DF-92 TECHNICAL CRUISE REPORT
SEDIMENT TRAP RECOVERY CRUISE
ROSS SEA, ANTARCTICA
U.S.C.G.C. POLAR SEA (FEB. 2-11, 1992)
AND R/V POLAR DUKE (FEB. 11-MAR 12, 1992)

by

David A. Mucciarone

Cruise Participants: Robert B. Dunbar, David A. Mucciarone, William A. Jones, and Jennifer C. Rogers (all S-216). David Lucyk, Geoffrey Pierson, and Leonardo Lagone (all S-268).

U.S.C.G.C. POLAR SEA:

We departed Houston on 1/27/92 and arrived in Christchurch, NZ on 1/29/92. All participants arrived in McMurdo Station on 1/31/92. Dunbar and Mucciarone boarded the Polar Sea to begin set up of the Carlo Erba NA1500 elemental analyzer and discuss cruise operations with the Captain and officers. The rest of the cruise party joined U.S.C.G.C. Polar Sea on 2/3/92. The cruise track on the Polar Sea was A to C to B to A (Figure 1). However, poor weather and sea conditions prevented us from retrieving the mooring at Site C. At Site A we encountered problems with the acoustic release, mooring A did not transpond during our first attempt on 2/4/92. Without success we headed for C to obtain that mooring, but poor seas prevented the recovery effort. During our transit back to Site A, Mucciarone and Dunbar performed a series of tests with the Inter Ocean deck units to make certain they were transponding and receiving on the 8 and 12KHz frequencies respectively. Both units were functioning properly.

Upon our second arrival at Site A we received good returns from transponding and sending release code, but with no avail. After a delay on 2/5/92 to remove a floating array from the Polar Duke screws we began dragging at Site A on 2/6/92 at approximately 12:45. The dragging operation was successful, floats appeared on the surface at 1830. It appears the acoustic release did not work despite good responses. The trawling wire cut the mooring line at the thimble below the bottom current meter. Evidence from the thimble suggests it cut most of the way through, but as we changed course the cable slid up the mooring line and snagged at the cable/chain connector at the bottom 6 floats. The cable connector actually hooked the mooring. The whole mooring was probably dragged for a short while until the last strands of VLS Duron rope broke. All but the release was retrieved. The bottom trap at Mooring A worked perfectly (15 samples), the top trap stopped after 5 samples because a screw jammed the carousel. See Figure 2 for a schematic representation of the mooring.

Mooring B went well considering the weather and seas did not cooperate. After arriving on 2/8/92, we didn't get to recover the mooring until 2/9/92. Both releases worked even though one unit was left enabled for one year. All equipment was recovered at Site B with the bottom trap collection 15 samples and the top 12 samples. There was no apparent reason for the rotation of the top trap to stop after sample 12. One possible explanation is the dates recorded by the traps tattle tale microprocessor. After a Julian Date of 365 or 366, the year would read 1994 and not 1992. However, the day was correct for each event. Three of the 4 traps recorded this information. The trap that stopped after 5 events did not give any information. Upon down load it gave an Error #21 which means it could not find the line in the program.

On 2/10/92 all but Dunbar and Lucyk transferred to the Polar Duke. The transfer was difficult because of rough seas. Dunbar and Lucyk stayed aboard the Polar Star to re deploy the mooring at Site A on 2/11/92 with 2 traps and no current meters. See Dunbar's report on the location, cup timing, water depth, etc. on the mooring at Site A. Due to time constraints brought on by bad weather and rough seas we were unable to retrieve the mooring at Site C with the Polar Sea. This recovery was performed on the Polar Duke.

R/V POLAR DUKE:

On 2/10/92, Mucciarone, Jones, and Rogers from S-216, Pierson and Lagone from S-268 arrived aboard the Polar Duke. The objective of this leg was to collect the mooring at Site C, deploy and recover floating arrays at Sites B, C, and C', analyze for • CO_2 and collect CO_2 for• • ^{13}C (DIC), as well as filter sea water for • ^{13}C (POC) using the elemental analyzer. In addition, 125ml sea water samples were collected for Amy Leventer Reed about every 2 to 4 stations along 2 east/west transects (30 to 60 kt mi). The elemental analyzer was set up by 2/11/92, and waters were collected beginning at Site B/Station 50.

• CO_2 Data Collection and • ^{13}C (DIC)

We began stripping 25 ml aliquots of sea water at Site B (station 50) on 2/11/92 for • CO_2. Refer to Appendix A for station locations. At this point the precision was approximately 1%. By station 83 we were able to improve the precision to around 0.3% using a different injection technique that reduced leaks. Septum leaks were the main cause for poor reproducibility. This change was timely because beginning at station 83 we encountered our first increase in biomass (See CTD profiles in Appendix B). The amount of biomass increased westward into Terra Nova Bay and slightly north towards Site C and decreased considerably by station 109. All raw • CO_2 results are reported in Appendix C. The CO_2 generated from the stripping procedure was collected for dissolved inorganic carbon isotopes, • ^{13}C (DIC).

Sea Water Filtering and • ^{13}C (POC)

Beginnings at station 50 we filtered 1 liter of sea water through 2.1 GFC filters that were collected at the same stations and depths as the • CO_2 samples (See Appendix A). Filters from stations 83 through 109 were combusted in the elemental analyzer on ship for C, N, and S. The• CO_2 from these stations were collected for particulate organic carbon isotopes, • ^{13}C (POC). All remaining filters were brought back to Rice University for later analysis.

Floating Sediment Trap Arrays

Floating arrays were deployed at Site A twice. The first deployment was for 24hrs. The second deployment at Site A ended in disaster, the array was caught in the propellers of the Polar Duke. Both deployments were performed by Walker Smith, and Ann Close of S-047. S-216 was responsible for the deployment of all floating arrays at Sites B, C, and C'. Sediment trap arrays at Site B were deployed twice for 24hrs and 12hrs respectively. They were re deployed at Site C only once for about 12hrs. The traps at Site C were recovered early due to dragging for mooring C. Floating traps were also deployed at Site C' for 24hrs. The trap depth at all sites was 50, 100, 200, and 250m. Samples from the floating arrays were split between Walker Smith, Dave Nelson, Rob Dunbar, and Amy Leventer. Walker's splits are 100ml for C/N, 100ml for HPLC, 25ml for Chlorophyll (Site A & C only), and 20ml for slides. Dave's split was for silica dissolution amounting to 120ml. Amy's split consists of 20ml and is poisoned with 3 ml of glutaraldyhyde. The remainder is for Rob, to do percent silica and carbon (approximately 140ml). See Table 1 below and summary in Appendix D.

Mooring Recovery

Moorings at Sites A and B were recovered using the Polar Sea. We dragged for A on 2/7/92 at approximately 1230 to 1300. Using the trawl winch we payed out 2400 meters of wire attached to 400 feet of chain with hooks. The trawl wire cut the mooring below the bottom current meter. The mooring was actually snagged by the tail of trawl wire at the termination. Floats were spotted at the surface at about 1730. All but the release was recovered. Mooring at Site B was recovered on 2/10/92 by conventional methods (i.e., both releases worked properly) using the casting deck on the port side of the Polar Sea.

On 2/21/92 we arrived at Site C and attempted to located the mooring using the Bio. Lab. deck unit. Using the Zodiac we tried to triangulate on the mooring but failed when a wave took out the deck unit. Sea water leaked in around the keyboard destroying a transistor and resistor. We continued our recovery efforts of mooring C on 2/22 at 0400 when Dr. De Master and I began a 12KHz search for the

elusive Mooring C. At 0710 we detected the mooring on the 12KHz. All of the floats, traps and even the current meters were detected. We began dragging at around 0900. Our first attempt yielded no results using a J-turn about the mooring using 2400 meters of trawl wire and 400 feet of chain with hooks. The chain came back with its hooks bent back. We are not sure whether this was caused by the mooring or the sea bottom. On our second attempt we changed our pattern to that of a small sigma (•), with a radius of approximately 300m. This second attempt began at 1400. We lowered the cable, chain, and 3 "Claws of Death" (grappling hooks made out of 3/8" steel about 2' long on the last half of the chain) to the bottom, then began to slowly circle the mooring at about 2 knots paying out cable and trying to maintain a 300 meter radius. When the circle was complete we moved tangentially until 3000 meters of cable was payed out. Keeping the ship stationary, we reeled in 3000m of cable. When we recovered the cable and chain we found the remainder of one claw (mounting bracket) and half of the chain missing. The maximum tension was 3000lbs for about 15 seconds. This reading was too early for the claws to have done any work. The loss of the "Claws of Death' was probably because they hooked in the bottom or on a rock.

We recovered the chain at 1700 and went back to see if the mooring was still there. After 5 passes we did not detect the mooring using the 12KHz unit. As we were talking on the bridge discussing a search pattern to spy for the floats, the Boson spotted both sets of floats about 300m off the bow. We began recovery operation at 1800 and finished at 2015. We recovered everything except the releases. The line was cut on the thimble below the bottom current meter. Almost the same way as at Site A.

As expected the traps at Site C died on March 19, 1990, and the springs broke. However, even though the springs broke, cup 6 on both traps remained under the cone opening preserving approximately two years of data. The top cup #6 was filled about 3/4 and the bottom cup #6 about 15/16. There was no sediment in either cone. Both of these cups were frozen for shipment to Rice University. The whole operation took a little over 16hrs. In addition, all but one dissolution experiment (C18) was recovered.

Table 1--Floating Sediment Trap Arrays From Sites A, B, C, and C'.

Site A: Trap depths 50, 100, 200, and 250m.

Deployment 1: (Event 2204.11)

Date	Stn	Latitude	Longitude	Time
2/04/92	6	76° 30.07'S	167 26.84'E	2148

Recovery 1: (Event 2205.05)

Date	Stn	Latitude	Longitude	Time
2/05/92	6	76 35.13'S	167 10.05'E	2130

Trap splits: (500ml)

C/N	HPLC	Tax (Amy)	Chlor.	Slds	Si Diss.
100ml	100ml	20ml	25ml	20ml	120ml

Site B: Trap depths 50, 100, 200, and 250m.

Deployment 1: (Event 2211.20)

Date	Stn	Latitude	Longitude	Time
2/11/92	50	76 30.04'S	175 00.98'W	2350

Recovery 1: (Event 2213.01)

Date	Stn	Latitude	Longitude	Time
2/13/92	50	76 25.34'S	175 11.02'W	0115

Trap splits: (500ml)

C/N	HPLC	Tax (Amy)	Chlor.	Slds	Si Diss.
100ml	100ml	20ml	0ml	20ml	120ml

Site B: Trap depths 50, 100, 200, and 250m.
Deployment 2: (Event 2213.02)

Date	Stn	Latitude	Longitude	Time
2/13/92	51	76 29.49'S	175 02.74'W	0245

Recovery 2: (Event 2213.10)

Date	Stn	Latitude	Longitude	Time
2/13/92	51	76 28.69'S	175 28.69'W	1525

Trap splits: (500ml)

C/N	HPLC	Tax (Amy)	Chlor.	Slds	Si Diss.
100ml	100ml	20ml	0ml	20ml	120ml

Site C: Trap depths 50, 100, 200, and 250m. Cup at 50m lost.

Deployment 1: (Event 2221.09)

Date	Stn	Latitude	Longitude	Time
2/21/92	104	72 28.80'S	172 30.57'E	1711

Recovery 1: (Event 2222.02)

Date	Stn	Latitude	Longitude	Time
2/22/92	104	72 25.91'S	172 21.97'E	0530

Trap splits:

C/N	HPLC	Tax (Amy)	Chlor.	Slds	Si Diss.
100ml	100ml	20ml	25ml	20ml	120ml

Site C': Trap depths 50, 100, 200, and 250m.

Deployment I: (Event 2227.02)

Date	Stn	Latitude	Longitude	Time
2/27/92	141	72 29.71'S	172 50.29'W	0525

Recovery I: (Event 2228.01)

Date	Stn	Latitude	Longitude	Time
2/28/92	141	72 29.15'S	172 56.36'W	0535

Trap splits:

C/N	HPLC	Tax (Amy)	Chlor.	Slds	Si Diss.
100ml	100ml	20ml	0ml	20ml	120ml

MOORING A RECOVERY: (February 08, 1992)

Mooring A: Recovered by dragging.

Date	Stn	Latitude	Longitude	Time
2/07/92	A	76 31.29'S	167 25.10'E	2106

Dragging began @	1530
Launched MSB @	1915
Top floats on deck @	2015
Top sediment trap on deck @	2030
Top current meter on deck @	2031
Bottom floats on deck @	1925*
Bottom sediment trap on deck @	2105
Bottom current meter on deck @	2106
Release (Dave)	LOST

Note:*Bottom floats were snagged by cable and were on deck first.

Trap Performance: (A-TOP)

Top Trap Rotated to cup 5. Set screw on one cup prevented rotation of carousel. Spring broke when trying to unwind.

Recovery Filename:	**A-FEB91R.TOP** (No information retrieved).
Program Error:	HOW ERROR #21 Line not found
Battery Condition:	4.38VDC (Micro 9v alkaline, 3/ea.)
	3.08VDC (RAM 3v lithium, 1/ea.)
	8.34VDC (Motor 9v alkaline, 4/ea.)

Trap Performance: (A-BOTTOM)

Bottom trap Rotated to cup 15. No problems.

Recovery Filename:	**A-FEB91R.BOT**
Program Error:	No errors
Battery Condition:	8.38VDC (Micro 9v alkaline, 3/ea.)
	3.18VDC (RAM 3v lithium, 1/ea.)
	8.81VDC (Motor 9v alkaline, 4/ea.)

Program Schedule: Recovered Sediment Traps for Site A (Top and Bottom).

Cup 1	Timer began on 2/13/91 at 09:12:35 (Top).		
	Timer began on 2/13/91 at 08:58:15 (Bottom).		
Cup 2	7 days	Event 1	20FEB91
Cup 3	21	Event 2	06MAR91
Cup 4	42	Event 3	27MAR91
Cup 5	70	Event 4	24APR91
Cup 6	98	Event 5	22MAY91
Cup 7	140	Event 6	03JUL91
Cup 8	182	Event 7	14AUG91
Cup 9	224	Event 8	25SEP91
Cup 10	252	Event 9	23OCT91
Cup 11	280	Event 10	20NOV91
Cup 12	301	Event 11	11DEC91
Cup 13	322	Event 12	01JAN92
Cup 14	336	Event 13	15JAN92
Cup 15	350	Event 14	29JAN92
Recovered on		08FEB92	

Cup Poisoning Solution: 10% Na-borate solution of formalin with filtered sea water.

MOORING A DEPLOYMENT: (February 11, 1992)

Robert Dunbar and David Lucyk were in charge of the re deployment of mooring A. The sediment trap program schedule is as follows.

Deployment Filename:	**A-FEB92D.TOP**
Battery Condition:	9.20VDC (Micro 9v alkaline, 3/ea.)
	3.23VDC (RAM 3v lithium, 1/ea.)
	9.21VDC (Motor 9v alkaline, 4/ea.)

Deployment Filename:	**A-FEB92D.BOT**
Battery Condition:	9.23VDC (Micro 9v alkaline, 3/ea.) 3.22VDC (RAM 3v lithium, 1/ea.) 9.21VDC (Motor 9v alkaline, 4/ea.)
Acoustic Releases:	Paul-2 pack = 7.7VDC; 4 pack = 7.55VDC
Battery Condition:	Carrie-2 pack = 7.6VDC; 4 pack = 7.57VDC

Program Schedule: Deployed Sediment Traps at Site A (TOP and BOTOM).

Cup 1	Timer begins on 2/11/92 at 00:06:00 (Top). Timers begin on 2/11/92 at 00:06:00 (Bottom). Actual deployment time: 10:13:00 on 2/11/92.		
Cup 2	22 days	Event 1	01MAR92
Cup 3	52	Event 2	31MAR92
Cup 4	83	Event 3	01MAY92
Cup 5	144	Event 4	01JUL92
Cup 6	206	Event 5	01SEP92
Cup 7	267	Event 6	01NOV92
Cup 8	328	Event 7	01JAN93
Cup 9	342	Event 8	15JAN93
Cup 10	359	Event 9	01FEB93
Cup 11	373	Event 10	15FEB93
Cup 12	387	Event 11	01MAR93
Cup 13	493	Event 12	15JUN93
Cup 14	615	Event 13	15OCT93
Cup 15	693	Event 14	01JAN94

Cup Poisoning Solution:	10% Na-borate solution of formalin with filtered sea water.
Mooring Statistics:	Top float to 8 float package = 10m 8 float package to top trap = 25m Top trap to 6 float package = 375m 6 float package to bottom trap = 105m (80m+25m) Bottom trap to release float = 25m Release float to acoustic releases = 10m Acoustic releases to 1400lb anchor = 4.5m (1.5m SS sling with 3m 1/2" chain) All rope is Sampson 3/8" VLS Duron

Release Command Codes:	**CARRIE**	**PAUL**
	Enable=DEG	**Enable=DEF**
	Release=ADFG	**Release=ACEH**
	Rearm=DEGH	**Rearm=DEGH**

Mooring Location:	**76 31.501'S 167 23.42'E (GPS) @ 840m**
Water Depth:	**800 meters**

MOORING B RECOVERY: (February 09, 1992)

Mooring B: Recovered by conventional methods.

Date	Stn	Latitude	Longitude	Time
2/09/92	B	76 31.30'S	175 01.80'W	1800

Release code sent @	1800
Launched MSB @	1830
Top floats on deck @	1955
Top sediment trap on deck @	2030
Top current meter on deck @	2035
Bottom floats on deck @	2049
Bottom sediment trap on deck @	2112
Bottom current meter on deck @	2115
Release (Carrie & Paul)	2116

Trap Performance: **(TOP)**

Top Trap Rotated to cup 12. No apparent reason for trap to stop rotating.

Recovery Filename:	**B-FEB91R.TOP**
Program Error:	No error
Battery Condition:	7.91VDC (Micro 9v alkaline, 3/ea.)
	3.20VDC (RAM 3v lithium, 1/ea.)
	8.63VDC (Motor 9v alkaline, 4/ea.)

Trap Performance: **(BOTTOM)**

Bottom trap Rotated to cup 15. No problems.

Recovery Filename:	**B-FEB91R.BOT**
Program Error:	No errors
Battery Condition:	7.91VDC (Micro 9v alkaline, 3/ea.)
	3.15VDC (RAM 3v lithium, 1/ea.)
	8.73VDC (Motor 9v alkaline, 4/ea.)

Acoustic Releases:	Paul-2 pack = 7.28VDC; 4 pack = 7.25VDC
Battery Condition:	Carrie-2 pack = 7.28VDC; 4 pack = 7.29VDC

Program Schedule: Recovered Sediment Traps at Site B (TOP and BOTTOM)

Cup 1	Timer began on 2/11/91 at 09:02:26 (Top).		
	Timer began on 2/11/91 at 08:46:19 (Bottom).		
Cup 2	9 days	Event 1	20FEB91
Cup 3	23	Event 2	06MAR91
Cup 4	44	Event 3	27MAR91
Cup 5	72	Event 4	24APR91
Cup 6	100	Event 5	22MAY91
Cup 7	142	Event 6	03JUL91
Cup 8	184	Event 7	14AUG91
Cup 9	226	Event 8	25SEP91

Cup 10	254	Event 9	23OCT91
Cup 11	282	Event 10	20NOV91
Cup 12	303	Event 11	11DEC91
Cup 13	324	Event 12	01JAN92
Cup 14	338	Event 13	15JAN92
Cup 15	352	Event 14	29JAN92
Recovered on		09FEB92	

Cup Poisoning Solution: 10% Na-borate solution of formalin with filtered sea water.

Mooring B was not re deployed.

MOORING C RECOVERY: (February 22, 1992)

Mooring C: Recovered by dragging.

Date	Stn	Latitude	Longitude	Time
2/22/92	104	72 28.81'S	172 31.43'E	1800

Dragging began @	1400
Launched Zodiac @	1815
Top floats on deck @	1849
Top sediment trap on deck @	1905
Top current meter on deck @	1922
Bottom floats on deck @	1942
Bottom sediment trap on deck @	2000
Bottom current meter on deck @	2008
Release (Marion & Richard)	LOST

Trap Performance: **(TOP)**

Top Trap Rotated to cup 6. Error in software stopped traps on 19 March 1990. All of the sediment until 2/22/92 fit into cup 6. No material in cone. Spring was broken but cup 6 remained under cone, cone did not drain during recovery.

Recovery Filename:	**C-FEB91R.TOP** (No information retrieved).
Program Error:	Error not retrieved
Battery Condition:	0.91VDC (Micro 9v alkaline, 1/ea.)
	2.90VDC (RAM 3v lithium, 1/ea.)
	8.89VDC (Motor 9v alkaline, 4/ea.)

Trap Performance: **(BOTTOM)**

Bottom trap Rotated to cup 6. Same condition as top trap (see notes above).

Recovery Filename:	**C-FEB91R.BOT**
Program Error:	No errors
Battery Condition:	0.90VDC (Micro 9v alkaline, 1/ea.)
	2.89VDC (RAM 3v lithium, 1/ea.)
	8.98VDC (Motor 9v alkaline, 4/ea.)

Program Schedule: Recovered Sediment Traps at Site C (TOP and BOTTOM).

Cup 1	Timer began on 1/22/90 at 02:00:00 (Top).		
	Timer began on 1/22/90 at 02:00:00 (Bottom).		
Cup 2	6 days	Event 1	28JAN90
Cup 3	10	Event 2	01FEB90
Cup 4	14	Event 3	05FEB90
Cup 5	16	Event 4	09FEB90
Cup 6	20	Event 5	06MAR90
Cup 7	24	Event 6	31MAR90
Cup 8	28	Event 7	20MAY90
Cup 9	75	Event 8	09JUL90
Cup 10	122	Event 9	28AUG90
Cup 11	169	Event 10	17OCT90
Cup 12	216	Event 11	11NOV90
Cup 13	263	Event 12	06DEC90
Cup 14	310	Event 13	31DEC90
Cup 15	357	Event 14	25JAN91
Recovered on		22FEB92	

Cup Poisoning Solution: Sodium Azide with filtered sea water.

Dissolution Experiments: S1, S2, S3: C10, C11, C12, C13, C14, C15, C16, C17, C18(NOT RECOVERED).

Mooring C was not re deployed.

SUMMARY:

All went well on both legs of the cruise. There were no problems with the deployment or recovery of the floating traps after the first disaster at Site A prior to the arrival of S-216. Both dragging operations at Sites A and C went very well. Only the acoustic releases were lost. As expected the traps at Site C died on March 19, 1990 at cup 6. Fortunately the cup remained under the top and bottom trap cones and collected two years of particulate matter in cup 6. These cups were subsequently frozen and returned to Rice University. All other samples were returned refrigerated (i.e., blue ice).

The • CO_2 stripper worked its best beginning at station 83 and beyond. Prior to station 83 the we had problems with septum leaks. This worked out well since the first bloom began at station 83 and ended at station 109. Filtering for • ^{13}C (POC) went well, we filtered at the same stations and depths as the • CO_2 samples. Listed below are the cruise transects for the Polar Sea and Polar Duke all of the station data can be found in Appendix E.

The cruise track summary on the Polar Sea is as follows: Site A (76 31.29'S 167 25.1'E) to Site C (72 28.8'S 172 31.6'E) to Site A (76 31.29'S 167 25.1'E) to Site B (76 31.2'S 175 00.98'W).

The cruise track summary on the Polar Duke is as follows: Granite Harbor, Station 1(77 19.34'S 165 50.84'E) to Site A, Station 6 (76 31.29'S 167 25.1'E) to Site B, Station 50 (76 31.2'S 175 00.98'W) to Station 55 (75 00.0'S 173 25.62'W) to Terra Nova Bay, Station 96 (75 00.0'S 164 09.9'E) to Site C, Station 104 (72 28.8'S 172 31.6'E) to Site C', Station 141 (72 30.6'S 172 38.1'W).

All equipment used on the R/V Polar Duke was crated and shipped to Rice University via Lee DeGalan in Port Hueneme, CA. See Appendix F for details, contents, and method of shipment.

APPENDIX A

Summary of Sample Station Locations From Polar Sea and Polar Duke

APPENDIX B

CTD Profiles and Bottle Depths From the Polar Duke

APPENDIX C

Raw Total CO2 Results From the Polar Duke

APPENDIX D

Floating Trap Sub-sampling by S-047 for Sites A, B, C, and C'

APPENDIX E

Copy of R/V Polar Duke Station Log Book Stations 1 - 141

APPENDIX F

Shipping Manifest for Equipment

From the Polar Duke