
155421	9.86	1.10	16.39	2 2 2
155421	9.90	1.10	16.79	2 2 2
155422	9.73	1.12	16.12	2 2 2
155422	9.77	1.10	16.25	2 2 2
155423	9.59	1.08	16.47	2 2 2
155423	9.67	1.09	16.55	2 2 2
155424	9.85	1.09	16.59	2 2 2
155424	9.82	1.08	16.48	2 2 2
155425	9.32	1.05	15.60	2 2 2
155425	9.35	1.05	15.66	2 2 2
155426	8.61	1.02	15.22	2 2 2
155426	8.61	1.03	15.40	2 2 2
155427	7.90	0.82	10.30	2 2 2
155427	7.87	0.81	10.40	2 2 2
155428	6.43	0.56	6.66	2 2 2
155428	6.49	0.55	6.79	2 2 2
155429	9.80	0.96	13.78	2 2 2
155429	9.83	0.94	13.83	2 2 2
155430	11.32	0.99	14.44	2 2 2
155430	11.41	0.99	14.50	2 2 2
155431	11.93	1.02	15.13	2 2 2
155431	11.99	1.01	14.98	2 2 2
155432	14.24	1.06	15.26	2 2 2
155432	14.00	1.06	15.24	2 2 2
155433	14.23	1.06	15.72	2 2 2
155433	14.38	1.06	15.92	2 2 2
155434	13.31	1.06	16.14	2 2 2
155434	13.36	1.06	16.21	2 2 2
155435	12.84	1.05	16.15	2 2 2
155435	12.89	1.08	16.01	2 2 2
155436	12.52	1.08	16.09	2 2 2
155436	12.43	1.09	16.15	2 2 2
155437	11.90	1.10	16.36	2 2 2
155437	12.00	1.10	16.38	2 2 2
155438	9.70	1.08	16.10	2 2 2
155438	9.76	1.10	16.14	2 2 2
155439	9.56	1.10	15.74	2 2 2
155439	9.79	1.09	16.06	2 2 2
155440	9.75	1.08	16.14	2 2 2
155440	9.76	1.09	16.16	2 2 2
155441	9.50	1.07	16.29	2 2 2
155441	9.78	1.08	16.18	2 2 2
155442	9.52	1.16	15.90	2 2 2
155442	9.38	1.16	16.00	2 2 2
155443	9.64	1.09	16.16	2 2 2
155443	9.61	1.08	16.51	2 2 2
155444	9.44	1.10	15.68	2 2 2
155444	9.54	1.09	15.78	2 2 2
155445	9.50	1.09	16.00	2 2 2
155445	9.65	1.10	16.04	2 2 2
155446	9.46	1.09	16.07	2 2 2
155446	9.58	1.09	16.17	2 2 2
155447	9.19	1.09	16.04	2 2 2
155447	9.28	1.07	16.08	2 2 2
155448	9.24	1.07	15.86	2 2 2
155448	9.21	1.08	15.65	2 2 2
155449	8.93	1.05	14.95	2 2 2
155449	9.02	1.06	15.27	2 2 2
155450	7.61	0.73	8.63	2 2 2
155450	7.83	0.74	8.66	2 2 2
155451	6.55	0.59	7.39	2 2 2
155451	6.67	0.61	7.74	2 2 2
155452	9.18	1.06	14.01	2 2 2
155452	9.29	0.99	14.11	2 2 2
155453	9.50	0.97	14.14	2 2 2
155453	9.53	0.98	14.29	2 2 2
155454	10.21	1.02	14.10	2 2 2
155454	10.46	1.04	14.20	2 2 2
155455	11.64	1.06	14.77	2 2 2
155455	11.46	1.05	14.49	2 2 2
155456	13.30	1.06	15.63	2 2 2
155456	13.36	1.09	15.53	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155457	13.50	1.08	15.56	2 2 2
155457	13.60	1.08	15.87	2 2 2
155458	13.01	1.10	15.48	2 2 2
155458	13.16	1.09	15.62	2 2 2
155459	12.00	1.09	15.70	2 2 2
155459	12.30	1.10	15.62	2 2 2
155460	11.44	1.12	15.71	2 2 2
155460	11.57	1.13	15.71	2 2 2
155461	11.07	1.12	15.92	2 2 2
155461	11.10	1.13	16.15	2 2 2
155462	9.73	1.11	16.00	2 2 2
155462	9.82	1.10	15.90	2 2 2
155463	9.46	1.09	15.87	2 2 2
155463	9.46	1.09	15.85	2 2 2
155464	9.36	1.11	15.97	2 2 2
155464	9.36	1.12	15.77	2 2 2
155465	9.57	1.13	16.18	2 2 2
155465	9.59	1.14	16.14	2 2 2
155466	9.61	1.14	16.22	2 2 2
155466	9.62	1.12	16.30	2 2 2
155467	9.33	1.13	16.25	2 2 2
155467	9.43	1.14	16.21	2 2 2
155468	9.41	1.19	16.37	2 2 2
155468	9.39	1.13	16.33	2 2 2
155469	9.23	1.13	16.15	2 2 2
155469	9.25	1.13	16.08	2 2 2
155470	8.89	1.12	15.50	2 2 2
155470	8.91	1.11	15.56	2 2 2
155471	8.71	1.14	15.41	2 2 2
155471	8.80	1.09	15.48	2 2 2
155472	8.70	1.12	15.66	2 2 2
155472	8.82	1.12	15.84	2 2 2
155473	8.09	0.97	12.69	2 2 2
155473	8.21	0.99	12.81	2 2 2
155474	6.42	0.66	7.37	2 2 2
155474	6.45	0.66	7.33	2 2 2
155475	10.72	0.94	14.35	2 2 2
155475	10.57	1.04	14.26	2 2 2
155476	10.86	0.94	14.06	2 2 2
155476	11.01	0.94	14.33	2 2 2
155477	12.16	0.99	14.61	2 2 2
155477	12.30	0.99	14.87	2 2 2
155478	12.30	0.99	15.02	2 2 2
155478	12.48	0.99	15.06	2 2 2
155479	13.81	1.02	15.50	2 2 2
155479	13.69	1.04	15.33	2 2 2
155480	13.10	1.02	15.31	2 2 2
155480	13.40	1.01	15.31	2 2 2
155481	13.31	1.03	16.01	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155481	13.45	1.03	15.79	2 2 2
155482	11.68	1.01	15.78	2 2 2
155482	11.86	1.01	15.96	2 2 2
155483	12.19	1.07	16.24	2 2 2
155483	12.10	1.02	16.08	2 2 2
155484	10.65	1.03	16.11	2 2 2
155484	10.59	1.06	16.53	2 2 2
155485	9.65	1.05	16.06	2 2 2
155485	9.74	1.04	16.46	2 2 2
155486	9.77	1.03	15.93	2 2 2
155486	9.86	1.07	16.46	2 2 2
155487	9.65	1.05	16.04	2 2 2
155487	9.68	1.05	15.95	2 2 2
155488	9.59	1.06	16.56	2 2 2
155488	9.65	1.06	16.22	2 2 2
155489	9.79	1.06	16.72	2 2 2
155489	9.76	1.08	16.93	2 2 2
155490	9.70	1.05	15.98	2 2 2
155490	9.79	1.05	16.33	2 2 2
155491	9.70	1.10	16.46	2 2 2
155491	9.50	1.04	16.22	2 2 2
155492	9.70	1.04	16.32	2 2 2
155492	9.70	1.02	16.03	2 2 2
155493	9.79	1.04	16.21	2 2 2
155493	9.85	1.04	16.10	2 2 2
155494	9.43	1.06	15.96	2 2 2
155494	9.61	1.05	16.02	2 2 2
155495	8.70	1.02	15.65	2 2 2
155495	8.78	1.02	15.71	2 2 2
155496	7.49	0.68	9.19	2 2 2
155496	7.55	0.70	9.21	2 2 2
155497	6.01	0.61	7.88	2 2 2
155497	5.92	0.66	7.72	2 2 2
155498	9.70	0.91	13.66	2 2 2
155498	9.70	0.92	13.64	2 2 2
155499	9.69	0.92	13.57	2 2 2
155499	9.69	0.97	14.02	2 2 2
155500	9.66	0.92	13.57	2 2 2
155500	9.84	0.94	13.63	2 2 2
155501	10.52	1.01	14.21	2 2 2
155501	10.64	0.96	14.41	2 2 2
155502	11.64	0.97	15.00	2 2 2
155502	11.76	0.99	14.80	2 2 2
155503	12.47	1.01	15.18	2 2 2
155503	12.53	1.03	15.35	2 2 2
155504	12.30	1.05	15.51	2 2 2
155504	12.24	1.02	15.49	2 2 2
155505	11.35	1.04	15.68	2 2 2
155505	11.55	1.04	15.54	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155506	10.90	1.01	16.05	2 2 2
155506	11.02	1.05	16.19	2 2 2
155507	10.22	1.09	15.49	2 2 2
155507	10.25	1.07	15.89	2 2 2
155508	9.56	1.03	16.14	2 2 2
155508	9.59	1.03	16.16	2 2 2
155509	9.71	1.02	16.18	2 2 2
155509	9.77	1.05	15.95	2 2 2
155510	9.71	1.05	15.97	2 2 2
155510	9.74	1.04	15.61	2 2 2
155511	9.38	1.06	15.56	2 2 2
155511	9.44	1.04	15.64	2 2 2
155512	9.53	1.03	15.53	2 2 2
155512	9.47	1.04	15.73	2 2 2
155513	9.41	1.04	16.00	2 2 2
155513	9.53	1.05	15.93	2 2 2
155514	9.17	1.04	15.94	2 2 2
155514	9.20	1.02	16.33	2 2 2
155515	9.05	1.08	15.04	2 2 2
155515	9.14	1.00	15.48	2 2 2
155516	8.69	1.00	15.25	2 2 2
155516	8.69	0.98	15.39	2 2 2
155517	8.75	1.00	15.18	2 2 2
155517	8.63	1.02	15.26	2 2 2
155518	8.39	0.98	14.97	2 2 2
155518	8.45	0.97	14.98	2 2 2
155519	7.20	0.69	8.34	2 2 2
155519	7.29	0.72	8.39	2 2 2
155520	6.13	0.54	6.66	2 2 2
155520	6.28	0.55	6.64	2 2 2
155521	9.70	0.90	13.56	2 2 2
155521	9.70	0.93	14.16	2 2 2
155522	9.70	0.94	13.45	2 2 2
155522	9.31	0.94	13.47	2 2 2
155523	10.62	1.00	14.35	2 2 2
155523	10.77	0.93	14.45	2 2 2
155524	11.09	0.95	14.28	2 2 2
155524	11.01	0.95	14.76	2 2 2
155525	13.60	1.02	15.05	2 2 2
155525	13.54	1.04	14.97	2 2 2
155526	13.93	1.03	15.80	2 2 2
155526	13.99	1.02	15.68	2 2 2
155527	13.33	1.05	15.10	2 2 2
155527	13.42	1.05	15.60	2 2 2
155528	11.75	1.05	15.21	2 2 2
155528	11.78	1.04	15.37	2 2 2
155529	11.06	1.04	15.80	2 2 2
155529	11.15	1.07	15.88	2 2 2
155530	10.37	1.03	15.69	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155530	10.28	1.06	15.71	2 2 2
155531	9.50	1.04	15.07	2 2 2
155531	9.71	1.12	14.86	2 2 2
155532	9.35	1.06	15.55	2 2 2
155532	9.38	1.07	15.90	2 2 2
155533	9.14	1.09	15.48	2 2 2
155533	9.14	1.04	15.56	2 2 2
155534	9.83	1.05	16.12	2 2 2
155534	9.77	1.08	15.89	2 2 2
155535	9.50	1.06	16.28	2 2 2
155535	9.56	1.06	16.25	2 2 2
155536	9.41	1.06	15.79	2 2 2
155536	9.50	1.07	15.61	2 2 2
155537	8.96	1.06	15.55	2 2 2
155537	9.08	1.03	15.37	2 2 2
155544	9.38	1.04	13.48	2 2 2
155544	9.50	0.93	13.50	2 2 2
155545	9.73	0.92	13.68	2 2 2
155545	9.76	1.00	13.56	2 2 2
155546	9.49	1.01	13.97	2 2 2
155546	9.49	0.94	13.75	2 2 2
155547	11.56	0.99	14.38	2 2 2
155547	11.53	0.99	14.55	2 2 2
155548	12.19	1.01	15.16	2 2 2
155548	12.40	0.99	15.10	2 2 2
155549	12.70	1.08	15.59	2 2 2
155549	12.79	1.04	15.21	2 2 2
155550	12.40	1.04	14.89	2 2 2
155550	12.46	1.05	14.89	2 2 2
155551	11.44	1.05	15.18	2 2 2
155551	11.23	1.04	15.12	2 2 2
155552	12.01	1.07	15.51	2 2 2
155552	12.22	1.08	15.78	2 2 2
155553	10.56	1.12	15.80	2 2 2
155553	10.84	1.10	15.77	2 2 2
155554	9.69	1.06	15.96	2 2 2
155554	9.75	1.09	15.99	2 2 2
155555	9.66	1.08	15.77	2 2 2
155555	9.66	1.06	15.71	2 2 2
155557	9.63	1.07	16.21	2 2 2
155557	9.60	1.09	15.84	2 2 2
155558	9.45	1.07	15.99	2 2 2
155558	9.51	1.08	15.81	2 2 2
155559	9.39	1.08	16.05	2 2 2
155559	9.48	1.07	16.28	2 2 2
155560	9.17	1.06	16.23	2 2 2
155560	9.30	1.04	16.29	2 2 2
155561	9.02	1.05	15.83	2 2 2
155561	9.02	1.04	15.77	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155562	8.87	1.06	15.65	2 2 2
155562	8.78	1.10	15.32	2 2 2
155563	8.66	1.02	15.57	2 2 2
155563	8.69	1.03	15.43	2 2 2
155566	6.24	0.56	5.34	2 2 2
155566	6.12	0.54	5.59	2 2 2
155567	9.44	0.93	14.31	2 2 2
155567	9.32	1.05	14.12	2 2 2
155568	8.89	0.93	14.31	2 2 2
155568	9.01	0.94	14.52	2 2 2
155569	9.04	0.96	14.16	2 2 2
155569	9.07	0.93	14.42	2 2 2
155570	9.89	1.02	16.22	2 2 2
155570	9.95	1.04	16.23	2 2 2
155571	12.81	1.06	15.50	2 2 2
155571	12.87	1.06	15.73	2 2 2
155572	12.41	1.04	15.97	2 2 2
155572	12.22	1.05	15.74	2 2 2
155573	12.98	1.08	16.27	2 2 2
155573	13.32	1.07	16.48	2 2 2
155574	11.64	1.10	16.23	2 2 2
155574	11.76	1.09	16.38	2 2 2
155575	11.24	1.15	16.57	2 2 2
155575	11.33	1.06	16.74	2 2 2
155576	10.44	1.06	16.76	2 2 2
155576	10.20	1.09	16.39	2 2 2
155577	9.53	1.09	16.75	2 2 2
155577	9.65	1.07	16.75	2 2 2
155578	9.59	1.09	16.52	2 2 2
155578	9.74	1.08	16.39	2 2 2
155579	9.53	1.09	16.67	2 2 2
155579	9.59	1.08	16.92	2 2 2
155580	9.67	1.08	16.57	2 2 2
155580	9.73	1.10	16.57	2 2 2
155581	9.55	1.09	16.88	2 2 2
155581	9.58	1.11	17.08	2 2 2
155582	9.67	1.07	16.53	2 2 2
155582	9.55	1.10	16.85	2 2 2
155583	9.33	1.17	16.66	2 2 2
155583	9.30	1.06	16.75	2 2 2
155584	9.12	1.06	16.75	2 2 2
155584	9.14	1.05	16.42	2 2 2
155585	8.54	1.07	16.10	2 2 2
155585	8.84	1.04	15.66	2 2 2
155586	8.51	1.03	15.77	2 2 2
155586	9.74	1.02	15.90	2 2 2
155587	8.14	1.02	14.06	2 2 2
155587	8.26	1.01	13.91	2 2 2
155588	6.03	0.71	7.69	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155588	6.00	0.65	7.66	2 2 2
155589	5.15	0.47	5.21	2 2 2
155589	5.18	0.50	5.15	2 2 2
155701	9.79	0.97	14.96	2 2 2
155701	9.92	1.02	14.68	2 2 2
155702	10.54	1.06	15.26	2 2 2
155702	10.57	0.99	14.97	2 2 2
155703	10.57	1.02	15.14	2 2 2
155703	10.81	1.00	15.14	2 2 2
155704	10.26	1.01	15.40	2 2 2
155704	10.44	0.98	15.10	2 2 2
155705	11.98	1.03	15.59	2 2 2
155705	12.13	1.04	15.78	2 2 2
155706	11.77	1.04	16.12	2 2 2
155706	11.71	1.04	16.12	2 2 2
155707	11.43	1.04	16.08	2 2 2
155707	11.61	1.07	15.78	2 2 2
155708	11.22	1.04	16.38	2 2 2
155708	11.31	1.07	15.87	2 2 2
155709	10.82	1.08	16.51	2 2 2
155709	10.91	1.07	16.28	2 2 2
155710	10.42	1.06	16.50	2 2 2
155710	10.54	1.16	16.24	2 2 2
155711	9.97	1.08	16.92	2 2 2
155711	10.03	1.09	16.63	2 2 2
155712	9.82	1.09	17.00	2 2 2
155712	9.90	1.17	16.77	2 2 2
155713	9.87	1.08	16.97	2 2 2
155713	9.99	1.12	16.99	2 2 2
155714	9.84	1.11	16.88	2 2 2
155714	9.81	1.09	17.31	2 2 2
155715	9.63	1.11	16.93	2 2 2
155715	9.84	1.11	16.76	2 2 2
155716	9.56	1.09	16.79	2 2 2
155716	9.59	1.13	16.83	2 2 2
155717	9.05	1.09	16.87	2 2 2
155717	9.26	1.07	16.37	2 2 2
155718	8.95	1.07	16.59	2 2 2
155718	9.10	1.14	16.06	2 2 2
155719	8.98	1.05	16.07	2 2 2
155719	8.95	1.04	16.30	2 2 2
155720	8.59	1.03	15.84	2 2 2
155720	8.68	1.04	15.27	2 2 2
155721	7.87	0.93	12.77	2 2 2
155721	7.99	0.94	12.62	2 2 2
155722	6.58	0.71	8.33	2 2 2
155722	6.61	0.71	8.31	2 2 2
155723	5.77	0.58	6.45	2 2 2
155723	5.83	0.57	6.42	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155724	9.36	1.01	14.88	2 2 2
155724	9.42	1.00	14.52	2 2 2
155725	9.74	0.98	14.71	2 2 2
155725	9.45	1.00	14.95	2 2 2
155726	10.19	1.08	14.70	2 2 2
155726	9.86	0.98	15.25	2 2 2
155727	11.14	1.02	15.49	2 2 2
155727	11.32	1.05	15.19	2 2 2
155728	11.53	1.05	15.97	2 2 2
155728	11.71	1.07	15.72	2 2 2
155729	11.74	1.08	16.48	2 2 2
155729	11.79	1.07	15.94	2 2 2
155730	10.62	1.06	15.96	2 2 2
155730	10.53	1.06	16.00	2 2 2
155731	10.80	1.07	16.47	2 2 2
155731	10.89	1.09	16.26	2 2 2
155732	10.44	1.09	16.74	2 2 2
155732	10.62	1.10	16.45	2 2 2
155733	9.99	1.09	16.37	2 2 2
155733	10.11	1.10	16.64	2 2 2
155734	9.62	1.19	16.65	2 2 2
155734	9.62	1.08	16.80	2 2 2
155735	9.83	1.10	16.59	2 2 2
155735	9.65	1.09	16.97	2 2 2
155736	9.71	1.10	16.53	2 2 2
155736	9.80	1.10	16.68	2 2 2
155737	9.26	1.09	16.68	2 2 2
155737	9.38	1.10	16.49	2 2 2
155738	8.90	1.11	16.53	2 2 2
155738	9.08	1.07	16.12	2 2 2
155739	8.51	1.04	15.06	2 2 2
155739	8.60	1.02	15.30	2 2 2
155740	8.27	0.96	13.26	2 2 2
155740	8.18	0.96	13.48	2 2 2
155741	7.82	0.86	10.73	2 2 2
155741	7.82	0.82	10.45	2 2 2
155742	6.15	0.57	6.22	2 2 2
155742	6.12	0.63	6.20	2 2 2
155747	11.08	1.08	15.33	2 2 2
155747	10.93	1.03	15.65	2 2 2
155748	10.66	1.04	15.87	2 2 2
155748	10.72	1.04	15.55	2 2 2
155749	10.48	1.08	15.93	2 2 2
155749	10.66	1.08	16.23	2 2 2
155750	10.48	1.07	16.31	2 2 2
155750	10.71	1.10	16.06	2 2 2
155751	10.38	1.09	15.98	2 2 2
155751	10.39	1.07	16.61	2 2 2
155752	10.15	1.09	16.47	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155752	9.97	1.08	16.40	2 2 2
155753	9.93	1.10	16.41	2 2 2
155753	9.99	1.11	16.66	2 2 2
155754	9.75	1.16	16.65	2 2 2
155754	9.78	1.11	16.21	2 2 2
155755	9.69	1.09	16.73	2 2 2
155755	9.78	1.10	16.77	2 2 2
155756	9.77	1.09	16.40	2 2 2
155756	9.71	1.10	16.97	2 2 2
155757	9.41	1.10	16.66	2 2 2
155757	9.50	1.11	16.80	2 2 2
155758	9.38	1.11	16.53	2 2 2
155758	9.47	1.11	16.58	2 2 2
155759	9.08	1.08	16.37	2 2 2
155759	9.14	1.08	16.50	2 2 2
155760	8.93	1.08	16.35	2 2 2
155760	9.02	1.08	16.29	2 2 2
155761	8.37	1.06	15.58	2 2 2
155761	8.49	1.04	15.60	2 2 2
155762	7.83	1.08	14.69	2 2 2
155762	7.83	1.00	16.74	2 2 2
155766	9.48	1.12	16.62	2 2 2
155766	9.45	1.12	16.85	2 2 2
155767	9.45	1.09	16.68	2 2 2
155767	9.45	1.10	16.68	2 2 2
155768	9.39	1.11	16.83	2 2 2
155768	9.39	1.10	16.66	2 2 2
155769	8.97	1.10	16.27	2 2 2
155769	9.06	1.09	16.52	2 2 2
155770	8.94	1.09	16.31	2 2 2
155770	9.03	1.10	16.31	2 2 2
155771	8.85	1.10	16.38	2 2 2
155771	8.73	1.10	16.30	2 2 2
155772	8.46	1.07	15.83	2 2 2
155772	8.52	1.04	15.80	2 2 2
155773	8.22	1.09	15.45	2 2 2
155773	8.37	1.05	15.80	2 2 2
155774	7.89	1.03	14.54	2 2 2
155774	7.98	1.02	14.83	2 2 2
155775	7.39	0.96	13.12	2 2 2
155775	7.45	0.97	13.12	2 2 2
155776	7.25	0.80	9.84	2 2 2
155776	7.30	0.82	9.86	2 2 2
155777	4.34	0.50	3.62	2 2 2
155777	4.37	0.44	3.62	2 2 2
155778	6.27	0.81	9.02	2 2 2
155778	6.24	0.78	9.09	2 2 2
155779	6.21	0.80	9.31	2 2 2
155779	6.24	0.81	9.53	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155780	5.95	0.81	9.98	2 2 2
155780	5.98	0.81	10.00	2 2 2
155781	1.97	0.60	1.12	2 2 2
155781	2.00	0.35	0.82	2 2 2
155782	6.00	0.79	9.17	2 2 2
155782	6.79	0.77	9.23	2 2 2
155783	5.80	0.80	9.21	2 2 2
155783	5.80	0.79	9.34	2 2 2
155784	5.39	0.76	8.74	2 2 2
155784	5.39	0.77	8.82	2 2 2
155785	1.88	0.34	1.33	2 2 2
155785	1.94	0.30	1.44	2 2 2
155786	8.75	0.98	13.24	2 2 3
155786	8.67	0.90	13.32	2 2 3
155787	11.16	0.99	14.62	2 2 2
155787	11.47	0.95	14.70	2 2 2
155788	11.81	0.97	14.49	2 2 2
155788	11.81	1.08	14.81	2 2 2
155789	12.90	0.98	15.56	2 2 2
155789	12.99	1.00	15.78	2 2 2
155790	13.82	1.02	15.81	2 2 2
155790	13.73	1.04	15.53	2 2 2
155791	13.10	1.02	15.86	2 2 2
155791	13.30	1.03	16.08	2 2 2
155792	13.04	1.04	16.54	2 2 2
155792	13.16	1.05	16.13	2 2 2
155793	12.39	1.06	16.30	2 2 2
155793	12.53	1.04	16.49	2 2 2
155795	10.44	1.10	15.94	2 2 2
155795	10.75	1.03	15.89	2 2 2
155796	9.72	1.04	16.41	2 2 2
155796	9.75	1.04	16.00	2 2 2
155797	9.55	1.03	16.58	2 2 2
155797	9.63	1.03	16.14	2 2 2
155798	9.46	1.05	16.38	2 2 2
155798	9.60	1.04	16.25	2 2 2
155799	9.57	1.04	16.73	2 2 2
155799	9.69	1.04	16.68	2 2 2
155800	9.46	1.05	16.50	2 2 2
155800	9.72	1.04	16.53	2 2 2
155801	9.49	1.06	16.57	2 2 2
155801	9.51	1.10	16.38	2 2 2
155802	9.51	1.03	16.01	2 2 2
155802	9.74	1.04	16.50	2 2 2
155803	9.57	1.11	16.58	2 2 2
155803	9.71	1.03	16.94	2 2 2
155804	9.63	1.07	16.97	2 2 2
155804	9.68	1.06	16.55	2 2 2
155805	9.31	1.04	16.32	2 2 2
155805	9.22	1.04	16.45	2 2 2
155806	9.11	1.04	15.29	2 2 2
155806	9.25	1.07	15.32	2 2 2
155807	5.60	0.67	9.98	2 2 2
155807	5.63	0.71	10.15	2 2 2
155808	5.36	0.65	9.29	2 2 2
155808	5.39	0.64	9.56	2 2 2
155809	8.90	0.93	13.64	2 2 2
155809	8.93	0.92	13.87	2 2 2
155810	9.33	0.95	14.46	2 2 2
155810	9.42	0.93	14.38	2 2 2
155811	10.88	0.99	15.06	2 2 2
155811	11.00	1.04	14.70	2 2 2
155812	12.04	1.12	15.81	2 2 2
155812	11.98	0.98	15.77	2 2 2
155813	13.22	1.04	15.90	2 2 2
155813	13.42	1.09	15.80	2 2 2
155814	12.18	1.05	15.77	2 2 2
155814	12.21	1.03	15.79	2 2 2
155815	12.01	1.04	15.86	2 2 2
155815	12.01	1.06	16.18	2 2 2
155816	11.37	1.05	16.59	2 2 2
155816	11.40	1.05	16.56	2 2 2
155817	10.88	1.07	16.12	2 2 2
155817	10.91	1.07	16.37	2 2 2
155818	9.67	1.07	16.36	2 2 2
155818	9.67	1.05	16.28	2 2 2
155819	9.58	1.07	15.80	2 2 2
155819	9.64	1.11	16.09	2 2 2
155820	9.55	1.06	16.34	2 2 2
155820	9.47	1.07	16.02	2 2 2
155821	9.61	1.06	16.60	2 2 2
155821	9.75	1.07	16.29	2 2 2
155822	9.46	1.07	16.34	2 2 2
155822	9.55	1.07	16.48	2 2 2
155823	9.49	1.09	15.75	2 2 2
155823	9.52	1.07	16.23	2 2 2
155824	9.55	1.08	15.87	2 2 2
155824	9.38	1.06	16.05	2 2 2
155825	9.52	1.07	15.71	2 2 2
155825	9.52	1.07	15.80	2 2 2
155826	9.69	1.10	16.65	2 2 2
155826	9.84	1.08	16.22	2 2 2
155827	9.63	1.13	16.36	2 2 2
155827	9.80	1.09	16.32	2 2 2
155828	9.60	1.09	16.74	2 2 2
155828	9.72	1.09	16.42	2 2 2
155829	7.69	0.95	14.64	2 2 2
155829	7.75	0.97	14.25	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155830	8.88	1.04	14.03	2 2 2
155830	9.02	1.05	13.73	2 2 2
155831	2.14	0.62	9.72	2 2 2
155831	2.19	0.64	9.70	2 2 2
155832	9.69	1.01	13.86	2 2 2
155832	9.89	0.99	13.84	2 2 2
155833	9.80	0.98	14.02	2 2 2
155833	9.80	1.01	14.02	2 2 2
155834	11.45	1.03	14.41	2 2 2
155834	11.45	1.04	14.26	2 2 2
155835	12.43	1.12	15.35	2 2 2
155835	12.55	1.05	15.59	2 2 2
155836	9.83	1.09	15.78	2 2 2
155836	9.74	1.09	15.88	2 2 2
155837	12.55	1.09	15.78	2 2 2
155837	12.75	1.07	15.96	2 2 2
155838	12.72	1.08	16.37	2 2 2
155838	12.81	1.12	15.77	2 2 2
155839	11.74	1.10	15.68	2 2 2
155839	11.77	1.09	15.56	2 2 2
155840	10.98	1.10	15.34	2 2 2
155840	10.95	1.09	15.37	2 2 2
155841	9.94	1.10	16.17	2 2 2
155841	9.82	1.11	15.74	2 2 2
155842	9.73	1.10	16.06	2 2 2
155842	9.79	1.09	16.04	2 2 2
155843	9.50	1.16	15.68	2 2 2
155843	9.56	1.10	16.18	2 2 2
155844	9.79	1.10	16.37	2 2 2
155844	9.85	1.09	16.10	2 2 2
155845	9.61	1.11	16.10	2 2 2
155845	9.85	1.07	16.10	2 2 2
155846	9.67	1.12	15.62	2 2 2
155846	9.67	1.11	15.99	2 2 2
155847	9.87	1.11	16.22	2 2 2
155847	10.02	1.14	15.83	2 2 2
155848	10.16	1.12	16.41	2 2 2
155848	10.08	1.11	16.66	2 2 2
155849	10.19	1.15	16.72	2 2 2
155849	10.19	1.14	16.56	2 2 2
155850	10.19	1.16	16.41	2 2 2
155850	10.22	1.17	17.08	2 2 2
155851	9.26	1.13	15.85	2 2 2
155851	9.49	1.21	15.80	2 2 2
155852	8.85	1.10	15.57	2 2 2
155852	9.05	1.10	15.72	2 2 2
155853	8.47	1.07	14.81	2 2 2
155853	8.47	1.07	15.00	2 2 2
155854	2.16	0.60	8.62	2 2 2
155854	2.13	0.63	8.57	2 2 2
155855	11.20	1.08	15.23	2 2 2
155855	11.28	1.00	15.25	2 2 2
155856	11.68	0.99	15.38	2 2 2
155856	11.65	0.98	15.04	2 2 2
155857	11.98	1.01	15.61	2 2 2
155857	12.30	1.00	15.67	2 2 2
155858	13.41	1.02	15.90	2 2 2
155858	13.58	1.01	16.03	2 2 2
155859	13.92	1.05	16.41	2 2 2
155859	14.03	1.04	16.54	2 2 2
155860	13.80	1.05	16.68	2 2 2
155860	13.85	1.05	16.31	2 2 2
155861	13.51	1.07	16.75	2 2 2
155861	13.54	1.08	16.52	2 2 2
155862	12.87	1.08	16.56	2 2 2
155862	13.27	1.08	16.48	2 2 2
155863	12.37	1.15	16.53	2 2 2
155863	12.45	1.08	16.90	2 2 2
155864	11.82	1.05	16.57	2 2 2
155864	12.08	1.09	17.01	2 2 2
155865	10.93	1.06	16.78	2 2 2
155865	11.04	1.06	16.89	2 2 2
155866	10.04	1.04	16.70	2 2 2
155866	10.13	1.07	17.12	2 2 2
155867	9.84	1.05	16.60	2 2 2
155867	9.92	1.05	16.83	2 2 2
155868	10.06	1.08	17.06	2 2 2
155868	9.89	1.06	17.12	2 2 2
155869	9.91	1.05	16.74	2 2 2
155869	9.94	1.06	17.00	2 2 2
155870	10.05	1.06	17.31	2 2 2
155870	10.19	1.09	17.31	2 2 2
155871	10.12	1.18	17.09	2 2 2
155871	10.23	1.09	17.03	2 2 2
155872	10.43	1.10	17.64	2 2 2
155872	10.40	1.12	17.45	2 2 2
155873	10.33	1.11	17.45	2 2 2
155873	10.25	1.12	17.60	2 2 2
155874	10.22	1.12	17.62	2 2 2
155874	10.30	1.12	17.90	2 2 2
155875	9.07	1.08	16.74	2 2 2
155875	9.13	1.08	16.51	2 2 2
155876	8.67	0.99	14.32	2 2 2
155876	8.78	1.02	14.44	2 2 2
155877	0.82	0.46	5.84	2 2 2
155877	0.88	0.38	6.03	2 2 2
155878	14.90	1.06	16.60	2 2 2
155878	14.79	1.14	16.51	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155879	14.83	1.18	16.75	2 2 2
155879	14.94	1.07	16.69	2 2 2
155880	15.24	1.05	16.84	2 2 2
155880	15.16	1.05	16.61	2 2 2
155881	15.10	1.08	16.95	2 2 2
155881	14.78	1.08	16.68	2 2 2
155882	14.87	1.06	16.60	2 2 2
155882	14.92	1.06	16.70	2 2 2
155883	14.69	1.08	16.84	2 2 2
155883	14.89	1.08	17.02	2 2 2
155884	14.11	1.08	16.52	2 2 2
155884	14.28	1.07	16.86	2 2 2
155886	12.97	1.07	17.09	2 2 2
155886	13.02	1.08	17.16	2 2 2
155887	11.99	1.09	16.91	2 2 2
155887	11.85	1.08	16.66	2 2 2
155888	11.46	1.08	17.13	2 2 2
155888	11.47	1.13	16.80	2 2 2
155889	10.06	1.07	16.74	2 2 2
155889	10.29	1.06	16.88	2 2 2
155890	10.17	1.06	17.06	2 2 2
155890	10.20	1.07	17.08	2 2 2
155891	10.37	1.08	17.12	2 2 2
155891	10.20	1.08	16.83	2 2 2
155892	10.25	1.09	17.02	2 2 2
155892	10.39	1.08	17.44	2 2 2
155893	10.53	1.11	17.47	2 2 2
155893	10.56	1.10	17.66	2 2 2
155894	10.58	1.12	17.60	2 2 2
155894	10.66	1.12	17.75	2 2 2
155895	10.32	1.11	17.77	2 2 2
155895	10.40	1.19	17.73	2 2 2
155896	9.68	1.09	17.08	2 2 2
155896	9.76	1.17	17.11	2 2 2
155897	9.67	1.08	17.44	2 2 2
155897	9.64	1.09	17.31	2 2 2
155898	8.99	1.06	16.44	2 2 2
155898	8.95	1.06	16.33	2 2 2
155899	8.61	0.99	14.52	2 2 2
155899	8.64	1.01	14.35	2 2 2
155900	0.34	0.27	3.38	2 2 2
155900	0.43	0.20	3.44	2 2 2
155901	14.82	1.12	16.57	2 2 2
155901	15.02	1.08	16.81	2 2 2
155902	15.16	1.08	17.01	2 2 2
155902	15.27	1.08	17.10	2 2 2
155903	14.75	1.06	16.64	2 2 2
155903	14.75	1.07	16.75	2 2 2
155904	14.57	1.16	16.81	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155904	14.70	1.06	16.94	2 2 2
155905	14.44	1.08	16.65	2 2 2
155905	14.67	1.08	17.13	2 2 2
155906	14.01	1.09	16.67	2 2 2
155906	14.10	1.09	16.92	2 2 2
155908	13.04	1.07	17.05	2 2 2
155908	13.13	1.07	17.12	2 2 2
155909	12.22	1.08	16.63	2 2 2
155909	12.30	1.09	16.84	2 2 2
155910	11.36	1.09	16.91	2 2 2
155910	11.41	1.06	17.16	2 2 2
155911	10.73	1.07	16.61	2 2 2
155911	10.70	1.07	16.70	2 2 2
155912	10.30	1.08	16.93	2 2 2
155912	10.32	1.09	17.08	2 2 2
155913	10.28	1.07	16.88	2 2 2
155913	10.31	1.15	17.04	2 2 2
155914	10.30	1.09	17.06	2 2 2
155914	10.31	1.09	16.93	2 2 2
155915	10.53	1.10	17.48	2 2 2
155915	10.64	1.09	17.57	2 2 2
155916	10.35	1.11	17.53	2 2 2
155916	10.44	1.10	17.34	2 2 2
155917	10.40	1.12	17.62	2 2 2
155917	10.46	1.13	17.88	2 2 2
155918	10.60	1.12	17.97	2 2 2
155918	10.62	1.13	17.78	2 2 2
155919	9.54	1.09	17.28	2 2 2
155919	9.52	1.08	17.06	2 2 2
155920	9.06	1.07	17.17	2 2 2
155920	9.17	1.07	16.96	2 2 2
155921	8.56	1.10	15.32	2 2 2
155921	8.64	1.03	15.54	2 2 2
155922	8.16	0.99	13.26	2 2 2
155922	8.19	0.98	13.26	2 2 2
155923	0.35	0.31	3.70	2 2 2
155923	0.41	0.25	3.81	2 2 2
155924	14.74	1.15	16.73	2 2 2
155924	14.51	1.07	16.81	2 2 2
155925	14.51	1.08	16.93	2 2 2
155925	14.54	1.08	16.94	2 2 2
155926	14.42	1.09	17.04	2 2 2
155926	14.56	1.08	17.16	2 2 2
155927	14.38	1.09	16.88	2 2 2
155927	14.39	1.09	17.17	2 2 2
155928	14.29	1.09	16.71	2 2 2
155928	14.30	1.08	16.64	2 2 2
155929	13.80	1.08	17.14	2 2 2
155929	13.80	1.16	17.03	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155930	13.26	1.08	16.67	2 2 2
155930	12.94	1.07	16.78	2 2 2
155931	12.80	1.07	16.70	2 2 2
155931	12.74	1.06	16.81	2 2 2
155933	11.57	1.09	17.10	2 2 2
155933	11.60	1.07	17.01	2 2 2
155934	11.06	1.12	17.33	2 2 2
155934	11.12	1.08	17.08	2 2 2
155935	10.80	1.10	16.92	2 2 2
155935	10.83	1.11	17.39	2 2 2
155936	10.49	1.11	17.18	2 2 2
155936	10.57	1.12	17.19	2 2 2
155937	10.73	1.12	17.77	2 2 2
155937	10.65	1.13	17.59	2 2 2
155938	10.66	1.11	17.71	2 2 2
155938	10.69	1.22	17.38	2 2 2
155939	10.80	1.15	18.07	2 2 2
155939	10.82	1.15	18.26	2 2 2
155940	10.85	1.16	18.44	2 2 2
155940	10.90	1.16	18.48	2 2 2
155941	10.67	1.15	18.53	2 2 2
155941	10.73	1.16	18.36	2 2 2
155942	8.55	1.06	15.96	2 2 2
155942	8.64	1.04	16.39	2 2 2
155943	8.24	1.05	15.65	2 2 2
155943	8.27	1.02	15.63	2 2 2
155944	8.43	1.03	15.72	2 2 2
155944	8.32	1.03	15.59	2 2 2
155945	6.87	0.95	12.96	2 2 2
155945	6.87	0.98	12.87	2 2 2
155946	0.47	0.49	5.74	2 2 2
155946	0.47	0.57	5.60	2 2 2
155947	14.84	1.12	16.71	2 2 2
155947	14.95	1.08	16.79	2 2 2
155948	14.26	1.13	16.54	2 2 2
155948	14.29	1.10	16.97	2 2 2
155949	13.19	1.10	16.65	2 2 2
155949	13.44	1.10	16.84	2 2 2
155950	12.45	1.08	16.74	2 2 2
155950	12.48	1.05	16.72	2 2 2
155951	11.68	1.08	17.15	2 2 2
155951	11.82	1.10	17.09	2 2 2
155952	10.83	1.07	17.09	2 2 2
155952	10.77	1.09	16.84	2 2 2
155953	10.43	1.09	16.84	2 2 2
155953	10.43	1.09	16.63	2 2 2
155954	10.36	1.08	17.20	2 2 2
155954	10.36	1.20	17.13	2 2 2
155955	10.41	1.10	16.91	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
155955	10.52	1.12	17.16	2 2 2
155956	10.51	1.12	17.54	2 2 2
155956	10.74	1.14	17.47	2 2 2
155957	10.31	1.15	17.72	2 2 2
155957	10.29	1.12	17.67	2 2 2
155958	10.05	1.14	17.84	2 2 2
155958	10.11	1.13	17.90	2 2 2
155959	8.47	1.06	15.82	2 2 2
155959	8.48	1.04	16.20	2 2 2
155960	8.42	1.08	15.66	2 2 2
155960	8.50	1.04	15.79	2 2 2
155961	8.27	1.04	15.75	2 2 2
155961	8.35	1.06	15.76	2 2 2
155962	3.92	0.77	9.12	2 2 2
155962	3.93	0.84	9.07	2 2 2
155963	0.53	0.42	4.42	2 2 2
155963	0.52	0.45	4.44	2 2 2
155964	14.77	1.08	16.81	2 2 2
155964	14.54	1.27	16.44	2 2 2
155965	14.69	1.07	16.77	2 2 2
155965	14.71	1.09	16.66	2 2 2
155966	13.78	1.08	16.82	2 2 2
155966	14.15	1.08	16.74	2 2 2
155967	13.33	1.08	16.52	2 2 2
155967	13.52	1.07	16.90	2 2 2
155968	12.68	1.05	16.58	2 2 2
155968	12.79	1.08	16.68	2 2 2
155969	12.37	1.07	16.90	2 2 2
155969	12.25	1.05	16.78	2 2 2
155970	11.46	1.17	16.90	2 2 2
155970	11.55	1.03	16.94	2 2 2
155971	10.87	1.07	17.08	2 2 2
155971	11.01	1.06	17.19	2 2 2
155974	10.42	1.28	17.52	2 2 2
155974	10.50	1.12	17.60	2 2 2
155975	10.59	1.13	18.17	2 2 2
155975	10.50	1.12	17.97	2 2 2
155976	10.00	1.11	17.73	2 2 2
155976	10.03	1.10	17.67	2 2 2
155977	8.71	1.04	16.40	2 2 2
155977	8.76	1.07	16.59	2 2 2
155978	8.01	0.99	15.40	2 2 2
155978	8.04	1.00	15.39	2 2 2
155979	8.03	1.05	15.51	2 2 2
155979	8.09	1.03	15.72	2 2 2
155980	8.09	1.00	15.34	2 2 2
155980	8.17	1.01	15.23	2 2 2
155981	2.86	0.70	9.15	2 2 2
155981	2.78	0.75	9.02	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
155982	0.75	0.53	6.11	2 2 2
155982	0.73	0.63	5.94	2 2 2
155983	13.45	1.15	16.41	2 2 2
155983	13.65	1.02	16.62	2 2 2
155984	13.34	1.04	16.55	2 2 2
155984	13.39	1.04	16.66	2 2 2
155985	12.68	1.05	16.09	2 2 2
155985	12.71	1.06	16.48	2 2 2
155986	12.46	1.05	16.33	2 2 2
155986	12.60	1.05	16.23	2 2 2
155987	12.54	1.07	16.51	2 2 2
155987	12.43	1.05	16.47	2 2 2
155988	12.46	1.07	16.90	2 2 2
155988	12.63	1.07	16.96	2 2 2
155989	12.00	1.11	16.96	2 2 2
155989	11.95	1.07	17.08	2 2 2
155990	10.42	1.26	16.21	2 2 2
155990	10.53	1.05	16.87	2 2 2
155991	10.45	1.07	17.00	2 2 2
155991	10.56	1.11	17.06	2 2 2
155992	10.22	1.09	16.95	2 2 2
155992	10.25	1.13	16.70	2 2 2
155993	10.44	1.09	16.92	2 2 2
155993	10.55	1.06	16.92	2 2 2
155994	10.58	1.09	17.29	2 2 2
155994	10.58	1.09	17.31	2 2 2
155995	10.38	1.13	17.30	2 2 2
155995	10.52	1.12	17.72	2 2 2
155996	10.52	1.15	17.80	2 2 2
155996	10.66	1.14	18.02	2 2 2
155997	10.01	1.13	17.81	2 2 2
155997	10.01	1.13	17.69	2 2 2
155998	7.92	0.98	15.47	2 2 2
155998	7.98	1.25	15.29	2 2 2
155999	8.03	1.03	15.49	2 2 2
155999	8.12	1.03	15.85	2 2 2
156000	4.65	0.82	10.58	2 2 2
156000	4.71	0.86	10.62	2 2 2
156001	1.43	0.41	5.09	2 2 2
156001	1.42	0.48	5.04	2 2 2
156002	17.27	1.07	16.74	2 2 2
156002	17.70	1.22	16.77	2 2 2
156003	17.16	1.09	16.43	2 2 2
156003	17.22	1.07	16.68	2 2 2
156004	17.02	1.07	16.74	2 2 2
156004	17.22	1.09	16.79	2 2 2
156005	17.21	1.09	16.85	2 2 2
156005	17.07	1.09	17.02	2 2 2
156006	16.24	1.27	16.61	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
156006	16.13	1.09	16.81	2 2 2
156007	14.70	1.07	16.58	2 2 2
156007	14.90	1.08	17.12	2 2 2
156008	13.82	1.04	16.62	2 2 2
156008	13.99	1.07	16.69	2 2 2
156009	13.39	1.09	16.62	2 2 2
156009	13.45	1.10	16.86	2 2 2
156011	12.43	1.14	16.95	2 2 2
156011	12.65	1.08	16.98	2 2 2
156012	11.60	1.07	16.80	2 2 2
156012	11.57	1.09	16.82	2 2 2
156013	10.55	1.06	16.67	2 2 2
156013	10.61	1.05	16.90	2 2 2
156014	10.46	1.08	16.87	2 2 2
156014	10.38	1.07	16.72	2 2 2
156015	10.77	1.25	17.27	2 2 2
156015	10.46	1.08	16.75	2 2 2
156016	10.43	1.15	17.04	2 2 2
156016	10.57	1.11	17.02	2 2 2
156017	10.60	1.10	17.81	2 2 2
156017	10.71	1.11	17.85	2 2 2
156018	10.85	1.12	18.01	2 2 2
156018	10.91	1.12	17.53	2 2 2
156019	10.73	1.17	18.15	2 2 2
156019	10.85	1.17	18.03	2 2 2
156020	8.89	1.05	16.47	2 2 2
156020	8.88	1.06	16.63	2 2 2
156021	8.85	1.07	16.42	2 2 2
156021	8.97	1.05	15.99	2 2 2
156022	8.85	1.04	15.82	2 2 2
156022	9.02	1.05	16.11	2 2 2
156023	0.36	0.36	3.15	2 2 2
156023	0.36	0.43	3.09	2 2 2
156025	17.89	1.12	16.52	2 2 2
156025	17.78	1.12	16.52	2 2 2
156026	17.29	1.14	16.58	2 2 2
156026	17.40	1.14	16.71	2 2 2
156027	16.79	1.17	16.78	2 2 2
156027	16.82	1.14	16.86	2 2 2
156028	16.30	1.11	16.99	2 2 2
156028	16.33	1.13	17.12	2 2 2
156029	14.91	1.15	17.10	2 2 2
156029	15.23	1.11	17.12	2 2 2
156030	14.10	1.15	16.52	2 2 2
156030	14.19	1.09	16.54	2 2 2
156031	13.69	1.12	16.73	2 2 2
156031	13.64	1.09	16.67	2 2 2
156032	13.00	1.08	16.76	2 2 2
156032	12.92	1.09	16.80	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156033	12.27	1.09	16.80	2 2 2
156033	12.44	1.09	16.93	2 2 2
156034	11.66	1.12	16.84	2 2 2
156034	11.66	1.10	16.76	2 2 2
156035	10.80	1.06	16.93	2 2 2
156035	10.82	1.09	17.04	2 2 2
156036	10.74	1.11	17.12	2 2 2
156036	10.79	1.10	17.29	2 2 2
156037	10.88	1.10	17.38	2 2 2
156037	10.85	1.09	17.36	2 2 2
156038	10.67	1.10	17.16	2 2 2
156038	10.70	1.10	17.21	2 2 2
156039	10.87	1.11	17.55	2 2 2
156039	10.87	1.15	17.55	2 2 2
156040	10.98	1.13	18.04	2 2 2
156040	11.01	1.11	17.93	2 2 2
156041	11.40	1.14	18.11	2 2 2
156041	11.17	1.16	17.96	2 2 2
156042	11.28	1.16	18.34	2 2 2
156042	11.43	1.17	18.56	2 2 2
156043	10.97	1.16	18.10	2 2 2
156043	11.11	1.17	18.23	2 2 2
156044	9.84	1.12	16.97	2 2 2
156044	9.98	1.11	17.12	2 2 2
156045	8.85	1.03	15.77	2 2 2
156045	8.94	1.02	15.98	2 2 2
156046	5.31	0.71	10.19	2 2 2
156046	5.39	0.73	10.21	2 2 2
156047	1.99	0.46	4.56	2 2 2
156047	1.96	0.46	4.63	2 2 2
156048	17.63	1.09	16.88	2 2 2
156048	17.60	1.10	16.67	2 2 2
156049	17.94	1.11	16.67	2 2 2
156049	17.96	1.07	16.82	2 2 2
156050	18.25	1.10	17.14	2 2 2
156050	18.25	1.09	16.95	2 2 2
156051	18.27	1.08	17.21	2 2 2
156051	18.36	1.10	17.25	2 2 2
156052	18.15	1.09	17.51	2 2 2
156052	18.18	1.08	17.18	2 2 2
156053	17.81	1.12	17.18	2 2 2
156053	17.52	1.12	17.14	2 2 2
156054	16.07	1.10	17.31	2 2 2
156054	16.13	1.09	17.36	2 2 2
156055	15.18	1.09	17.51	2 2 2
156055	15.12	1.09	17.53	2 2 2
156056	14.02	1.08	17.31	2 2 2
156056	14.11	1.07	17.32	2 2 2
156057	12.92	1.08	17.27	2 2 2

ID	SiO2	PO4	NO2+ NO3	QF
156057	13.12	1.11	17.27	2 2 2
156058	11.67	1.10	17.18	2 2 2
156058	11.85	1.15	17.33	2 2 2
156059	11.09	1.09	16.78	2 2 2
156059	11.21	1.09	16.78	2 2 2
156060	10.74	1.05	17.03	2 2 2
156060	10.92	1.07	16.99	2 2 2
156061	10.37	1.08	17.16	2 2 2
156061	10.45	1.10	17.05	2 2 2
156062	10.34	1.10	17.44	2 2 2
156062	10.36	1.07	17.40	2 2 2
156064	11.11	1.18	18.09	2 2 2
156064	11.28	1.15	17.89	2 2 2
156065	10.27	1.15	17.83	2 2 2
156065	10.59	1.16	17.66	2 2 2
156066	11.73	1.23	18.85	2 2 2
156066	11.79	1.22	18.73	2 2 2
156067	10.40	1.17	17.89	2 2 2
156067	10.55	1.16	17.80	2 2 2
156068	7.52	0.93	14.52	2 2 2
156068	7.37	0.92	14.54	2 2 2
156069	3.94	0.64	7.84	2 2 2
156069	3.94	0.64	8.01	2 2 2
156070	1.95	0.38	2.90	2 2 2
156070	2.01	0.37	2.95	2 2 2
156071	17.04	1.06	16.48	2 2 2
156071	17.10	1.09	16.80	2 2 2
156072	17.53	1.13	16.84	2 2 2
156072	17.09	1.09	16.32	2 2 2
156072	16.95	1.07	16.99	2 2 2
156072	17.55	1.07	17.08	2 2 2
156073	16.94	1.05	16.87	2 2 2
156073	17.00	1.12	16.76	2 2 2
156073	17.55	1.06	17.12	2 2 2
156073	17.61	1.09	17.06	2 2 2
156074	16.53	1.08	17.01	2 2 2
156074	16.88	1.09	16.93	2 2 2
156075	14.62	1.07	16.71	2 2 2
156075	15.09	1.08	16.50	2 2 2
156076	13.68	1.05	17.02	2 2 2
156076	13.59	1.07	16.96	2 2 2
156077	12.68	1.07	16.56	2 2 2
156077	12.70	1.09	16.88	2 2 2
156078	12.79	1.08	17.34	2 2 2
156078	12.53	1.08	17.17	2 2 2
156079	12.02	1.08	17.24	2 2 2
156079	11.88	1.06	16.89	2 2 2
156080	11.13	1.09	16.92	2 2 2
156080	11.39	1.06	17.12	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156081	11.18	1.05	17.27	2 2 2
156081	11.25	1.04	17.38	2 2 2
156082	10.71	1.08	17.47	2 2 2
156082	10.86	1.07	17.17	2 2 2
156083	10.68	1.09	17.91	2 2 2
156083	11.00	1.09	17.99	2 2 2
156084	11.47	1.09	17.70	2 2 2
156084	11.41	1.10	17.85	2 2 2
156085	11.43	1.16	18.50	2 2 2
156085	11.46	1.16	18.31	2 2 2
156086	12.01	1.19	18.96	2 2 2
156086	11.96	1.22	19.48	2 2 2
156087	11.48	1.22	19.08	2 2 2
156087	11.54	1.22	19.35	2 2 2
156094	19.47	1.06	17.20	2 2 2
156094	19.53	1.14	17.05	2 2 2
156095	18.79	1.09	16.81	2 2 2
156095	19.23	1.08	16.80	2 2 2
156096	18.76	1.11	17.29	2 2 2
156096	18.79	1.10	17.23	2 2 2
156097	18.46	1.07	16.91	2 2 2
156097	18.64	1.08	17.04	2 2 2
156098	17.16	1.09	17.38	2 2 2
156098	17.37	1.10	17.30	2 2 2
156099	15.64	1.10	17.34	2 2 2
156099	15.81	1.08	16.96	2 2 2
156100	14.17	1.09	17.03	2 2 2
156100	14.20	1.08	17.18	2 2 2
156101	13.11	1.09	17.37	2 2 2
156101	13.25	1.10	17.05	2 2 2
156102	12.31	1.06	17.17	2 2 2
156102	12.31	1.09	16.83	2 2 2
156103	11.89	1.08	17.53	2 2 2
156103	11.92	1.07	17.32	2 2 2
156104	11.51	1.09	17.11	2 2 2
156104	11.51	1.07	17.20	2 2 2
156105	11.01	1.08	17.45	2 2 2
156105	11.06	1.10	17.70	2 2 2
156106	11.00	1.14	17.68	2 2 2
156106	11.06	1.13	18.02	2 2 2
156107	10.82	1.11	17.86	2 2 2
156107	11.00	1.10	17.67	2 2 2
156108	11.14	1.13	18.11	2 2 2
156108	10.99	1.16	18.34	2 2 2
156109	12.01	1.16	19.18	2 2 2
156109	12.10	1.20	19.01	2 2 2
156110	12.09	1.25	19.56	2 2 2
156110	12.20	1.25	19.96	2 2 2
156111	8.89	1.00	15.97	2 2 2
156111	8.92	1.01	15.96	2 2 2
156112	5.73	0.74	12.26	2 2 2
156112	5.88	0.75	12.45	2 2 2
156113	5.26	0.67	10.94	2 2 2
156113	5.29	0.70	11.13	2 2 2
156114	2.69	0.37	6.30	2 2 2
156114	2.74	0.37	6.35	2 2 2
156115	2.19	0.28	4.18	2 2 2
156115	2.19	0.28	4.27	2 2 2
156116	0.52	0.08	0.72	2 2 2
156116	0.52	0.08	0.74	2 2 2
156117	18.77	1.06	16.70	2 2 2
156117	18.97	1.02	16.62	2 2 2
156118	19.22	1.08	16.79	2 2 2
156118	19.46	1.04	17.09	2 2 2
156119	19.69	1.07	16.94	2 2 2
156119	19.84	1.05	17.45	2 2 2
156120	20.06	1.08	17.51	2 2 2
156120	19.95	1.10	17.36	2 2 2
156121	19.86	1.06	17.81	2 2 2
156121	20.03	1.07	17.60	2 2 2
156122	17.71	1.07	17.23	2 2 2
156122	17.80	1.07	17.44	2 2 2
156123	16.09	1.04	17.63	2 2 2
156123	16.21	1.08	17.73	2 2 2
156124	15.27	1.05	17.21	2 2 2
156124	15.27	1.04	17.30	2 2 2
156125	14.36	1.06	17.26	2 2 2
156125	13.95	1.08	17.45	2 2 2
156126	12.70	1.06	17.29	2 2 2
156126	12.85	1.11	17.08	2 2 2
156127	11.32	1.10	17.35	2 2 2
156127	11.39	1.07	17.42	2 2 2
156128	11.06	1.09	17.23	2 2 2
156128	11.09	1.10	17.00	2 2 2
156129	10.79	1.11	17.66	2 2 2
156129	10.82	1.10	17.55	2 2 2
156130	10.76	1.12	17.59	2 2 2
156130	10.76	1.12	17.80	2 2 2
156131	10.70	1.14	18.14	2 2 2
156131	10.75	1.12	18.35	2 2 2
156132	11.71	1.17	18.25	2 2 2
156132	11.51	1.17	18.98	2 2 2
156133	12.06	1.22	19.18	2 2 2
156133	12.15	1.22	19.11	2 2 2
156134	11.87	1.27	20.25	2 2 2
156134	12.19	1.24	19.90	2 2 2
156135	10.82	1.18	18.06	2 2 2
156135	10.93	1.17	17.87	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156136	8.85	1.04	16.17	2 2 2
156136	9.00	1.07	16.08	2 2 2
156137	5.47	0.70	10.54	2 2 2
156137	5.43	0.73	10.22	2 2 2
156138	5.75	0.79	11.98	2 2 2
156138	5.81	0.79	11.75	2 2 2
156139	0.51	0.14	0.57	2 2 2
156139	0.54	0.12	0.59	2 2 2
156140	16.24	1.05	16.05	2 2 2
156140	16.38	1.06	15.88	2 2 2
156141	17.29	1.09	16.78	2 2 2
156141	17.38	1.08	16.60	2 2 2
156142	17.95	1.11	16.68	2 2 2
156142	18.42	1.10	16.80	2 2 2
156143	17.59	1.07	16.81	2 2 2
156143	18.45	1.11	16.53	2 2 2
156144	16.92	1.09	17.08	2 2 2
156144	16.91	1.08	16.75	2 2 2
156145	15.82	1.11	17.26	2 2 2
156145	15.89	1.10	16.67	2 2 2
156146	14.97	1.10	17.03	2 2 2
156146	15.24	1.08	17.03	2 2 2
156147	13.97	1.10	16.65	2 2 2
156147	14.09	1.09	16.88	2 2 2
156148	12.51	1.12	17.04	2 2 2
156148	12.71	1.12	16.93	2 2 2
156149	11.21	1.12	16.60	2 2 2
156149	11.30	1.11	16.97	2 2 2
156150	10.97	1.13	16.97	2 2 2
156150	11.15	1.13	16.60	2 2 2
156151	10.76	1.09	17.43	2 2 2
156151	10.85	1.09	17.47	2 2 2
156152	10.73	1.13	16.91	2 2 2
156152	10.73	1.13	17.22	2 2 2
156153	10.67	1.15	17.80	2 2 2
156153	10.84	1.13	18.01	2 2 2
156154	11.27	1.15	18.30	2 2 2
156154	11.42	1.16	17.87	2 2 2
156155	11.62	1.21	18.61	2 2 2
156155	11.80	1.29	18.50	2 2 2
156156	11.88	1.28	19.09	2 2 2
156156	11.85	1.27	19.57	2 2 2
156157	10.79	1.23	18.67	2 2 2
156157	10.79	1.21	18.40	2 2 2
156158	7.40	0.96	14.62	2 2 2
156158	7.66	0.99	14.43	2 2 2
156159	6.55	0.87	13.19	2 2 2
156159	6.61	0.88	13.05	2 2 2
156160	5.26	0.75	11.12	2 2 2
156160	5.26	0.80	10.94	2 2 2
156161	3.34	0.39	3.73	2 2 2
156161	3.37	0.40	3.67	2 2 2
156162	1.16	0.22	0.59	2 2 2
156162	1.16	0.20	0.61	2 2 2
156163	16.26	1.13	16.15	2 2 2
156163	16.38	1.14	15.92	2 2 2
156164	17.38	1.17	16.12	2 2 2
156164	17.41	1.17	16.25	2 2 2
156165	18.00	1.16	16.72	2 2 2
156165	18.20	1.15	16.81	2 2 2
156166	17.57	1.15	16.56	2 2 2
156166	17.66	1.17	16.83	2 2 2
156167	17.03	1.16	17.36	2 2 2
156167	17.20	1.15	17.55	2 2 2
156168	16.01	1.14	17.16	2 2 2
156168	15.97	1.15	17.24	2 2 2
156169	13.89	1.15	17.45	2 2 2
156169	14.13	1.15	17.22	2 2 2
156170	11.69	1.13	16.76	2 2 2
156170	11.70	1.14	17.24	2 2 2
156171	10.82	1.13	16.74	2 2 2
156171	10.84	1.12	16.87	2 2 2
156172	11.02	1.13	17.34	2 2 2
156172	10.87	1.14	17.51	2 2 2
156173	11.51	1.15	17.49	2 2 2
156173	11.39	1.14	17.49	2 2 2
156174	11.53	1.15	18.04	2 2 2
156174	11.62	1.16	17.90	2 2 2
156175	11.20	1.13	17.92	2 2 2
156175	11.29	1.14	17.69	2 2 2
156176	11.52	1.15	18.23	2 2 2
156176	11.64	1.15	18.50	2 2 2
156177	12.19	1.22	19.47	2 2 2
156177	12.22	1.22	19.09	2 2 2
156178	13.51	1.33	21.34	4 3 3
156178	13.45	1.33	21.07	4 3 3
156179	7.31	0.90	14.59	2 2 2
156179	7.31	0.91	14.30	2 2 2
156180	6.86	0.90	14.76	2 2 2
156180	6.84	0.92	15.07	2 2 2
156181	2.35	0.38	5.95	2 2 2
156181	2.35	0.39	5.86	2 2 2
156182	1.97	0.35	5.27	2 2 2
156182	2.00	0.34	5.17	2 2 2
156183	2.05	0.33	5.23	2 2 2
156183	2.08	0.33	5.33	2 2 2
156184	2.19	0.32	5.25	2 2 2
156184	2.22	0.33	5.33	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156185	0.97	0.07	0.00	2 2 2
156185	0.99	0.07	0.00	2 2 2
156186	17.64	1.02	16.71	2 2 2
156186	17.31	1.02	16.73	2 2 2
156187	18.84	1.05	16.73	2 2 2
156187	19.16	1.03	17.02	2 2 2
156188	20.04	1.06	17.46	2 2 2
156188	19.68	1.07	17.64	2 2 2
156189	19.03	1.08	17.06	2 2 2
156189	19.20	1.06	17.31	2 2 2
156190	17.78	1.07	17.74	2 2 2
156190	18.19	1.07	17.64	2 2 2
156191	15.66	1.06	17.35	2 2 2
156191	15.69	1.06	17.31	2 2 2
156192	14.51	1.05	17.78	2 2 2
156192	14.60	1.04	17.56	2 2 2
156193	13.45	1.06	17.78	2 2 2
156193	13.51	1.05	17.43	2 2 2
156194	12.54	1.06	17.78	2 2 2
156194	12.56	1.04	17.89	2 2 2
156195	11.96	1.03	17.93	2 2 2
156195	12.13	1.04	17.72	2 2 2
156196	11.75	1.04	17.68	2 2 2
156196	11.83	1.06	17.49	2 2 2
156197	11.80	1.09	17.54	2 2 2
156197	11.91	1.08	17.64	2 2 2
156198	11.61	1.13	17.91	2 2 2
156198	11.91	1.10	17.86	2 2 2
156199	11.93	1.20	17.82	2 2 2
156199	11.99	1.23	17.76	2 2 2
156200	11.87	1.24	18.07	2 2 2
156200	11.86	1.22	18.23	2 2 2
156201	11.71	1.25	18.50	2 2 2
156201	11.92	1.25	18.77	2 2 2
156202	12.03	1.27	18.58	2 2 2
156202	12.05	1.26	18.79	2 2 2
156203	11.80	1.23	18.66	2 2 2
156203	11.91	1.22	18.93	2 2 2
156204	9.24	1.07	16.35	2 2 2
156204	9.00	1.09	15.90	2 2 2
156205	7.81	0.97	14.03	2 2 2
156205	7.69	0.93	14.10	2 2 2
156206	6.58	0.86	12.81	2 2 2
156206	6.67	0.87	12.85	2 2 2
156207	3.19	0.50	5.44	2 2 2
156207	3.25	0.51	5.46	2 2 2
156208	1.22	0.18	0.95	2 2 2
156208	1.28	0.18	0.90	2 2 2
156209	17.07	1.07	16.08	2 2 2
156209	17.32	1.09	16.21	2 2 2
156210	18.33	1.08	16.74	2 2 2
156210	18.31	1.10	16.52	2 2 2
156211	17.29	1.10	16.25	2 2 2
156211	17.84	1.08	16.58	2 2 2
156212	17.25	1.10	16.66	2 2 2
156212	17.11	1.12	16.56	2 2 2
156213	16.54	1.11	17.15	2 2 2
156213	16.46	1.11	16.93	2 2 2
156214	14.05	1.11	16.64	2 2 2
156214	14.25	1.10	16.60	2 2 2
156215	13.29	1.11	16.93	2 2 2
156215	13.37	1.12	17.07	2 2 2
156216	11.26	1.10	16.66	2 2 2
156216	11.32	1.11	16.58	2 2 2
156217	10.56	1.12	16.64	2 2 2
156217	10.62	1.10	16.93	2 2 2
156218	10.61	1.13	16.86	2 2 2
156218	10.59	1.10	17.17	2 2 2
156219	10.57	1.12	16.80	2 2 2
156219	10.65	1.12	16.84	2 2 2
156220	10.85	1.11	17.40	2 2 2
156220	10.93	1.14	17.56	2 2 2
156221	10.78	1.15	17.29	2 2 2
156221	11.10	1.15	17.65	2 2 2
156222	11.29	1.15	18.02	2 2 2
156222	11.15	1.19	17.96	2 2 2
156223	11.95	1.22	19.00	2 2 2
156223	11.97	1.22	18.67	2 2 2
156224	12.17	1.30	19.37	2 2 2
156224	12.25	1.29	19.53	2 2 2
156225	11.10	1.25	19.47	2 2 2
156225	11.38	1.25	19.62	2 2 2
156226	5.63	0.81	12.66	2 2 2
156226	5.66	0.80	12.57	2 2 2
156227	3.41	0.56	8.45	2 2 2
156227	3.46	0.55	8.60	2 2 2
156228	2.72	0.45	6.76	2 2 2
156228	2.69	0.45	6.95	2 2 2
156229	2.14	0.36	5.45	2 2 2
156229	2.11	0.36	5.44	2 2 2
156230	1.57	0.28	3.91	2 2 2
156230	1.62	0.29	3.96	2 2 2
156231	0.50	0.09	0.00	2 2 2
156231	0.53	0.09	0.00	2 2 2
156232	19.10	1.10	16.34	2 2 2
156232	19.43	1.10	16.52	2 2 2
156233	19.74	1.10	16.76	2 2 2
156233	19.81	1.09	16.83	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156234	19.20	1.10	16.58	2 2 2
156234	19.17	1.12	16.27	2 2 2
156235	17.49	1.11	16.41	2 2 2
156235	17.94	1.12	16.33	2 2 2
156236	15.47	1.10	16.51	2 2 2
156236	15.65	1.07	16.65	2 2 2
156237	14.37	1.07	16.75	2 2 2
156237	14.55	1.07	16.26	2 2 2
156238	13.83	1.07	16.58	2 2 2
156238	13.77	1.08	16.46	2 2 2
156239	13.24	1.06	16.91	2 2 2
156239	13.50	1.06	16.99	2 2 2
156240	11.95	1.03	16.37	2 2 2
156240	11.97	1.02	16.62	2 2 2
156241	11.38	1.06	16.91	2 2 2
156241	11.53	1.05	16.76	2 2 2
156242	11.11	1.07	17.19	2 2 2
156242	11.11	1.07	17.09	2 2 2
156243	11.19	1.10	17.24	2 2 2
156243	11.28	1.09	17.07	2 2 2
156244	11.45	1.10	17.07	2 2 2
156244	11.33	1.10	17.26	2 2 2
156245	11.38	1.13	17.71	2 2 2
156245	11.17	1.15	17.77	2 2 2
156246	6.28	0.71	11.17	4 4 4
156246	6.30	0.71	11.23	4 4 4
156247	11.92	1.23	19.57	2 2 2
156247	11.95	1.23	19.19	2 2 2
156248	11.57	1.25	19.89	2 2 2
156248	11.72	1.24	20.14	2 2 2
156249	6.79	0.87	14.08	2 2 2
156249	6.82	0.87	13.82	2 2 2
156250	4.12	0.57	9.30	2 2 2
156250	4.06	0.57	9.40	2 2 2
156251	2.62	0.40	6.45	2 2 2
156251	2.68	0.40	6.47	2 2 2
156252	2.01	0.30	5.20	2 2 2
156252	2.01	0.29	5.16	2 2 2
156253	2.00	0.28	4.72	2 2 2
156253	2.03	0.28	4.71	2 2 2
156254	0.44	0.00	0.00	2 2 2
156254	0.44	0.00	0.00	2 2 2
156255	18.53	1.04	16.56	2 2 2
156255	18.77	1.04	16.44	2 2 2
156256	18.74	1.08	16.21	2 2 2
156256	19.09	1.05	16.13	2 2 2
156257	18.76	1.07	16.50	2 2 2
156257	18.96	1.08	16.62	2 2 2
156258	19.01	1.10	16.74	2 2 2
156258	19.09	1.10	16.46	2 2 2
156259	18.50	1.10	16.62	2 2 2
156259	18.53	1.09	16.54	2 2 2
156260	16.38	1.08	16.54	2 2 2
156260	16.50	1.07	16.46	2 2 2
156261	14.92	1.08	16.62	2 2 2
156261	15.06	1.08	16.79	2 2 2
156262	14.00	1.07	16.73	2 2 2
156262	14.04	1.06	16.93	2 2 2
156263	12.72	1.09	16.44	2 2 2
156263	12.77	1.08	16.46	2 2 2
156264	12.69	1.08	16.81	2 2 2
156264	12.55	1.09	16.73	2 2 2
156265	11.38	1.08	16.63	2 2 2
156265	11.43	1.07	16.45	2 2 2
156266	11.57	1.09	16.92	2 2 2
156266	11.60	1.08	16.82	2 2 2
156267	11.22	1.10	17.29	2 2 2
156267	11.24	1.12	17.39	2 2 2
156268	11.47	1.12	17.53	2 2 2
156268	11.41	1.12	17.74	2 2 2
156269	11.72	1.16	17.96	2 2 2
156269	11.69	1.14	17.70	2 2 2
156270	11.83	1.17	17.96	2 2 2
156270	11.94	1.18	18.13	2 2 2
156271	11.79	1.24	19.29	2 2 2
156271	12.03	1.24	19.08	2 2 2
156272	10.90	1.22	18.82	2 2 2
156272	10.93	1.22	19.21	2 2 2
156273	6.77	0.88	13.90	2 2 2
156273	6.77	0.88	13.86	2 2 2
156274	4.24	0.63	10.21	2 2 2
156274	4.23	0.63	10.25	2 2 2
156275	3.11	0.48	7.04	2 2 2
156275	3.14	0.48	6.87	2 2 2
156276	2.24	0.32	3.68	2 2 2
156276	2.24	0.32	3.64	2 2 2
156277	0.23	0.11	0.30	2 2 2
156277	0.00	0.11	0.24	2 2 2
156278	19.06	1.07	16.51	2 2 2
156278	19.21	1.08	16.26	2 2 2
156279	19.26	1.10	16.85	2 2 2
156279	19.28	1.10	16.81	2 2 2
156280	18.98	1.09	16.57	2 2 2
156280	19.25	1.09	16.47	2 2 2
156281	17.10	1.09	16.65	2 2 2
156281	17.21	1.11	16.75	2 2 2
156282	15.53	1.11	16.43	2 2 2
156282	15.42	1.09	16.65	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156283	14.66	1.13	16.23	2 2 2
156283	14.69	1.12	16.43	2 2 2
156284	13.81	1.11	16.53	2 2 2
156284	13.85	1.10	16.49	2 2 2
156285	12.05	1.09	16.68	2 2 2
156285	12.28	1.10	16.56	2 2 2
156286	11.21	1.09	16.88	2 2 2
156286	11.21	1.09	16.88	2 2 2
156288	10.95	1.11	16.76	2 2 2
156288	11.00	1.11	16.74	2 2 2
156289	10.84	1.10	17.24	2 2 2
156289	10.92	1.14	17.38	2 2 2
156290	11.23	1.17	17.90	2 2 2
156290	11.40	1.17	17.40	2 2 2
156291	11.71	1.20	17.94	2 2 2
156291	11.73	1.20	18.00	2 2 2
156292	12.25	1.30	19.39	2 2 2
156292	12.27	1.30	19.57	2 2 2
156293	9.03	1.08	16.46	2 2 2
156293	8.97	1.08	16.52	2 2 2
156294	5.67	0.80	12.15	2 2 2
156294	5.64	0.80	12.27	2 2 2
156295	4.69	0.70	10.64	2 2 2
156295	4.69	0.70	10.72	2 2 2
156296	4.26	0.65	9.85	2 2 2
156296	4.29	0.65	9.91	2 2 2
156297	3.53	0.56	8.46	2 2 2
156297	3.53	0.57	8.52	2 2 2
156298	2.41	0.38	4.51	2 2 2
156298	2.46	0.38	4.44	2 2 2
156299	0.21	0.12	0.00	2 2 2
156299	0.21	0.13	0.00	2 2 2
156301	19.28	1.28	16.51	2 2 2
156301	19.45	1.12	16.18	2 2 2
156302	18.86	1.12	16.19	2 2 2
156302	18.91	1.14	16.32	2 2 2
156303	18.44	1.11	16.58	2 2 2
156303	18.49	1.14	16.81	2 2 2
156304	16.78	1.10	16.41	2 2 2
156304	16.39	1.11	16.32	2 2 2
156305	15.37	1.08	16.63	2 2 2
156305	15.37	1.08	16.55	2 2 2
156306	13.74	1.09	16.17	2 2 2
156306	13.94	1.30	16.41	2 2 2
156307	12.52	1.06	16.70	2 2 2
156307	12.62	1.09	16.89	2 2 2
156308	11.78	1.06	16.57	2 2 2
156308	11.78	1.09	16.70	2 2 2
156309	10.99	1.28	16.96	2 2 2
156309	11.21	1.09	17.23	2 2 2
156310	11.42	1.08	17.28	2 2 2
156310	11.41	1.09	17.22	2 2 2
156311	11.20	1.10	17.91	2 2 2
156311	11.10	1.10	17.56	2 2 2
156312	11.15	1.10	17.98	2 2 2
156312	11.54	1.11	18.46	2 2 2
156313	11.56	1.14	18.72	2 2 2
156313	11.69	1.15	18.97	2 2 2
156314	11.84	1.14	19.04	2 2 2
156314	12.11	1.18	19.60	2 2 2
156315	12.11	1.19	19.73	2 2 2
156315	12.24	1.18	19.93	2 2 2
156316	12.31	1.23	20.84	2 2 2
156316	12.18	1.23	20.49	2 2 2
156317	11.22	1.34	19.55	2 2 2
156317	11.27	1.16	19.93	2 2 2
156318	7.58	0.83	15.10	2 2 2
156318	7.43	0.88	15.12	2 2 2
156319	5.58	0.72	12.18	2 2 2
156319	5.59	0.70	12.44	2 2 2
156320	5.31	0.70	11.72	2 2 2
156320	5.36	0.71	11.84	2 2 2
156321	4.72	0.65	10.95	2 2 2
156321	4.74	0.66	11.01	2 2 2
156322	2.81	0.36	5.33	2 2 2
156322	2.84	0.35	5.46	2 2 2
156323	0.27	0.07	0.00	2 2 2
156323	0.31	0.00	0.00	2 2 2
156324	19.69	1.25	17.18	2 2 2
156324	19.85	1.08	17.13	2 2 2
156325	18.63	1.08	16.54	2 2 2
156325	18.97	1.24	16.65	2 2 2
156326	17.94	1.10	16.79	2 2 2
156326	18.09	1.11	16.92	2 2 2
156327	17.03	1.07	16.94	2 2 2
156327	17.15	1.08	16.70	2 2 2
156328	15.58	1.09	16.53	2 2 2
156328	15.60	1.07	16.41	2 2 2
156329	14.46	1.09	16.70	2 2 2
156329	14.61	1.07	16.72	2 2 2
156330	13.44	1.06	16.15	2 2 2
156330	13.24	1.07	16.17	2 2 2
156331	11.74	1.08	16.36	2 2 2
156331	11.76	1.07	16.17	2 2 2
156332	11.14	1.08	16.30	2 2 2
156332	11.23	1.08	15.94	2 2 2
156333	10.78	1.23	16.19	2 2 2
156333	10.83	1.07	16.42	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF
156334	10.97	1.08	16.62	2 2 2
156334	10.83	1.08	16.84	2 2 2
156335	11.22	1.09	17.00	2 2 2
156335	11.11	1.08	16.73	2 2 2
156336	11.16	1.11	17.40	2 2 2
156336	11.22	1.12	17.14	2 2 2
156337	11.21	1.11	17.47	2 2 2
156337	11.30	1.11	17.71	2 2 2
156338	11.29	1.15	18.09	2 2 2
156338	11.49	1.15	17.95	2 2 2
156339	11.60	1.18	18.47	2 2 2
156339	11.86	1.20	18.32	2 2 2
156340	12.19	1.23	19.87	2 2 2
156340	12.08	1.23	19.72	2 2 2
156341	9.12	1.21	16.81	2 2 2
156341	9.25	1.04	17.34	2 2 2
156342	6.23	0.73	13.26	2 2 2
156342	6.08	0.78	12.99	2 2 2
156343	5.22	0.68	11.64	2 2 2
156343	5.20	0.70	11.73	2 2 2
156344	4.26	0.57	10.20	2 2 2
156344	4.27	0.59	10.23	2 2 2
156345	2.85	0.28	4.45	2 2 2
156345	2.87	0.33	4.39	2 2 2
156346	0.40	0.00	0.00	2 2 2
156346	0.42	0.07	0.00	2 2 2
156347	18.52	1.06	17.35	2 2 2
156347	18.57	1.22	17.30	2 2 2
156348	16.98	1.05	16.69	2 2 2
156348	16.71	1.07	16.44	2 2 2
156349	16.69	1.08	16.26	2 2 2
156349	16.85	1.26	15.99	2 2 2
156350	15.99	1.09	16.45	2 2 2
156350	15.97	1.09	16.49	2 2 2
156351	14.76	1.10	16.01	2 2 2
156351	14.83	1.10	16.01	2 2 2
156352	13.43	1.09	16.09	2 2 2
156352	13.44	1.09	16.24	2 2 2
156353	12.75	1.08	16.00	2 2 2
156353	12.82	1.10	16.42	2 2 2
156354	11.41	1.09	15.96	2 2 2
156354	11.46	1.07	15.67	2 2 2
156355	10.86	1.09	15.96	2 2 2
156355	10.93	1.10	15.94	2 2 2
156356	10.81	1.10	15.75	2 2 2
156356	10.85	1.13	15.84	2 2 2
156357	10.56	1.27	15.79	2 2 2
156357	10.61	1.10	15.99	2 2 2
156358	10.54	1.12	16.26	2 2 2
156358	10.65	1.11	16.03	2 2 2
156359	10.78	1.15	16.81	2 2 2
156359	10.81	1.12	16.41	2 2 2
156360	11.19	1.17	17.53	2 2 2
156360	11.21	1.19	17.20	2 2 2
156361	11.43	1.18	17.87	2 2 2
156361	11.53	1.20	18.18	2 2 2
156362	11.86	1.28	18.81	2 2 2
156362	11.72	1.28	19.16	2 2 2
156363	8.47	1.05	15.92	2 2 2
156363	8.54	1.02	15.85	2 2 2
156364	5.05	0.68	11.50	2 2 2
156364	5.16	0.74	11.33	2 2 2
156365	4.34	0.77	10.01	2 2 2
156365	4.36	0.65	10.26	2 2 2
156366	3.85	0.56	9.10	2 2 2
156366	3.73	0.57	8.84	2 2 2
156367	2.52	0.37	5.88	2 2 2
156367	2.57	0.40	5.92	2 2 2
156368	2.42	0.34	4.29	2 2 2
156368	2.44	0.36	4.23	2 2 2
156369	0.25	0.08	0.00	2 2 2
156369	0.26	0.00	0.00	2 2 2
156370	16.72	1.26	16.78	2 2 2
156370	16.87	1.10	16.90	2 2 2
156371	16.75	1.10	16.80	2 2 2
156371	16.76	1.11	16.53	2 2 2
156372	15.78	1.13	16.54	2 2 2
156372	16.05	1.12	16.45	2 2 2
156373	14.60	1.13	16.44	2 2 2
156373	14.75	1.13	16.58	2 2 2
156374	12.93	1.12	16.00	2 2 2
156374	13.05	1.14	15.94	2 2 2
156375	11.60	1.10	15.96	2 2 2
156375	11.69	1.11	16.09	2 2 2
156376	11.33	1.12	16.32	2 2 2
156376	11.42	1.12	16.24	2 2 2
156377	11.56	1.13	15.95	2 2 2
156377	11.57	1.15	16.20	2 2 2
156378	7.13	0.81	11.99	4 4 4
156378	7.06	0.78	11.82	4 4 4
156379	11.33	1.14	16.59	2 2 2
156379	11.35	1.20	16.94	2 2 2
156380	11.39	1.20	17.17	2 2 2
156380	11.59	1.39	16.90	2 3 2
156381	11.41	1.20	17.93	2 2 2
156381	11.46	1.20	18.17	2 2 2
156382	11.51	1.29	18.79	2 2 2
156382	11.53	1.27	18.49	2 2 2

Table C.3 Replicate nutrient water sample values in moles/kg, along with their quality flags.

ID	SiO2	PO4	NO2+ NO3	QF	ID	SiO2	PO4	NO2+ NO3	QF
156383	8.78	1.10	16.54	2 2 2					
156383	8.67	1.08	16.73	2 2 2					
156384	5.39	0.80	11.70	2 2 2					
156384	5.40	0.73	11.85	2 2 2					
156385	3.56	0.59	8.72	2 2 2					
156385	3.57	0.54	8.60	2 2 2					
156386	2.89	0.50	7.39	2 2 2					
156386	2.92	0.47	7.43	2 2 2					
156387	2.11	0.35	5.05	2 2 2					
156387	2.12	0.34	4.98	2 2					
156388	1.24	0.25	1.81	2 2					
156388	1.26	0.19	1.84	2 2					
156389	0.37	0.07	0.00	2 2 2					
156389	0.33	0.09	0.00	2 2 2					

5. Dissolved Inorganic Carbon in Seawater
(Bob Gershey)

a. Description of Equipment and Technique

The total dissolved inorganic carbon content of seawater is defined as the total concentration of carbonate ion, bicarbonate ion and unionized species of carbon dioxide.

Before analysis, the sample was treated with acid to convert all ionized species to the unionized form, which was then separated from the liquid phase and subsequently measured using the coulometric titration technique. This involved the reaction of carbon dioxide gas with a dimethysulfoxide solution of ethanoline to produce hydroxyethylcarbamic acid. The acidic solution was titrated with a hydroxide ion formed by the electrolytic decomposition of water. The progress of the titration was followed through colorimetric measurement of the absorbance of a pH indicator dye (thymolphthalein) in the ethanolamine solution.

A known volume of seawater was dispensed into a stripping chamber from a pipet of known volume and temperature controlled to within 0.4 °C. It was then acidified with ten percent its volume of an eight percent solution of carbon dioxide-free phosphoric acid. The solution was stripped of carbon dioxide gas by bubbling with a stream of nitrogen gas directed through a glass frit. The carrier gas exiting the stripper passed through a magnesium perchlorate trap to remove water vapour and acidic water droplets.

The gas stream was then directed into the coulometric titrator where the total amount of carbon dioxide gas was quantified. The coulometer was calibrated in two ways. Calibration using gas loops was accomplished by filling stainless steel sample loops (1.5, 2.5 ml) with 99.995% carbon dioxide gas and injecting these into the coulometer. The temperature and pressure of the gas within the loops must be known to within 0.05 °C and 20 Pa respectively. Standard solutions of sodium carbonate were also used to calibrate the system. These samples were treated in the same manner as a seawater sample.

Values were reported in units of μmol/kg. The overall precision of the analysis should have been at least 1.5 μmol/kg for samples with concentrations in the range of 1800-2300 μmol/kg.

b. Sampling Procedure and Data Processing Technique

Water samples were initially collected using a 10 litre rosette bottle. Samples for analysis of total inorganic carbon were drawn immediately following the drawing of the oxygen samples in order to minimize exchange of carbon dioxide gas with the headspace in the sampler. This exchange will typically result in a loss of carbon dioxide. It was desirable that the samples be drawn before half the sampler was emptied and within ten minutes of recovery. Clean borosilicate glass bottles were rinsed twice with 30 - 50 ml of the sample. The bottle was then filled from the bottom using a length of vinyl tubing attached to the spigot of the sampler. The sample was overflowed by at least a half of the volume of the bottle (typically 250 ml). A headspace of 1% was left to allow for expansion without leakage. If samples were not to be analyzed within four to five hours, the sample was poisoned with 100 µl / 250 ml of 50% saturated mercuric chloride solution. The bottle was tightly sealed and stored preferably at the temperature of collection in the dark.

c. Replicate Analysis

In total, 113 replicate carbonate measurements were obtained for 107 sample id numbers; 105 sample id numbers had one replicate, while two sample id number had three replicates. The following is a statistical summary of the absolute value of the replicate differences. Table C.4 lists all 113 replicate measurements.

Number of Replicate Differences = 2 id had two replicates * 4 possible differences + 105 ids had one replicate * 1 possible difference = 8 + 105 = 113

Statistic	Value
Number of Replicate Differences	113
Minimum (µmoles/kg)	0.0
Maximum (µmoles/kg)	33.3
Mean (µmoles/kg)	0.8
Median (µmoles/kg)	0.3
Standard Deviation (µmoles/kg)	3.2

Table C.4 Replicate water sample total carbon values in moles.kg.

Sample ID Number	Total Carbon	WOCE QF	Sample ID Number	Total Carbon	WOCE QF
155204	2112.8	2	155288	2147.4	2
155204	2112.8	2	155288	2148.6	2
155218	2112.1	2	155293	2155.8	2
155218	2113.2	2	155293	2156.1	2
155223	2109.0	2	155298	2154.3	2
155223	2109.0	2	155298	2154.3	2
155225	2127.0	2	155339	2151.0	2
155225	2127.3	2	155339	2151.0	2
155227	1971.4	2	155342	2150.2	2
155227	1971.4	2	155342	2150.7	2
155228	2135.7	2	155378	2155.7	2
155228	2135.7	2	155378	2155.7	2
155232	2122.7	2	155383	2154.7	2
155232	2122.9	2	155383	2155.3	2
155237	2120.1	2	155389	2150.8	2
155237	2120.1	2	155389	2151.1	2
155238	1969.0	2	155418	2153.0	2
155238	1968.8	2	155418	2153.0	2
155240	2112.4	2	155422	2152.3	2
155240	2113.0	2	155422	2152.4	2
155243	1942.9	2	155437	2155.4	2
155243	1942.9	2	155437	2155.7	2
155244	2127.5	2	155442	2153.3	2
155244	2128.2	2	155442	2153.3	2
155247	2126.2	2	155457	2158.9	2
155247	2126.2	2	155457	2158.9	2
155252	2125.8	2	155462	2149.6	2
155252	2125.3	2	155462	2151.5	2
155254	2117.1	2	155474	2097.4	2
155254	2117.1	2	155474	2095.9	2
155256	2145.2	2	155485	2152.2	2
155256	2145.2	2	155485	2153.2	2
155257	2141.5	2	155487	2152.9	2
155257	2142.4	2	155487	2152.9	2
155260	2127.7	2	155537	2149.6	2
155260	2129.1	2	155537	2149.6	2
155267	2146.7	2	155553	2154.0	2
155267	2146.7	2	155553	2154.8	2
155269	2146.2	2	155707	2156.2	2
155269	2147.2	2	155707	2154.1	2
155279	2153.2	2	155711	2155.2	2
155279	2153.2	2	155711	2148.8	2

Table C.4 Replicate water sample total carbon values in moles.kg.

Sample ID Number	Total Carbon	WOCE QF
155714	2150.7	2
155714	2150.7	2
155731	2151.3	2
155731	2151.3	2
155759	2152.6	2
155759	2152.6	2
155768	2154.0	2
155768	2155.2	2
155776	2113.0	4
155776	2113.0	4
155778	2107.8	4
155778	2105.7	4
155782	2102.9	4
155782	2102.9	4
155784	2094.3	4
155784	2095.1	4
155787	2152.6	2
155787	2154.0	2
155808	2103.6	2
155808	2103.6	2
155821	2152.1	2
155821	2152.1	2
155823	2150.6	2
155823	2150.9	2
155830	2110.2	2
155830	2143.5	2
155838	2155.6	2
155838	2155.6	2
155840	2152.4	2
155840	2152.8	2
155861	2155.4	2
155861	2156.3	2
155866	2150.3	2
155866	2150.3	2
155915	2152.9	2
155915	2157.1	2
155920	2149.4	2
155920	2149.4	2
155920	2148.6	2
155920	2148.6	2
155952	2152.4	2
155952	2151.6	2
155954	2150.3	2
155954	2150.3	2
155955	2152.2	2
155955	2152.5	2
155974	2157.8	2
155974	2159.0	2
155975	2159.5	2
155975	2159.5	2
155985	2157.1	2
155985	2157.7	2
155994	2156.4	2
155994	2156.4	2
155995	2156.8	2
155995	2158.7	2
156006	2159.5	2
156006	2160.1	2
156009	2157.0	2
156009	2157.0	2
156029	2156.8	2
156029	2157.2	2
156038	2154.4	2
156038	2154.4	2
156038	2155.3	2
156038	2155.3	2
156051	2158.8	2
156051	2159.0	2
156055	2156.5	2
156055	2155.8	2
156059	2152.3	2
156059	2152.3	2
156072	2159.9	2
156072	2159.9	2
156074	2158.6	2
156074	2159.1	2
156094	2160.2	2
156094	2161.6	2
156096	2161.1	2
156096	2161.1	2
156117	2162.4	2
156117	2161.4	2
156139	2052.9	2
156139	2052.9	2
156141	2160.3	2
156141	2160.3	2

Table C.4 Replicate water sample total carbon values in moles.kg.

Sample ID Number	Total Carbon	WOCE QF
156142	2158.9	2
156142	2159.1	2
156146	2155.3	2
156146	2155.3	2
156164	2160.7	2
156164	2160.7	2
156166	2159.9	2
156166	2160.3	2
156199	2155.3	2
156199	2155.3	2
156208	2044.4	2
156208	2043.7	2
156210	2159.9	2
156210	2159.9	2
156211	2158.3	2
156211	2160.5	2
156216	2151.3	2
156216	2153.0	2
156233	2161.0	2
156233	2161.0	2
156251	2100.4	2
156251	2097.2	2
156260	2156.7	2
156260	2156.3	2
156268	2156.5	2
156268	2157.1	2
156275	2096.9	2
156275	2096.9	2
156280	2159.5	2
156280	2159.5	2
156296	2118.5	2
156296	2119.0	2
156302	2161.4	2
156302	2161.4	2
156304	2158.4	2
156304	2157.6	2
156327	2158.6	2
156327	2159.2	2
156340	2170.7	2
156340	2170.7	2
156359	2155.9	2
156359	2156.9	2
156365	2119.0	2
156365	2119.0	2
156370	2161.3	2
156370	2161.3	2
156374	2155.7	2
156374	2155.7	2

6. Alkalinity

(Frank Zemlyak)

a. Description of Equipment and Technique

Total alkalinity was determined using the Marine Chemistry automated titration system. Total alkalinity was determined using a potentiometric titration of the seawater sample using hydrochloric acid. Once the sample was connected to the system, the operation proceeded automatically, from the reaction vessel being rinsed and filled with the sea water sample, to the final calculations at the conclusion of the titration.

When the reaction vessel was filled, the semi-micro combination Ross electrode sensed when the sample had come to equilibrium, the initial relative mvolt reading was then logged, at the same time, the cell temperature was also recorded. At this point, a rather large quantity of 0.2N hydrochloric acid was added to the cell with a Metrohm E-655 Dosimat. The addition of this large quantity of acid titrated the sample beyond the carbonate endpoint. At this point, smaller aliquots (0.040mL) of acid were added until the sample had been titrated to and beyond the second inflection point. With each addition of acid the sample was allowed to come to equilibrium, the mvolt reading was logged. Thus, with these relative changes in the voltage in the cell, the endpoint was calculated by using a modified Gran function. Using the sample salinity, sample temperature and the nutrients silicate and phosphate corrections were made to the final total alkalinity result.

b. Sampling Procedure and Data Processing Technique

The 500 ml samples used for alkalinity analysis were collected from 10 litre rosette bottles in much the same fashion as the total carbonate samples. The alkalinity samples were drawn immediately following the drawing of the total carbonate samples. The samples were stored in a cold water bath whilst awaiting analysis.

c. Replicate Analysis

The precision of the alkalinity data is 3 to 5 µmoles/kg. The alkalinity replicates consisted of 40 duplicate measurements. A statistical summary of the absolute value of the replicate differences is below. Only acceptable sample values were used when calculating replicate differences. All replicates and their quality flags are given in Table C.5.

Statistic	Value
Number of Replicate Differences	31
Minimum (µmoles/kg)	0.3
Maximum (µmoles/kg)	117.0
Mean (µmoles/kg)	20.8
Median (µmoles/kg)	12.1
Standard Deviation (µmoles/kg)	26.3

Table C.5 Replicate water sample total alkalinity values in moles/kg.

Sample ID Number	Total Alkalinity	WOCE QF
155217	2196.3	2
155217	2192.8	2
155222	2186.1	2
155222	2198.2	2
155224	2213.0	2
155224	2223.5	2
155230	2225.9	3
155230	2232.4	3
155235	2224.8	3
155235	2214.9	3
155259	2248.6	2
155259	2249.3	2
155273	2262.6	3
155273	2268.4	3
155286	2264.3	3
155286	2279.5	3
155296	2265.9	2
155296	2267.1	2
155341	2267.3	3
155341	2258.3	3
155390	2269.1	3
155390	2263.0	3
155412	2272.5	2
155412	2273.7	2
155439	2268.0	2
155439	2268.8	2
155464	2262.4	2
155464	2262.6	2
155472	2280.6	2
155472	2278.8	2
155484	2284.9	3
155484	2299.2	3
155521	2295.2	2
155521	2299.7	2
155534	2285.5	2
155534	2288.4	2
155774	2274.6	3
155774	2306.3	3
155781	2205.8	2
155781	2207.3	2
155783	2266.3	3
155783	2240.8	3
155814	2294.8	2
155814	2331.6	2
155850	2288.4	2
155850	2365.2	2
155863	2312.8	2
155863	2336.8	2
155906	2326.2	2
155906	2303.5	2
155909	2285.2	2
155909	2313.8	2
155957	2281.1	2
155957	2282.9	2
155980	2297.2	2
155980	2300.9	2
156070	2308.1	2
156070	2329.4	2
156083	2332.5	2
156083	2273.9	2
156095	2416.1	2
156095	2299.0	2
156118	2296.8	2
156118	2323.0	2
156124	2283.1	2
156124	2302.0	2
156143	2289.5	2
156143	2321.2	2
156171	2282.2	2
156171	2281.9	2
156188	2282.6	2
156188	2300.2	2
156209	2295.0	2
156209	2306.0	2
156256	2300.7	2
156256	2358.6	2
156305	2294.4	2
156305	2325.2	2
156376	2310.1	2
156376	2291.2	2

7. CFC s

(Mike Hingston)

a. *Description of Equipment and Technique*

The analyses were carried out on two purge and trap systems developed at the Bedford Institute of Oceanography. The water samples were injected into the systems directly from the syringes. To ensure proper rinsing, at least two volumes of water were passed through the sample pipette before the actual sample volume. The samples were purged for 4 minutes with ultra high purity nitrogen at a flow rate of 60 ml/min. The components were trapped in a Porapak-N trap that was cooled to a temperature of less than 100 °C. They were then desorbed by heating the trap up to at least 170°C. The contents of the trap were then passed through a 75 m DB-624 megabore column.

b. *Sampling Procedure and Data Processing Technique*

All samples were collected directly from the Niskin bottles using 100 ml syringes. The syringes were rinsed three times before they were filled. To prevent contamination, the CFC samples were the first samples that were collected from the Niskin bottles. The samples were then stored in a water bath of continuously flowing surface sea water until analysis. Air samples from the winch room were taken periodically to ensure that it had not become contaminated. The analysis of the samples was always completed within 24 hours after they had been drawn.

c. *Replicate Analysis*

A total of 48 unique sample id numbers had replicate CFC water samples drawn. In total, three sample id numbers had duplicate samples drawn and 45 sample id numbers had triplicate samples drawn. Replicates were taken at each station, with some of these being run on each system to ensure that the results were comparable. A statistical summary of the absolute value of the replicate differences is below. Only acceptable sample values were used when calculating replicate differences. All replicates and their quality flags are given in Table C.6.

Statistic		CFC11	CFC12	CFC113	Carbon Tet.	Methyl Chl.
Number of Replicate Differences		138	136	134	137	138
Minimum	(pmoles/kg)	0.000	0.001	0.000	0.000	0.006
Maximum	(pmoles/kg)	0.332	1.033	0.186	0.646	2.786
Mean	(pmoles/kg)	0.057	0.205	0.040	0.131	0.718
Median	(pmoles/kg)	0.041	0.141	0.033	0.111	0.564
Standard Deviation	(pmoles/kg)	0.057	0.202	0.031	0.109	0.634
Detection Limits	(pmoles/kg)	0.022	0.017	0.010	0.040	0.017

Table C.6 Replicate water sample CFC values in pmoles/kg.

Sample ID	Freon 11	Freon 12	Freon 13	Carbon Tet.	Methyl Chl.	WOCE QF
155220	6.600	2.984	0.307	9.910	20.167	2 2 2 2 2
155220	6.645	2.531	0.344	10.551	21.401	2 2 2 3 2
155227	5.832	2.636	0.485	9.513	15.903	2 2 2 2 2
155227	5.896	2.886	0.473	9.387	16.141	2 2 2 2 2
155227	5.848	3.378	0.558	9.811	16.810	2 2 2 2 2
155233	5.432	2.670	0.472	8.355	15.453	2 2 2 2 2
155233	5.358	3.051	0.500	7.709	16.264	2 2 2 2 2
155233	5.463	3.229	0.486	8.029	17.248	2 2 2 2 2
155246	4.963	3.251	0.362	7.194	15.312	2 2 2 2 2
155246	5.045	3.400	0.325	7.187	15.019	2 2 2 2 2
155246	4.882	2.495	0.282	6.985	15.038	2 2 2 2 2
155261	4.829	2.321	0.394	7.161	15.194	2 2 2 2 2
155261	4.591	2.342	0.346	6.760	14.463	2 2 2 2 2
155261	4.642	2.309	0.316	6.807	15.025	2 2 2 2 2
155266	3.895	2.109	0.314	5.836	11.698	2 2 2 2 2
155266	3.899	2.490	0.222	5.950	11.678	2 2 2 2 2
155266	3.802	2.509	0.408	5.808	13.322	2 2 2 2 2
155282	3.479	1.798	0.209	5.274	11.807	2 2 2 2 2
155282	3.470	2.263	0.176	5.381	10.940	2 2 2 2 2
155282	3.400	1.229	0.164	5.187	10.653	2 2 2 2 2
155301	3.560	1.580	0.171	5.610	11.334	2 2 2 2 2
155301	3.550	1.586	0.167	5.591	11.277	2 2 2 2 2
155301	3.504	1.576	0.178	5.316	10.929	2 2 2 2 2
155320	3.752	1.797	0.236	5.804	11.665	2 2 2 2 2
155320	3.631	1.852	0.275	5.810	11.854	2 2 2 2 2
155320	3.748	1.968	0.333	5.839	12.513	2 2 2 2 2
155336	2.120	1.157	0.074	3.369	6.258	2 2 2 2 2
155336	1.974	1.340	0.142	3.562	6.985	2 2 2 2 2
155336	1.984	1.146	0.047	3.394	7.188	2 2 2 2 2
155361	1.953	0.931	0.019	3.323	5.870	2 2 2 2 2
155361	1.892	1.008	0.081	3.262	6.284	2 2 2 2 2
155361	1.936	0.916	0.047	3.418	6.612	2 2 2 2 2
155419	3.561	1.641	0.244	5.579	11.303	2 2 2 2 2
155419	3.645	1.695	0.225	5.643	12.967	2 2 2 2 2
155419	3.703	1.957	0.261	5.927	12.434	2 2 2 2 2
155448	4.022	2.138	0.274	6.366	12.359	2 2 2 2 2
155448	4.021	2.762		6.300	14.242	2 2 5 2 2
155448	4.056	2.397	0.296	6.262	12.963	2 2 2 2 2

Table C.6 Replicate water sample CFC values in pmoles/kg.

Sample ID	Freon 11	Freon 12	Freon 13	Carbon Tet.	Methyl Chl.	WOCE QF
155462	3.379	1.885	0.276	5.491	11.403	2 2 2 2 2
155462	3.398	2.043	0.221	5.354	11.944	2 2 2 2 2
155462	3.322	2.059	0.200	5.250	10.847	2 2 2 2 2
155481	1.473	0.428	0.066	2.789	4.732	2 2 2 2 2
155481	1.456	0.588	0.066	2.671	4.667	2 2 2 2 2
155481	1.481	0.903	0.066	2.732	4.530	2 2 2 2 2
155515	3.788	1.830	0.259	6.055	11.600	2 2 2 2 2
155515	3.904	1.891	0.192	5.828	11.488	2 2 2 2 2
155515	3.868	1.792	0.236	6.021	12.165	2 2 2 2 2
155557	3.536	1.699	0.212	5.535	11.917	2 2 2 2 2
155557	3.533	1.738	0.164	5.461	11.277	2 2 2 2 2
155557	3.583	1.650	0.213	5.576	11.403	2 2 2 2 2
155587	4.355	2.428	0.289	6.840	12.963	2 2 2 2 2
155587	4.340	2.436	0.335	7.006	12.814	2 2 2 2 2
155587	4.306	2.441	0.302	6.752	12.664	2 2 2 2 2
155718	3.912	1.920	0.243	6.033	11.993	2 2 2 2 2
155718	3.881	2.145	0.260	5.981	11.467	2 2 2 2 2
155718	3.894	1.947	0.259	5.992	11.595	2 2 2 2 2
155757	3.414	1.983	0.258	5.285	11.693	2 2 2 2 2
155757	3.408	2.244	0.376	5.483	12.348	2 2 2 2 2
155773	3.656	1.904	0.286	5.477	11.486	2 2 2 2 2
155773	3.824	2.026	0.336	5.632	11.110	2 2 2 2 2
155773	3.804	2.183	0.302	5.597	11.898	2 2 2 2 2
155790	1.448	0.772	0.059	3.038	4.773	2 2 2 2 2
155790	1.440	0.999	0.021	2.541	2.538	2 2 2 2 2
155790	1.499	0.609	0.016	2.773	4.729	2 2 2 2 2
155815	1.704	0.945	0.058	3.083	5.353	2 2 2 2 2
155815	1.726	1.261	0.038	2.937	3.464	2 2 2 2 2
155815	1.678	0.788	0.051	2.966	3.303	2 2 2 2 2
155852	3.815	1.916	0.257	5.955	11.098	2 2 2 2 2
155852	3.799	1.865	0.267	6.148	11.204	2 2 2 2 2
155852	3.958	2.029	0.211	6.079	10.563	2 2 2 2 2
155867	3.554	1.764	0.241	5.636	11.297	2 2 2 2 2
155867	3.575	2.010	0.188	5.625	11.212	2 2 2 2 2
155867	3.523	1.671	0.243	5.635	11.641	2 2 2 2 2
155899	4.391	2.355	0.441	7.081	13.959	2 2 2 2 2
155899	4.325	2.535	0.383	7.045	11.651	2 2 2 2 2
155899	4.394	2.535	0.403	7.006	11.885	2 2 2 2 2

Table C.6 Replicate water sample CFC values in pmoles/kg.

Sample ID	Freon 11	Freon 12	Freon 13	Carbon Tet.	Methyl Chl.	WOCE QF
155921	4.269	2.204	0.313	6.801	12.585	2 2 2 2 2
155921	4.414	2.335	0.448	7.096	12.004	2 2 2 2 2
155921	4.340	2.778	0.332	6.944	12.591	2 2 2 2 2
155941	2.634	1.375	0.117	3.667	7.826	2 2 2 2 2
155941	2.584	1.395	0.178	3.789	7.655	2 2 2 2 2
155941	2.673	1.492	0.139	3.688	8.751	2 2 2 2 2
155953	2.986	1.472	0.200	4.902	10.283	2 2 2 2 2
155953	2.973	1.557	0.113	4.722	10.105	2 2 2 2 2
155953	2.967	1.617	0.173	4.795	9.271	2 2 2 2 2
155966	1.285	0.330	0.101	2.180	1.266	2 2 2 2 2
155966	1.268	0.478	0.000	2.349	1.672	2 2 2 2 2
155966	1.277	1.086	0.033	2.356	4.052	2 2 2 2 2
155991	2.600	1.288	0.113	4.288	8.567	2 2 2 2 2
155991	2.599	1.425	0.089	4.323	9.376	2 2 2 2 2
156009	1.337	0.583	0.026	2.314	4.387	2 2 2 2 2
156009	1.319	0.703	0.015	2.426	5.239	2 2 2 2 2
156009	1.331	0.804	0.044	2.565	4.583	2 2 2 2 2
156040	2.549	1.202	0.110	4.040	8.480	2 2 2 2 2
156040	2.518	1.259	0.132	3.980	8.137	2 2 2 2 2
156040	2.543	1.436	0.125	4.008	8.707	2 2 2 2 2
156051	1.103	0.561	0.039	2.224	3.366	2 2 2 2 2
156051	1.268	0.859	0.135	2.357	4.279	2 2 2 2 2
156051	1.103	0.486	0.082	2.126	3.239	2 2 2 2 2
156075	1.143	0.501	0.074	2.368	3.420	2 2 2 2 2
156075	1.134	0.540	0.012	2.204	3.274	2 2 2 2 2
156075	1.080	0.448	0.022	2.169	2.952	2 2 2 2 2
156100	1.057	0.371	0.043	2.017	3.015	2 2 2 2 2
156100	1.038	0.477	0.040	2.088	3.137	2 2 2 2 2
156100	1.023	0.560	0.015	2.267	0.553	2 2 2 2 2
156135	2.581	1.272	0.153	3.454	6.454	2 2 2 2 2
156135	2.541	1.705	0.112	3.358	5.029	2 2 2 2 2
156135	2.483	1.296	0.175	3.223	7.400	2 2 2 2 2
156160	2.881	1.430	0.134	3.288	5.781	2 2 2 2 2
156160	2.794	1.695	0.201	3.421	7.127	2 2 2 2 2
156160	2.795	1.775	0.159	3.263	7.242	2 2 2 2 2
156168	0.855	0.334	0.000	1.857	2.997	2 2 2 2 2
156168	0.829	0.379	0.070	1.849	2.723	2 2 2 2 2
156168	0.870	0.469	0.024	1.871	2.441	2 2 2 2 2

Table C.6 Replicate water sample CFC values in pmoles/kg.

Sample ID	Freon 11	Freon 12	Freon 13	Carbon Tet.	Methyl Chl.	WOCE QF
156206	3.119	2.142	0.186	4.078	10.173	2 2 2 2 2
156206	3.045	2.371	0.240	3.777	9.501	2 2 2 2 2
156206	3.031	1.677	0.179	3.888	8.547	2 2 2 2 2
156214	1.051	0.606	0.000	2.321	3.570	2 2 2 2 2
156214	1.092	0.640	0.022	2.206	3.197	2 2 2 2 2
156214	1.073	0.580	0.033	2.181	3.284	2 2 2 2 2
156245	2.329			3.194	7.548	2 5 5 2 2
156245	2.007	0.975	0.094	3.314	6.308	2 2 2 2 2
156245	1.996	1.158	0.127	3.392	6.006	2 2 2 2 2
156264	2.277	1.131	0.071	3.687	7.356	2 2 2 2 2
156264	2.219	1.352	0.120	3.783	7.300	2 2 2 2 2
156264	2.180	1.335	0.121	3.659	6.720	2 2 2 2 2
156285	1.592	0.599	0.059	3.090	4.426	2 2 2 2 2
156285	1.639	0.719	0.029	3.050	4.623	2 2 2 2 2
156285	1.607	0.732	0.054	3.026	5.304	2 2 2 2 2
156320	2.594	1.277	0.117	2.384	6.918	2 2 2 2 2
156320	2.657	1.348	0.157	2.337	6.503	2 2 2 2 2
156320	2.648	1.356	0.178	2.353	7.585	2 2 2 2 2
156330	1.195	0.474	0.035	2.604	3.349	2 2 2 2 2
156330	1.148	0.504	0.031	2.389	3.165	2 2 2 2 2
156330	1.167	0.609	0.000	2.312	3.412	2 2 2 2 2
156362	1.826	0.766	0.080	2.197	6.515	2 2 2 2 2
156362	1.821	0.790	0.056	2.281	6.459	2 2 2 2 2
156362	1.946	1.178	0.050	2.283	5.702	2 2 2 2 2
156375	1.596	0.754	0.116	3.255	4.977	2 2 2 2 2
156375	1.581	0.632	0.034	3.124	5.493	2 2 2 2 2
156375	1.561	0.726	0.024	3.018	4.762	2 2 2 2 2

d. Standards Used

Standardization was carried out using gas standards made up at Brookhaven National Laboratories. Standard volumes were corrected for lab temperature and pressure. Results were reported in units of pmol/kg of sea water. Clean air samples were also analyzed with each station, as a check on the standardization.

8. Reversing Thermometers

(Anthony W. Isenor)

a. Description of Equipment and Technique

Sensoren-Instrumente-Systeme digital reversing thermometers model RTM 4002 were used to verify CTD thermistor readings on most deep stations. The thermometers had a depth range of up to 10000 m. The pressure housing was made of a glass tube closed at the ends by metal stoppers. One end contained the platinum sensor and the other end housed the battery compartment. The thermometers were placed on bottles 2 and 4 on the rosette, thus sampling temperature at the second and forth deepest bottle trips.

The thermometers were placed in standard reversing thermometer racks on the Niskin bottles. Before deployment, a magnet was passed over the thermometers to clear the display and place the thermometer in sample mode. A new temperature was then recorded upon reversal of the thermometer.

b. Sampling Procedure and Data Processing Technique

The digital thermometers indicate the temperature reading via a digital display. The temperature was read and noted on log sheets. The readings were later digitized and corrections applied using the water sample database system.

The following table lists the number of reading from each thermometer.

Thermometer Ser. No.	Number of Readings
000T345	18
000T347	36
000T354	16
000T881	36
000T884	13
000T885	15

In total, 134 readings were obtained. Of these, 18 had confirmed or suspected problems with either the thermometer or with insufficient soaking time. Thus, only 116 valid thermometer temperature values were available to be used in comparisons with the CTD thermistor.

c. Calibration Data

The digital reversing thermometers were calibrated at BIO in March 1995.

d. Replicate Analysis

Typically, a rack containing three thermometers would be tripped when the second and forth Niskin bottles were fired. Thus, we would obtain three independent temperature readings. However, due to the loss of a rack of three thermometers and the malfunction of other thermometers, many readings near the end of the cruise resulted in only two independent thermometer readings.

A total of 52 sample id numbers had digital thermometer temperature replicates. One sample id number had no replicates, 20 sample id numbers had one replicate and 31 sample id numbers had two replicates. The following is a statistical summary of the absolute value of the replicate differences. Only acceptable values were used in calculating the statistics.

Statistic	Value (°C)
Number of Replicate Differences	90
Minimum Difference	0.000
Maximum Difference	0.008
Mean Difference	0.003
Median Difference	0.002
Standard Deviation of Differences	0.003

All of the replicate reversing thermometer temperature values, along with the reversing thermometer pressure values are given in Table C.7.

Using the median difference as a measure of the inter-thermometer comparison (the mean is influenced equally by all points, including outliers), we noted that the estimated thermometer difference is 0.002°C. Thus, the difference between thermometers was the same as the difference between thermometers and the CTD. Therefore, we could not distinguish the difference between the thermometers and the CTD. Consequently, we did not apply any temperature calibration to the CTD.

Table C.7 **Replicate Reversing Thermometer samples. Temperature is in °C and ITS-90 scale.**

Sample ID Number	Thermo-meter Serial Number	Main Corrected	WOCE QF
155204	t345	0.171	2
155204	t347	0.175	2
155204	t354	0.176	2
155313	t345	1.825	2
155313	t347	1.831	2
155313	t881	1.830	2
155315	t354	2.824	2
155315	t884		9
155315	t885	2.821	2
155333	t345	1.689	2
155333	t347	1.695	2
155333	t881	1.695	2
155335	t354	2.158	2
155335	t885	2.156	2
155356	t345	1.782	2
155356	t347	1.788	2
155356	t881	1.789	2
155358	t354	2.273	2
155358	t884		9
155358	t885	2.270	2
155379	t345	1.768	2
155379	t347	1.773	2
155379	t881	1.774	2
155381	t354	2.259	2
155381	t885	2.257	2
155407	t345	1.706	2
155407	t347	1.711	2
155407	t881	1.713	2
155409	t354	2.187	2
155409	t884	2.187	2
155409	t885	2.185	2
155430	t345	1.732	2
155430	t347	1.738	2
155430	t881	1.736	2

Sample ID Number	Thermo-meter Serial Number	Main Corrected	WOCE QF
155432	t354	2.282	3
155432	t884	2.281	3
155432	t885	2.279	3
155453	t345	1.570	2
155453	t347	1.577	2
155453	t881	1.578	2
155455	t354	2.002	2
155455	t884	2.002	2
155455	t885	2.000	2
155476	t345	1.677	2
155476	t347	1.683	2
155476	t881	1.682	2
155478	t354	2.072	2
155478	t884	2.070	3
155478	t885	2.069	2
155499	t345	1.677	2
155499	t347	1.684	2
155499	t881	1.684	2
155501	t354	2.059	2
155501	t884	1.885	3
155501	t885	2.058	2
155522	t345	1.516	2
155522	t347	1.522	2
155522	t881	1.521	2
155524	t354	1.941	2
155524	t884	1.853	3
155524	t885	1.938	2
155545	t345	1.520	2
155545	t347	1.526	2
155545	t881	1.526	2
155547	t354		9
155547	t884		9
155547	t885	1.962	2
155568	t345	1.571	2

Table C.7 **Replicate Reversing Thermometer samples. Temperature is in °C and ITS-90 scale.**

Sample ID Number	Thermo-meter Serial Number	Main Corrected	WOCE QF
155568	t347	1.577	2
155568	t881	1.576	2
155570	t354	1.977	2
155570	t884		9
155570	t885	1.975	2
155702	t345	1.921	2
155702	t347	1.928	2
155702	t881	1.928	2
155704	t354	2.038	2
155704	t884	2.036	2
155704	t885	2.036	2
155725	t345	1.779	2
155725	t347	1.786	2
155725	t881	1.785	2
155727	t354	2.058	2
155727	t884	2.058	2
155727	t885	2.056	2
155748	t345	2.511	2
155748	t347	2.516	2
155748	t881	2.508	2
155750	t354	2.870	2
155750	t884	2.870	2
155750	t885	2.868	2
155767	t345	3.302	2
155767	t347	3.306	2
155767	t881	3.306	2
155786	t345		9
155786	t347	1.987	2
155786	t881	1.986	2
155810	t347	1.768	2
155810	t881	1.769	2
155833	t347	1.856	2
155833	t881	1.856	2
155856	t347	2.158	2

Sample ID Number	Thermo-meter Serial Number	Main Corrected	WOCE QF
155856	t881	2.159	2
155879	t347	2.676	3
155879	t881	2.675	3
155902	t347	2.876	2
155902	t881	2.876	2
155925	t347	3.006	2
155925	t881	3.006	2
155948	t347	3.047	2
155948	t881	3.047	2
155965	t347	2.980	2
155965	t881	2.981	2
156164	t347	2.297	3
156164	t881	2.296	3
156187	t347	2.261	2
156187	t881	2.260	2
156210	t347	2.271	2
156210	t881	2.270	2
156233	t347	2.350	2
156233	t881	2.349	2
156256	t347	2.329	2
156256	t881	2.328	2
156279	t347	2.383	2
156279	t881	2.382	2
156302	t347	2.428	2
156302	t881	2.426	2
156325	t347	2.467	2
156325	t881	2.467	2
156348	t347	2.716	2
156348	t881	2.714	2
156371	t347	2.910	3
156371	t881	2.910	3

9. Helium/Tritium

(Maureen K. F. Noonan)

A total of 242 samples of He and Tr samples were collected by Maureen Noonan for Peter Schlosser of Lamont-Doherty Earth Observatory, Columbia University. See Figure 8 below for the sampling locations across the Labrador Sea.

a. Description of Equipment and Technique

He samples were collected through tygon tubing into copper tubes (40 g capacity) bolted into aluminum channels for support and protection. Tr samples were collected into one-litre Argon filled brown glass bottles, directly from the Niskin spigot.

b. Sampling Procedure and Data Processing Technique

He samples were drawn after the CFC's. Delivery was through tygon tubing, cured in seawater to reduce bubbles, which was monitored for air bubbles. All detected bubbles were worked out of the line. The metal channel holding the copper sample tube was then struck several times on both sides with a ratchet in a pattern from the intake end towards the outflow end of the copper tube in order to pass any air bubbles out of the sample tube. Flushing of the copper tube took place during both parts of the bubble-removing procedure. When air removal and flushing were complete, both ends of the copper tube were sealed by tightening the two bolts at each end with a ratchet wrench starting at the outflow end. GMT time of sampling was routinely noted for each sample. These samples will be shipped to Lamont for analysis.

Tritium samples were collected into argon-filled bottles without rinsing or flushing after all other samples were collected from the rosette. The bottle caps were secured with electrical tape at the completion of each station. These samples will be shipped to Lamont for analysis. Occassionally, the Niskins were drained before the tritium was collected. Careful rinsing of all samples helped alleviate this problem.

Replacement watches were handed out to all persons in the scientific party and the winch drivers who normally wore luminous-dial watches, and a sign was posted at each rosette room door to avoid wearing luminous-dial watches inside the room.

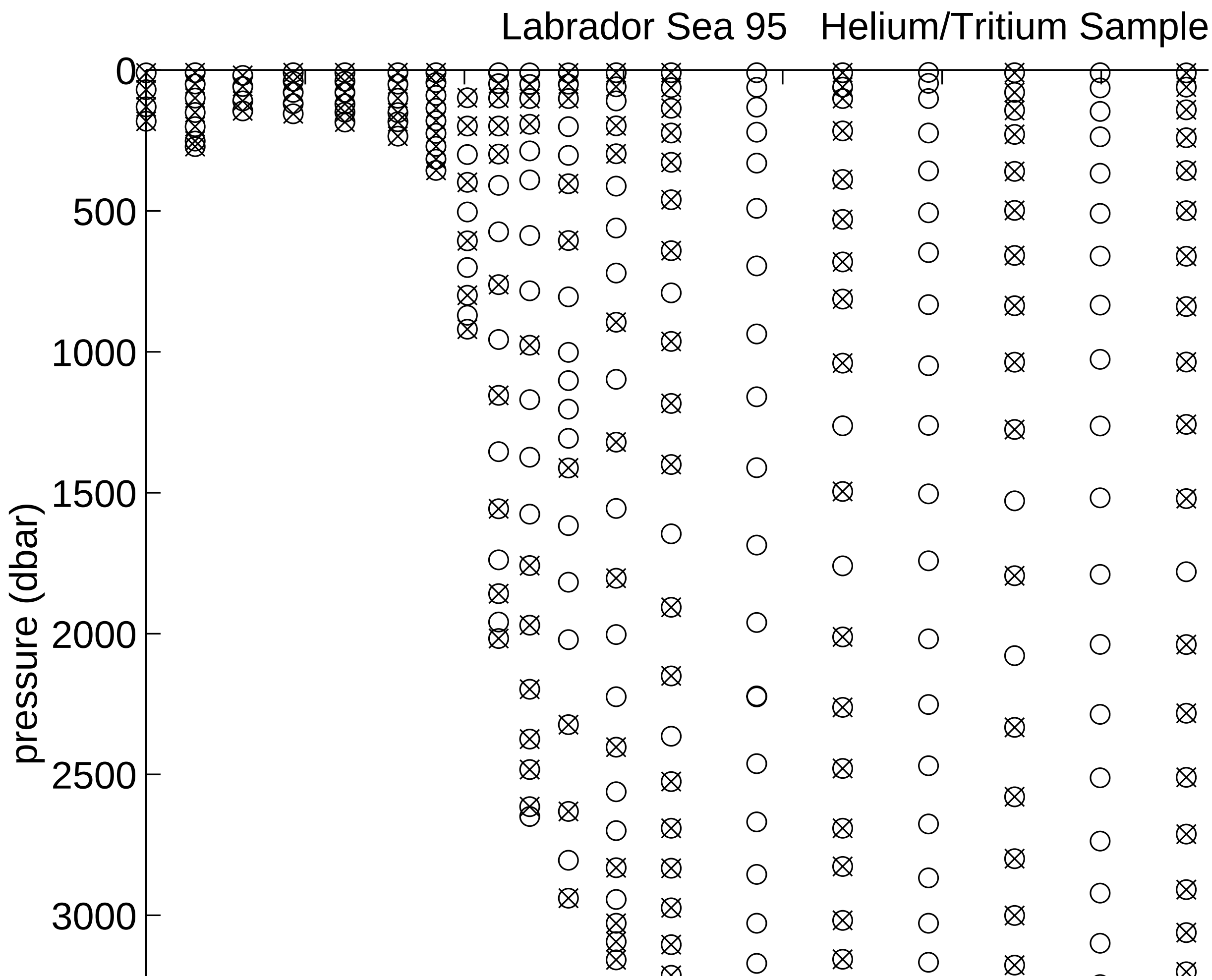


Figure 8. Location of Helium/Tritium samples drawn across the LSW.

10. Oxygen Isotopes
(Anthony W. Isenor)

a. Sampling Procedure

Water samples were initially collected using a 10 litre rosette bottle. Samples for oxygen isotope analysis were collected last in the sampling. A total of about 600 isotope samples were drawn. Duplicates were drawn on some stations. Samples were collected in 15 ml sample bottles. Samples are being sent to Bob Houghton at Lamont Geological Earth Observatory, Columbia University, Palisades, NY.

D. MOORED MEASUREMENTS - DESCRIPTIONS, TECHNIQUES AND CALIBRATIONS

1. Current Meter Moorings

(John R. N. Lazier)

a. Description of the Equipment and Technique

There was one recovery (1168) and two deployments (1194 & 1200) of BIO deep sea moorings on cruise 95011.

The recovered mooring (1168) and its replacement (1194) had the same configuration of six Aanderaa current meters, one IOS CTD, one WOTAN, one ADCP, six Seacat CT probes, seven back up buoyancy packages and two acoustic releases. The main subsurface float was either a Braincon float constructed of 10″ glass balls supported in a fiberglass structure or a syntactic foam float formed in the same streamlined shape as the Braincon floats.

The second deployed mooring (1200) had a configuration of one main float called a Hibernia Package, one Aanderaa Current Meter, two backup buoyancy packages and one acoustic release.

All three of these moorings were constructed using jacketed 1/4″ wire and 5/16″ or 1/4″ Kevlar. Stainless steel shackles and swivels were used to connect the instruments and backup buoyancy packages. All shackles were secured with a short piece of wire. The acoustic releases were 723A EG&G DACs. The moorings were designed for a 12 month deployment.

The back-up buoyancy packages consisted of two 17″ glass balls contained in plastic hard hats and fastened to a stainless steel tension bar one meter in length. These backup buoyancy packages were shackled together to form doubles and triples before they are shackled into the mooring line.

b. Sampling Procedure and Data Processing Techniques

The recovered Aanderaa current meters recorded at a sampling interval of three hours. The data will be processed using standard software packages within the BIO Oceans suite of programs.

c. Calibration Data

The temperature, pressure and direction sensors of the Aanderaa current meters were calibrated in the laboratory prior to deployment. These calibrations were not included in this cruise report.

d. Deployment and Recovery Logs

Deployment

Mooring No:	**1194**				
Geographic Area:	Labrador Sea	Intended Duration:	1 year		
Ship:	Hudson	Cruise no.:	95011	Date:	May 13/95
Sea State:	2	Weather Conditions:	cloudy, cool, S wind		
Mooring Tech.:	Murray Scotney	Navigation Inst.	GPS		
Latitude:	56 45.15 N	Longitude:	52 27.36 W	Time of Fix:	2018 Z
Depth:	Raw:	1876 ftm	Corrected:	3502 m	
Main Float:	Type:	Braincon	Markings:	Govt. of Canada stickers, no numbers	
Radio beacon:	Type:	OAR	Freq.:	163.000	
Light:	Type:	Novatech	Colour/Rate:	White, 1 sec	
Mooring Line:	Type:	Jacketed	Colour:	Yellow	
Release	Type:	DAC	S/N:	308806 (upper	
			Release Code:	_____	
				504801 (lower)	

Deployment Log

Time (Z)	Instrument	Remarks
1838	Main Float	in water
	SEACAT 1493	in water
1841	CM 4355	in water
1844	WOTAN	in water
1847	3 BUB Packages	in water
1850	SEACAT 1893	in water
1857	ADCP	in water
1859	SEACAT 1897	in water
1905	CM 4200	in water
1908	2 BUB Packages	in water
1914	SEACAT 1898	in water
1921	CM 7123	in water
1925	2 BUB Packages	in water
1928	SEACAT 1894	in water
1933	CM 818	in water
1935	SEACAT 1895	in water
1950	CM 9328; SEACAT 1896	in water
2005	Release 308806	in water
2011	CM 4195	in water
2017	Release 504801	in water
2018	Anchor	release

Recovery

Mooring No: **1168**
Ship: Hudson   Cruise No: 95011   Date: May 13/95
Mooring Tech: Scotney
Type of Nav: GPS
Sea State: 2   Weather Conditions: 20 kt winds

Recovery Log

Time (Z)	Instrument	Remarks
0935		release activated and released
0955		recovery started
1010	IOS CTD SN 1630	Upper float and IOS CTD out of water
1017	CM 9607	on deck
1022	WOTAN	on deck
1027	Seacat 1623	on deck
		slight winch problems with cog
1040	ADCP	on deck
	SEACAT 1624	on deck. screws from nylon end piece gone. Some bio growth Sea Snot
	CM 6407	on deck - rotor spinning
1100	SEACAT 1628	on deck - cleaner than 1624
1105	CM 6412	on deck - rotor spinning
1114	SEACAT 1625	on deck - clean
1117	CM 5001	on deck - rotor spinning
	SEACAT 1626	on deck - clean
1130	CM 2664	on deck - rotor spinning
1130	SEACAT 1627	on deck - clean - anode corroded more than other Seacats
1140	Release #1	307405 - Some anodes corroded - 1 gone
1143	CM 5359	on deck - rotor spinning
	Release #2	107002 - some corrosion of anodes
1400	Argos Beacon ID 5837	shut off (we hope). fax from Ross Hendry to say beacon had been picked up by Argos

Deployment

Mooring No:	**1200**				
Geographic Area:	Labrador Slope	Intended Duration:	1 year		
Ship:	Hudson	Cruise no.:	95011	Date:	May 12/95
Sea State:	0	Weather Conditions:	clear and calm		
Mooring Tech.:	Murray Scotney	Navigation Inst.:	GPS		

Latitude:	55 7.34 N	Longitude:	54 5.74 W	Time of Fix:	0304 Z
Depth:	Raw:	1061 m	Corrected:	1061 m	
Main Float:	Type:	_____	Markings:	________	
Radio beacon:	Type:	OAR	Freq.:	163.000 MHz	
Light:	Type:	OAR	Colour/Rate:	White	
Mooring Line:	Type:	Yellow Jacketed wire	Colour:	Yellow	
Release	Type:	EG&G	S/N:	100606	
	Release Code:	____			

Deployment Log

Time (Z)	Instrument	Remarks
0230	Release	Test OK
0245		Mooring assembled
		Light flashing - Beacon working
0300	CM 5577	current meter submerged

2. Inverted Echo Sounders

(Randy Watts)

a. Labrador Sea Deployment.

An Inverted Echo Sounder (IES) was launched to serve as a water-column calorimeter along the hydrography line in the central Labrador Sea. The vertically integrated acoustic travel time, which the IES measures round-trip from the ocean bottom to the surface, determines the vertically integrated heat content (relative to one or more calibration CTDs during its moored measurement period).

The site was chosen to take advantage of this natural vertically integrating nature of the measurement, and to attempt to avoid situations where higher order vertical structure might produce significant internal-cancelling. Thus, we were more interested in the central Labrador Sea and its main lens of Labrador Sea Water, than around its periphery, which is known to have surface currents of varied temperature/salinity characteristics. The site, at 57°22.72'N, 51°47.19'W (Station 27, Location 16), was chosen "near" the former Ocean Weather Ship Bravo site, to build upon its historical record; yet "far" (relative to estimated eddy scales) from the Lazier/Rhines mooring, in order to provide heat-content information that is independently affected by eddies. The planned deployment period is about two years, to span the winters of 95-96, and 96-97.

Deployment details:

14-Jun-1995 06:22Z. Deployed IES076 at Location 16 (Station 27) along WOCE line.
57° 22.65'N, 51° 47.07'W (by GPS), depth(corr) 3463m.
CTD= site#16, event#28. Down time: 08:02Z @ 57°23.08'N 51°46.42'W.
RADIO/FLASHER # 25 @ 156.875MHz
Backup timed release is 800d from final reset @ 18:00Z 13-Jun-1995
= (better double check this) 21-Aug-1997.
IES is pinging exactly on the hour ; we tracked it in beacon mode to the bottom. It hit bottom in 38-39 minutes, after the first few pings of sample.
It couldn't have drifted more than 0.3 NM or 0.5 km.

I reconfirmed this position against what the bridge recorded (57° 22.72'N 51° 47.19'W), which coincided more exactly with the launch time. (Ours was 4 minutes after launch). They were still getting ready to take the calibration CTD while the IES sank, and didn't begin until a few minutes after the IES was on the bottom; so the time is coincident.

b. Newfoundland Basin/ North Atlantic Current recovery.

Six Inverted Echo Sounders with bottom pressure sensors (PIES) had been deployed in August 1993 along the NAC current meter line (on the same R/V Oceanus cruise as the current meter moorings).

The acoustic travel times in this region are functionally related (i.e., with small noise relative to the dominant signals) to the dynamic heights between 3500dbar and a variety of shallower levels in the water column. For initial and final calibration, the IES records require CTD stations.

The baroclinic geostrophic current profile may be determined from the profile of dynamic height differences between neighbouring pairs of IESs. The abyssal or barotropic reference current to make these current profiles absolute may be determined from the gradient of pressure along a deep level. For this purpose, the bottom pressure records will be "levelled" relative to the time-average deep currents that have been coherently measured in this same experiment by the deepest current meters along the NAC line.

An alternative way to reference the velocities, in a time-dependent sense that allows independently for temporally-varying shear in the deep water, is relative to the vertically-averaged currents. The latter may, in future deployments along this same NAC line, be measured by moored horizontal electric field (HEF) recorders. For this experiment, the HEF performance will be simulated from the currents measured at seven levels on the moorings.

This experiment was designed to improve and refine the calibrations and functional relationships that will allow quantitatively accurate determination of the currents and transports in the North Atlantic Current, using a combination of IES/P/HEF and CM measurements.

Recovery Details:

<u>June 28, 1995.</u> At the first IES recovery site IES 73 (# 8.5, Station 81) the instrument was silent or gone.

At site 8.0 IES 71 (Station 82, Cast 1) was recovered with no problems; recovery site agreed within 0.1 km with launch site. CTD Station 82, Cast 2 at 0932-1058Z (start-bottom), 41°54.7'N 44°34.55'W to 41°55.58'N 44°35.32'W. D=4726m.

<u>June 29, 1995.</u> At site 6.5 IES 75 (Station 83, Cast 2) was recovered without problems, but it began screeching once aboard. We had to open it fast since we could not shut it off, both on and reset LED s were constantly on. There was˚water inside and more impressive there was a large crack in˚the sphere, we were very lucky it didn't implode. The water appears to have entered after releasing, and the data tape appears to be good.

CTD Station 83, Cast 1 at 1911-2043Z (start-bottom) 42°13.03N 45°39.75'W to 42°13.76'N 45°40.45'W. D= 4580m.

At site 5.5 IES 67 (Station 84, Cast 1) was dead or gone. No acoustic responses. A cable-laying ship was working nearby on a line that passed within less than a mile from site 5.5---makes us wonder if they damaged or knocked it free?˚

June 30, ˚1995. At site 4.0 we recovered IES 65 (Station 85, Cast 2). It also had a small amount of water that entered after recovery. Data tape appears to be good. CTD Station 85, Cast 1 at 1104-1210 (start-bottom) 42°44.10'N 47°23.20'W to 42°44.33'N to 47°22.64'W. D=3821m.

July 1, 1995. Recovered IES 69 at site 3.0 (Station 86, Cast 2) during the night. All went well. CTD Station 86, Cast 1 at 0321-0420Z (start-bottom) at 42°56.99N 48°11.07W to 42°56.51'N 48°11.17'W. D=(approx) 3322 dbar.

E. ACKNOWLEDGEMENTS

F. APPENDICES

Appendix 1: Along Track CTD Calibration Information

BSB SEABIRD Model 25-03 Serial Number 258917-0116

Temperature Sensor 031548

$$T = 1/\{a + b[\ln(f_o/f)] + c[\ln^2[f_o/f] + d[\ln^3(f_o/f)]\} - 273.15$$

where ln indicates a natural logarithm, f is the frequency

a = 3.68120903 E-03
b = 6.05726873 E-04
c = 1.57453931 E-05
d = 2.37605653 E-06
f_o = 6145.410
slope = 1, offset = 0(Seabird calibration dated November 2, 1993)

Conductivity Sensor 041124

$$\text{Conductivity} = (af^m + bf^2 + c + dt)/[10(1-9.57(10^{-8})p)]$$

where f is the frequency, p is pressure in dbars, t is the temperature

m = 4.4
a = 7.91164000 E-06
b = 4.91698742 E-01
c = -4.03526125 E+00
d = 6.64743265 E-05
Slope = 1.00000000
Offset = 0.000

Irradiance Sensor 1567

where

m = -0.7558000
b = -3.4702000
Calibration Constant = 3.34000
Multiplier = 1.000

Fluorometer Sensor 304

where

Scale Factor = 10.000
Offset = 0.000

Appendix 2: 95011 CTD Oxygen Calibrations

INTRODUCTION

The difference between the water sample oxygen values and their corresponding down cast CTD oxygen values was used to calculate suitable CTD oxygen calibration coefficients. There were 88 stations occupied during cruise 95011. All 88 stations used the same CTD oxygen sensor. No Seabird CTD data were obtained at stations: 9, 15, 17, 18, 20, 21, 22, 25, 26, 27, 31, 36, 38, 45, 49, 51, 54, 56, 62, 64, 68, 75, 80, 81, 84, 87 and 88.

Before any CTD oxygen calibrations could be produced, a useful data file had to be assembled that could be used in the calibration process. Two consecutive file merges were performed for each station on the cruise having CTD oxygen data and water sample oxygen data. The resulting merged files were then concatenated to form the data file containing all the necessary data from the cruise.

The two file merges are described below in more detail:

1. The up cast CTD data (including only the data obtained from the CTD at the time when the water sample bottles were closed) and the down cast CTD data (2 dbar average) were sorted by pressure in ascending order, then merged. The merge combines up cast CTD records containing a water sample id number with the down cast CTD data having the closest pressure within ± 2 dbar of the up cast CTD pressure. If no down cast CTD data record was found within 2 dbar, then no record was output to the merged CTD file for that sample id number.

2. Using sample id numbers as the merging variable, the CTD file was then merged with a file containing the mean water sample oxygen values.

A plot of oxygen difference (water sample oxygen - down cast CTD oxygen) versus pressure for all stations is shown in Figure 1. The plot indicates considerable nonlinear drift, which make it unreasonable to calculate just one calibration equation for all the data. After looking more closely at the data, it was decided that the cruise should be broken up into smaller groups. The smaller groups were based on the similarity of the oxygen difference versus pressure profiles. Each group was then calibrated separately. The groupings are listed in Table 1.

Table 1.

Station Range	Number of Unique Sample ID Numbers	Number of IDs having no water sample oxygen value(s)	Number of IDs not having a down CTD oxygen value and/or not being present in the Merged CTD file	Number of IDs having both a mean water sample oxygen value and a down cast CTD oxygen value that was contained in the Merged CTD file
1 - 7	55	1	0	54
8	9	0	0	9
10	12	2	0	10
11	16	1	0	15
12	19	0	0	19
13	20	0	1	19
14	23	0	0	23
16	23	0	0	23
19	23	1	0	22
23 - 43	385*	126	1	258
44 - 79	607	20	2	585
82 - 86	20	20	0	0
TOTAL	1212*	171	4	1037

* There were 111 sample id numbers, 155590 - 155700, that were not used, but are included in these totals.

Near Surface Data Points Not Used

All oxygen differences associated with a pressure between 0 dbar and 180 dbar were automatically removed prior to CTD oxygen calibration processing. By excluding these points, the turbulent near surface region was avoided thereby making the calibration procedure more accurate for the remainder of the CTD casts. This pressure cutoff was initially applied to the 18HU90012 CTD oxygen calibration process.

WOCE Accuracy Guideline

WOCE has an accuracy guideline for CTD oxygen measurements, which states that the CTD oxygen values should be within 1.0 % to 1.5 % of the mean water sample oxygen value for the cruise.

The mean water sample oxygen value for 95011 was 6.527 ml/l. Therefore, according to WOCE s accuracy guideline, this would imply that the standard deviations of the differences between the water sample oxygens and the calibrated CTD oxygens should be within or below the interval 0.07 to 0.10 ml/l.

Summary of Variables Used in the Calibration Process

The following describes the notation used in the calibration.

j : station

i : observation taken on station j

n_j : is the number of observations taken for station j

p_{ij}: pressure for the ith observation of station j

b_{ij}: water sample oxygen for the ith observation of station j

c_{ij}: down CTD oxygen for the ith observation of station j

$d_{ij} = b_{ij} - c_{ij}$: ith oxygen difference for station j

$d_{.j} = \frac{\sum_{i=1}^{n} d_{ij}}{n_j}$: mean of the oxygen differences for station j

$e_{ij} = d_{ij} - d_{.j}$: the ith oxygen difference expressed as a deviation from the mean oxygen difference for station j

ε_{ij} : predicted value of d_{ij} (when $d_{.j}$ offset not used) or e_{ij} (when $d_{.j}$ offset is used) from the regression analysis depending if a station offset was subtracted from the station differences before performing the regression analysis

$r_{ij} = d_{ij} - \varepsilon_{ij}$ or $e_{ij} - \varepsilon_{ij}$: ith residual for station j resulting from the regression analysis

k_{ij} : calibrated CTD oxygen

if a station offset was used:	if no station offset was used:
since $r_{ij} = e_{ij} - \varepsilon_{ij} = b_{ij} - k_{ij}$ $d_{ij} - d_{.j} - \varepsilon_{ij} = b_{ij} - k_{ij}$ $b_{ij} - c_{ij} - d_{.j} - \varepsilon_{ij} = b_{ij} - k_{ij}$	since $r_{ij} = d_{ij} - \varepsilon_{ij} = b_{ij} - k_{ij}$ $b_{ij} - c_{ij} - \varepsilon_{ij} = b_{ij} - k_{ij}$
therefore the calibration is: Eqn. 1 $k_{ij} = c_{ij} + d_{.j} + \varepsilon_{ij}$	therefore the calibration is: (when $d_{.j}$ not used) $k_{ij} = c_{ij} + \varepsilon_{ij}$

Stations 1 to 7

Only 6 points were below the near surface region. Three points for station 3, one for station 6 and two for station 7. Due to the lack of data points it was decided not to produce calibrations for these stations.

Stations 8 to 19

A plot of the oxygen differences versus pressure for these stations is displayed in Figure 2. Each of these stations had CTD oxygen data calibrated separately because of the large drift.

Station 8

Five data points were used in calculating a station offset (mean of the oxygen differences) to be used in calibrating this station s CTD oxygen data. No regression was computed because of the clustered nature of the data points.

Table 2.

Station	Mean of Oxygen Differences (ml/l)	Standard Deviation of Differences (ml/l)
8	3.463	0.15

Station 10

Nine data points were analyzed using regression analysis to obtain calibration coefficients. The regression analysis used oxygen difference (d_{ij}) as the dependent variable and pressure (p_{ij}) as the independent variable. Figure 3 is a plot of d_{ij} against p_{ij}, along with the regression equation (ε_{ij}).

The regression equation was:

Eqn. 2. $\varepsilon_{ij} = 4.036 + 1.518E\text{-}04 * p_{ij}$

The residuals had a standard deviation of 0.027 ml/l.

Station 11

A regression analysis was performed using 13 data points. The analysis used oxygen difference (d_{ij}) as the dependent variable and pressure (p_{ij}) as the independent variable. A plot of d_{ij} against p_{ij} is shown in Figure 4, along with the regression equation (ε_{ij}).

The regression equation was:

Eqn. 3. $\varepsilon_{ij} = 4.514 - 2.714E\text{-}04 * p_{ij}$

The residuals had a standard deviation of 0.088 ml/l.

Station 12

A regression analysis using oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables was performed to find calibration coefficients using 16 data points. Figure 5 shows a plot of d_{ij} against p_{ij} and the resulting regression equation (ε_{ij}).

The regression equation was:

Eqn. 4. $\varepsilon_{ij} = 3.917 + 4.844E\text{-}04 * p_{ij} - 4.654E\text{-}07 * p_{ij}^2 + 9.091E\text{-}11 * p_{ij}^3$

The residuals had a standard deviation of 0.036 ml/l.

Station 13

Sixteen data points were used in performing a regression analysis. The regression analysis used oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables. A plot showing d_{ij} against p_{ij} and the estimated regression equation (ε_{ij}) is given in Figure 6.

The regression equation was:

Eqn. 5. $\varepsilon_{ij} = 3.431 + 6.670E\text{-}04 * p_{ij} - 5.584E\text{-}07 * p_{ij}^2 + 1.128E\text{-}10 * p_{ij}^3$

The residuals had a standard deviation of 0.040 ml/l.

Station 14

A regression analysis using 20 data points, oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables was conducted to find calibration coefficients. A plot of d_{ij} against p_{ij} is pictured in Figure 7. The estimated regression equation (ε_{ij}) is also displayed.

The regression equation was:

Eqn. 6. $$\varepsilon_{ij} = 2.897 + 9.746E\text{-}04 * p_{ij} - 7.048E\text{-}07 * p_{ij}^2 + 1.327E\text{-}10 * p_{ij}^3$$

The residuals had a standard deviation of 0.052 ml/l.

Station 16

Twenty data points were used in a regression analysis. The regression analysis used oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables to obtain calibration coefficients. A plot of d_{ij} against p_{ij} and the estimated regression equation (ε_{ij}) are given in Figure 8.

The regression equation was:

Eqn. 7. $$\varepsilon_{ij} = 2.761 + 7.149E\text{-}04 * p_{ij} - 5.186E\text{-}07 * p_{ij}^2 + 9.504E\text{-}11 * p_{ij}^3$$

The residuals had a standard deviation of 0.032 ml/l.

Station 19

A regression analysis using oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables was conducted to find calibration coefficients using 20 data points. Figure 9 shows d_{ij} plotted against p_{ij}, the estimated regression equation (ε_{ij}) is also shown.

The regression equation was:

Eqn. 8. $$\varepsilon_{ij} = 2.450 + 6.894E\text{-}04 * p_{ij} - 4.388E\text{-}07 * p_{ij}^2 + 7.643E\text{-}11 * p_{ij}^3$$

The residuals had a standard deviation of 0.054 ml/l.

Stations 23 to 43

There were 216 data points available for a regression analysis that used oxygen difference (d_{ij}) as the dependent variable and p_{ij}, p_{ij}^2 and p_{ij}^3 as the independent variables. Figure 10 displays a plot of d_{ij} against p_{ij} and the estimated regression equation (ε_{ij}).

The regression equation was:

Eqn. 9. $$\varepsilon_{ij} = 2.229 + 4.174E\text{-}04 * p_{ij} - 3.187E\text{-}07 * p_{ij}^2 + 6.226E\text{-}11 * p_{ij}^3$$

A residual plot is given in Figure 11. The residuals had a standard deviation of 0.108 ml/l.

Note: All data points for stations 42 and 43 were located in the near surface region; but the data points lay within the data points for stations 23 to 41. Therefore, the regression equation computed for stations 23 to 41 (i.e. Eqn. 9) will also be used for stations 42 and 43.

Stations 44 to 79

An outlier data point corresponding to sample id number 155833 was removed. A plot of the oxygen differences versus pressure for these stations is displayed in Figure 12. The mean of the oxygen differences (station offset $d_{.j}$) for each station was calculated (see Table 3), then the e_{ij} values were calculated. A regression analysis was performed using the 491 remaining data points. The regression used e_{ij} as the dependent variable and p_{ij}, p_{ij}^2,and p_{ij}^3 as the independent variables. The regression equation is given below as Eqn. 10. A plot of e_{ij} versus p_{ij}, along with the estimated regression curve (ε_{ij}) is shown in Figure 13.

Table 3.

Station	Mean of Oxygen Differences (ml/l)	Standard Deviation of the Difference (ml/l)
44	1.986	0.11
46	2.113	0.09
47	2.078	0.13
48	2.013	0.17
50	1.966	0.13
52	2.009	0.10
53	1.937	0.12
55	2.031	0.11
57	1.911	0.15
58	1.932	0.21
59	1.973	0.11
60	1.924	0.25
61	1.955	0.20
63	2.002	0.24
65	1.824	0.27
66	1.767	0.18
67	1.970	0.26
69	1.878	0.34
70	2.017	0.22
71	1.913	0.32
72	1.924	0.34
73	1.860	0.26
74	1.882	0.22
76	1.886	0.27
77	1.897	0.24
78	1.875	0.25
79	1.749	0.27

The regression equation was:

Eqn. 10. $$\varepsilon_{ij} = -0.525 + 7.124E\text{-}04 * p_{ij} - 2.671E\text{-}07 * p_{ij}^{2} + 3.273E\text{-}11 * p_{ij}^{3}$$

A residual plot is given in Figure 14. The residuals had a standard deviation of 0.149 ml/l. However, the standard deviation for the points having a pressure >=1500 dbars is 0.077 ml/l.

Stations 82 to 86

No water sample oxygen values were available for these stations; thus no oxygen differences could be calculated and used in calibrating the CTD oxygen data. In order to calibrate the data for these stations, the average of the oxygen differences for stations 76 to 79 (1.852 ± 0.08) and Eqn. 10 was used in the calibration of these stations.

CTD Oxygen Calibration Procedure

The CTD oxygen data was calibrated for each CTD station according to the following expression:

Eqn. 1 $k_{ij} = c_{ij} + d._j + \varepsilon_{ij}$

where k_{ij} is the calibrated CTD oxygen value

c_{ij} is the raw CTD oxygen value

$d._j$ the station offset:

- is given in Table 2 for station 8,
- is 0 for stations 10 to 14, 16, 19, 23 to 43 and
- is given in Table 3 for stations 44 to 79, and
- is given by 1.852 for stations 82 to 86.

ε_{ij} the regression offset:

- is 0 for station 8,
- is given as Eqn. 2 for station 10,
- is given as Eqn. 3 for station 11,
- is given as Eqn. 4 for station 12,
- is given as Eqn. 5 for station 13,
- is given as Eqn. 6 for station 14,
- is given as Eqn. 7 for station 16,
- is given as Eqn. 8 for station 19,
- is given as Eqn. 9 for station 23 to 43, and
- is given as Eqn. 10 for station 44 to 86.

All CTD oxygen data for the listed stations will be calibrated by the above procedure regardless of pressure.

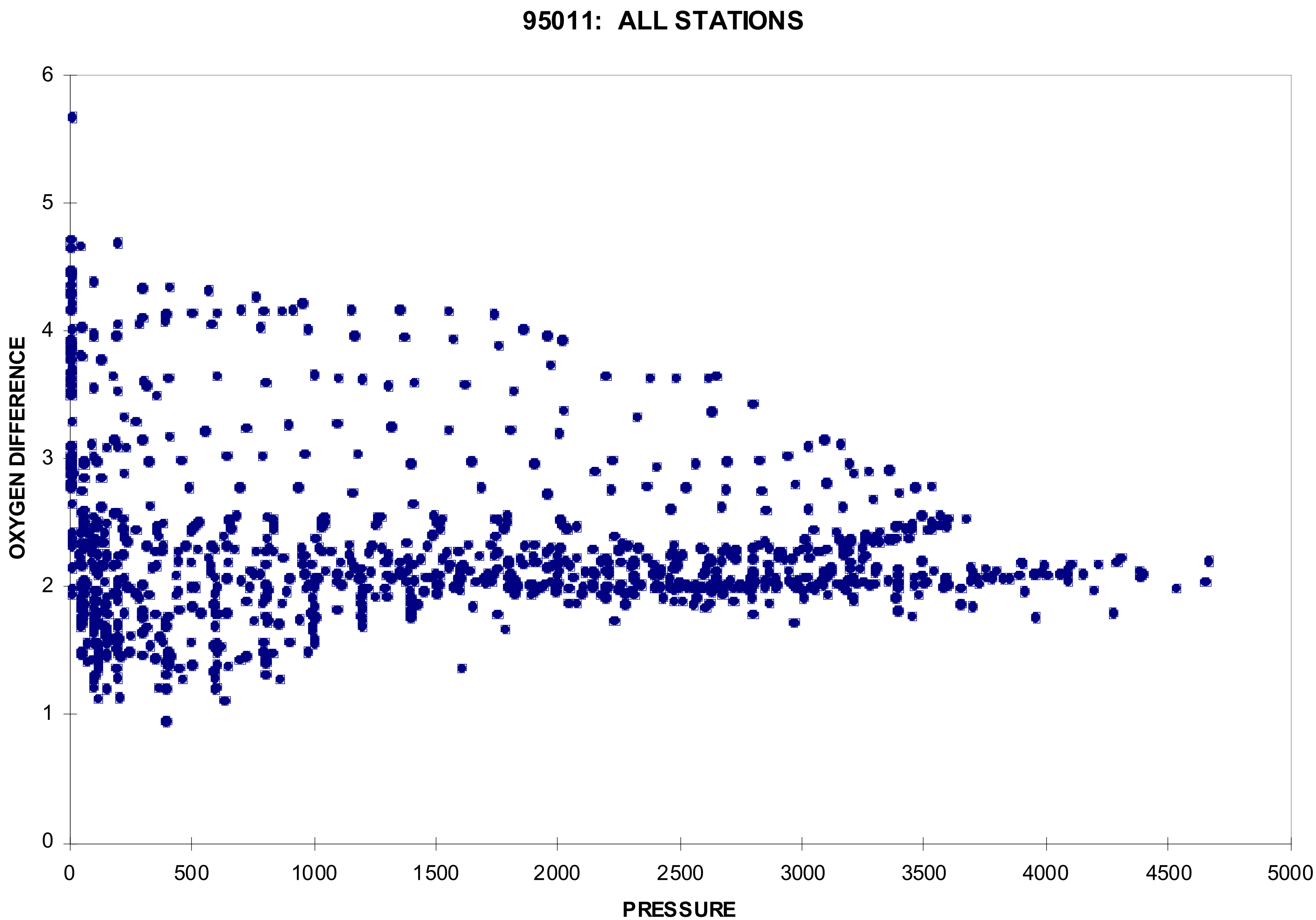


Figure 1. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij).

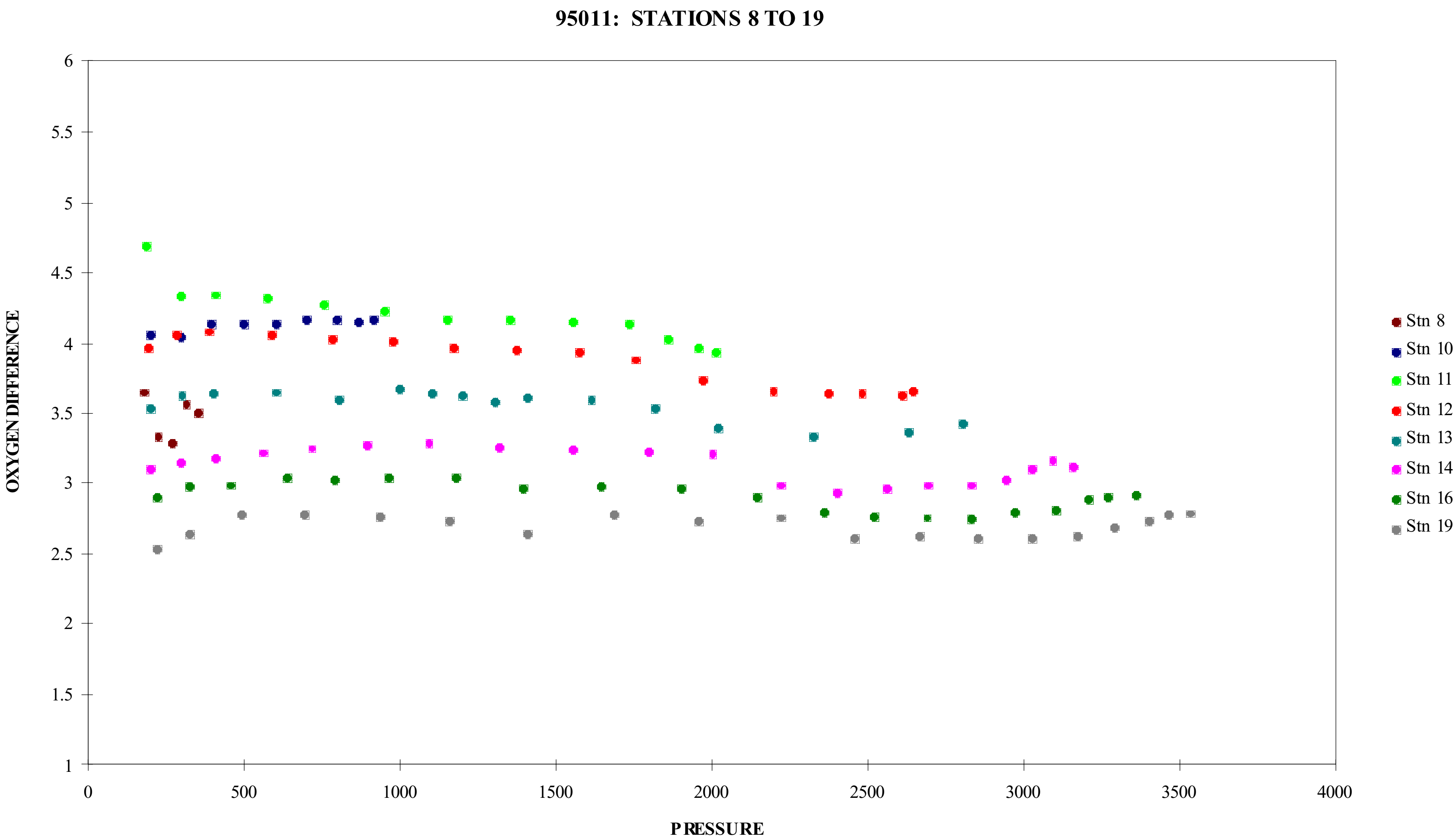


Figure 2. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij).

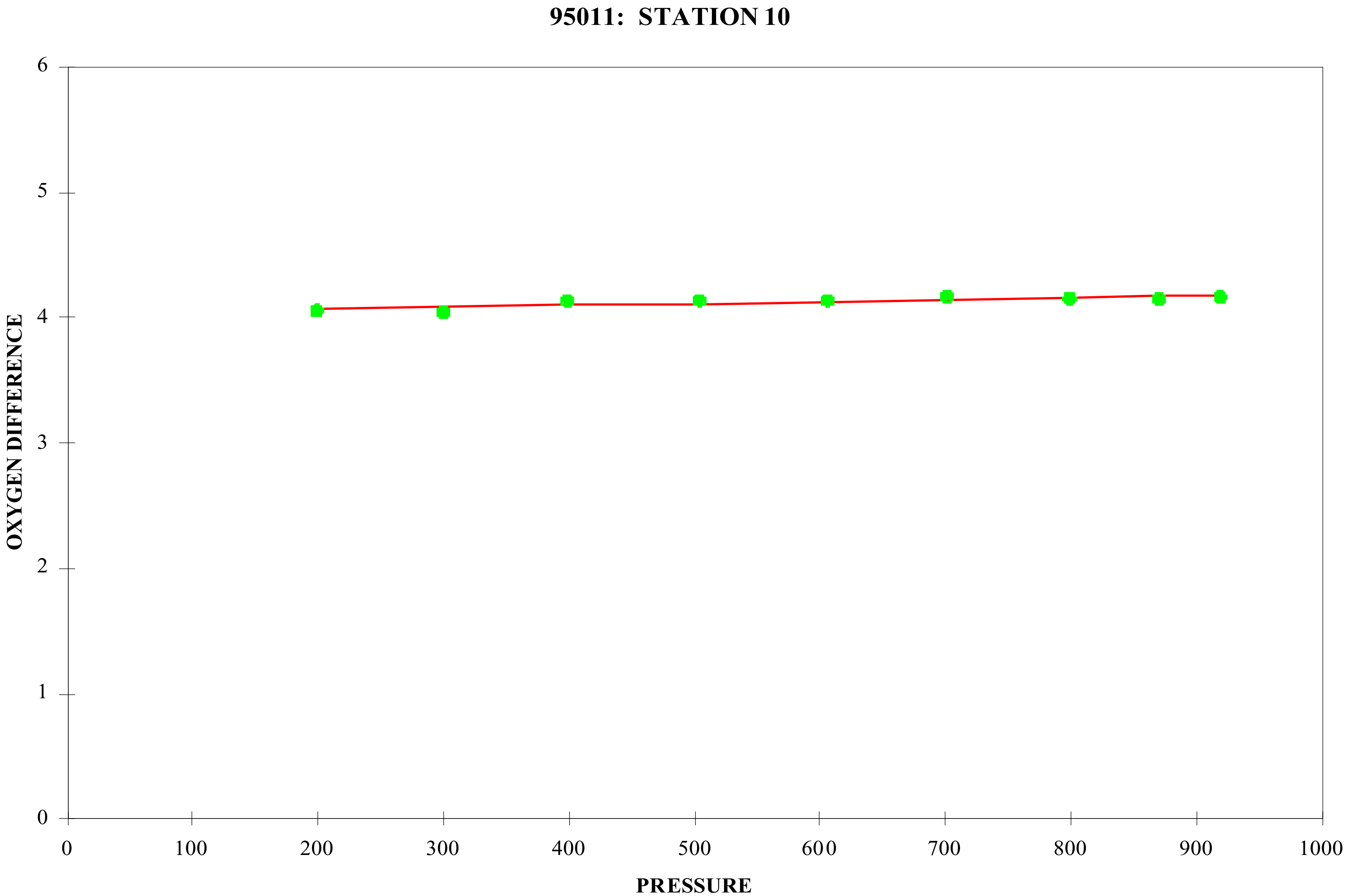


Figure 3. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

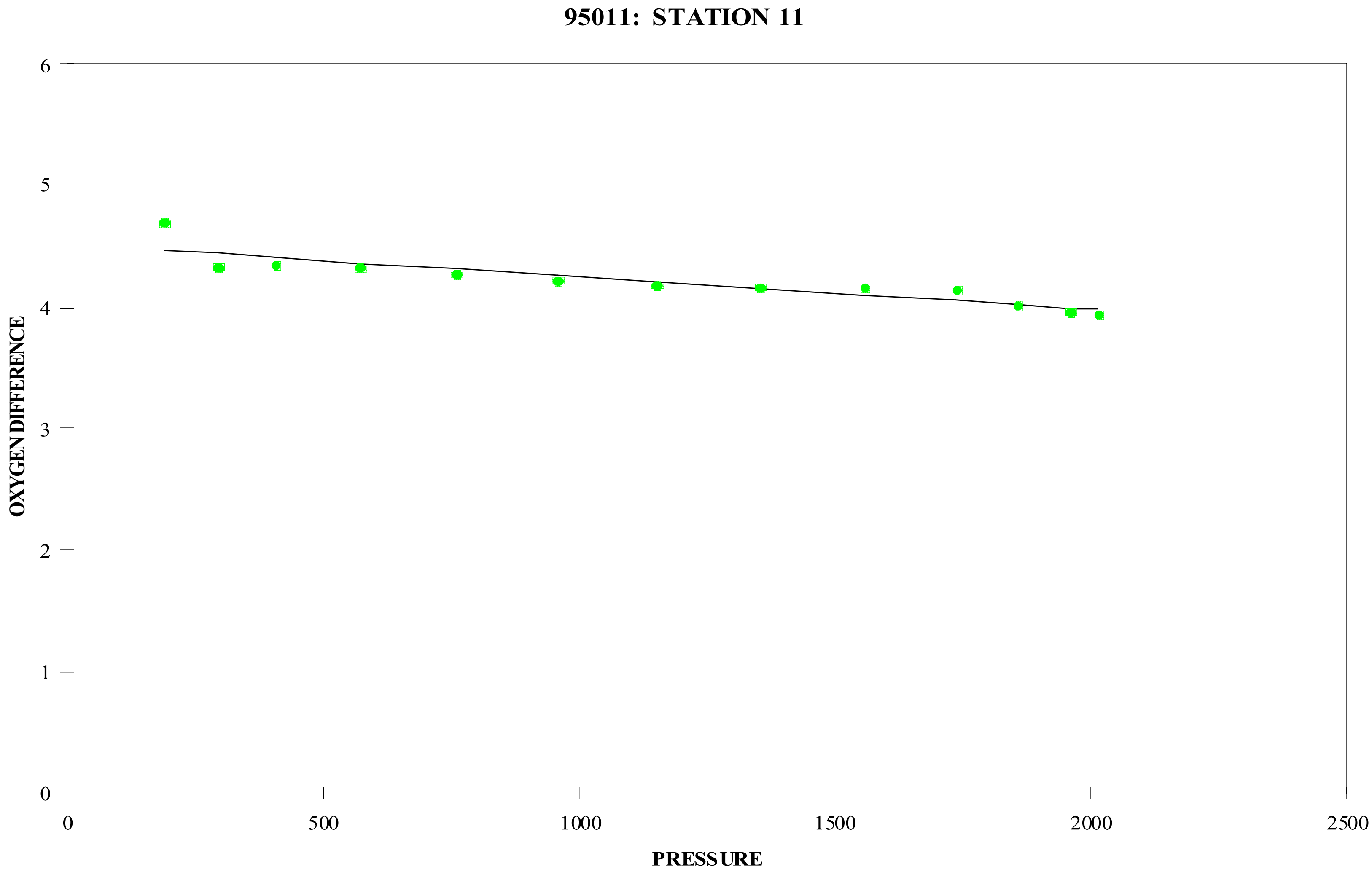


Figure 4. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

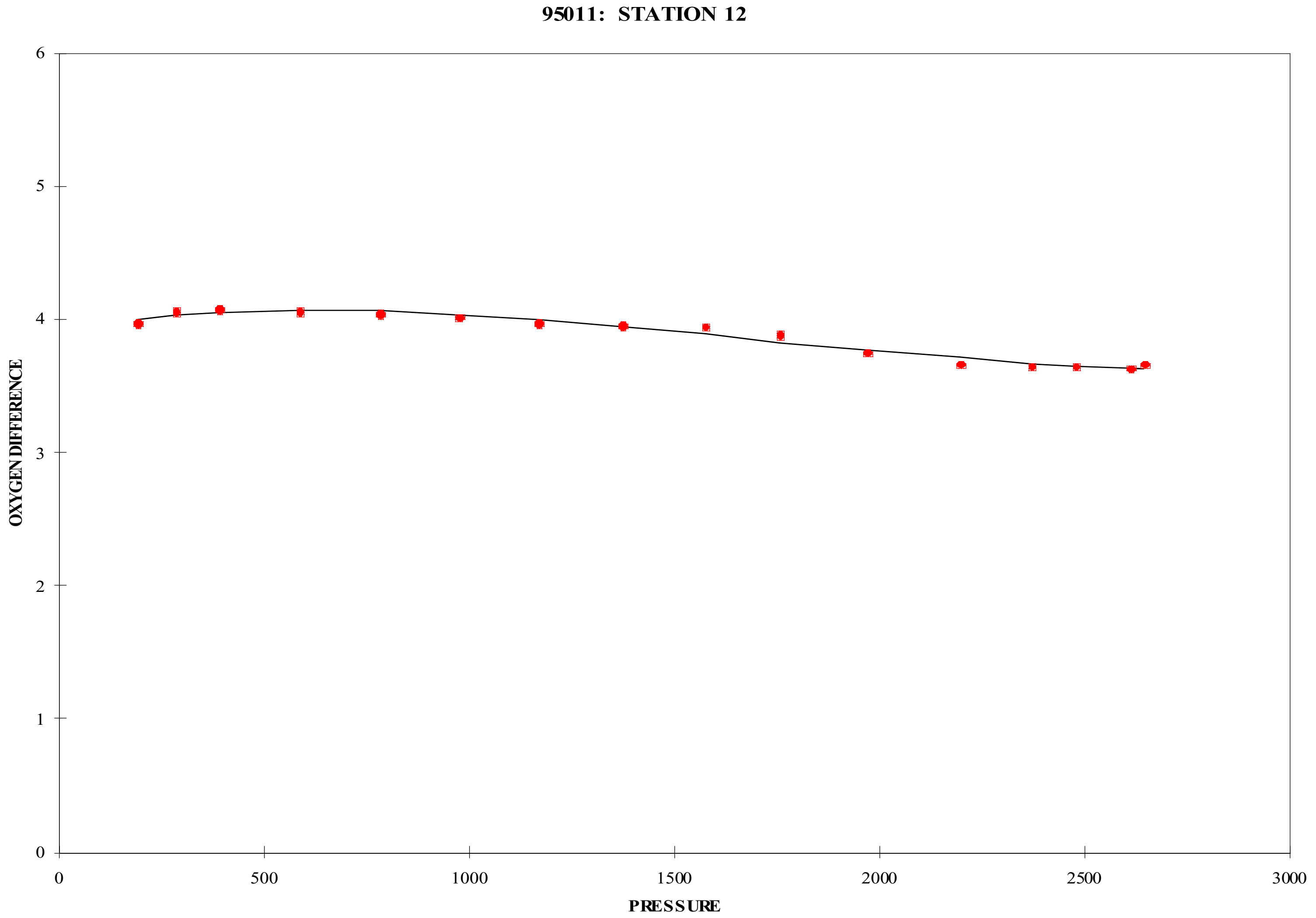


Figure 5. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

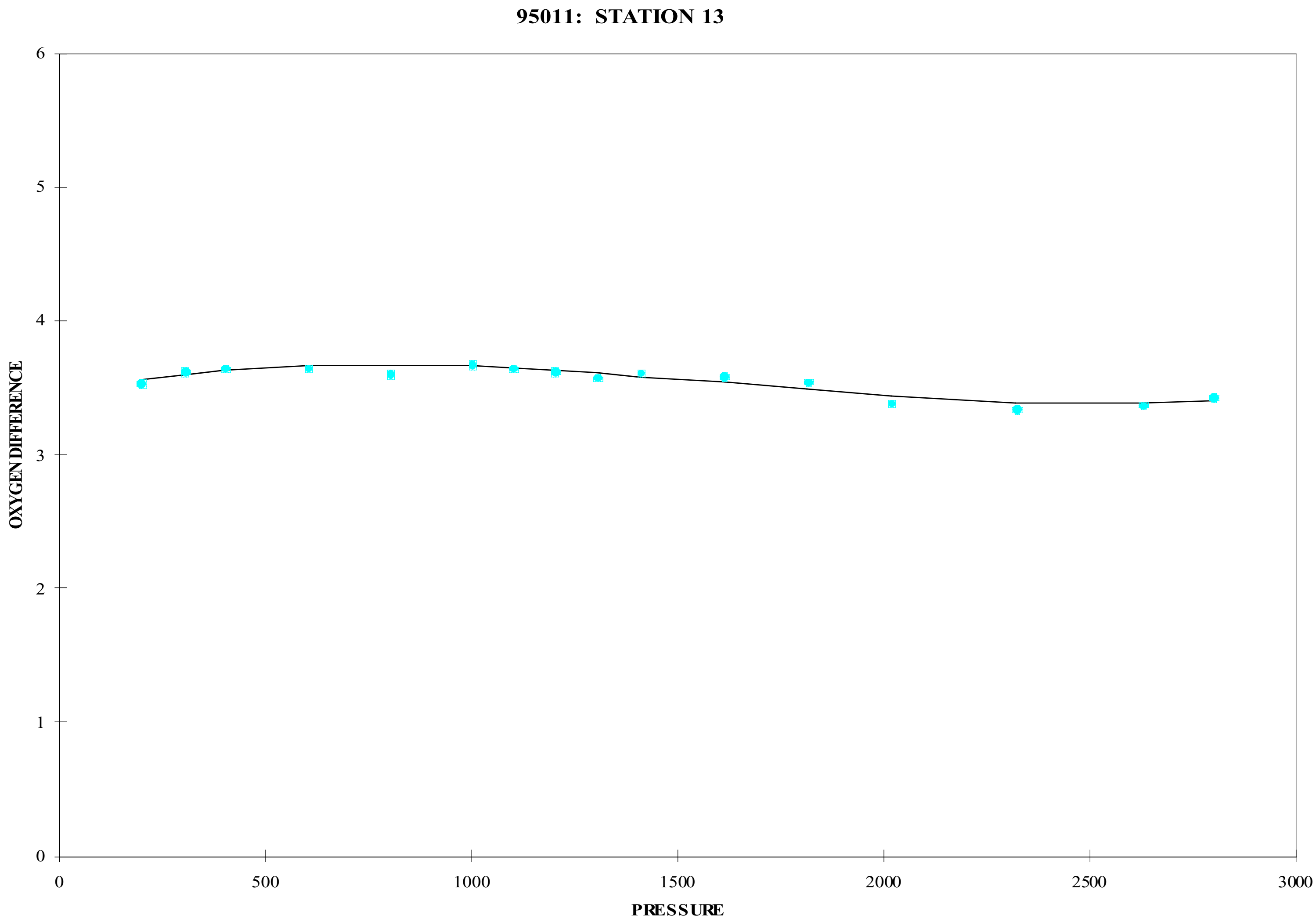


Figure 6. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

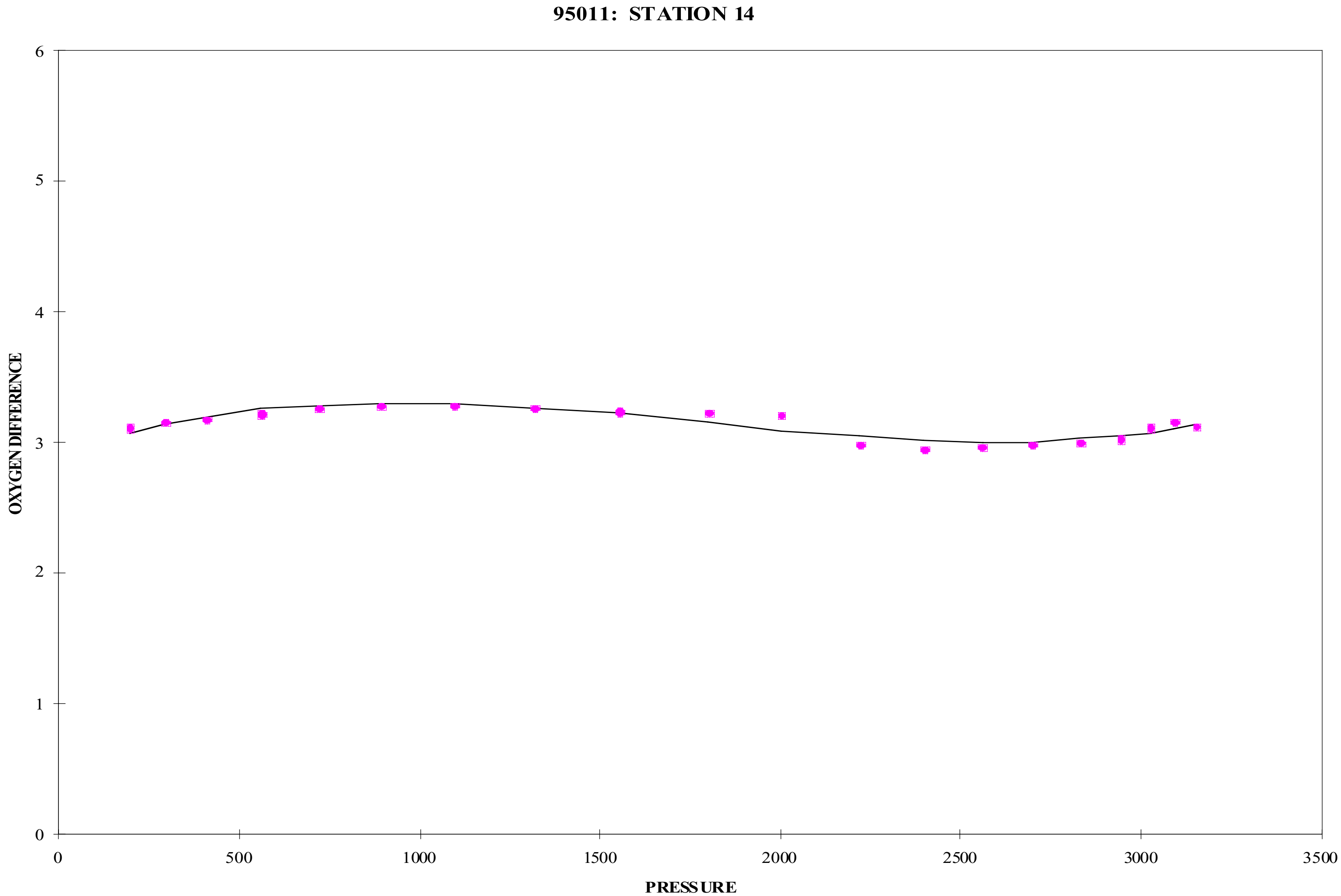


Figure 7. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

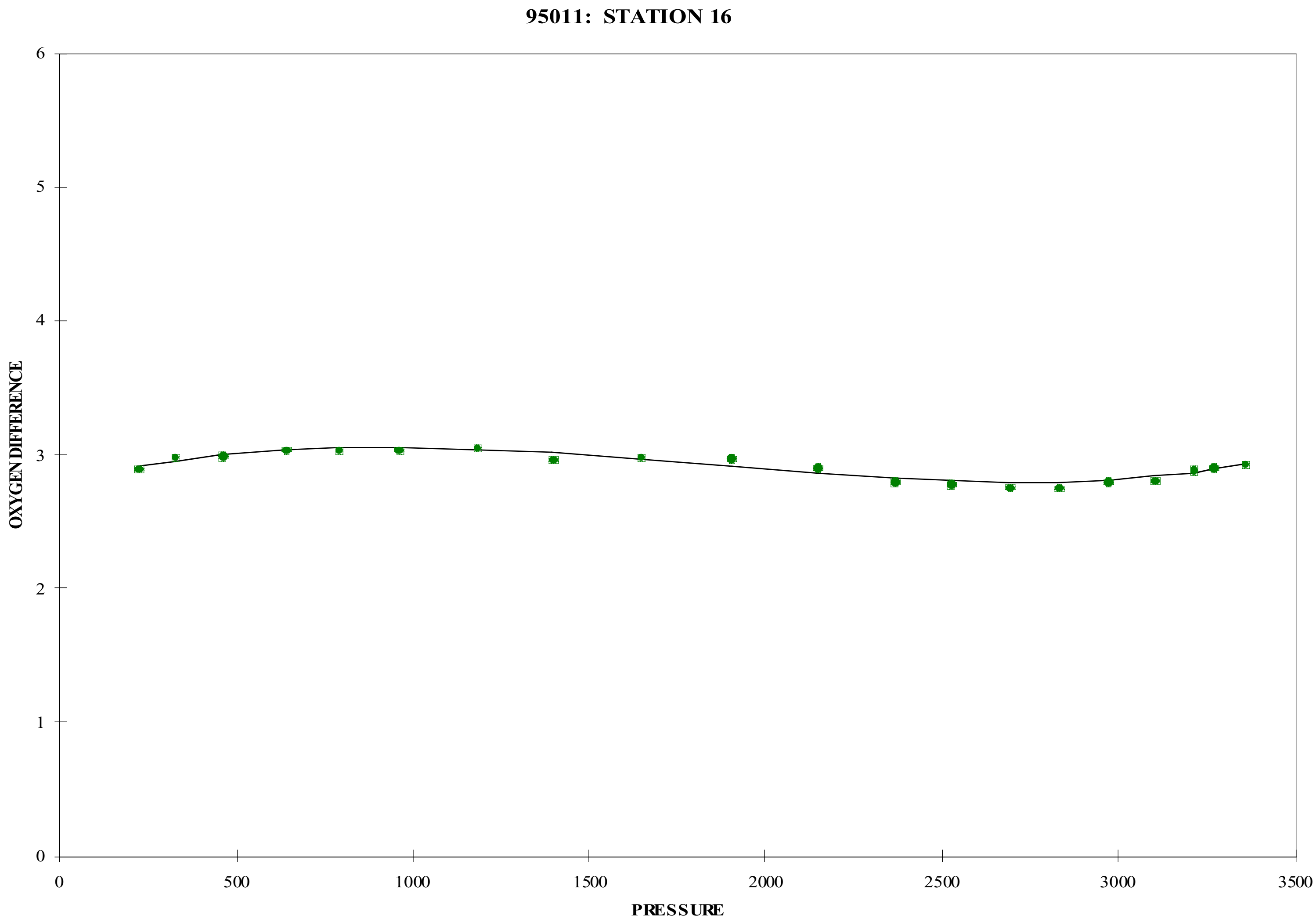


Figure 8. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

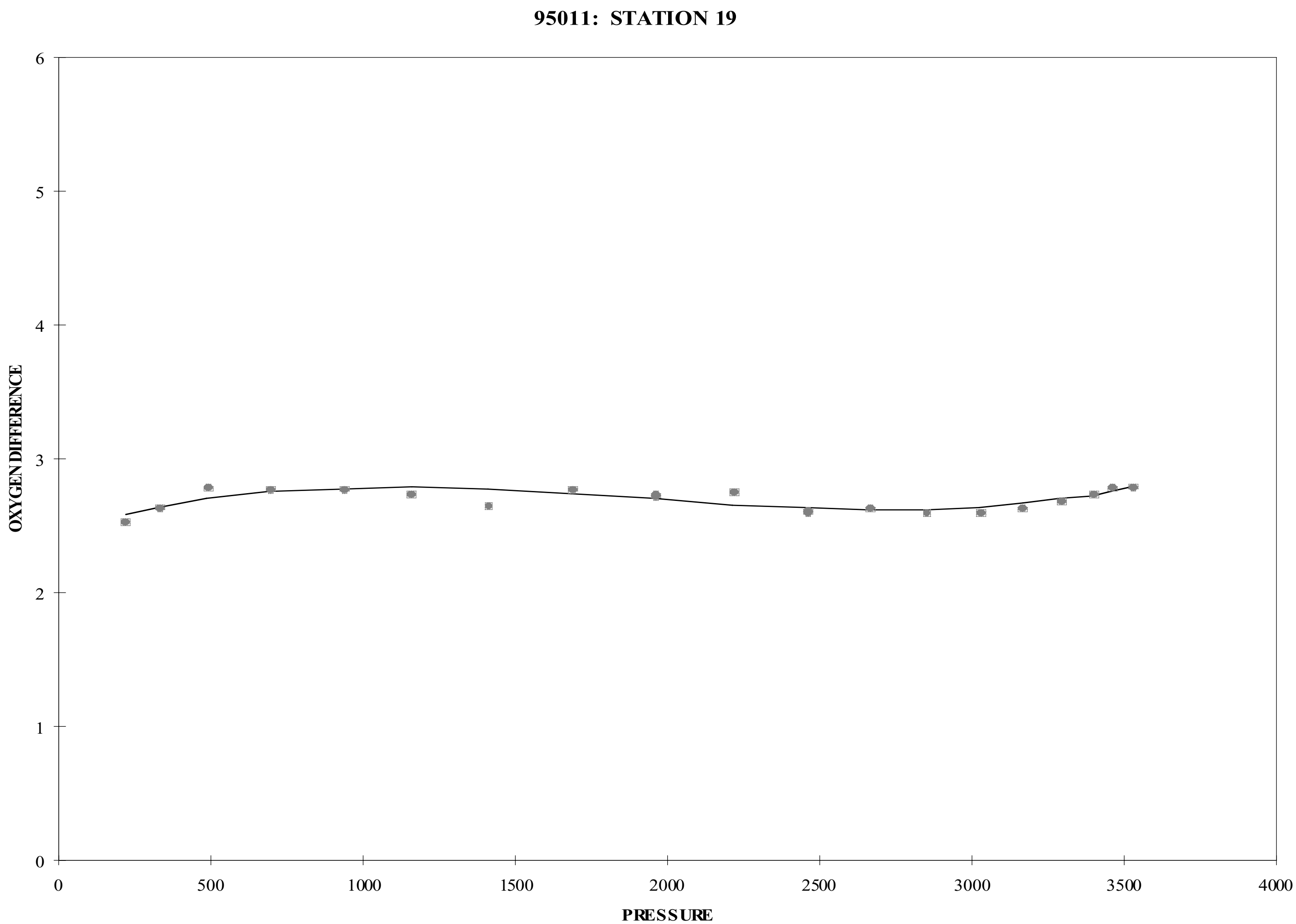


Figure 9. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown. The symbol colors are the same as used in Figure 2 for this station.

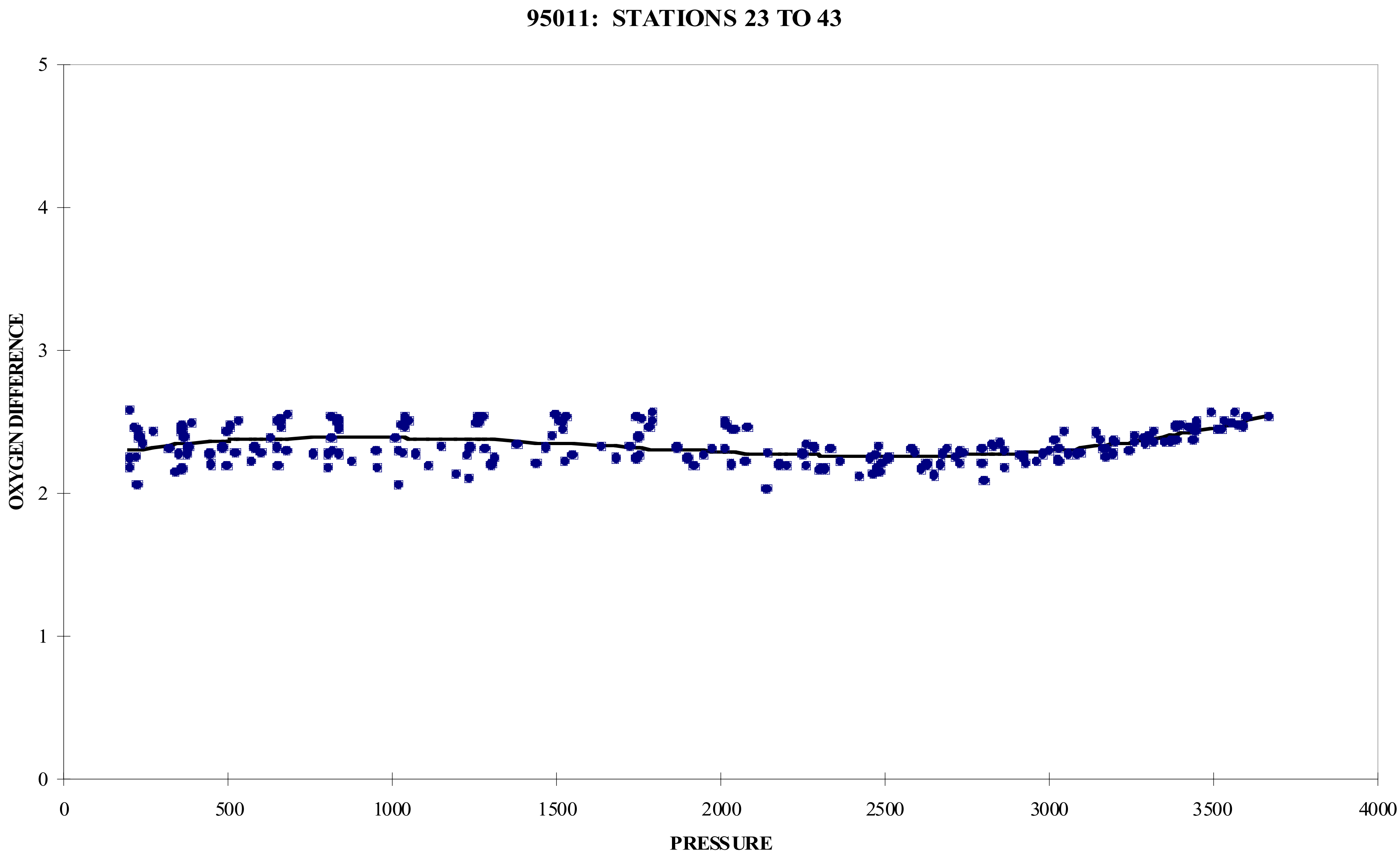


Figure 10. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij). Regression line is also shown.

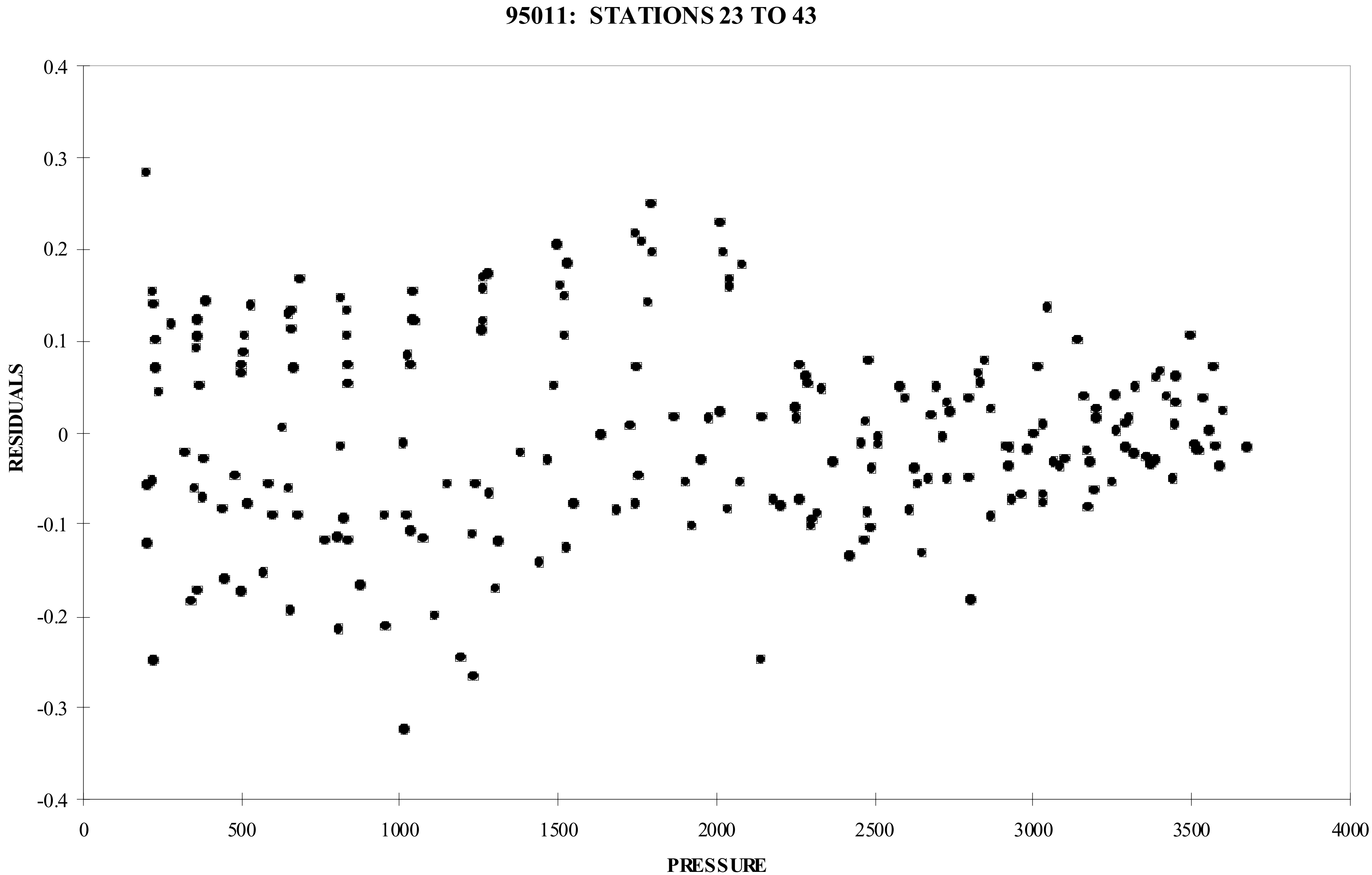


Figure 11. Residuals (rij) remaining after the regression offset have been removed.

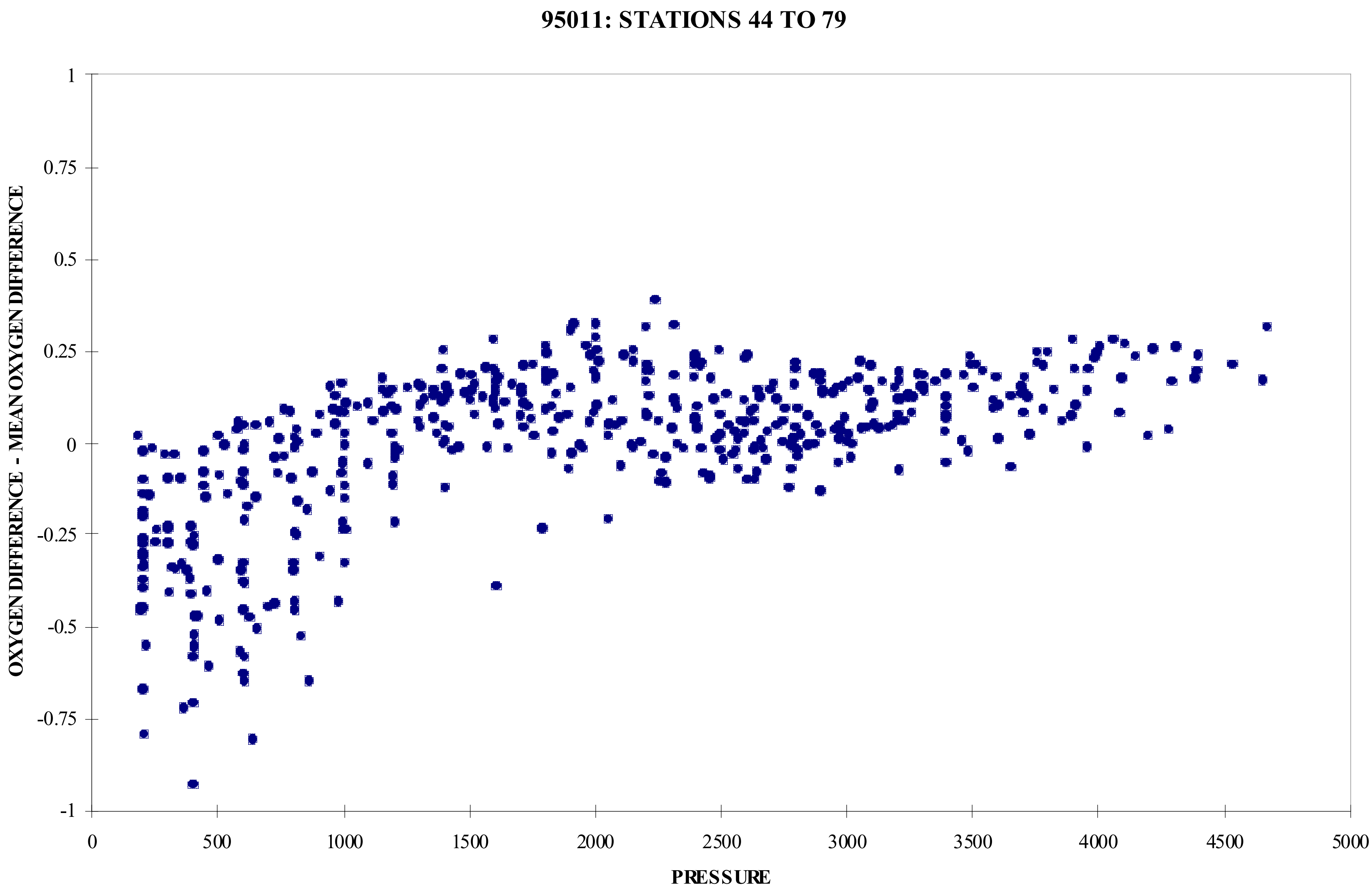


Figure 12. Water sample oxygen minus CTD down cast oxygen (dij) plotted against pressure (pij).

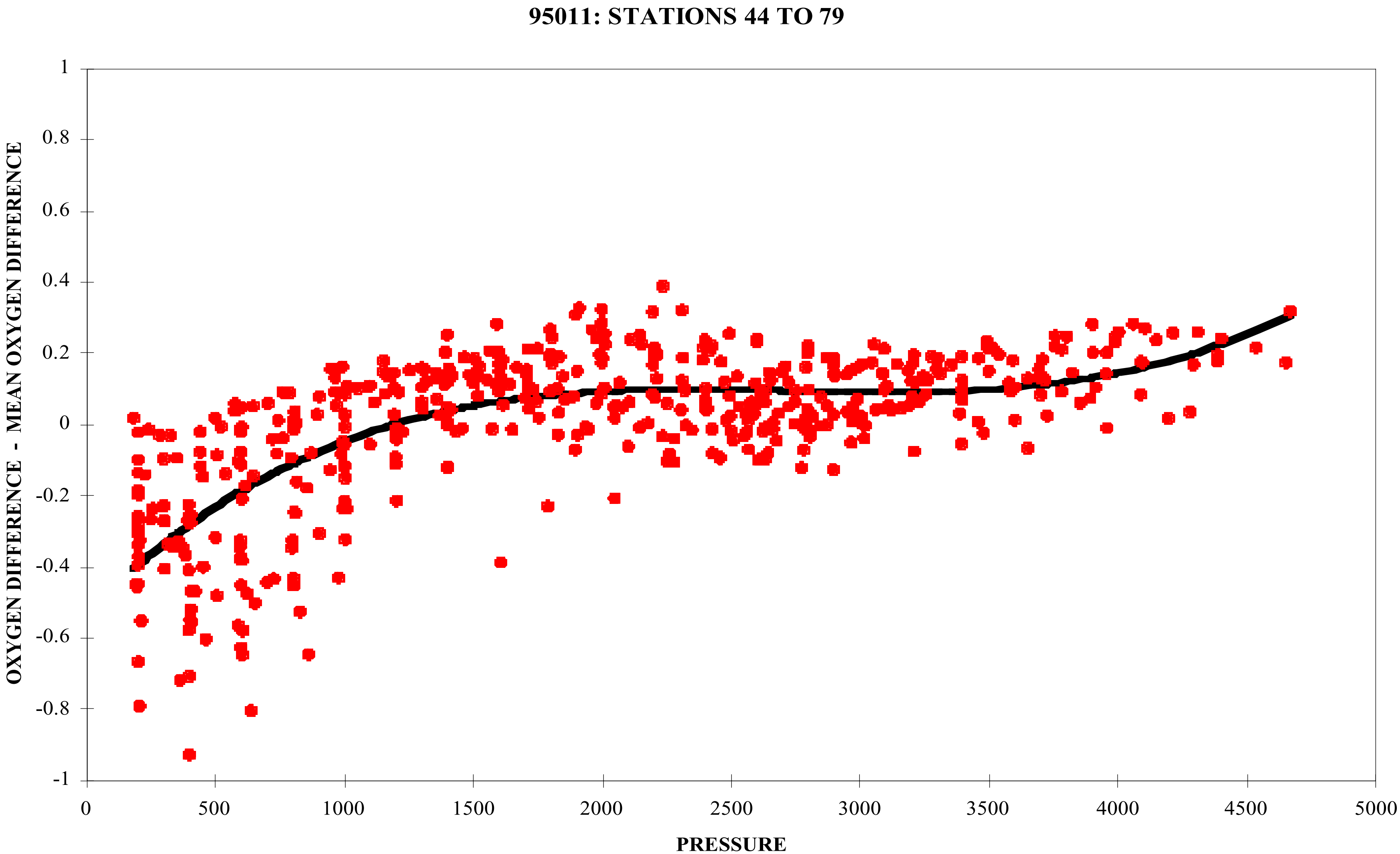


Figure 13. Oxygen difference expressed as a deviation from the mean oxygen difference (eij) plotted against pressure (pij) with regression line shown.

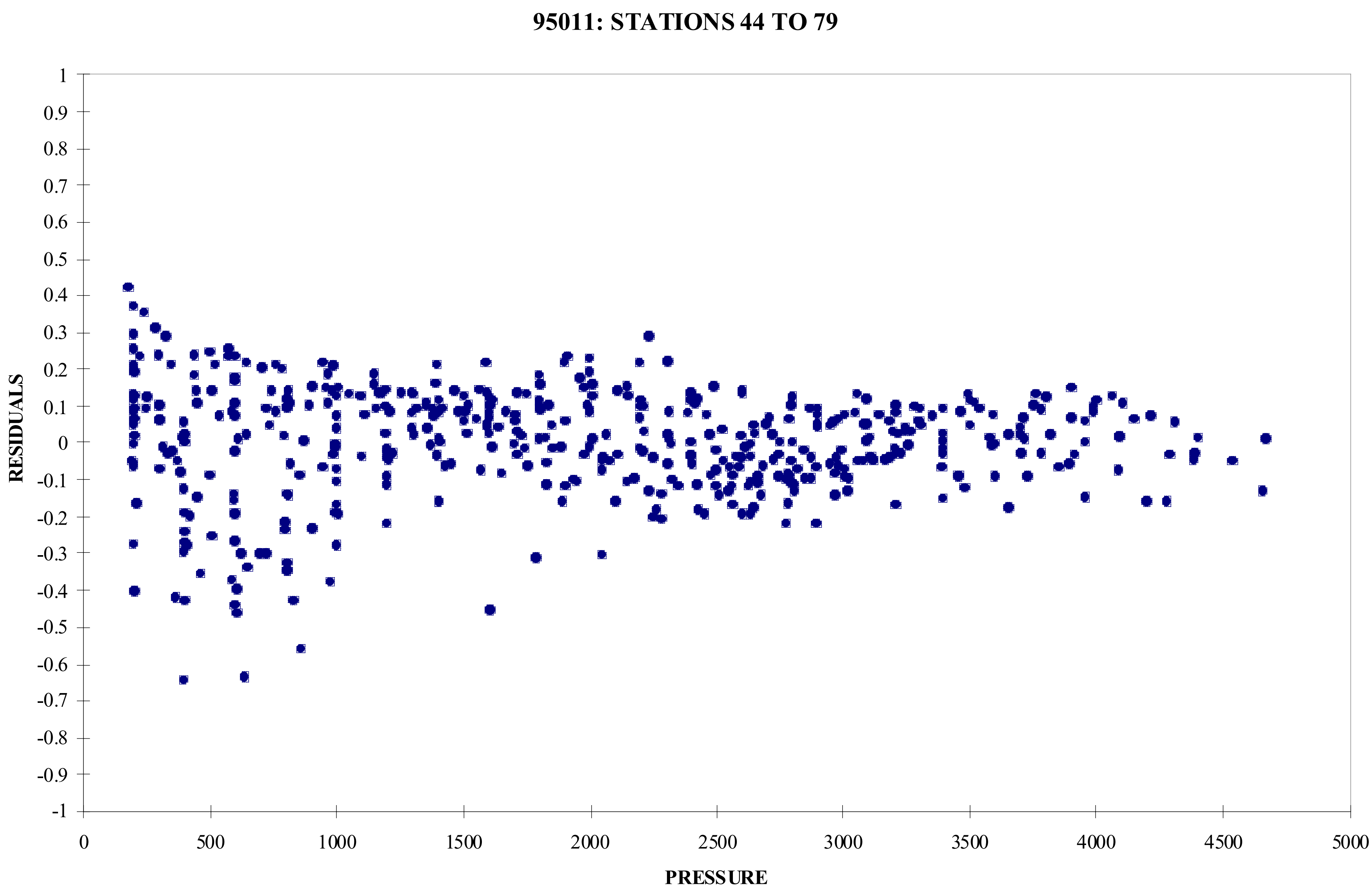


Figure 14. Residuals (rij) remaining after the station and regression offsets have been removed.

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. A NASCO Report, Jour. Mar. Res., 24, 268-318.

Clarke, R. Allyn, Jean-Guy Dessureault and Geoff Lebans. 1995. Upper Ocean Profiling from Vessels Underway, Sea Technology, February 1995.

Jones, E.P., F. Zemlyak and P. Stewart. 1992. Operating Manual for the Bedford Institute of Oceanography Automated Dissolved Oxygen Titration System. Can. Tech. Rep. of Hydrography and Ocean Sci. 138: iv+51p.

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.

Data Processing History:

Date	Last Name	Data Type	Data Status	Summary
8/22/95	Lazier	CTD/SUM/DOC	Submitted	
11/5/96	Sy	CTD/BTL	Update Needed	See note:

BSH, Hamburg
A. Sy

5 November 1996
To whom it may concern:

Cruise "Meteor" 30, leg 3, bottle data processing.

Because of the very limited resources it was necessary to deviate in some points from requirements outlined in WHPO 90-1. Otherwise different bottle data files ought to have been assembled according specific needs and specific computer software. Thus please, note the differences from WHP water sample requirements as described in WHPO 90-1 (section 3.3).

Data are reported in terms of corrected samples, i.e. mis- or double trips in the CTD rosette are corrected. No serious rosette problems occured during this cruise.

Clearly bad (wrong) bottle trips have been removed completely. Bad single measurements have been removed and marked by 4. Samples drawn from leaking (malfunctioning) bottles are not reported except values seem to be more or less reasonable.

BIO denotes the Bedfort numbering system we used.

CTDRAW is not a real raw pressure. The values reported are calibrated in our acquisition data stream (transformation in physical units (dbar)) and stored in the bottle data file. CTDRAW is corrected according laboratory calibration results (unloading courve) and pressure offset correction from beginning of profile.

CTDTMP is reported in ITS-90.

CTDSAL has been corrected with in-situ salinity correction. Standard Conductivity used was C(15,35,0)=42.914.

OXYGEN has not been yet converted to UMOL/KG. They are reported as measured.

Finally: if you find errors of any kind, discrepancies in the data, etc, etc, please contact me. As anyone else I would like to work with the best available version of Meteor 30/3 data.

Address information or inquiries should be sent to:
Alexander Sy
Bundesamt fuer Seeschiffahrt und Hydrographie
Bernhard-Nocht-Str. 78
D-22359 Hamburg

Germany
Tel: + 40 3190 3430
Fax: + 40 3190 5000
email: sy@hamburg.bsh.d400.de

Data Processing History:

Date	Last Name	Data Type	Data Status	Summary
4/7/98	Schott	Cruise ID	Data Update	
	North Atlantic cruise list Enclosed please find a list of cruises (since 1990) we use as references for our work or are aware of in the North Atlantic. 18HU95011-1 Hudson 09.06.-02.07.1995 J. Lazier BIO			
3/9/99	Kappa	DOC	PDF Version Created	
2/11/00	Diggs	CTD/BTL/SUM/ DOC	Website Updated	files added to website
3/24/00	Schlosser	He/Tr	Data are Public	See note:
	as mentioned in my recent message, we will release our data with a flag that indicates that they are not yet final. We started the process of transferring the data and we will continue with the transfer during the next weeks. I had listed the expected order of delivery in my last message.			
2/20/01	Kappa	DOC	Doc Update	
	Found complete doc to replace online docs. Caroline is producing txt version.			
3/16/01	Uribe	CTD/BTL	Website Updated	Expocodes updated
	Danie and I have edited the expocode in all ctd files and the bottle to match the underscored expocode in the sum and bottle files. New files were zipped and replaced existing ctd files online. Old files were moved to original directory.			
4/23/01	KAPPA	DOC	PDF, TXT files updated	
	Data Processing History added, Figures linked to text references in PDF file, WHO cruise track added to PDF file, numerous sections added to PDF and TXT files.			