

The CTD/Rosette profiling and water sampling program aboard the CCGS “Louis S. St-Laurent”.



A brief report on the instrumentation and methods for data collection including preliminary plots of the data collected during the Joint Western Arctic Climate Studies (JWACS) and Ocean Exploration expedition across the Canada Basin in the Summer of 2002.

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Overview

As a crucial part of the Science program, a CTD/Rosette system (CTD/R) was used to obtain profile data on water mass properties and to collect *in situ* water samples from discrete depths for bio-geo-chemical analysis. This section shows a map of science station locations, provides details about the electronic instrumentation used for profiling, and includes some plots with the initial findings along the section completed during the voyage. The appendix lists the dates, times and locations of all activities at the science stations. Details of the water sample types collected, sampling techniques, analysis on board or storage methods for later analysis in land-based laboratories are described in a separate report.



The Canadian Coast Guard icebreaker “Louis S. St-Laurent” (LSL) proceeded along a track that took her from the CG Base in Nova Scotia, across the Labrador Shelf on the Atlantic side of Canada, through Baffin Bay and the Northwest Passage, past the islands of the Canadian Arctic Archipelago, across Amundsen Gulf, into the Beaufort Sea, across the depths of the Canada Basin of the Arctic Ocean and out to the Northwind Ridge. Data were collected at along the ship’s track. The map below shows the locations of the CTD/rosette science stations in the Beaufort Sea, Canada Basin and Northwind Ridge regions. Appendix Table 1 lists the station names, locations, dates, and activity.

At each station, the CTD/R was lowered to either the bottom or to specified sampling depth, and individual water bottles were closed at selected depths to bring back water samples back up.

Equipment and methods

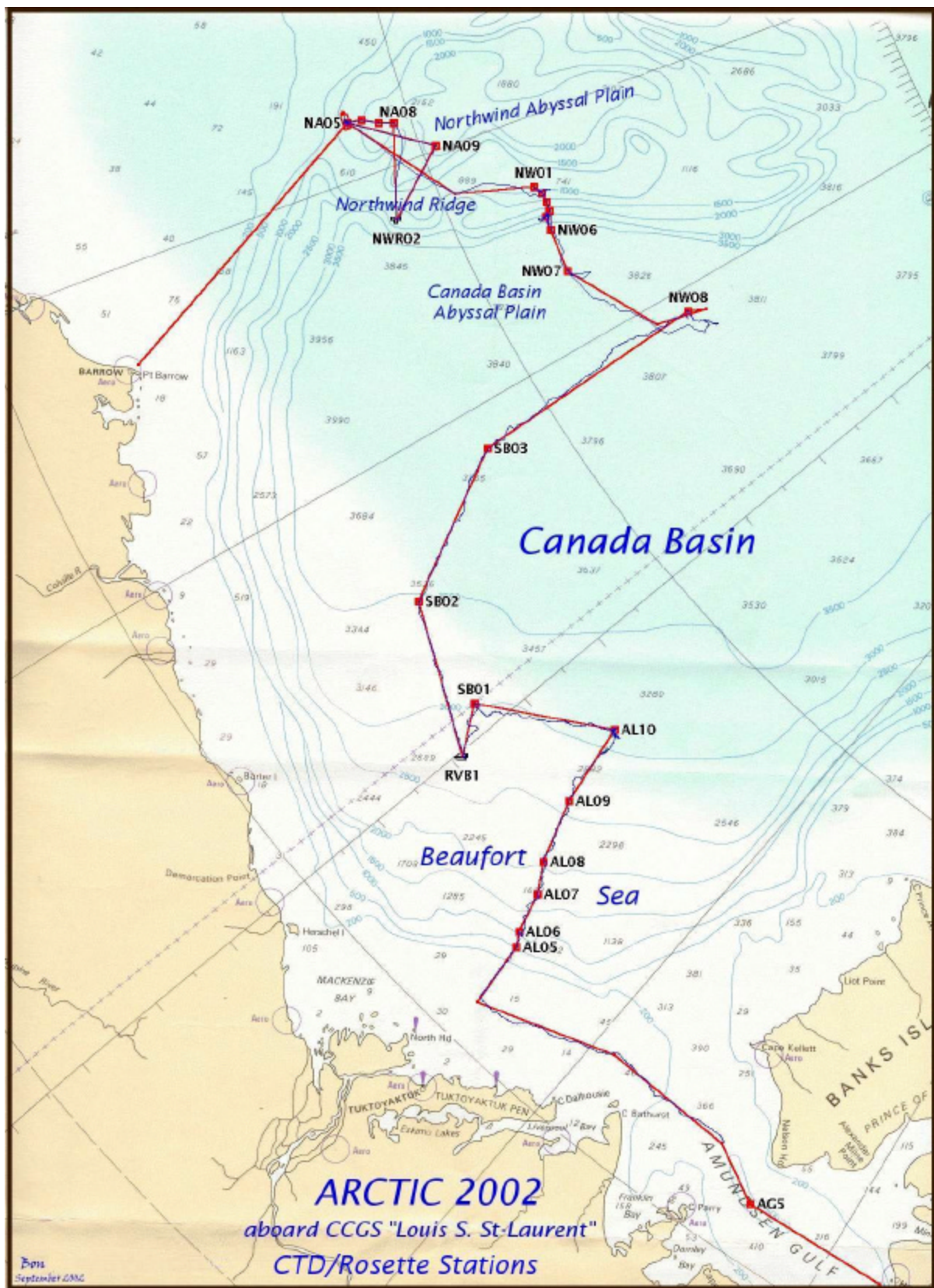
The main CTD used was a Seabird Electronics model SBE-9 S/N 0443 with a Paroscientific Digiquartz temperature-compensated pressure sensor S/N 63507, and dual ducted temperature and conductivity sensors (primary T&C sensors S/N 4044 & 2232, secondary T & C sensors S/N 4109 & 2676 respectively). In addition, the CTD also collected data from a number of external sensors: dissolved oxygen levels were measured with a Seabird D.O. sensor SBE-43 S/N 0052, added to the pumped duct of the secondary C/T sensor pair; chlorophyll concentrations were measured with a Seapoint Fluorometer S/N 2336; this sensor was not in a pumped duct, and its gain was set for maximum resolution with a range of 0-5 µg/L; light transmission levels were measured with a SeaTech transmissometer: the initial sensor with high pressure housing (S/N D192) failed during cast #(?) and was replaced with another sensor (S/N 139), rated for maximum 2000 meters depth, thus only used on casts done in water shallower than that.

The Seabird SBE-9 was used with SBE-11 S/N 0423(?) deck unit. GPS position co-ordinates and UTC time & date at the start of each cast were automatically entered into the header of the data file by the NMEA interface that was connected to a feed of the ship's GPS system. The deck unit was connected to two serial ports on a Dell-200 MHz computer, one port to capture the data stream, the other to communicate with the Rosette water sampler pylon and "fire" (close) sample bottles at the press of a button when the CTD reached the desired depth. The data acquisition was done using the Seabird "Seasave" software (ver 1.24) with a configuration file that included the latest calibration coefficients for all the above sensors. During each cast, the data were displayed on screen both as a plot and in numerical form to ensure that sensors were behaving within expected parameters.

The CTD cage containing the sensors and electronics housing, was mounted in the centre of a General Oceanics 24-position water sampling rosette frame, equipped with a Seabird Carousel pylon used to trigger the 10-litre BOT sampling bottles (figure 2). A hydrographic winch with nearly 4000 metres of conducting cable (figure 3) was used to lower the CTD/rosette system, to obtain a live data stream from the CTD sensors, and to transmit control commands to the pylon to close sample bottles at depth.



Before each cast, when approaching the location of a science station, the Rosette was prepared for launching by emptying all sampling bottles, hooking the lanyards from the top and bottom flaps of each bottle into the Carousel pylon, and closing the valves and vents on the bottles. The station name and location, cast particulars, sounding and information about sea state were entered in the CTD log book, as well as any other factors that might affect or alter how the system behaved.

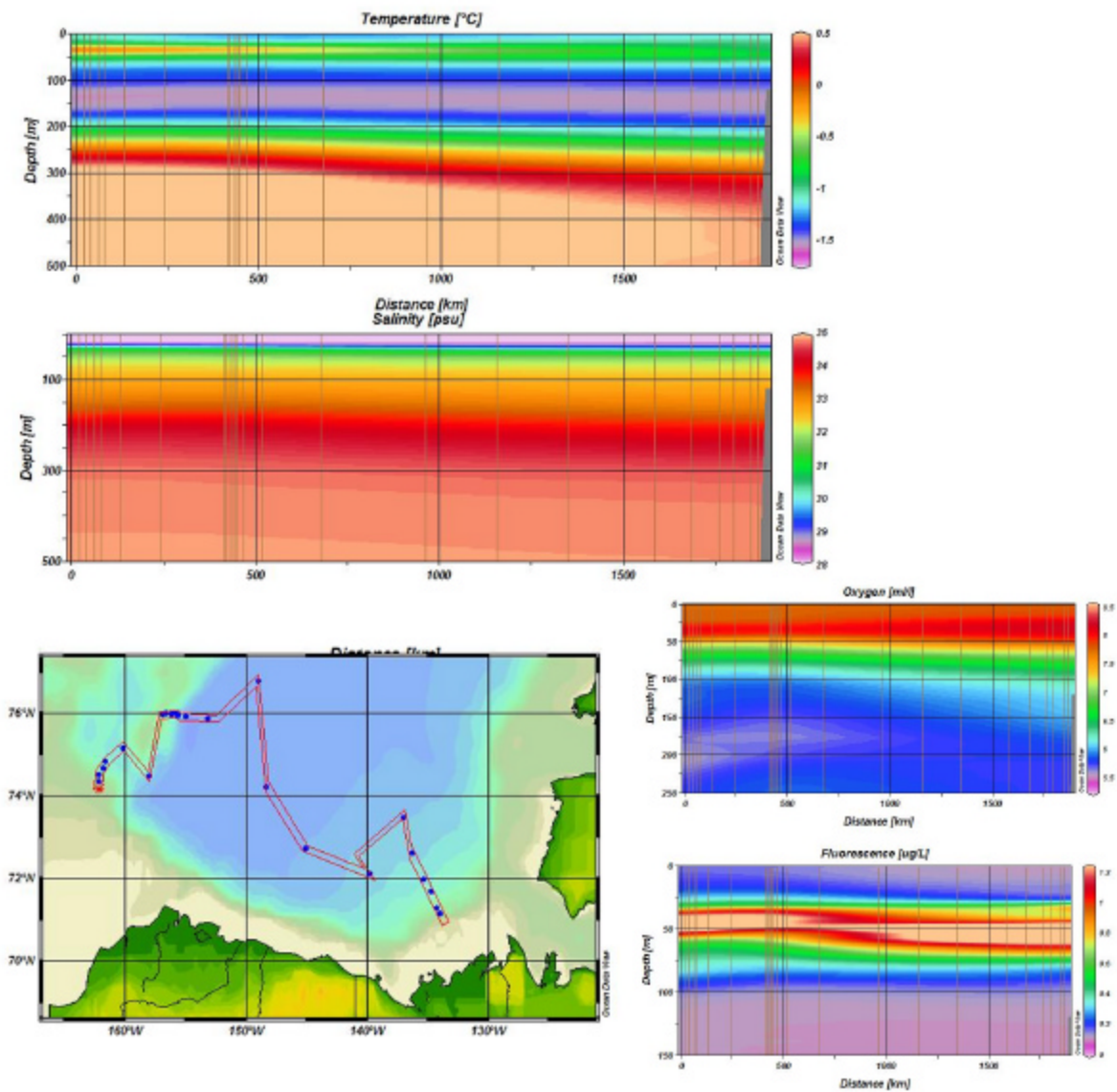


For each cast, the CTD data acquisition system was set to start collecting data prior to lowering the CTD/R system over the side. It was held for one minute just below the surface of the water to allow temperatures and electronics to stabilise and air to escape from the sensor ducts. The two T/C duct pumps were then turned on by software command and the unit held for another minute to flush all air out of the lines before starting the descent. The unit was then lowered at a nearly constant speed of one meter per second to ensure optimal response from the sensors. However, at depths over ~ 2000 meters, the added weight of the conducting cable required that the descent speed be reduced to around 0.6 meters per second to avoid surging in the winch hydraulics. A bottom alarm was activated when a trip weight, hanging below the CTD/R on a 5 meter monofilament line, touched the ocean bottom.



VFH radios were used to relay depth information from the CTD lab to the winch operator. During the return to the surface, the CTD/R was stopped at each of the selected depths (or rather at pressure values) and held for 30 seconds before activating the trigger on the acquisition deck unit to close one of the 10 litre Rosette sample bottles at that depth. On return to the surface, the CTD/R system was brought back on board and moved into the Rosette sampling lab. Bottles were checked for integrity and leaks, and water samples were then drawn from each bottle in a fixed order and by the prescribed method for each of the different constituents being sampled. This included dissolved oxygen, salinity, barium, iodine-129, chlorophyll (for details see geochemistry report).

After each cast, plots were produced of the data from the electronic sensors in order to check their behavior, and the Ocean Data View software was used to provide a preliminary contour view of the measured and calculated parameters at successive stations along the ship's track. Raw values of bottle trip depths, and corresponding temperatures, salinities, oxygen etc. were produced at the request of the geochemical analysis team, and the preliminary CTD plots were displayed in the main lab.



Example of a preliminary data section from JWACS – 2002 aboard the CCG "Louis S. St-Laurent".

The table in the appendix lists all activities at each of the science stations. This included:

- CTD/Rosette casts
- Plankton sampling with Bongo nets
- Measurement of Photosynthetically Active Radiation (PAR)
- Sediment collection by Box Core
- Deployments of the Remotely Operated Vehicle configured to either observe water and collect pelagic samples in the water column or to observe and collect benthic samples
- Deployment of fine mesh live nets
- Launch of Expendable CTD probes (XCTD) while underway
- Ice camps to sample snow & ice by various methods
- Dive team activities to collect samples & specimens near and under the ice
- Deployment of the JAMSTEC Arctic drifting buoy (J-CAD), and
- Deployment of two instrumented moorings in the Northwind Ridge area

Two northern wild life observers collected information on birds and mammals at and in-between science stations.



Appendix:

Table 1. Science station names, locations, dates and activities.

STATION	ACTIVITY	Latitude	Longitude	DATE
AG-05	CTD Rosette	70 35	122 59	16/8/02
AG-05	Bongo 236 um, 0.6 m diam. At 100m	70 35	122 59	16/8/02
AG-05	Bongo 236 um, 0.6 m diam. At 100m	70 36	122 56	16/8/02
AG-05	PAR	70 36	122 56	16/8/02
AG-05	Box core	70 35	122 59	16/8/02
AG-05	Bongo 236 um, 0.6 m diam. At 100m	70 35	122 59	16/8/02
AG-05	Bongo 150um & 53um at 100m	70 35	122 59	16/8/02
AG-05	CTD Rosette- SHALLOW	70 35	122 59	16/8/02
IF1	ROV Deploy	70 52	133 52	18/8/02
AL05	CTD Rosette	71 09	133 57	18/8/02
XC01	XCTD	71 13	134 03	18/8/02
AL-06	CTD Rosette	71 17	134 15	18/8/02
XC02	XCTD	71 25	133 20	18/8/02
AL-07	CTD Rosette	71 42	134 41	18/8/02
AL-07	Bongo 236 um, 0.6 m diam. At 100m	71 42	134 41	18/8/02
AL-07	Bongo 236 um, 0.6 m diam. At 100m	71 42	134 41	18/8/02
AL-07	Live net 60um at 200m	71 42	134 41	18/8/02
AL-07	Live net 60um at 500m	71 42	134 41	18/8/02
AL-07	Small Bongo 150um & 53um at 100m	71 42	134 41	18/8/02
AL-07	Box core	71 42	134 42	18/8/02
AL-07	CTD Rosette- SHALLOW	74 42	134 44	18/8/02
XC03	XCTD	71 50	134 57	18/8/02
AL-08	ROV Deploy	71 59	135 17	19/8/02
AL-08	ROV Deploy	71 59	135 17	19/8/02
AL-08	CTD Rosette- SHALLOW	71 59	135 19	19/8/02
AL-08	CTD Rosette	71 59	135 19	19/8/02
XC04	XCTD	72 13	135 36	19/8/02
XC05	XCTD	72 25	135 55	19/8/02
AL-09	CTD Rosette- SHALLOW	72 38	136 14	19/8/02
AL-09	Box core (winch test)	72 38	136 14	19/8/02
AL-09	CTD Rosette	72 38	136 14	19/8/02
XC06	XCTD	72 53	136 32	19/8/02
AL09B	Ice Camp	72 53	136 31	20/8/02
XC07	XCTD	73 08	136 45	20/8/02
*	ROV cable spooling	73 14	136 39	20/8/02
AL-10	Ice Camp	73 30	136 59	20/8/02
AL-10	CTD Rosette	73 30	136 59	20/8/02
AL-10	Bongo 236 um, 0.6 m diam. At 100m	73 29	137 00	20/8/02
AL-10	Bongo 150um & 53um at 100m	73 29	137 00	20/8/02
AL-10	Small Bongo 150um & 53um at 100m	73 29	137 00	20/8/02
AL-10	Live net 60um at 500m	73 29	137 00	20/8/02
AL-10	Box core #1	73 30	137 00	20/8/02
AL-10	Box core #2	73 30	137 00	21/08/02
AL-10	CTD Rosette	73 29	137 00	21/08/02
XC08	XCTD	73 29	137 00	21/08/02
AL-10	Mooring	73 28	137 00	22/08/02
AL-10	CTD Rosette	73 29	136 49	22/08/02
AL-10	ROV (pelagic dive)	73 27	136 50	22/08/02

STATION	ACTIVITY	Latitude	Longitude	DATE
AL-10	Ice Camp	73 27	136 50	22/08/02
AL-10	Dive team	73 27	136 42	22/08/02
AL-10	Phytoplankton	73 28	136 47	23/08/02
AL-10	Phytoplankton	73 28	136 47	23/08/02
AL-10	Phytoplankton	73 28	136 47	23/08/02
AL-10	Mooring release check	73 28	137 00	23/08/02
XC09	XCTD	73 22	137 35	23/08/02
XC10	XCTD	73 12	138 04	23/08/02
XC11	XCTD	73 02	138 48	23/08/02
XC12	XCTD	72 54	139 26	23/08/02
XC13	XCTD	72 38	140 21	23/08/02
SB-01	CTD Rosette	72 33	141 00	23/08/02
SB-01	Bongo 236 um, 0.6 m diam. At 100m	72 34	141 00	23/08/02
SB-01	Small Bongo 150um & 53um at 100m	72 34	141 00	23/08/02
XC14	XCTD	72 34	141 00	23/08/02
SB-01	Live net 60um at 500m	72 35	140 54	23/08/02
SB-01	Bongo 236 um, 0.6 m diam. At 100m	72 35	140 54	23/08/02
SB-01	CTD Rosette - LARGE VOLUMES	72 36	140 52	23/08/02
SB-01	Live net 60um at 1000m	72 36	140 49	23/08/02
SB-01	CTD Rosette- larg vol & shallow	72 36	140 49	24/08/02
XC15	XCTD	72 22	140 32	24/08/02
RVB1	ROV – benthic dive	72 06	139 50	24/08/02
RVB1	Ice camp: diving & video	72 06	139 50	24/08/02
RVB1	CTD	72 07	139 48	25/08/02
XC16	XCTD	72 09	140 05	25/08/02
XC17	XCTD	72 30	143 02	25/08/02
XC20	XCTD	72 16	140 58	25/08/02
XC18	XCTD	72 21	141 40	25/08/02
XC19	XCTD	72 29	142 35	25/08/02
XC21	XCTD	72 36	143 41	25/08/02
XC22	XCTD	72 27	144 00	25/08/02
XC23	XCTD	72 40	144 23	25/08/02
SB02	CTD Rosette	72 44	145 02	25/08/02
SB02	Bongo 236 um, 0.6 m diam. At 100m	72 44	145 02	25/08/02
SB02	Bongo 236 um, 0.6 m diam. At 100m	72 44	145 02	25/08/02
SB02	Small Bongo 150um & 53um at 100m	72 44	145 02	25/08/02
SB02	Live net 60um at 1000m	72 44	145 02	25/08/02
XC48	XCTD	72 59	145 34	26/08/02
XC49	XCTD	73 15	146 07	26/08/02
XC50	XCTD	73 30	146 38	26/08/02
XC51	XCTD	73 45	147 15	26/08/02
XC52	XCTD	74 00	147 54	26/08/02
SB03	CTD/rosette - shallow at PAR	74 14	148 22	26/08/02
SB03	Dive team	74 14	148 22	26/08/02
SB03	PAR	74 14	148 22	26/08/02
SB03	CTD/rosette - deep	74 14	148 22	26/08/02
SB03	Bongo 236 um, 0.6 m diam. At 100m	74 14	148 22	26/08/02
SB03	Bongo 236 um, 0.6 m diam. At 100m	74 14	148 22	26/08/02
SB03	Small Bongo 150um & 53um at 100m	74 14	148 22	26/08/02
SB03	Live net 60um at 1000m	74 14	148 22	26/08/02
XC53	XCTD	74 30	148 35	26/08/02
XC54	XCTD	74 52	148 33	26/08/02
XC55	XCTD	75 07	148 41	27/08/02

STATION	ACTIVITY	Latitude	Longitude	DATE
XC56	XCTD	75 25	148 46	27/08/02
XC57	XCTD	75 38	148 49	27/08/02
NW08	Rosette	76 46	148 57	27/08/02
NW08	Dive team	76 46	148 57	27/08/02
NW08	Bongo 236 um, 0.6 m diam. At 100m	76 46	148 57	27/08/02
NW08	Bongo 236 um, 0.6 m diam. At 100m	76 46	148 57	27/08/02
NW08	Small Bongo 150um & 53um at 100m	76 46	148 57	27/08/02
NW08	Live net 60um at 500m	76 46	148 57	27/08/02
NW08	Icecamp: coring	76 46	148 57	27/08/02
XC58	XCTD	75 91	149 11	27/08/02
XC59	XCTD	76 07	149 11	27/08/02
XC60	XCTD	76 26	148 58	27/08/02
XC61	XCTD	76 53	148 06	8/28/2002
NW08	Live net 60um at 1500m	76 52	148 10	8/28/2002
NW08	Dive team	76 53	14 80	8/28/2002
C6BN	J-CAD Deployment	76 53	148 03	8/28/2002
NW08	Dive team	76 53	148 05	8/28/2002
XC62	XCTD	75 59	151 38	8/29/2002
XC63	XCTD	75 55	152 38	8/29/2002
NW07	CTD Rosette-deep	75 53	153 07	8/29/2002
NW07	Bongo 236 um, 0.6 m diam. At 100m	75 33	153 08	8/29/2002
NW07	Bongo 236 um, 0.6 m diam. At 100m	75 33	153 08	8/29/2002
NW07	Small Bongo 150um & 53um at 100m	75 33	153 08	8/29/2002
NW07	Live net 60um at 500m	75 33	153 08	8/29/2002
NW07	CTD Rosette -Deep	75 54	152 55	8/30/2002
NW07	CTD Rosette -Shallow	75 54	152 50	8/30/2002
NW07	CTD Rosette -Shallow	76 03	152 35	8/30/2002
XC64	XCTD	75 54	153 51	8/30/2002
NW06	CTD Rosette-deep	75 55	155 01	8/30/2002
NW05	Box coring (unsuccessful)	75 56	155 19	8/30/2002
CX65	XCTD	75 55	155 24	8/31/2002
NW05	Box Coring	75 57	155 39	8/31/2002
NW05	Box Coring	75 57	155 39	8/31/2002
NW05	CTD Rosette-deep	75 56	155 38	8/31/2002
NW05	Rov Deep	75 57	155 46	8/31/2002
NW05	Dive team	75 57	155 46	8/31/2002
NW05	Box Coring	75 56	155 39	9/1/2002
NW05	Box Coring	75 56	155 39	9/1/2002
NW05	Bongo 236 um, 0.6 m diam. At 100m	75 56	155 42	9/1/2002
NW05	Bongo 236 um, 0.6 m diam. At 100m	75 56	155 42	9/1/2002
NW05	Small Bongo 150um & 53um at 100m	75 56	155 42	9/1/2002
NW05	Live net 60um at 500m	75 56	155 42	9/1/2002
XC66	XCTD	75 59	155 40	9/1/2002
XC67	XCTD	75 59	155 40	9/1/2002
NW03	CTD Rosette-Deep	75 59	156 11	9/1/2002
NW02	CTD Rosette	75 59	156 38	9/1/2002
NW01	CTD Rosette-Shallow	75 57	157 01	9/1/2002
NW01	Rov Deep	75 58	156 55	9/1/2002
NW01	CTD Rosette-deep	75 58	156 51	9/2/2002
NW01	Bongo 236 um, 0.6 m diam. At 100m	75 59	156 52	9/2/2002
NW01	Bongo 236 um, 0.6 m diam. At 100m	75 59	156 52	9/2/2002
NW01	Box Coring	75 58	156 49	9/2/2002
CX66	XCTD	75 51	156 45	9/2/2002

STATION	ACTIVITY	Latitude	Longitude	DATE
CX67	XCTD	75 46	157 23	9/2/2002
CX68	XCTD	75 41	157 33	9/2/2002
CX69	XCTD	75 35	157 46	9/2/2002
CX70	XCTD	75 30	157 56	9/2/2002
CX71	XCTD	75 24	158 00	9/2/2002
CX72	XCTD	75 19	158 00	9/2/2002
CX73	XCTD	75 14	158 02	9/2/2002
CX74	XCTD	75 09	158 09	9/2/2002
CX75	XCTD	75 04	158 31	9/2/2002
CX76	XCTD	74 59	158 50	9/2/2002
CX77	XCTD	74 57	159 05	9/2/2002
CX78	XCTD	74 52	159 20	9/2/2002
CX79	XCTD	74 49	159 39	9/2/2002
CX80	XCTD	74 45	160 01	9/2/2002
CX81	XCTD	74 42	160 21	9/3/2002
CX82	XCTD	74 38	160 42	9/3/2002
CX83	XCTD	74 32	161 22	9/3/2002
NA05	CTD Rosette-shallow	74 21	160 10	9/3/2002
NA05	Bongo 236 um, 0.6 m diam. At 100m	74 21	162 10	9/3/2002
NA05	Bongo 236 um, 0.6 m diam. At 100m	74 21	162 10	9/3/2002
NA05	Small Bongo 150um & 53um at 100m	74 21	162 10	9/3/2002
NA05	CTD Rosette-deep	74 21	162 11	9/3/2002
CHP02	Mooring-1480m	74 22	162 06	9/3/2002
NA05	CTD Rosette-deep	74 23	162 14	9/3/2002
NA06	CTD Rosette-deep	74 40	161 49	9/3/2002
NWR02	CTD Rosette-deep	74 49	161 38	9/4/2002
NWR02	CTD Rosette-Shallow	74 29	158 01	9/4/2002
NWR02	CTD Rosette	74 29	158 01	9/4/2002
NWR02	Mooring Buoy Deploy	74 29	158 00	9/4/2002
XC84	XCTD	74 52	159 13	9/4/2002
NA09-1	CTD Rosette-deep	75 09	160 12	9/5/2002
NA09-2	CTD Rosette-Shallow	75 09	160 12	9/5/2002
NA09-1	Bongo 236 um, 0.6 m diam. At 100m	75 09	160 11	9/5/2002
NA09-1	Bongo 236 um, 0.6 m diam. At 100m	75 09	160 11	9/5/2002
NA09-1	Small Bongo 150um & 53um at 100m	75 09	160 11	9/5/2002
NA09-1	Live net 60um at 500m	75 09	160 11	9/5/2002
NA05	Box Coring	74 20	160 19	9/5/2002
NA05	Box Coring	74 20	162 19	9/5/2002