HLY-04-02 Service Group Bottle Data Documentation

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Nome, Alaska to Nome, Alaska

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Data Set Overview

98 CTD casts on 35 stations were attempted. One of these was aborted, with no CTD data and no water samples, six additional casts were aborted, the CTD data from these casts were reported, but there were no water samples. These casts were:

Station	Cast	
003	01	CTD data reported, 12 bottles tripped.
006	02	CTD data reported, 12 bottles tripped.
016	01	CTD data reported, 4 bottles tripped.
016	03	CTD data not reported, no bottles
027	01	CTD data reported, no bottles.
031	03	CTD data reported, aborted mid down-cast

Instrumentation

CTD casts were performed with a rosette system consisting of a 12-place rosette frame with 30 liter bottles and a 12-place SBE-32 Carousel pylon. Underwater electronic components consisted of:

- Sea-Bird Electronics, Inc. (SBE) 911plus CTD,
- WETLabs C-Star transmissometer with a 25cm path length and 660nm wavelength,
- Biospherical Instruments, Inc. Photosynthetically Active Radiation (PAR) sensor,
- Chelsea MkIII Aquatracka fluorometer, and
- Simrad, 5 volt - 500 meters altimeter.

Additionally, a Dr. Haardt fluorometer designed to detect colored organic matter (CDOM) and a Secchi disk were mounted on the CTD package. The CTD, transmissometer, and the two fluorometers were mounted horizontally along the bottom of the rosette frame. The PAR sensor was located at the top of the rosette. The surface PAR sensor was located on the aft, starboard railing of the helicopter shack. All sensors except the Secchi disk were interfaced with the CTD system. This instrument package provided pressure, dual temperature and dual conductivity channels as well as light transmissivity and fluorometric signals at a sample rate of 24 scans per second.

The bottles on the rosette were General Oceanic 30 liter bottles. The bottles were equipped with internal nylon coated springs and silicone o-rings which are used to minimize toxicity to the sample. Bottle numbering is 1 to 12 with 1 tripped first usually at the deepest sampling level and 12 tripped last at the shallowest sampling level. The rosette system was suspended from a standard UNOLS 3 conductor 0.322" electromechanical cable.

The CTD used was serial number 09P24152-0638 and the sensor's model and serial numbers are listed in Table 1.

TABLE 1. Instrument/Sensor Serial Numbers

Primary Temperature	Primary Conductivity	Secondary Temperature	Secondary Conductivity	Pressure	Transmissometer
SBE 3plus	SBE 4C	SBE 3plus	SBE 4C	401K-105	C-Star
03-2796	04-2545	03-2824	04-2568	83009	CST-390DR

Oxygen	Fluorometer	PAR	Surface PAR	Altimeter
SBE 43	Aqua 3	QSP-2300	QSR-240	807
0459	088233	4643	6367	9711090

Equipment Positions

TABLE 2. Instrument mounting heights in reference to the bottom of the rosette frame.

Sensor	Height above base of rosette		Sensor	Height above base of rosette
Altimeter	2 cm		Pressure	19cm
Transmissometer	8 cm		T (pri)	10 cm
Fluorometer (Chelsea)	10 cm			
Fluorometer (Haardt)	8 cm		Par	215cm Sta. < 2000 m

The distance of the mid-points of the 30 L Niskin bottles from the bottom-mounted sensors was ~1.19m. The 30 Liter Niskin bottles are ~1.0 m long. The secchi disk was mounted 2.2m above the bottom of the rosette frame.

Problems and/or Procedural changes

Bottle 7 was replaced after station 010. At times the nylon coating on the springs broke down and some rust was apparent. To minimize the occurrence of rust, the springs were inspected before the cruise and, as feasible during the cruise. During the mid-cruise servicing of the CTD/rosette system that occurred following station 021, all springs were inspected and 6 were replaced. HLY0402 rosette operations were continually beset by problems with bottle leaks caused by Niskin bottle end o-rings falling out of position. Typically, each cast had one such occurrence. Although some Niskin bottles were more prone than others to have an o-ring problem, in general the problem shifted from bottle to bottle between casts. Some of the problems were gross, i.e. the o-ring would be visible out the side of the end cap, but others were more subtle. Every time an o-ring problem was suspected, the o-ring was carefully inspected, and replaced if necessary. Also, at several points during the cruise all o-rings were inspected. The contents of various packages of spare o-rings were measured to locate 'large' or 'small' o-rings (within the manufacturer's tolerance), and a remedial 'large' set was installed. Another time Coast Guard personnel replaced all the o-rings from their own supply. Yet all these remedial attempts were to no particular avail. The problem bears further thought toward a satisfactory solution.

CTD Data

CTD Laboratory Calibration Procedures

Pre-cruise laboratory calibrations of CTD pressure, temperature and conductivity sensors were used to generate coefficients for the calculation of these parameters from their respective sensor frequencies. The temperature and conductivity calibrations were performed at Sea-Bird Electronics, Inc. in Bellevue, Washington. Calibration of the pressure sensor was performed by Scripps Institution of Oceanography, Shipboard Technical Support/Oceanographic Data Facility (SIO/STS/ODF) personnel. The Sea-Bird laboratory temperature calibrations were referenced to the International Temperature Scale of 1990 (ITS-90).

CTD Data Acquisition

The CTD 911plus was operated generally as suggested in the Sea-Bird CTD Operating and Repair Manual, which contains a description of the system, its operation and functions (Sea-Bird Electronics, Inc., 2002). One difference from Sea-Bird's operation is that data acquisition was started on deck. This procedure allows a check of the pressure offset and an unblocked reading of the transmissometer. The Seasoft acquisition program as described in the CTD Data Acquisition Software Manual (Sea-Bird Electronics, Inc., 2001) provided a real-time graphical display of selected parameters adequate to monitor CTD performance and information for the selection of bottle-tripping depths. Raw data from the CTD were archived on the PC's hard disk at the full 24 Hz sampling rate.

A CTD Station Sheet form was filled in for each deployment, providing a record of times, positions, bottom depth, bottle sampling depths, and every attempt to trip a bottle, as well as any pertinent comments. When the equipment and personnel were ready, data acquisition was started. The CTD operator pressed a control key (flag), which appends a summary line into the files created for "inventory" files. This file contains a summary of the time, ship's position, and current scan number each time the control key is pressed. They are used as a reference to mark important events during the cast, such as on deck pressure, when the lowering was initiated, when the package was at the bottom, when bottles were tripped and the on-deck pressure with ending position. After the initial flag, the rosette/CTD system was lowered into the water and held at 5 meters wire out for 3-5

minutes to permit activation of the CTD pumps and equilibration of the sensors. Then, the operator had the CTD raised to the surface, again created a flag, and simultaneously directed the winch operator to begin lowering. The operator created a flag at the deepest point of the cast. Bottom depths were calculated by combining the distance above bottom, reported by the altimeter, and the maximum depth of the CTD package when bottom altimeter readings were available. If there was no altimeter reading, then the bottom depth is reported from the ship's Bathy 2000 or Knudsen model 320B/R depth recorder. These data, corrected for the draft of the transducer, were logged in uncorrected meters (assuming a sound velocity of 1500 m/sec). If the altimeter and depth recorder data were unavailable, the final resort was to use depth data from the SeaBeam system (corrected sound velocities).

The wire out corresponding to each bottle trip was written on the station log and the trips were electronically flagged in the data file. The performance of all sensors was monitored during the cast. After the rosette recovery, the operator created a final flag denoting the end of the cast. Any faulty equipment or exceptionally noisy data were noted on the log sheet.

Problems and Procedural changes

Prior to station 007, position information was not being appended to every scan. The wrong configuration file was later inadvertently chosen and the absolute positions were not appended to the data for Stations 020 casts 3-7, 021 cast 01, 023 casts 1-1, 024 casts 2-3 and 025 cast 1.

CTD Data Processing

Pressure

CTD values determined on deck before and after each cast were compared to determine a pressure offset correction. The comparison suggested that no pressure offset was necessary.

Temperature

The temperature sensors were calibrated in November of 2003. The dual temperature sensors were monitored during the expedition and exhibited good agreement. It appears that no additional corrections need to be applied. A post-cruise calibration will be performed.

Conductivity

Corrected CTD pressure and temperature values were used with bottle salinities to back-calculate bottle conductivities. Comparison of these bottle values with the CTD primary conductivity values indicated no additional offset needed to be applied to the data.

Transmissometer

A WETLabs calibrated transmissometer was utilized throughout the cruise. An on deck calibration check was performed and even though there was little degradation from the last calibration, the new coefficients were applied to the data set.

Oxygen, Fluorometer, and PAR

The CTD oxygen data are only intended for qualitative use. Similarly, the fluorometric and PAR data are not calibrated.

Data Processing

Sea-Bird Seasoft CTD processing software was employed. The processing programs are outlined below. A more complete description may be found in the Sea-Bird Software Manual which is available from the Sea-Bird website (www.seabird.com).

The sequence of programs that were run in processing CTD data from this cruise are as follows:

- ***DATCNV*** - Converts data from raw frequencies and voltages to corrected engineering units
- ***WILDEDIT*** - Eliminates large spikes
- ***CELLTM*** - Applies conductivity cell thermal mass correction
- ***FILTER*** – A low pass filter to smooth pressure for LOOPEDIT
- ***LOOPEDIT*** - Marks scans where velocity is less than selected value to avoid pressure reversals from ship roll, or during bottle flushing.
- ***DERIVE*** - Computes calculated parameters
- ***BINAVG*** - Average data into desired pressure bins

The quality control steps included:

- ***Sensor verification*** After the CTD was set up and sensor serial numbers and sensor location was entered into the computer, another check was made to verify that there were no tabulation errors.
- ***Seasoft Configuration File*** was reviewed to verify that individual sensors were represented correctly, with the correct coefficients.
- ***Temperature*** was verified by comparing primary and secondary sensor data.
- ***Conductivity*** was checked by comparison of the two sensors with each other and with bottle salinity samples.
- ***Position Check*** A chart of the ship's track was produced and reviewed for any serious problems. The positions were acquired from the ship's Trimble P-code navigation system.
- ***Visual Check*** Plots of each usable cast were produced and reviewed for any noise and spikes that may have been missed by the processing programs.
- The density profile was checked for inversions that might have been produced by sensor noise or response mismatches.

CTD Data Footnoting

WHP water bottle quality flags were assigned as defined in the WOCE Operations Manual (Joyce and Corry, 1994). These flags and interpretation are tabulated in the CTD and Bottle Data Distribution, Quality Flags section of this document.

Data Comments

Fine structure including minor density inversions that may appear in the upper ~ 10 m of the profiles is most likely caused by ship discharges/turbulence. To minimize the ship effect, engine cooling water discharges were restricted to the port side of the Healy. A "yo yo" procedure was adopted to induce bottle flushing whenever waves and ship motion were weak. This procedure was employed for all bottle trips under quiescent conditions except for productivity casts. Regardless of the procedure employed, the CTD operators were instructed to wait for at least 1 minute (typically > 1.5 minutes) before tripping the bottle.

All salinity, nutrient and dissolved oxygen data collected by the "service" team have gone through several stages of editing and are not likely to change significantly. This included a post-cruise

examination of the nutrient data by L.A. Codispoti who pointed out suspect values that were then double checked and flagged as appropriate by SIO/ODF personnel.

Bottle Data

There were five generic types of casts performed with differing sampling protocols. Generally speaking, the samplings during these casts were as follows, but there is some cast-to-cast variation.

- **Hydrographic**
  - ***Oxygen,***
  - ***Total CO2,***
  - ***Total Alkalinity,***
  - ***Nutrients***
  - ***Chlorophyll/Phaeophytin***
  - ***Phytoplankton***
  - ***Salinity***
  - ***O18/O16***
  - ***Benthic***
  - ***Dissolved Organic Matter/Particulate Organic Matter***
  - ***Thorium-234***
- **Productivity/Zooplankton**
  - ***Oxygen***
  - ***Oxygen Respiration***
  - ***Productivity***
  - ***Nutrients***
  - ***Chlorophyll***
  - ***HPLC***
  - ***Bacteria***
  - ***Micro Zooplankton***
  - ***Particulate Organic Matter***
  - ***Dissolved Organic Matter/Lignin***
  - ***Bio-Optics***
  - ***Taxonomy***
  - ***C13/N15***
- **Bio-Markers**
  - ***Nutrients***
  - ***Particulate Organic Matter***
  - ***Dissolved Organic Matter/Lignin***
- **Radium**
  - ***Nutrients***
  - ***Radium***
- **Zooplankton**
  - ***Nutrients***
  - ***Micro Zooplankton***
  - ***C13/N15***

The correspondence between individual sample containers and the rosette bottle from which the sample was drawn was recorded on the sample log for the cast. This log also included any comments or anomalous conditions noted about the rosette and bottles.

Normal sampling practice included opening the drain valve before the air vent on the bottle, to check for air leaks. This observation together with other diagnostic comments (e.g., "lanyard caught in lid", "valve left open") that might later prove useful in determining sample integrity was routinely noted on the sample log.

Bottle Data Processing

After the samples were drawn and analyzed, the next stage of processing involved merging the different data streams into a common file. The rosette cast and bottle numbers were the primary identification for all ODF-analyzed samples taken from the bottle, and were used to merge the analytical results with the CTD data associated with that bottle.

Diagnostic comments from the sample log, and notes from analysts and/or bottle data processors were entered into a computer file associated with each station (the "quality" file) as part of the quality control procedure. Sample data from bottles suspected of leaking were checked to see if the properties were consistent with the profile for the cast, with adjacent stations, and, where applicable, with the CTD data. Direct inspection of the tabular data, property-property plots and vertical sections were all employed to check the data. Revisions were made whenever there was an objective reason to delete, annotate or re-calculate a datum. WHP water sample codes were selected to indicate the reliability of the individual parameters affected by the comments. WHP bottle codes were assigned where evidence showed the entire bottle was affected, as in the case of a leak, or a bottle trip at other than the intended depth.

Specific data processing and techniques and additional quality control are included with the parameter write-up.

Pressure and Temperatures

All pressures and temperatures for the bottle data tabulation were obtained by averaging CTD data for a brief interval at the time the bottle was closed and then applying the appropriate calibration data.

The temperatures are reported using the International Temperature Scale of 1990.

Salinity

384 salinity samples were analyzed in 14 analyses runs.

Sampling and Data Processing

Salinity samples were drawn into 200 ml high alumina borosilicate bottles, which were rinsed three times with sample prior to filling. The bottles were sealed with custom-made plastic insert thimbles and Nalgene screw caps. This container provides very low container dissolution and sample evaporation.

Equipment and Techniques

A Guildline Autosal 8400B #65-715, standardized with IAPSO Standard Seawater (SSW) batch P-144, was used to measure the salinities. Prior to the analyses, the samples were stored to permit

equilibration to laboratory temperature, usually 8-20 hours. The salinometer was outfitted with an Ocean Scientific International interface for computer-aided measurement. The salinometer was standardized with a fresh vial of standard seawater (SSW) at the beginning of each analysis run. Instrument drift was determined by running a SSW vial after the last sample was run through the autosal. The salinometer cell was flushed until two successive readings met software criteria for consistency; these were then averaged for a final result. The estimated accuracy of bottle salinities run at sea is usually better than 0.002 PSU relative to the particular standard seawater batch used.

Laboratory Temperature

The temperature stability in the salinometer laboratory was good; variation was no more than 1ºC during a run of samples. The laboratory temperature was generally 2-3ºC lower than the Autosal bath temperature.

Oxygen

463 samples were analyzed for oxygen.

Sampling and Data Processing

Samples were collected for dissolved oxygen analyses as the first sample after the rosette was brought on board. Using a Tygon drawing tube, nominal 125ml volume-calibrated iodine flasks were rinsed three times, then filled and allowed to overflow for approximately 3 flask volumes. The sample draw temperature was measured with a small platinum resistance thermometer embedded in the drawing tube. Reagents were added to fix the oxygen before stoppering. The flasks were shaken twice to assure thorough dispersion of the precipitate, once immediately after drawing, and then again after about 20 minutes. The samples were usually analyzed within a few hours of collection. Thiosulfate normalities were calculated from each standardization and corrected to 20ºC. Periodically, the 20ºC normalities and the blanks were plotted versus time and were reviewed for possible problems. New thiosulfate normalities were recalculated as a linear function of time, if warranted. The oxygen data were recalculated using the smoothed normality and an averaged reagent blank. Oxygens were converted from milliliters per liter to micromoles per kilogram using the sampling temperature.

Equipment and Techniques

Dissolved oxygen analyses were performed with an ODF-designed automated oxygen titrator using photometric end-point detection based on the absorption of 365nm wavelength ultra-violet light. The titration of the samples and the data logging were controlled by PC software. Thiosulfate was dispensed by a Dosimat 665 buret driver fitted with a 1.0 ml buret. The ODF method used a whole-bottle modified-Winkler titration following the technique of Carpenter (1965) with modifications by Culberson (1991), but with higher concentrations of potassium iodate standard (approximately 0.012N) and thiosulfate solution (55 g/l). Standard KIO3 solutions prepared ashore were run at the beginning of each run. Reagent and distilled water blanks were determined, to account for presence of oxidizing or reducing materials.

Volumetric Calibration

Oxygen flask volumes were determined gravimetrically with degassed deionized water to determine flask volumes at ODF's chemistry laboratory. This was done once before using flasks for the first time and periodically thereafter when a suspect bottle volume was detected. The

volumetric flasks used in preparing standards were volume-calibrated by the same method, as was the 10 ml Dosimat buret used to dispense standard iodate solution.

Standards

Potassium iodate was obtained from Johnson Matthey Chemical Co. and was reported by the supplier to be >99.4% pure.

Nutrients

1229 samples were analyzed for nutrients in 63 analyses runs.

Sampling and Data Processing

Nutrient samples were drawn into 45 ml polypropylene, screw-capped "oak-ridge type" centrifuge tubes. The tubes were rinsed with 10% HCl and then with sample three times before filling. Standardizations were performed at the beginning and end of each group of analyses (typically 6-24 samples) with an intermediate concentration mixed nutrient standard, which was prepared prior to each run from a secondary standard in a low-nutrient seawater matrix. The secondary standards were prepared aboard ship by dilution from primary standard solutions. Dry standards were pre-weighed at the laboratory at ODF, and transported to the vessel for dilution to the primary standard. Sets of 6-7 different standard concentrations covering the range of sample concentrations were analyzed periodically to determine the deviation from linearity, if any, as a function of concentration for each nutrient analysis. A correction for non-linearity was applied to the final nutrient concentrations when necessary. After each group of samples was analyzed, the raw data file was processed to produce another file of response factors, baseline values, and absorbances. These values were then checked for accuracy against values taken from strip chart recordings. A stable deep seawater check sample was run occasionally as a substandard check.

Nutrients, when reported in micromoles per kilogram, were converted from micromoles per liter by dividing by sample density calculated at 1 atm pressure (0 db), *in situ* salinity, and the sample temperature measured at the time of analysis.

Equipment and Techniques

Nutrient analyses (nitrate+nitrite, nitrite, phosphate, silicate, ammonium, and urea) were performed on an ODF-modified 6-channel Technicon AutoAnalyzer II, generally within a few hours after sample collection. The samples were kept in the dark by covering with tin foil or refrigerated at 4°C, if necessary, but brought to within 5°C of lab temperature before analysis. The analog outputs from each of the six channels were digitized and logged automatically by computer (PC) at 2-second intervals.

A modification of the Armstrong *et al*. (Armstrong 1967) procedure was used for the analysis of nitrate and nitrite. For the nitrate plus nitrite analysis, the seawater sample was passed through a cadmium reduction column where nitrate was quantitatively reduced to nitrite. The stream was then passed through a 15mm flowcell and the absorbance measured at 540nm. The same technique was employed for nitrite analysis, except the cadmium column was bypassed, and a 50mm flowcell was used for measurement. Periodic checks of the column efficiency were made by running alternate equal concentrations of NO2 and NO3 through the NO3 channel to ensure that column efficiencies were high (> 95%). Nitrite concentrations were subtracted from the nitrate+nitrite values to obtain nitrate concentrations.

Phosphate was analyzed using a modification of the Bernhardt and Wilhelms [Bernhardt 1967.] technique. The reaction product was heated to ~55ºC to enhance color development, then passed through a 50mm flowcell and the absorbance measured at 820m.

Silicate was analyzed using the technique of Armstrong *et al.*, (Armstrong, 1967). The sample was passed through a 15mm flowcell and the absorbance measured at 660nm.

Ammonium was determined by the Berthelot reaction (Patton and Crouch 1977) in which sodium hypochlorite and phenol react with ammonium ion to produce indophenol blue, a blue compound. The solution was heated to 55°C and passed through a 50mm flowcell at 640nm.

Urea was analyzed via a modification of the method of Rahmatullah and Boyde (1980), which is based on the classic diacetyl monoxime method. A solution of diacetyl monoxime, thiosemicarbizide and acetone is followed by the addition of ferric chloride, which acts as a catalyst. The resultant solution was heated to 90°C and passed through a 50mm flowcell. The absorbance was measured at 520nm.

Also reported is N**, a parameter calculated from nitrate, nitrite, ammonium and phosphate concentrations. This parameter is defined as N** = ((N-16P + 2.98)μM) 0.87, where P = the phosphate concentration in μM, and N = (nitrate+nitrite+ammonium in μM). This parameter is quite similar to the original N* parameter defined by Gruber and Sarmiento (1997) except that we include ammonium concentrations because of the high ammonium concentrations that can occur in the SBI region. The underlying premise of both N* and N** is that the N/P atomic regeneration ratio in seawater is normally close to the 16/1 N/P Redfield ratio. The assumption is that deviations from this ratio in N/P ratios in a water mass arise primarily from nitrogen fixation which produces organic matter with N/P ratios in excess of 16/1, or denitrification which consumes nitrate and other forms of fixed nitrogen and converts these forms into elemental dinitrogen gas. Values less than 2.98 suggest that a water mass has experienced net denitrification and higher values suggest net nitrogen fixation. The factors 2.98 and 0.87 are explained by Gruber and Sarmiento (1997), and there is some debate about whether they should be included, but we do so in order to facilitate comparison with the distributions presented by Gruber and Sarmiento (1997).

Nutrient Standards

Na_2SiF_6, the silicate primary standard, was obtained from Johnson Matthey Company and Fisher Scientific and was reported by the suppliers to be >98% pure. Primary standards for nitrate (KNO3), nitrite ($NaNO_2$), and phosphate (KH_2PO_4) were obtained from Johnson Matthey Chemical Company, and the supplier reported purities of 99.999%, 97%, and 99.999%, respectively. Ammonia, (NH4(SO4)2), and Urea primary standards were obtained from Fisher Scientific and reported to be >99% pure.

Bottle Data Footnoting

WHP water bottle quality flags were assigned as defined in the WOCE Operations Manual [Joyce]. These flags and interpretation are tabulated in the Data Distribution, Bottle Data, Quality Flags section of this document.

Data Distribution

The CTD and bottle data can be obtained through NCAR's Earth Observing Laboratory web site, www.eol.ucar.edu/projects/sbi. These data were formerly mounted on a JOSS web site. The data are reported using the WHP-Exchange (WOCE Hydrographic Program) format and the quality coding follows those outlined by the WOCE program (Joyce, 1994). In addition, the format can be obtained through the WOCE Hydrographic Program website, WHPO.ucsd.edu. The descriptions in this document have been edited from the reference to annotate the format specific to this data distribution. ASCII files for each station were created with comments recorded on the CTD Station Logs during data acquisition. These ASCII files include data processing comments noting any problems, the resolution, and footnoting that may have occurred. A separate ASCII file was also created with the comments from the Sample Log Sheets that include problems with the Niskin bottles that could compromise the samples. Comments arising from inspection and checking of the data are also included in the ASCII file. These comment files are also in the EOL/JOSS database. Raw (unprocessed) CTD data are located in the EOL/JOSS database as well. The file hly0402_ctd_raw.zip contains ssscc.cfg, ssscc.con, ssscc.dat and ssscc.hdr (where sss = station number and cc = cast number) files as acquired by the SeaBird SeaSave acquisition program, sbscan.sum file and calibration information for all sensors. The *.cfg file is datcnv.cfg with the beginning scan number and *.con files may include a correction based on the bottle salinity samples. The sbscan.sum file is a list of stations and beginning scan number. Configuration files for the various SeaBird CTD processing programs are also included where applicable.

General rules for WHP-exchange:

1. Each line must end with a carriage return or end-of-line.
2. With the exception of the file type line, lines starting with a "#" character, or including and following a line which reads "END_DATA", each line in the file must have exactly the same number of commas as do all other lines in that file.
3. The name of a quality flag always begins with the name of the parameter with which it is associated, followed by an underscore character, followed by "FLAG", followed by an underscore, and then followed by an alphanumeric character, W.
4. The "missing value" for a data value is always defined as -999, but written in the decimal place format of the parameter in question. For example, a missing salinity would be written -999.0000 or a missing phosphate -999.00.
5. The first four characters of the EXPOCODE are the U.S. National Oceanographic Data Center (NODC) country-ship code, then followed by up to an 8 characters expedition name of cruise number, i.e. 32H1HLY0402.

CTD Data

CTD data is located in file 32H1hly0402_ct1.zip. This file contains ssscc_ct1.csv files for each station and cast where sss=3 digit station identifier and cc=2 digit cast identifier.

Description of ssscc_ct1.csv file layout.

1st line File type, here CTD, followed by a comma and a DATE_TIME stamp

YYYYMMDDdivINSwho

YYYY 4 digit year
MM 2 digit month
DD 2 digit day
div division of Institution
INS Institution name
who initials of responsible person

# lines	A file may include 0-N optional lines at the start of a data file, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file change/update history may be included here, for example.
2nd line	NUMBER_HEADERS = n (n = 10 in this table and the example_ct1.csv file.)
3rd line	EXPOCODE = [expocode] The expedition code, assigned by the user.
4th line	SECT_ID = [section] The SBI station specification. *Optional*.
5th line	STNNBR = [station] The originator's station number
6th line	CASTNO = [cast] The originator's cast number
7th line	DATE = [date] Cast date in YYYYMMDD integer format.
8th line	TIME = [time] Cast time that CTD was at the deepest sampling point.
9th line	LATITUDE = [latitude] Latitude as SDD.dddd where "S" is sign (blank or missing is positive), DD are degrees, and dddd are decimal degrees. Sign is positive in northern hemisphere, negative in southern hemisphere
10th line	LONGITUDE = [longitude] Longitude as SDDD.dddd where "S" is sign (blank or missing is positive), DDD are degrees, and dddd are decimal degrees. Sign is positive for "east" longitude, negative for "west" longitude
11th line	DEPTH = [bottom] Reported depth to bottom. Preferred units are "meters" and should be specified in Line 2. In general, corrected depths are preferred to uncorrected depths. Documentation accompanying data includes notes on methodology of correction. *Optional.*
next line	Parameter headings.
next line	Units.
data lines	A single _ct1.csv CTD data file will normally contain data lines for one CTD cast.
END_DATA	The line after the last data line must read END_DATA, and be followed by a carriage return or end of line.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Parameter names, units, format, and comments

Parameter	Units	Format	Comments
CTDPRS	DB	F7.1	CTD pressure, decibars
CTDPRS_FLAG_W		I1	CTDPRS quality flag
CTDTMP	ITS-90	F8.3	CTD temperature, degrees C (ITS-90)
CTDTMP_FLAG_W		I1	CTDTMP quality flag
CTDSAL		F8.3	CTD salinity
CTDSAL_FLAG_W		I1	CTDSAL quality flag
CTDOXY	UMOL/KG	F7.1	CTD oxygen, micromoles/kilogram

CTDOXY_FLAG_W		I1	CTDOXY quality flag
STHETA		F8.3	Sigma Theta
STHETA_FLAG_W		I1	Sigma Theta quality flag
XMISS	%TRANS	F7.1	Transmissivity, percent transmittance
XMISS_FLAG_W		I1	XMISS quality flag
FLUOR	VOLTS	F8.3	Fluorometer, voltage
FLUOR_FLAG_W		I1	Fluorometer quality flag
PAR	VOLTS	F8.3	PAR, voltage
PAR_FLAG_W		I1	PAR quality flag
SPAR	VOLTS	F8.3	Surface PAR, voltage
SPAR_FLAG_W		I1	Surface PAR quality flag
FLCDOM	VOLTS	F8.3	CDOM Fluorometer, voltage
FLCDOM_FLAG_W		I1	CDOM Fluorometer quality flag
DEPTH	METERS	F8.0	Depth

Quality Flags

CTD data quality flags were assigned to the CTDTMP (CTD temperature), CTDSAL (CTD salinity) and XMISS (Transmissivity) parameters as follows:

2 Acceptable measurement.

3 Questionable measurement. *The data did not fit the station profile or adjacent station comparisons (or possibly bottle data comparisons). The data could be acceptable, but are open to interpretation.*

4 Bad measurement. *The CTD data were determined to be unusable.*

5 Not reported. *The CTD data could not be reported, typically when CTD salinity is flagged 3 or 4.*

9 Not sampled. *No operational sensor was present on this cast*

WHP CTD data quality flags were assigned to the CTDOXY (CTD O_2), FLUORO (Fluorometer), PAR (PAR), SPAR (Surface PAR), and HAARDT (Haardt Fluorometer CDOM) parameter as follows:

1 Not calibrated. *Data are uncalibrated.*

9 Not sampled. *No operational sensor was present on this cast. Either the sensor cover was left on or the depth rating necessitated removal.*

Bottle Data

Description of 32H1HLY0402_hy1.csv file layout.

1st line File type, here BOTTLE, followed by a comma and a DATE_TIME stamp YYYYMMDDdivINSwho
YYYY 4 digit year

MM 2 digit month
DD 2 digit day
div division of Institution
INS Institution name
who initials of responsible person

#lines	A file may include 0-N optional lines, typically at the start of a data file, but after the file type line, each beginning with a "#" character and each ending with carriage return or end-of-line. Information relevant to file change/update history of the file itself may be included here, for example.
2nd line	Column headings.
3rd line	Units.
data lines	As many data lines may be included in a single file as is convenient for the user, with the proviso that the number and order of parameters, parameter order, headings, units, and commas remain absolutely consistent throughout a single file.
END_DATA	The line after the last data line must read END_DATA.
other lines	Users may include any information they wish in 0-N optional lines at the end of a data file, after the END_DATA line.

Header columns

Parameter	Format	Description notes
EXPOCODE	A12	The expedition code, assigned by the user.
SECT_ID	A7	The SBI station specification. *Optional*.
STNNBR	A6	The originator's station number.
CASTNO	I3	The originator's cast number.
BTLNBR	A7	The bottle identification number.
BTLNBR_FLAG_W	I1	BTLNBR quality flag.
DATE	I8	Cast date in YYYYMMDD integer format.
TIME	I4	Cast time (UT) as HHMM
LATITUDE	F8.4	Latitude as SDD.dddd where "S" is sign (blank or missing is positive), DD are degrees, and dddd are decimal degrees. Sign is positive in northern hemisphere, negative in southern hemisphere
LONGITUDE	F9.4	Longitude as SDDD.dddd where "S" is sign (blank or missing is positive), DDD are degrees, and dddd are decimal degrees. Sign is positive for "east" longitude, negative for "west" longitude
DEPTH	I5	Reported depth to bottom. Preferred units are "meters" and should be specified in Line 2. In general, corrected depths are preferred to uncorrected depths. Documentation accompanying data includes notes on methodology of correction. *Optional.*

Parameter names, units, and comments:

Parameter	Units	Format	Comments
CTDPRS	DB	F9.1	CTD pressure, decibars
CTDPRS_FLAG_W		I1	CTDPRS quality flag
SAMPNO		A7	Cast number *100+BTLNBR.

			Optional
CTDTMP	ITS-90	F9.4	CTD temperature, degrees C, (ITS-90)
CTDTMP_FLAG_W		I1	CTDTMP quality flag
CTDCOND	MS/CM	F9.4	CTD Conductivity, milliSiemens/centimeter
CTDCOND_FLAG_W		I1	CTDCOND quality flag
CTDSAL		F9.4	CTD salinity
CTDSAL_FLAG_W		I1	CTDSAL quality flag
SALNTY		F9.4	bottle salinity
SALNTY_FLAG_W		I1	SALNTY quality flag
SIGMA	THETA	F9.4	Sigma Theta
SIGMA_FLAG_W		I1	Sigma Theta quality flag
CTDOXY	UMOL/KG	F9.1	CTD oxygen, micromoles/kilogram
CTDOXY_FLAG_W		I1	CTDOXY quality flag
CTDOXY	ML/L	F9.3	CTD oxygen, milliliters/liter
CTDOXY_FLAG_W		I1	CTDOXY quality flag
OXYGEN	UMOL/KG	F9.1	bottle oxygen
OXYGEN_FLAG_W		I1	OXYGEN quality flag
OXYGEN	ML/L	F9.3	bottle oxygen, milliliters/liter
OXYGEN_FLAG_W		I1	OXYGEN quality flag
O2TEMP	DEGC	F6.1	Temperature of water from spigot during oxygen draw, degrees C
O2TEMP_FLAG_W		I1	O2TEMP quality flag
SILCAT	UMOL/KG	F9.2	SILICATE, micromoles/kilogram
SILCAT_FLAG_W		I1	SILCAT quality flag
SILCAT	UMOL/L	F9.2	SILCATE, micromoles/liter
SILCAT_FLAG_W		I1	SILCAT quality flag
NITRAT	UMOL/KG	F9.2	NITRATE, micromoles/kilogram
NITRAT_FLAG_W		I1	NITRAT quality flag
NITRAT	UMOL/L	F9.2	NITRATE, micromoles/liter
NITRAT_FLAG_W		I1	NITRAT quality flag
NITRIT	UMOL/KG	F9.2	NITRITE, micromoles/kilogram
NITRIT_FLAG_W		I1	NITRIT quality flag
NITRIT	UMOL/L	F9.2	NITRITE, micromoles/liter
NITRIT_FLAG_W		I1	NITRIT quality flag
PHSPHT	UMOL/KG	F9.2	PHOSPHATE, micromoles/kilogram
PHSPHT_FLAG_W		I1	PHSPHT quality flag

PHSPHT	UMOL/L	F9.2	PHOSPHATE, micromoles/liter
PHSPHT_FLAG_W		I1	PHSPHT quality flag
NH4	UMOL/KG	F9.2	AMMONIUM, micromoles/kilogram
NH4_FLAG_W		I1	NH4 quality flag
NH4	UMOL/L	F9.2	AMMONIUM, micromoles/liter
NH4_FLAG_W		I1	NH4 quality flag
UREA	UMOL/KG	F9.2	UREA, micromoles/kilogram
UREA_FLAG_W		I1	UREA quality flag
UREA	UMOL/L	F9.2	UREA, micromoles/liter
UREA_FLAG_W		I1	UREA quality flag
FLUORO	VOLTS	F8.3	Fluorometer, voltage
FLUORO_FLAG_W		I1	Fluorometer quality flag
PAR	VOLTS	F8.3	PAR, voltage
PAR_FLAG_W		I1	PAR quality flag
SPAR	VOLTS	F8.3	Surface PAR, voltage
SPAR_FLAG_W		I1	Surface PAR quality flag
HAARDT	VOLTS	F8.3	CDOM Fluorometer, voltage
HAARDT_FLAG_W		I1	CDOM Fluorometer quality flag
N**	UMOL/L	F9.2	N**, micromoles/liter
N**_FLAG_W		I1	N** quality flag
CHLORO	UG/L	F8.2	Chlorophyll, micrograms/liter
CHLORO_FLAG_W		I1	Chlorophyll quality flag
PHAEO	UG/L	F8.2	Phaeophytin, micrograms/liter
PHAEO_FLAG_W		I1	Phaeophytin quality flag
BTL_DEP	METERS	F5.0	bottle depth, meters
BTL_LAT		F8.4	Latitude at time of bottle trip, decimal degrees
BTL_LONG		F9.4	Longitude at time of bottle trip, decimal degrees
JULIAN		F8.4	Julian day and time as fraction of day of the bottle trip.

Quality Flags

CTD data quality flags were assigned to CTDPRS (CTD pressure), CTDTMP (CTD temperature), CTDCOND (CTD Conductivity), and CTDSAL (CTD salinity) as defined in Data Distribution, CTD Data, Quality Flags section of this document. CTDOXY (CTD O_2), FLUORO (Fluorometer), PAR (PAR), and SPAR (Surface PAR) parameters are flagged with either a 2, acceptable or 9, not drawn.

Bottle quality flags were assigned to the BTLNBR (bottle number) as defined in the WOCE Operations Manual [Joyce] with the following additional interpretations:

2 No problems noted.

3 Leaking. *An air leak large enough to produce an observable effect on a sample is identified by a flag of 3 on the bottle and a flag of 4 on the oxygen. (Small air leaks may have no observable effect, or may only affect gas samples.)*

4 Did not trip correctly. *Bottles tripped at other than the intended depth were assigned a flag of 4. There may be no problems with the associated water sample data.*

9 The samples were not drawn from this bottle.

WHP water sample quality flags were assigned to the water samples using the following criteria:

1 The sample for this measurement was drawn from the water bottle, but the results of the analysis were not (*yet*) received.

2 Acceptable measurement.

3 Questionable measurement. *The data did not fit the station profile or adjacent station comparisons (or possibly CTD data comparisons). No notes from the analyst indicated a problem. The data could be acceptable, but are open to interpretation.*

4 Bad measurement. *The data did not fit the station profile, adjacent stations or CTD data. There were analytical notes indicating a problem, but data values were reported. Sampling and analytical errors were also flagged as 4.*

5 Not reported. *The sample was lost, contaminated or rendered unusable.*

9 The sample for this measurement was not drawn.

Not all of the quality flags are necessarily used on this data set.

References

Armstrong, F. A. J., Stearns, C. R., and Strickland, D. H., "The measurement of upwelling and subsequent biological processes by means of the Technicon AutoAnalyzer and associated equipment," *Deep-Sea Research*, 14, pp. 381-389, (1967).

Bernhardt, Wilhelms A., "The continuous determination of low level iron, soluble phosphate and total phosphate with the AutoAnalyzer", *Technicon Symposia*, **I**, pp. 385-389 (1967).

Carpenter, J. H., "The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method," *Limnology and Oceanography*, 10, pp. 141-143 (1965).

Culberson, C. H., Knapp, G., Stalcup, M., Williams, R.T., and Zemlyak, F., "A comparison of methods for the determination of dissolved oxygen in seawater," Report WHPO 91-2, WOCE Hydrographic Programme Office (Aug 1991).

Gordon, L.I., Jennings, J.C., Ross, A.A. and J.M. Krest, "A Suggested Protocol for Continuous Flow Automated Analysis of Seawater Nutrients in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study". 1993. WOCE Hydrographic Programs Office, Methods Manual WHPO 91-1.

Gruber, N. and J.L. Sarmiento, "Global patterns of marine nitrogen fixation and denitrification." *Global Biogeochem. Cycles,* 11(2), pp. 235-266, (1997).

Intergovernmental Oceanographic Commission, Scientific Committee on Oceanic Research Manual and Guides 29 Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. UNESCO, 170pp., (1994).

Joyce, T. ed., and Corry, C. ed., "Requirements for WOCE Hydrographic Programme Data Reporting," Report WHPO 90-1, WOCE Report No. 67/91 3.1, pp. 52-55, WOCE Hydrographic Programme Office, Woods Hole, MA, USA (May 1994, Rev. 2), UNPUBLISHED MANUSCRIPT

Patton, C.J. and Crouch, S.R., "Spectrophotometric and kinetics investigation of the Berthelot reaction for the determination of ammonia," *Analytical Chemistry*, 49(3), pp.464-469 (1977).

Rahmatullah, Mohammed, and Boyde, T.R.C, "Improvements in the determination of urea using diacetyl monoxime; methods with and without deproteinisation," *Clinica Chimica Acta, 107, pp.3-9 1980.*

Sea-Bird Electronics, Inc, CTD Data Acquisition Software Manual, March 2001.

Sea-Bird Electronics, Inc., CTD Operating and Repair Manual, February 2002.

APPENDIX A: Bottle Quality Comments

Remarks for deleted samples, missing samples, PI data comments, and WOCE codes other than 2 from USCGC Healy, HLY-04-02. Comments from the Sample Logs and the results of ODF's investigations are included in this report. Investigation of data may include comparison of bottle salinity and oxygen data with CTD data, review of data plots of the station profile and adjoining stations, and rereading of charts (i.e. nutrients). Units stated in these comments are degrees Celsius for temperature, Practical Salinity Units for salinity, and unless otherwise noted, milliliters per liter for oxygen and micromoles per liter for Silicate, Nitrate, Nitrite, Phosphate and Urea and Ammounium, if appropriate. The first number before the comment is the cast number (CASTNO) times 100 plus the bottle number (BTLNBR).

Station 001.001

101-104 Nutrients: "Autoanalyzer error, clorox line popped off, NH4 samples lost."
103 Urea appears 0.2 high compared with station profile. No analytical problems noted, higher on chart, could be bad. Footnote urea questionable.
103-104 Oxygen and salinity not drawn per sampling schedule.
104 Sampled for POM.
105 Sample Log: "Leak in bottle from top vent." Oxygen as well as other samples are acceptable. Salinity: "Loose thimble." Bottle salinity agrees with CTD and appears okay on profile.
109-111 Oxygen and salinity not drawn per sampling schedule.
110 Sampled for DOM.
111 Sampled for DOM and Lignin.
112 Sample Log: "Leak in small spigot." Oxygen and salinity as well as nutrients are acceptable.

Station 002.001

105 Salinity, oxygen and nutrients were not drawn per sampling strategy.
107 Sample Log: "Leak in bottle from top cap." Oxygen as well as other samples are acceptable.
109 Sampled for POM.
110 Sampled for DOM and Lignin.

Station 003.001

Cast 1 CTD: "No samples were drawn because the top vents had been left open. Cast was redone as cast 02."

Station 003.002

203-204 No samples taken per sampling strategy.
207 Sample Log: "Top cap leak on bottle." Salinity appears a little low. O2 is high. Bottle leak appears to have effected the samples, nutrients appear okay. Footnote bottle leaking, salinity and oxygen bad.
210 Nosamples taken.
211 Sampled for POM, DOM-2 and Lignin.
212 Sample Log: "Major leak on bottle from small bottom spigot." Oxygen as well as other samples are acceptable. Salinity: "Thimble popped off." Bottle salinity agrees with CTD and appears okay on profile.

Station 004.001

103 Oxygen, salinity and nutrients not drawn per sampling schedule, samples taken for

POM.
105 Oxygen: "Computer crashed lost sample."
106 Salinity: "Bung broke off before salinity analyzed, delay. Loose thimble." Bottle salinity agrees with CTD and appears okay on profile. PI: "NH4 may be high." Nutrient analyst: "Bubble in line, corrected value, data okay."
107 Sample Log: "Small air vent or cap leak on bottle." Oxygen as well as other samples are acceptable.
109 Oxygen, salinity and nutrients not drawn per sampling schedule, samples taken for POM, DOM and Lignin.
110 Oxygen, salinity and nutrients not drawn per sampling schedule, samples taken for POM and DOM.
111 Salinity: "Loose thimble." Bottle salinity agrees with CTD and appears okay on profile. Oxygen: "Computer crashed lost sample."
112 SampleLog: "Major leak in bottle and will not be sampled out of until repaired."

Station 005.001

102 Samples taken for Benthic.
106 Salinity: "Loose thimble." Bottle salinity agrees with CTD and appears okay on profile. Oxygen: "Computer crashed lost sample."
107 Sample Log: "Small vent leak on bottle." Oxygen as well as other samples are acceptable. Salinity: "Three readings before two good readings were made. Second reading was low and would make the salinity even less saline. No obvious reason why salinity low by about about 0.005. Footnote salinity bad.
109 Samples taken for POM only.
110 Samples taken for DOM and Lignin only.
112 SampleLog: "No sample taken out of bottle due to major leak."

Station 006.001

101 Samples taken for Bact, C13/N15 only.
103 Samples taken for Bact, C13/N15 only.
106 Samples taken for POM only.
107 Samples taken for POM and Lignin only.
109 Sample Log: "Small bubbles found in Oxy flask upon second shake." Oxygen appears slightly high compared with CTD and station profile. Footnote oxygen bad.
111 Nosamples drawn per sampling strategy.
112 Nosamples drawn per sampling strategy.
Cast 1 Salinity not drawn, Productivity cast.

Station 006.002

Cast 2 CTD: "A-Frame h.p.u was dead. Rosette hung out under A-Frame (-0.36) until whole A-frame power was being restored. No water samples taken."

Station 006.003

304 Nosamples drawn per sampling strategy.
306 Salinity 0.01 high vs. the CTD, could be interpreted as high on the station profile. Both conductivity sensors agree fairly well. No analytical or sample drawing notes to indicate a problem. Footnote salinity uncertain.
308 Samples taken for POM only.
310 Nosamples drawn per sampling strategy.

Station 006.004

401 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
402-412 Salinity, oxygen and nutrients not drawn unless noted otherwise, Radium cast.

Station 007.001

101-110 Salinity, oxygen and nutrients not drawn, Radium cast and Thorium.
111 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
112 Salinity, oxygen and nutrients not drawn, Radium cast and Thorium.

Station 007.002

207 Samples taken for POM.
208 Nosamples drawn per sampling strategy.
211 Nosamples drawn per sampling strategy.

Station 007.003

301 Samples taken for Bacteria only.
303 PI: "Urea and NH4 high." Nutrient analyst: "No analytical problems noted; possible contamination, NH4 could be related to higher Urea." Footnote Urea and NH4 questionable.
304 Sample Log: "Bubble noticed in oxygen on second shake." Oxygen agrees with CTD and station profile.
306 Samples taken for POM only.
307 Samples taken for DOM/Lignin only.
308 SampleLog: "Oxygen redrawn." Oxygen agrees with CTD and station profile.
310-311 No samples taken per sampling strategy.
312 Samples taken for O2 incubation only.
Cast 3 Salinity not drawn, Productivity cast.

Station 008.001

101 Samples taken for Bact, C13/N15 only.
102 Samples taken for POM only.
103 Samples taken for DOM/Lignin only.
105 Sample Log: "Bottom cap leak, not stopped by jiggling cap. Serious leak when air vent open." Samples not drawn.
106 SampleLog: "Used for the samples originally intended for 5."
108 Samples taken for POM only.
112 Samples taken for O2 respiration only.
Cast 1 Salinity not drawn, Productivity cast. Taxonomy samples were not written down, not sampled in order. Received sample numbers after the cast. Sample Log: "Sampled from deep to shallow."

Station 009.001

101 Samples taken for Bact, C13/N15 and O18 only.
102 SampleLog: "Redraw on oxygen."
104 Samples taken for HPLC, Taxonomy, and C13/N15 only.
106 Samples taken for POM only.
107 Samples taken for DOM/Lignin and O18 only.
108 Samples taken for O2 incubation only.
110 SampleLog: "Redraw on oxygen."
112 Nosamples drawn per sampling strategy.
Cast 1 Salinity not drawn, Productivity cast.

Station 009.002

201 Onlynutrients drawn, Zooplankton cast also N15/C13.

202 Nosamples drawn per sampling strategy.
203 Onlynutrients drawn, no other samples drawn.
204 Nosamples drawn per sampling strategy.
205-209 Samples taken for Zooplankton.
210 Nosamples drawn per sampling strategy.
211-212 Samples taken for Zooplankton.

Station 009.003

301 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
302-312 Salinity, oxygen and nutrients not drawn per sampling strategy, Radium cast.

Station 009.004

401 Salinity: "Loose thimble." Levels at the bottom (3 bottles) and at 30 meters, bottle 4, CTD salinity 0.277 higher, bottles on 0.070 higher. CTD Oxygen 0.440 lower, bottle Oxygen only 0.034 lower. Water changed salinity in 2-3 meters about the same as what the difference is between the bottle and CTD. The salinity problem on bottle 4 accounts for only a small part of the 4 vs. 1 bottle differences.
401-403 CTD Log: "Small near-bottom layer, too close to yo-yo."
402 SampleLog: "Suspect only about 18l in bottle." Samples taken for C13/N15 only.
403 Samples taken for POM only.
404 Salinity: "Suspect salt crystal entered from chipped neck seal." The salt crystal would make the salinity a little higher which it is, ˜0.006. Footnote salinity questionable.
407 Sample Log: "Vent is open." Oxygen and salinity are acceptable, therefore, other samples okay too.
409 Nosamples drawn per sampling strategy.
412 Nosamples drawn per sampling strategy.

Station 010.001

101 O2 high, salinity low, nutrients also indicate bottle may not have been flushed adequately. Footnote samples questionable.
106 Nosamples drawn per sampling strategy.
107 SampleLog: "Top cap leak."
108 Nosamples drawn per sampling strategy.
110 Nosamples drawn per sampling strategy.
111 Sample Log: "Bottom cap leak, o-ring is out of position." Samples taken for POM only.

Station 010.002

201 Onlynutrients drawn per sampling schedule, samples for POM, Zooplankton cast.
202-205 POM only samples drawn.
206 DOMonly samples drawn.
207 Only nutrients drawn per sampling schedule, Zooplankton cast. Bottle was changed out at the end of the last cast.
208 Nosamples drawn per sampling strategy.
209 Onlynutrients drawn per sampling schedule, Zooplankton cast.
210-212 Samples for Zooplankton only.

Station 011.001

101 Sample Log: "Water froze in spigot." Only nutrients drawn per sampling schedule, Bacteria.
102 Samples taken for C13/N15 only.

103 SampleLog: "Water froze in spigot."
104 Oxygen appears to be ˜0.5 low, no analytical problems noted. Footnote oxygen questionable.
105 Samples taken for C13/N15 only.
107-108 No samples drawn per sampling strategy.
110 Samples taken for O2 incubation only.
Cast 1 Salinity not drawn, Productivity cast.

Station 012.001

101 Sample Log: "Slight leak from spigot when vented, suspect ice stuck in cap." Samples taken for O2 and POM only. Switch sampling to bottle 2.
104 Sample Log: "Slight leak from spigot when vented." Bottle salinity ˜0.5 high, O2 ˜0.04 low relative to CTD; suggest non-ideal flushing. Leave as is.
105 SampleLog: "Bottom cap leak when vented."
109 Samples taken for C13/N15, DOM and POM only.
111 Nosamples drawn per sampling strategy.
112 Sample Log: "Bottom cap leak when vented. O2 redrawn." Oxygen high by about 0.07 ml/l. Footnote oxygen questionable.
Cast 1 Biological slime on rosette.

Station 013.001

103 Bottle salinity appears to be low by about 0.1, oxygen appears high by 0.1-0.2 compared to CTD. Acceptable for gradients.
105 Samples taken for TH-234, C13/N15 only.
107 Samples taken for TH-234.
108 Bottle O2 high by about 0.02-0.03. No analytical notes. Could be a drawing problem. Within the accuracy of the measurement, leave as is.
109 Samples taken for TH-234, C13/N15 only.
111 Samples taken for TH-234.

Station 014.001

101-102 Bottle salinity low compared to CTD, but appears to be close to correct for gradient.
103 Samples taken for TH-234, C13/N15 only.
104 Sample Log: "Small spigot leak when vented." Oxygen high by ˜0.3 and salinity low by 0.04-0.05. Salinity appears to be close to correct for gradient, (bottles are 1.5m shallower than CTD). Okay as is. Footnote bottle leaking, oxygen questionable.
105 Salinity: "Thimble blew out when cap removed." Salinity may by low by 0.02, footnote salinity questionable. Bottle salinity low compared to CTD, but appears to be close to correct for gradient.
109 Samples taken for TH-234, C13/N15 only.
111 Samples taken for TH-234 only.

Station 015.001

102 Samples taken for DOM/Lignin only.
103 CTDO2 agrees with bottle O2 that 103 has lower O2, higher nutrient water than does 101. Data is acceptable.
103-105 Bottle salinity lower than CTD, but appears to be correct for vertical gradient (bottle is 1.5m above CTD).
109-111 Bottle salinity higher than CTD. No apparent issues. Data is acceptable.
Cast 1 CTD: "Waited five minutes for bridge to give permission, secondary temperature sensor -1.8 degrees at deployment, may have frozen a bit, was okay in water."

Station 016.001
101-104 Bottles were tripped, no samples taken.
Cast 1 CTD: "Cast was aborted due to data communication problems. Cast was redone as cast 02."
Station 016.002
201 SampleLog: "Leak in small spigot." O2 could be a little low, leave as is.
205 NO2high by by ˜0.04. Higher on chart, no problems. Footnote NO2 questionable.
212 CTD: "Pulled rosette out of the water before the last bottle tripped reinserted rosette wait for pumps to come back on before tripping last bottle."
Cast 2 Cast 1, Productivity, aborted, problem with CTD.
Station 016.003
Cast 1 CTD: "Cast was aborted when pumps did not turn on. Cast was redone as cast 04. The sample depth for 3-13 are to be mid-point of bottle, or CTD 1.5m deeper than desired depths.
Station 016.004
401 Sample Log reports samples were not drawn, but nutrients are reported. Sample Log: "Major bottom cap leak when air vent was opened." MSTs reported bottle leaking on deck. Urea high compared to this level at other casts. Urea higher than adjacent samples, but so is NH4. No analytical problem or contaminated? Footnote Urea questionable.
402 Samples taken for DOM/Lignin.
403 Onlynutrients drawn, Zooplankton cast.
404 Samples taken for Zooplankton.
405 SeeUrea comments on 401. Footnote urea questionable.
405-407 Only nutrients drawn, Zooplankton cast.
406 SeeUrea comments on 401. Footnote urea questionable.
408-410 Samples taken for Zooplankton.
411 Onlynutrients drawn per sampling schedule, Zooplankton cast.
412 Nosamples drawn per sampling strategy.
Cast 4 Cast 3 aborted. CTD: "The sample depth for bottles 3-13 are to be mid-point of bottle, or CTD 1.5m deeper than desired depths.
Station 016.005
501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
502 Salinity, oxygen and nutrients not drawn, DOM/Lignin only.
503-512 Salinity, oxygen and nutrients not drawn, Radium cast.
Station 016.006
601 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
602-606 Salinity, oxygen and nutrients not drawn, Radium cast.
607 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
608-612 Salinity, oxygen and nutrients not drawn, Radium cast.
Station 017.001
102 Samples taken for DOM/Lignin only.
103 Samples taken for POM only.
104 Samples taken for POM only.
105 Oxygen: "Lost sample, possibly pickling error, no end point reached."
110 Samples taken for DOM/Lignin only.
111 Samples taken for POM only.

112 Samples taken for POM only.

Station 017.002

203 NH4˜0.04 high. Leave as is. NO2 0.04-0.05 high. No analytical problems, definitely higher. Leave as is.
205 Samples taken for Bact, C13/N15, and POM only.
206 Samples taken for O2 incubation only.
207 Samples taken for DOM/Lignin only.
210 Samples taken for Bact, C13/N15 only.
211 Nosamples drawn per sampling strategy.

Station 017.003

301 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
302-306 Salinity, oxygen and nutrients not drawn, Radium cast.
307 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea high by ˜0.3, NH4 by ˜0.05, compared with cast 1 and 2. Odd looking peaks Urea-could easily be lower. Footnote Urea questionable. NH4 within analytical precision, but could be high-noisy peak. Leave NH4 as is.
308-312 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 017.004

401 Nutrients drawn per sampling schedule, Bacteria sampled.
402 Nutrients drawn per sampling schedule, Bacteria sampled.
403 Oxygen: "Sample lost, overtitrated then back-titrated but sample never went to clear."
405 SampleLog: "O2 redrawn."
406 Samples taken for O2 incubation only.
410-412 No samples drawn per sampling strategy.
Cast 4 Salinity not drawn, Productivity cast.

Station 018.001

101 Sample Log: "leak in bottle 1, cap not sealed." No samples drawn per sampling strategy.
102 NO2seems high, but there is a near-bottom increase though not to such a high level, at Station 17 (but not at Station 19). Still may be questionable. No analytical problems, data are acceptable.

Station 019.001

103 Ureaappears to be ˜0.04 high. Urea high on chart. Footnote Urea questionable.
104 Salinity: "Bottle loose thimble, no fit with others-retired bottle." Salinity agrees with CTD. Data are acceptable.
107 Sample Log: "Has a small leak." Salinity and O2 agrees with CTD. Data are acceptable.
112 Bottle O2 ˜0.12 high compared to CTDO, but it is possible this is correct for gradient.

Station 019.002

206 Salinity: "Bottle thimble popped out, salt drop ran into bottle use first reading." Salinity is 0.05 higher than CTD. Gradient, leave as is.
207 Sample Log: "Still has a small leak." Salinity 0.04 higher than CTD, O2 agrees fairly well.
210 SampleLog: "Top o-ring is out of place." No samples drawn except O-18.

Station 019.003

301 Nutrients drawn per sampling schedule, Zooplankton cast.
302-309 Samples taken for Zooplankton only.
310 Nutrients drawn per sampling schedule, Zooplankton cast.

311-312 Samples taken for Zooplankton only.

Station 019.004

401-405 Salinity, oxygen and nutrients not drawn, Radium cast.
406 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Autoanalyzer error nh4 channel only
407-411 Salinity, oxygen and nutrients not drawn, Radium cast.
412 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Autoanalyzer error nh4 channel only

Station 019.005

501-508 Salinity, oxygen and nutrients not drawn, Radium cast.
509 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Autoanalyzer error nh4 channel only
510-512 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 019.006

601-602 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
603-604 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
605-607 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
608 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
609-610 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
611 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast. Autoanalyzer error nh4 channel only
612 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.

Station 019.007

701-702 Nutrients drawn per sampling schedule, samples taken for Bacteria.
705 SampleLog: "Redraw oxygen."
707 Samples taken for O2 incubation only.
710-712 No samples drawn per sampling strategy, Productivity cast.
Cast 7 Salinity not drawn, Productivity cast.

Station 020.001

101 Samples taken for Bacteria.
105 Samples taken for O2 incubation only.
106-107 No samples drawn per sampling strategy.
110 SampleLog: "Oxygen redrawn." Oxygen is acceptable.
111-112 No samples drawn per sampling strategy.
Cast 1 Salinity not drawn, Productivity cast.

Station 020.002

201 Nutrients drawn per sampling schedule, Zooplankton cast.
202-209 Samples taken for Zooplankton only.
210 Sample Log: "Vent not shut tight." Nutrients drawn per sampling schedule, Zooplankton cast.
211-212 Samples taken for Zooplankton only.
Cast 2 Oxygen and Salinity not drawn, Zooplankton cast.

Station 020.003

302 Samples taken for DOM/Lignin only.

303-305 Samples taken for POM only.
312 Sample Log: "Small bottom cap leak-stopped when reset (pushed in)." Oxygen and salinity are acceptable.

Station 020.004

402-403 Autoanalyzer problem, PO4 lost.
407 Salinity: "Too full above shoulder." Salinity is 0.007 compared with CTD, gradient. Okay as is.
410 Salinity: "Too full above shoulder." Salinity is 0.023 high compared with CTD, gradient. Okay as is.
412 Sample Log: "Leak when vent is open on bottom cap." Salinity: "Too full above shoulder." Oxygen and salinity are acceptable.

Station 020.005

501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
502-503 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
504 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
505-506 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
507-508 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
509 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
510 Sample Log: "Major bottom cap leak, o-ring out of groove, visibly." No samples drawn.
511 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
512 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.

Station 020.006

601 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea ˜0.08 high compared with other casts. No analytical problems, data are acceptable.
602-606 Salinity, oxygen and nutrients not drawn, Radium cast.
607 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
608-612 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 020.007

701 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
702-706 Salinity, oxygen and nutrients not drawn, Radium cast.
707 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea about 0.05-0.08 high compared with other bottles/casts near this level. No analytical problems, data is acceptable.
708-712 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 021.001

106 Salinity ˜0.04 high, could be okay for gradient and incomplete flushing except that bottle O2 does not show same sense of error. May be questionable salinity. Footnote salinity questionable.
107-108 Appears that nutrient tubes were switched. No equivalent structure was seen in CTDO and O2. Switch nutrients.

Station 022.001

101 Samples taken for O2 incubation and POM.
106 Samples taken for Bact, C13/N15 only.
107 Samples taken for O2 incubation and Zoop.
110 Samples taken for O2 incubation.
111 Samples taken for DOM/Lignin.
112 Samples taken for POM only.
Cast 1 Salinity not drawn, Productivity cast.

Station 022.002

201 Nutrients drawn per sampling schedule, Zooplankton cast.
202-208 Samples taken for Zooplankton only.
209 Nosamples drawn per sampling strategy.
210 Samples taken for DOM/Lignin only.
211 Nosamples drawn per sampling strategy.
212 Samples taken for POM only.

Station 023.001

101 Urea approximately 0.05 higher than same depth other samples. No analytical problems found on recheck of data. NH4 higher as as well; probably okay. 0.05 is within analytical precision.
102 Samples taken for DOM/Lignin only.
107 SampleLog: "Small leak in niskin when vent was closed". Oxygen agrees with CTD.
111 Samples taken for DOM/Lignin only.
112 Salinity: "Salinity bottle mislabeled on Sample Log Sheet as 12."

Station 023.002

201 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
202-204 Salinity, oxygen and nutrients not drawn, Radium cast.
205 Sample Log: "May be leaking as came on deck, pushed up on bottom cap and then it stopped." No samples drawn.
206-208 Salinity, oxygen and nutrients not drawn, Radium cast.
209 Nosamples drawn per sampling strategy.
210 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, C13/N15.
Urea is 0.29 higher than similar depths on other casts. Analytical recheck indicates peak in higher, but noisy, other nutrients are higher too than 212. Footnote urea questionable.
211 Salinity, oxygen and nutrients not drawn, O2 incubation.
212 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Zooplankton.
Urea is 0.13 higher than similar depths on other casts. No analytical problem found.
Footnote urea questionable.

Station 024.001

101 Bottle salinity low by approximately 0.15, but is in high gradient, high salinity bottom layer so it probably okay.
105 Sample Log: "Major leak from bottom end cap when vented." Did not sample for oxygen. Nutrients and salinity samples were taken and very little water was left.
After cast repair found o-ring had come out of groove. Salinity: "Three readings to obtain two good readings." Salinity is acceptable.
107 This is an unusual water sample, but CTDS agrees with bottle salinity, CTDO agrees with bottle O2, and nutrients agree with O2, so appears to be genuine.
108 Bottle salinity low by approximately 0.2, but could be okay for high salinity gradient.

111 Sample Log: "Bottom cap leak when vented, water pouring out. After cast repair found o-ring had come out of groove.

Station 024.002

201 Salinity, oxygen and nutrients not drawn, DOM/Lignin.
202-203 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
204 Salinity, oxygen and nutrients not drawn, POM only.
205-207 No samples taken per sampling strategy.
Cast 2 Cast was changed to Bio-Mark cast, only 7 bottles tripped when the ice closed in on rosette, had to bring back on board.

Station 024.003

301-302 Nutrients drawn per sampling schedule, Bacteria.
303 Samples taken for O2 incubation only.
305-306 Samples taken for C13/N15 only.
306 SampleLog: "Bottom o-ring leak.
308 Samples taken for O2 incubation only.
Cast 3 Salinity not drawn, Productivity cast.

Station 024.004

401 Nutrients drawn per sampling schedule, Zooplankton cast. Urea high by about 0.2 compared to other samples near this level at this station. No analytical problems found. Footnote urea questionable.
402-404 Samples taken for Zooplankton only.
405 Nutrients drawn per sampling schedule, Zooplankton cast.
406-412 Samples taken for Zooplankton only.
Cast 4 Oxygen and Salinity not drawn, Zooplankton cast.

Station 024.005

501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea slightly high for this level. No analytical problems found.
502-506 Salinity, oxygen and nutrients not drawn, Radium cast.
505 SampleLog: "Also did not seat, but not as bad as 8."
507 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
508 SampleLog: "Did not seat properly (bad leak)."
508-512 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 025.001

101 NH4appears high; may be okay for this layer at nearby casts. No analytical problems found.
101-104 Salinity and oxygen not drawn per sampling schedule, Bacteria.
105 Salinity, oxygen and nutrients not drawn per sampling schedule, samples for O2 incubation and DOM/lignin.
107 Ureais high for this level, approximately 0.08. No analytical problems found. Footnote urea questionable.
108 Salinity, oxygen and nutrients not drawn per sampling schedule, samples for O2 incubation.
Cast 1 Salinity not drawn, Productivity cast.

Station 026.001

107 SampleLog: "Leak from top cap."

Station 026.002

205 SampleLog: "Top cap out of line-leaking."
211 Sample Log: "No water left for nutrients." No salinity, oxygen or nutrients, samples for C13/N15.
212 Nutrients drawn per sampling schedule, no salinity or oxygen, samples for C13/N15.

Station 026.003

301 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea unusually high for this station. No analytical problem found, the "peak' is higher than other samples, could be contamination. Footnote questionable.
302-306 Salinity, oxygen and nutrients not drawn, Radium cast.
307 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
308-312 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 026.004

401 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
402-406 Salinity, oxygen and nutrients not drawn, Radium cast.
407 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
408-412 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 026.005

501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
502-503 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
504 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
505 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
506 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
507 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
508 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
509 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
510 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
511 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
512 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.

Station 026.006

601-602 Nutrients drawn per sampling schedule, Bacteria.
603 Nutrients drawn, no other measurements.
604 Nutrients drawn per sampling schedule, Bacteria.
606 SampleLog: "O2 redrawn."
611 Samples taken for O2 incubation and Bacteria.
612 Samples taken for O2 incubation only.
Cast 6 Salinity not drawn, Productivity cast.

Station 027.001

Cast 1 Cast aborted, no water samples.

Station 027.002

201 Nutrients drawn per sampling schedule, Zooplankton cast.

202-203 Samples taken for Zooplankton only.
204-205 Samples taken for C13/N15 only.
206 Nutrients drawn per sampling schedule, Zooplankton cast. Sample Log: "Bottom cap leak when vented."
207-212 Samples taken for Zooplankton only.
Cast 2 Oxygen and Salinity not drawn, Zooplankton cast.

Station 027.003

302 Sample Log: "O2 redraw, twice." Similar agreement with CTD as other samples. Oxygen is acceptable.
310 Sample Log: "Bad leak bottom when vented." Oxygen is acceptable, gradient area, salinity is acceptable.
311 Sample Log: "Leaking bottom cap when spigot pushed in." Salinity does not agree with CTD, oxygen is a little low, gradient and data are acceptable.

Station 027.004

401-402 Nutrients drawn per sampling schedule, Bacteria sampled.
403 Samples taken for O2 incubation and Bacteria.
406 Samples taken for O2 incubation and Bacteria.
407 SampleLog: "Top cap leak." Oxygen as well as other samples are acceptable.
409 Sample Log: "Triplicate oxygen drawn for O2 incubation experiment." Salinity and nutrients not drawn per sampling schedule.
412 Samples taken for Bacteria only.
Cast 4 Salinity not drawn, Productivity cast.

Station 027.005

505 Sample Log: "Top cap leak." O2 high, but is in unusual layer, so may be okay; bottle salinity is okay as are nutrients.
506 Sample Log: "Bottom cap did not seal, leaking, o-ring, did not sample oxygen or salinity."
511 Sample Log: "Bottom cap small leak." Salinity and oxygen are acceptable, good agreement with CTD.

Station 027.006

601 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
602-606 Salinity, oxygen and nutrients not drawn, Radium cast.
607 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
608-612 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 027.007

701 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
702-706 Salinity, oxygen and nutrients not drawn, Radium cast.
707 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea is highest value, 0.05, at this level on Stations 024-027. But compares to Station 026, so may be okay. Rechecked data, no analytical problems.
708-712 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 027.008

801 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
802-803 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
804 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker

cast.
805 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
806-807 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
808 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
809 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
810 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
811 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
812 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.

Station 028.001

101-104 Nutrients drawn per sampling schedule, Bacteria.
105 Samples taken for O2 incubation only.
112 Samples taken for O2 incubation, HPLC Bio-Optics and taxonomy.
Cast 1 Salinity not drawn, Productivity cast.

Station 028.002

201 Nutrients drawn, Zooplankton cast.
203 SampleLog: "Bottom o-ring replaced before cast, bottles look okay at end of cast."
204-205 Samples taken for C13/N15.
208 SampleLog: "Bottom o-ring replaced before cast, bottles look okay at end of cast."
209-211 Samples drawn for Zooplankton.
212 Nutrients drawn, Zooplankton cast.
Cast 2 Salinity, Oxygen and nutrients not drawn, except as noted, Zooplankton cast.

Station 028.003

304 Urea is slightly high for this level. No analytical problems found. Data are acceptable.
307 SampleLog: "Top cap leak." Oxygen and salinity are acceptable.
312 Large O2/CTDO difference seems to be okay for gradient.

Station 028.004

407 Sample Log: "Small leak with vent closed-suspect crack in handle mount." CTD vs. bottle oxygen difference is a little lower than other bottles, but is in a gradient that supports this difference. Nutrients are in general agreement. Bottle oxygen is okay.

Station 028.005

501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
502-503 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
504 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
505-506 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
507 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
508-509 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
510 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
511-512 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.

Station 028.006

601 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
602-606 Salinity, oxygen and nutrients not drawn, Radium cast.
606 SampleLog: "Bottom end cap leak."
607 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
608-612 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 028.007

701 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
702-712 Salinity, oxygen and nutrients not drawn, Radium cast.
708 SampleLog: "Bottom end cap leak."

Station 029.001

101-102 Interesting nutrient relationship at bottom; SiO3 and PO4, Urea, NH4 increase while NO3 and NO2 decrease. Probably okay. NO2 looks looks, NO3 does decrease, no analytical problems found, oxygen lower.
103 SampleLog: "Top cap leak cannot get water out of spigot." No samples.
105 SampleLog: "Oxygen 1542 broken after draw, but before pickling had to redraw oxygen." Oxygen is acceptable.
108 Sample Log: "Leak when put pallet jack down, stopped leaking by reseating. At Oxygen draw, top cap leak when vented, bottom cap leak, flow." Bottle O2 is a little high, but not outrageously so. Oxygen is acceptable.

Station 029.002

201 Nutrients drawn per sampling schedule, samples taken for Bact.
202 Nutrients drawn per sampling schedule, samples taken for Bact, C13/N15 only.
203 Samples taken for O2 incubation only.
206 Samples taken for O2 incubation only.
207 Samples taken for C13/N15.
211 Sample Log: "Top cap leak, changed sampling to 12." Samples taken for Bact, zoop.
Cast 2 Salinity not drawn, Productivity cast.

Station 029.003

301 Nutrients drawn per sampling schedule, Zooplankton cast.
306-302 Samples taken for Radium only.
311-307 Samples taken for Zooplankton only.
312 Bottle appears to have mistripped (see below). Nutrients drawn per sampling schedule, Zooplankton cast. NO3 higher by 10-12 uM than other samples near this level at this and nearby stations. Other nutrients also high for this level, but not to the extent of NO3. NO3 is higher, no analytical problems, so are PO4 and SIL, could be contamination. Footnote all nutrients questionable.
Cast 3 Oxygen and Salinity not drawn, Zooplankton cast.

Station 030.001

101 Salinity bottle-CTD difference is low, but low salinity is okay for gradient.
104 SampleLog: "Bottle loose on mount - needs to be replaced".
106 Sample Log: "Large leak from bottom cap, no O2's drawn". No samples drawn due to leak.
109 SampleLog: "Small bottom cap leak". Oxygen is acceptable.

Station 031.001

105 SampleLog: "Top cap leak; o-ring". Oxygen is acceptable.
106 SampleLog: "Bottom cap leak, no samples taken". No samples drawn due to leak.

108-110 CTD Log: "Bottles tripped on the fly." Salinity CTD-bottle very high, but bottles were tripped on the fly due to sea ice. Data are acceptable.

Station 031.002

201 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea is approximately 0.2 higher than any other near this level at this station. Footnote urea questionable. No analytical problem found, but it is higher.
202-206 Salinity, oxygen and nutrients not drawn, Radium cast.
207 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
208-212 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 031.003

Cast 3 CTD: "Launch delayed for ice floes drifting past. CTD stopped at ˜70meters, due to ice floe problem. Cast aborted."

Station 031.004

401 NH4is slightly high, but there are some similar values nearby. Leave as is. No analytical problems found, urea is higher too.
401-402 Nutrients drawn per sampling schedule, Bacteria.
Cast 4 Salinity not drawn, Productivity cast. Cast was aborted after bottle 2 was tripped, ice encrouchment.

Station 031.005

501 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
502-503 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
504 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
505-506 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
507 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
508-509 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
510 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Bio-Marker cast.
511 Salinity, oxygen and nutrients not drawn, Bio-Marker cast.
512 Salinity not drawn, oxygen and nutrients drawn per sampling schedule, Bio-Marker cast.

Station 032.001

104 Sample Log: "Small leak before vent open." Oxygen as well as other data are acceptable.
107 Sample Log: "Small leak before vent open." Oxygen as well as other data are acceptable.
111 Sample Log: "Big leaker out of bottom. No samples." Footnote bottle leaking and no samples drawn.
Cast 1 Appears to have been a bad SSW vial at the beginning of the run, corrected salinity files by approximately 0.002. Salinity is acceptable.

Station 033.001

108 Salinity difference, CTD-bottle, is moderately high, but is okay for gradient.

Station 034.001

101 Salinity and oxygen not drawn, nutrients drawn per sampling schedule, Bacteria and POM. Urea is very high. NH4 and NO2 are also high, but for them 102 and 101 are about the same, whereas 101 urea is much higher than 102. Rechecked data, no analytical

problems found. Footnote urea questionable.
102 Nutrients drawn per sampling schedule, Bacteria and DOM/Lignin.
103 Nutrients drawn per sampling schedule, Bacteria and POM. Sample Log: "Leaking from bottom cap, reseated then okay until top vent opened then flowing."
104 Samples taken for O2 incubation only. Sample Log: "Leaking from bottom cap, flowing."
106 SampleLog: "Oxygen redrawn."
107 Samples taken for O2 incubation only.
111 Sample Log: "Oxygen redrawn." Oxygen is acceptable. Urea is high. No supporting data in other parameters, including Station 34 cast 2. Rechecked data, no analytical problems found. Footnote urea questionable.
112 Samples taken for O2 incubation only.
Cast 1 Salinity not drawn, Productivity cast.

Station 034.003

301 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast. Urea is somewhat high compared to other values near this depth. Rechecked data, no analytical problems found. Footnote urea questionable.
302-306 Salinity, oxygen and nutrients not drawn, Radium cast.
307 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
308-312 Salinity, oxygen and nutrients not drawn, Radium cast.

Station 035.001

101 Sample Log: "Oxygen redraw." Oxygen is acceptable. Oxygen is consistent with nutrients. CTDO at 103 is a bit low, but no problem exists.
102 Sample Log: "Bottom leak coming out of water. Major leak when vented." Samples taken for POM only.
105 SampleLog: "Oxygen redraw." Oxygen is acceptable.

Station 035.002

201 Salinity and oxygen not drawn, nutrients drawn per sampling strategy, Radium cast.
202-212 Salinity, oxygen and nutrients not drawn, Radium cast.